Types, Ratios and Sizes of Nematocysts in Phyllorhiza punctata (von Lendenfeld, 1884)

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Preface

Water is crucial for all living organisms that covers almost 80% of our planet. Although productivity of water resources is unproportionally distributed, all of them host vast biodiversity but only very minor part in freshwaters is available for human life. Aquatic life in these ecosystems are progressively threatened by invasive species, climate change and habitat destructions mainly through anthropogenic pollution, water abstraction, unpredictable fluctuations in water level and invasive species. All these impacts interact and enhance uncertainty about the availability of aquatic life.

Our most important goal is to ensure a sufficient supply of good-quality aquatic life and water for future generations. However, the maintenance and management of aquatic ecosystems require the close cooperation of scientists, politicians and stakeholders, and must arise from the best available knowledge and experience provided by ecologists. We therefore organize the first symposium on Marine and Freshwater Sciences, which is an ecosystem based symposium aiming to cover studies on protected areas, tourism economy, energy, natural sources, and education and offer an opportunity to bring together experts from various disciplines and contribute substantially to increasing our knowledge of the theoretical and practical aspects of marine and freshwater sciences.

Final Declaration

The First Symposium on Marine and Freshwater Sciences (MarFresh2018), which took place at the Mirage Park Hotel, Kemer, Antalya, Turkey, 18–21 October 2018, was organised by the Iskenderun Technical University, Muğla Sıtkı Koçman University, Harran University with the support of Blue and Green Nature and Science Association (Mavi Yeşil Doğa ve Bilim Derneği), Değirmen Reklam, Payas Municipality, Sektörel Dergisi, Madam Seta İpekçilik and Ecovasion.

Overall, 145 participants from 13 research center and institutions and 42 universities attended the symposium. Scientists from Turkey (107) were the most numerous amongst symposium participants, but also in attendance were 137 experts from fourteen different countries (Turkey, Russia, Tunisia, Libya, Algeria, Finland, Italy, Greece, Montenegro, Romania, Bulgaria, Pakistan, Indonesia and United Kingdom). 103 oral and 36 poster presentations were contributed, including both original and review studies, which were predominantly involved marine and freshwater fishes, invertebrates (i.e. jellyfish, molluscs, cephalopods) and plants, amphibia, waterbirds.

In total, there were five key-note speeches presented, ranging from using meiobenthic organisms in assessing Ecological Quality Status in marine ecosystems (Federicca Semprucci), overlooked freshwater invertebrates in Asia (Ivan Bolotov), marine protected areas (Paraskevi Karachle), biomonitoring using meiobenthic nematodes (Fehmi Boufahja) and current status in eel research in Indonesia (Zainal Muchlisin).

Overall, this first symposium on Marine and Freshwater Science was an excellent opportunity for all participants to discuss all kinds of aquatic species with various study subjects and to examine prospective options for collaboration and information exchange. As such, this symposium stimulated highly productive and useful discussions, and provide a baseline for further steps that should be taken on aquatic species in general in Turkey and elsewhere in the World. Indeed, the symposium acted as a very useful platform to exchange information and experiences and for take-home messages.

In final closing speech of the symposium, a fully agreed idea for continuation of this symposium as to organized once in two years was reached. Also, most importantly, in the next meetings (first to be planned in 2020) establishing some working groups on special and interesting issues, and organizing open discussions in round table fashion to reach joint resolutions along with initial steps towards the implementation of solutions were suggested by participants.

Meiobenthic organisms to assess the Ecological Quality Status in marine ecosystems

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Meiofauna is a collective name for a size category (generally 500-42 µm) represented by organisms that share a distinctive lifestyle, ecological relations and commonly evolutionary traits. Meiofaunal organisms are fundamental contributors to ecosystem processes and functions, including nutrient cycling and supply of food to higher trophic levels. Despite their importance in the marine ecosystems, benthic ecologists neglected this group in the ecological assessment. Thus, my primary research has been focused on the development of new possible tools to assess the Ecological Quality (EcoQ) by means of meiofauna and, in particular, of free-living nematodes. Indeed, nematodes are the best candidates for the EcoQ assessment within the meiofaunal community. They have colonized all climatic areas and types of environments with high levels of biodiversity and abundance. They are easy to collect, providing a highly reliable database for statistical analyses, even when only small-sized samples are available. The results so far obtained on the use of nematode descriptors according to the European directives (WFD, 2000/60/EC and MSFD 2008/56/EC) are here discussed.

Keywords: marine meiofauna, nematodes, anthropogenic disturbance, ecological quality status.

The Last Lost Worlds: Species-Rich but Largely Overlooked Freshwater Evolutionary Hotspots in Asia

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Asia is a huge continent (44.6 million km^2) covering approximately 30% of Earth's land area. This continuous terrain extends from the equatorial belt to the High Arctic, crossing a plethora of biomes. Numerous mountains and highlands (e.g. Tibetan Plateau, Himalayan, Tian Shan, Ural and Zagros Ranges) form exceptionally high altitudinal heterogeneity of landscapes across the continent. Freshwater biodiversity of Asia attracts full attention of scientists for at least three centuries, but our knowledge on this topic is very far from being complete.

During the few last years, we have discovered several new family-level taxa of freshwater mussels from East and Southeast Asia, e.g. the Gibbosulinae Bogan, Bolotov, Froufe & Lopes-Lima, 2018 (new subfamily of the Margaritiferidae), Indochinellini Bolotov, Pfeiffer, Vikhrev & Konopleva, 2017, Leoparreysiini Vikhrev, Bolotov & Kondakov, 2017, Cristariini Lopes-Lima, Bogan & Froufe, 2017, Lanceolariini Froufe, Lopes-Lima & Bogan, 2017, and Chamberlainiini Bogan, Froufe & Lopes-Lima, 2017 (new tribes of the Unionidae). New genera of freshwater mussels (Bivalvia: Unionidae) from tropical Asia were described, e.g. *Indochinella* Bolotov, Pfeiffer, Vikhrev & Konopleva, 2018, *Trapezidens* Bolotov, Vikhrev & Konopleva, 2017, and *Leoparreysia* Vikhrev, Bolotov & Aksenova, 2017 (Bivalvia: Unionidae). A new endemic genus of the lymnaeid pond snails, *Tibetoradix* Bolotov, Vinarski & Aksenova, 2018, was recorded from the Greater Tibetan Plateau.

A freshwater lineage of the rock-boring mussel, *Lignopholas fluminalis*, has been discovered in Myanmar. This record reveals that the rocks with bivalve macro-borings are not a direct indicator of marine paleo-ecosystems, but may also reflect freshwater habitats. The neotectonic uplift of the area leading to gradual decrease of the sea level with subsequent shift from estuarine to freshwater environment was the most likely driver for the origin of this freshwater lineage and an accessory invertebrate community.

This study is supported by National Geographic Society (grant no. NGS-274R-18).

Keywords: Integrative taxonomy, molecular phylogeny, Unionidae, Margaritiferidae, Lymnaeidae, Asia

Current Status of the Eels (Anguillidae) Research in Indonesia

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Eels are the commercial group of fishes; Presently, a total of 19 eels are recorded worldwide where 9 species are recorded in Indonesia. These are the migrating species, they are spawning in ocean waters and growing in freshwater. The eels are very promising for aquaculture businesses. However, there was a very limited report on the bio-ecology and aquaculture of the tropical eels in Indonesia; this information is very crucial in relation to develop breeding and feeding technologies. Therefore, this paper is presenting the current research on eels in Indonesia especially in Aceh province focusing on migration behavior of the larvae, genetic and morphometric variations, parasites infestation, feed, and feeding.

Keywords: Glass eels, genetic, morphometric, protein, stocking density, parasites

What can still be explored in biomonitoring using meiobenthic nematodes?

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The development of simple, inexpensive and rapid biotests and early and accurate methods for biomonitoring is essential. Nematodes are the second most abundant and diverse metazoan taxa on Earth. Since the 1960s, those living in marine environments have been generally used to assess biotopic quality through their community structure or the presence or absence of indicative species. Now, the research efforts are confronted with two major disabilities: (1) the first signs of stress exposure are often missed because of the slow compositional changes within the nematode communities. To date, the suitability of various biomarkers of exposure has been examined in a several kinds of organisms (fish, molluscs...) but never in meiobenthic nematodes. (2) The morphological taxonomy of nematodes faces several difficulties: (i) the concept of species, which is rather poorly defined since it is based on morphometric indices, which fluctuate with stress conditions, (ii) the taxonomy of nematodes, which changed over time since it has always been dependent on the progress of the microscopes used during identifications and, (iii) the cryptic species, which constitute an important problem in meiobenthic nematology. The use of genomic markers (DNA barcoding) would therefore be essential to address the molecular taxonomy of marine nematode species.

Keywords: biomonitoring, meiobenthic, molecular taxonomy, marine nematode

Marine Protected Areas: a sanctuary for marine life

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According to IUCN a protected area is "*a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values*". Yet, in the marine realm, the concept of protected area is a more complex, as under the term Marine Protected Areas (MPAs) we include areas with

(a) different types of area-based conservation measures (national or regional), varying degree of protection, from strictly protected marine reserves (no-take zones) to marine parks where various activities and at varying degrees can take place
(b) spatial closures for fisheries, such as fishing protected areas, fisheries restricted areas (FRAs), habitats protection, prohibition to use towed gears or purse seiners
(c) other human activities or human-induced grounds unsuitable for fishing (e.g. oil-gas platforms, wind farms, communication cables or pipelines, shipwrecks, submerged breakwaters, artificial reefs, archaeological sites)
(d) sea-floor topography, hydrographic characteristics, distance from the ports and the presence of hard habitats, that do not allow a wide range of activities.

The Convention of Biological Diversity, and more specifically the Aichi target 11, set the goal of a 10% protection of all marine and coastal areas by 2020. Yet, amongst the scientific community this 10% is just a milestone; at least 30% of ocean protection should be achieved. In the Mediterranean, from the beginning of this century until now the number of MPAs has tripled, with approximately 1140 designated MPAs (6.5% of the Mediterranean Sea area). Nevertheless, only a mere 0.04% is fully protected (i.e. 76 areas covering an area of 5 km^2). Acknowledging the importance of MPAs, DG-MARE funded three projects, one for each Mediterranean sub-area ("SAFENET" at the West, "MANTIS" at the Central and "PROTOMEDEA" at the East Mediterranean), under a call entitled "Marine Protected Areas: Network(S) for enhancement of sustainable fisheries in EU Mediterranean waters".

PROTOMEDEA project focuses on mapping existing MPAs while also planning proposed MPA networks in two areas of the Eastern Mediterranean: the Aegean Sea (GSA 22) and Cyprus (GSA 25). Within this concept the establishment of MPA network(s), properly designed not only for the conservation of ecological features but also for supporting the sustainable exploitation of biological resources, is essential for implementing the ecosystem approach to fisheries management. The need of such an establishment is even more important for the Eastern Mediterranean, which is oligotrophic, the least productive sub-region of the Mediterranean, and highly exploited by the largest (in number of vessels) fishing fleet in Europe.

PROTOMEDEA's overall objective is to improve the exploitation pattern in the study area and help achieve Maximum Sustainable Yields (MSYs), while also apply precautionary ecosystem-based approaches to achieve the long-term sustainability of biological resources and to reach Good Environmental Status (GES) according to the Marine Strategy Framework Directive (MSFD).

Towards this direction, the mapping of essential fish habitats, the effect of MPA in achieving the MSY objectives of the Common Fisheries Policy (CFP) and the development of ECOPATH models in selected areas are foreseen in order to evaluate the current overall contribution of MPAs in fisheries sustainability. “What if” scenaria of MPA impacts on MSY and Ecopath/Ecospace models will be evaluated and different management schemes will be developed and examined in order to support the optimization of fishery management.

PROTOMEDEA’s key outcomes achieved so far include among others:

- Mapping of the currently existing MPAs in the EU Eastern Mediterranean waters (i.e. Greek Aegean Sea (GSA 22) and Cyprus) as well as description of their legal status and the type of protection.
- Compilation and update of the existing information on the identification and location of nursery areas (juveniles in their first and, if appropriate, second year of life) for the most important demersal and small pelagic species in the Eastern Mediterranean included in Appendix VU of Council Regulation (EC) No 199/2008 as well as for the species subject to minimum size (Council Regulation (EC) No 1967/2006-Annex III).
- Estimation of the distribution of the fishing effort and mapping of the foot print from the commercial (trawling, purse-seining, small-scale) and recreational fishing fleet operating in the open sea and coastal zone of the selected study areas.
- Field research (Underwater visual surveys, Experimental fishing trials) in order to investigate the effectiveness of MPAs on fish abundance and biomass.
- Socio Economic evaluation of marine ecosystems aiming to assess the value of particularly representative goods and services rendered by the important habitats / species in the Aegean, and the cost of their degradation under Directive 2014/89 / EC establishing a framework for MPA.
- Spatial Planning (1st round), by means of a systematic conservation planning approach (MARXAN), of a network of MPAs in the Aegean Sea and Cyprus, that takes into consideration the protection of ecological features of conservation importance and essential fish habitats, important areas for fisheries, as well as the socio-economic impact/cost of additional fisheries restrictions, under a participatory bottom-up procedure.
- Organization of Stakeholder meetings (Nicosia, Cyprus and Athens, Greece), along with an extensive survey which aimed at recording the perceptions of a range of stakeholder on preferences of different types of MPAs, the importance of the goods and services provided by the marine environment and the acceptability of specific protection targets.

Currently the MPA effect on MSY is being examined through evaluating the biological, technical, economic and governance conditions which will ensure with high probability that the establishment of a coherent network of MPAs will have beneficial effects on the achievement of the MSY objectives for certain stocks and fisheries, as well as evaluating whether and how a system of dynamic MPAs (i.e real-time and/or seasonal fisheries closures) could complement the network of permanent marine protected areas and exert beneficial effects with regard to better exploitation patterns and short-term reductions of the fishing pressure towards the achievement of the MSY objectives. Towards this direction, testing the effects of coherent network(s) of protected areas on the populations of some major fish stocks and on their bio-economic effectiveness in terms of allowing fisheries to achieve the MSY objectives is also foreseen. Ecosystem models (ECOPATH with ECOSIM (EwE)) are being developed in selected case studies in order to set up and run spatial and temporal simulations aiming to explore management strategies, while bio-economic modelling will allow evaluating the pros and cons of different management schemes and will support the optimization of fishery management. Finally, the time-dynamic (ECOSIM) and spatially resolved (ECOSPACE) modules of the "EwE" methodology will be developed and utilized to hindcast past periods and calibrate the models so as to produce an -as much as possible- operational model that will address specific questions and management scenarios.

Keywords: ROTOMEDEA, ECOSIM, ECOSPACE, Marine Protected Areas

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ORAL PRESENTATIONS

Presence of Knobby Swim Crab, *Macropipus tuberculatus* (Roux, 1830) (Decapoda: Brachyura: Polybiidae) on the Levantine Sea Coast of Turkey

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The knobby swim crab, *Macropipus tuberculatus* (Roux, 1830) known from the Aegean Sea coast of Turkey previously, is for the first time reported from the Samandağ coast, Turkish Mediterranean Sea. Specimens of two adult male were captured by means of a trawl haul on a sandy bottom at the depths between 160 and 200 m depth.

Keywords: *Macropipus tuberculatus*, Crustacea Decapoda, Mediterranean Sea, Turkey.

Introduction

A limited knowledge on decapod crustaceans in deep waters of Turkish Seas present, yet, studies on species composition, distributions, and populations of deep sea decapod crustaceans on the Levantine coast of Turkey are not enough.

The deep-sea knobby swim crab, *Macropipus tuberculatus* (Roux, 1830), is a portunid crab that inhabits muddy areas on the deepest part of the continental shelf and on the upper slope along the eastern North Atlantic, from West Norway to Morocco and the Azores including the Mediterranean Sea (Christiansen, 1969; Manning & Holthuis, 1981; Zariquiey-Álvarez, 1968; Balkıs & Asurluoğlu, 2002; Koçataş & Katağan, 2003; Hassan *et al*., 2008). *M. tuberculatus* occurs on the Aegean sea coast of Turkey and it is for the first time recorded only from the Aegean sea coast of Turkey in 2000-2001 (Balkıs & Asurluoğlu, 2002). Later, *M. tuberculatus* was reported off Gökova Bay in 1988, Sığacık and Kuşadası Bay in 1992 (Kocataş & Katağan, 2003). Bakır *et al*., (2014) stated that a total of 254 species of decapod crustaceans was recorded from Turkish coast and 207 of them are from the sea of Levantine basin of Turkish Mediterranean. Hassan *et al.,* (2008) found this species from Lattaki (Syria) coast. This study is on new record of *M. tuberculatus* from the Mediterranean coast of Turkey.

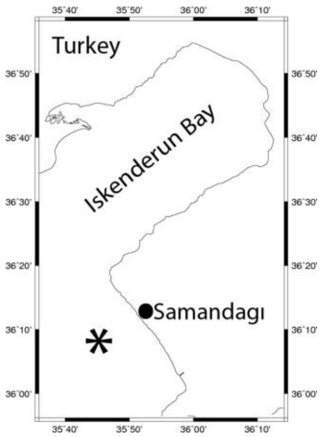

Figure 1. Map of the study area.

Material and Methods

Samplings were carried out at three stations (GPS coordinates: 36˚10´240˝ N-035˚46´475˝ E and 36˚08´500˝ N-035˚52´820˝ E) off Samandağ (Turkish Mediterranean Sea) on 14 April 2016 (Fig. 1) by means of a bottom trawl with a cod end mesh size of 22 mm.

Results and Discussion

Two male specimens of *M. tuberculatus* were captured on sandy bottom at a depth range between 180 and 210 m (Fig. 2). *M. tuberculatus* inhabits on open-sea sandy, muddy, silty, detritic organogenic sediments (Stevcic, 1990; Koçataş & Katağan, 2003; Fanelli *et al*., 2007) sometimes it prefers the bathyal muddy bottoms (Massuti & Renones, 2005). *M. tuberculatus* is found on the deepest part of the continental shelf and on the upper slope from 20 to 850 m (Holthuis, 1987; Abelló, 1989; Balkıs & Asurluoğlu, 2002; Koçataş & Katağan, 2003; Fanelli *et al*., 2007; Özcan & Katağan, 2011; Despalatović *et al*., 2012), but it inhabits rarely at the depths less than 1400 m (Abello & Valladares, 1988; Mura & Cau, 1994). Özcan & Katağan (2011) indicated that *M. tuberculatus* is distributed at the depths of 200-300 and 300-400 m but, its dense populations are observed at the depths 300-400 m during trawl hauls.

Figure 2. *Macropipus tuberculatus* (Roux, 1830) dorsal view.

Individuals captured in trawling hauls are considered as by-catch. Besides, *M. tuberculatus* is known to be commercial in various localities of the Mediterranean (Falciai & Minervini, 1992). However, this crab species are defined as discard in commercial fishing activities conducted on the Turkish coast. The distribution areas, bathymetry, population structure, and ecology of *M. tuberculatus* to be considered as human food in the future should be studied.

Consequently, present study reports the first record of portunid crab, *Macropipus tuberculatus* from the Samandağ, Levantine Sea coast of Turkey.

Acknowledgements

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References

Abelló, P., 1989. Feeding habits of *Macropipus tuberculatus* (Brachyura, Portunidae) off the Catalan coast (NW Mediterranean). Misc. Zool., 13: 45-50.

Abello, P. & Valladares, F.J., 1988. Bathyal decapod crustaceans of the Catalan Sea (North-western Mediterranean). Mesogee, 48:97-102.

Balkıs, H. & Asurluoğlu, L., 2002. The crab species found on the coasts of Bozcaada Island in the Aegean Sea. Cercet Mar., 34: 59-69.

Bakır, A.K., Katağan, T., Aker, H.V., Özcan, T., Sezgin, M., Ateş, A.S., Koçak, C. & Kırkım, F., 2014. The marine arthropods of Turkey. Turkish Journal of Zoology, 38: 765-831.

Christiansen, E., 1969. Marine Invertebrates of Scandinavia. No. 2. Crustacea Decapoda Brachyura. Universitetsforlaget, Oslo. 143P.

Despalatović, M., Cvitković, I., Zuljević, A., Vana Grubelić, I. & Piccinetti, C., 2012. Distribution and abundance of the knobby swimcrab, *Macropipus tuberculatus* (Roux, 1830) (Decapoda, Portunidae), in the Northern and Middle Adriatic Sea. Crustaceana, 85(7): 835-845

Hasan, H., Zeini, A. & Noel, Y.P., 2008. The marine decapod crustacea of the area of Lattakia, Syria. Crustaceana, 81(5): 513-536.

Holthuis, L.B., 1987. Vrais Crabes. In: Fiches FAO d'identification des especes pour les besoins de la peche Mediterranee et Mer Noire Zone de peche 37 (eds., W. Fisher, M. Schneider and M.L. Bauchot), Revision 1 Vol. 1 Vegetaux et invertebres, FAO, Rome, pp. 323-367.

Falciai, L. & Minervini, R., 1992. Guide des homards, crabes, langoustes, crevettes et autres crustacés décapodos d’Europe. Delachaux et Niestle SA, Lausanne-Paris. 287P.

Fanelli, E., Colloca, F. & Ardizzone, G.D., 2007. Decapod crustacean assemblages off the West coast of central Italy (western Mediterranean). Sci. Mar., 71(1): 19-28.

Kocataş, A. & Katağan, T., 2003. The Decapod Crustacean fauna of the Turkish Seas. Zoology in the Middle East, 29: 63-74.

Manning, R.B. & Holthuis, L.B., 1981. West African brachyuran crabs (Crustacea: Decapoda). Smithsonian Contr. Zool., 306: 1-379.

Massuti, E. & Renones, O., 2005. Demersal resource assemblages in the trawl fishing grounds off the Balearic Islands (western Mediterranean). Sci. Mar., 69(1): 167-181.

Mura, M. & Cau, A., 1994. Community structure of the decapod crustaceans in the middle bathyal zone of the Sardinian Channel. Crustaceana, 67(3): 259-266.

Özcan, T. & Katagan, T., 2011. Length-weight relationship of eight decapod crustaceans of the Sığacık Bay, Aegean Sea coast of Turkey. IUFS Journal of Biology, 70(1): 45-48.

Stevcic, Z., 1990. Check-list of the Adriatic decapod Crustacea. Acta Adriatica, 31(1/2): 183-274.

Zariquiey-Álvarez, R., 1968. Crustáceos decápodos ibéricos. Investigación

Genotypic clustering on the blue mussel for the genomic association analyses

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Genome wide association studies (GWASs) and genomic selection (GS) models commonly used to search for genetic variants associated with phenotypes in marine sciences. Population stratification due to unpredictable genetic relations may cause the false positives in GWAS. In this study we tried different number of genotypic clusters and GS models to incorporate genomic information for the GWAS. We analysed the blue mussel genotypes and net rate calcification (NRC). The genome consisted of 171.645 Single Nucleotide Polymorphisms (SNPs). The number of population individuals were 322. We assumed different number of clusters for the genotypes and NRC. We also investigated if the NRC could be controlled over different number of major genes and/or polygenic effects. We used genomic relation matrix and principal components to take into account of genetic kinship among mussels. We detected genomic signals for the NRC based on various model referring genetic architecture of the NRC. Genomic heritability was predicted as 0.0475. By assuming only major genes model lead to weak genomic signals due to multiple hypothesis testing procedure. However, we are able to explain the genomic variances (8.2%) using 412 SNPs by using polygenic and major gene model together. Our results suggested that the NRC could be explained by polygenic and major genes together.

Keywords: blue mussel, genomic selection, genome wide association study, net rate calcification

A Preliminary Study on the Ecological Quality of a Protected Lagoon (Çanakkale Strait, Turkey) Using TUBI Index

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In this primary study the state of ecologic quality in Cardak Lagoon located in the Çanakkale Strait was determined based on the TUBI Index. A total of 832 specimens belonging to 66 macrozoobenthic species (1 Oligochaeta, 1 Nemetina, 1 Nematoda, 17 Polychatea, 3 Chiton, 13 Bivalvia, 17 Gastropoda, 1 Echinodermata, 12 Crustacea) were found in the study area. TUBI values were between 2.95 and 3.67 for the sampling sites. According to the results of the study, the lagoon area could be classified as “good” in terms of ecological quality.

Keywords: TUBI Index, ecological quality, zoobenthos, Çardak Lagoon, Çanakkale Strait.

Introduction

Coastal lagoons are known to be marine environments connected to the sea via one or more tidal inlets and they are ecotones between marine and freshwater environments. On the other hand, lagoons exhibit a number of different changes on the biota as well as the physical conditions as a result of human activities where ecosystem structures change and ecological processes can be deteriorated (Pravoni *et al*., 2008; Arima *et al*., 2013). Biotic communities in coastal lagoons adapt to significant natural stress conditions associated with highly variable physico-chemical conditions (annual elasticities in temperature and salinity, organic matter input, wave and current effects, turbidity, freshwater input) (Heinz Center, 2002; Norton, 2005). Thus, benthic assemblages play an important role in ecosystems of coastal lagoons (Pravoni *et al.*, 2008). This primary study is conducted to determine the ecological status of the Çardak Lagoon which is declared as a first-degree natural site by the Decree No. 3298 dated 06 August of the Council for the Protection of Cultural and Natural Assets. For this purpose, TUBI index based on the current state of macrozoobenthic populations was used.

Material and Methods

The study area included the depths of 0 to 3 m of 6 different sampling points (GPS Coordinates: 40 ° 23'14 "K, 26 ° 43'30" D) in Cardak Lagoon located in the northeast of the Canakkale Strait (Fig. 1). The sediment samples were collected once on 16 April 2016, by means of a metal-framed quadrat system of 30x30 cm^{-2} by a SCUBA diver. Bottom material were fixed in neutralized formaldehyde of 4% in plastic bags of 5 L. Species belonging to benthos material (mollusk, polychaeta, crustacea, echinoderm) were diagnosed in trinocular stereomicroscope acoording to definiations in related previous studies and all specimens were counted. TUBI ecological indices (Çınar *et al*., 2015) was calculated with the following formula.

TUBI Index= Metric 1 + (5- Metric 2)/2, TUBI= $H'^{\dagger}$ + [0x G1%+3xG2%+5xG3% / 100] / 2

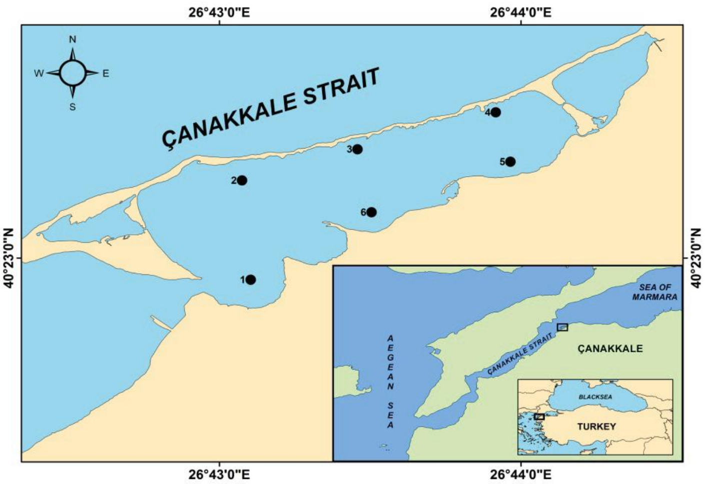

Figure 1. The study area showing the sampling stations.

Results

A total of 832 specimens belonging to 66 macrozoobenthic species (1 Oligochaeta, 1 Nemetina, 1 Nematoda, 17 Polychatea, 3 Chiton, 13 Bivalvia, 17 Gastropoda, 1 Echinodermata, 12 Crustacea) were found at 6 different sampling points in the study area (Table 1).

Table 1. List of species found in the study area.

	Sampling sites									
Species	**1**	**2**	**3**	**4**	**5**	**6**	**∑**	***f* (%)**	**Di (%)**	**EG**
Crustacea										
Bodotria arenosa Goodsir, 1843	0	0	1	0	0	0	1	16.6	0.12	I
Iphinoe tenella Sars, 1878	0	3	3	0	0	0	6	33.3	0.73	I
Paranthura costana Spence Bate & Westwood, 1866	0	0	8	0	0	0	8	16.6	0.97	I
Ampithoe ramondi Audouin, 1826	0	1	0	0	0	0	1	33.3	0.12	III
Caprella rapax Mayer, 1890	2	21	5	0	0	0	28	50.0	3.16	II
Dexamine spinosa (Montagu, 1813)	0	2	0	0	0	0	2	16.6	0.24	II
Maera inaequipes (Costa, 1857)	3	35	4	0	0	0	42	50.0	4.75	I
Microdeutopus sp.	0	0	5	0	0	0	5	16.6	0.60	II
Athanas nitecens Linnaeus, 1758	0	1	0	0	0	0	1	16.6	0.12	I
Carcinus aestuarii Nardo, 1846	0	2	0	0	0	0	2	16.6	0.24	III
Hippolyte garciarasoi d'Udekem d'Acoz, 1996	0	7	0	0	0	0	7	16.6	0.85	I
Pisidia longimana (Risso, 1816)	0	1	0	0	0	0	1	16.6	0.12	II
Nemertini										
Cerebratulus sp.	0	0	2	0	0	0	2	16.6	0.24	II
Oligochaeta										
Oligochaeta sp.	0	75	6	0	0	1	82	50.0	9.98	IV
Nematoda										
Nematoda sp.	0	5	4	0	0	0	9	33.3	1.09	IV
Polycheata										
Aricidea (Acmira) *catherinae* Laubier, 1967	0	0	1	0	0	0	1	33.3	0.12	I
Eumida sanguinea (Örsted, 1843)	0	1	0	0	0	1	2	33.3	0.24	II
Exogone dispar (Webster, 1879)	0	0	1	0	0	0	1	16.6	0.12	I
Exogone naidina Örsted, 1845	0	1	0	0	0	0	1	16.6	0.12	II
Hediste diversicolor (O.F. Müller, 1776)	0	0	1	0	0	0	1	16.6	0.12	III
Heteromastus filiformis (Claparède, 1864)	0	0	1	0	0	0	1	16.6	0.12	V
Glycera alba (O.F. Müller, 1776)	1	0	1	0	0	0	1	33.3	0.12	III
Micronephthys stammeri (Augener, 1932)	0	0	1	0	0	0	1	16.6	0.12	III
Nephtys hombergii Savigny, 1818	1	1	8	0	0	1	11	66.6	1.21	IV

Nereiphylla rubiginosa (Saint-Joseph, 1888)	0	1	2	0	0	0	3	33.3	0.36	III
Phyllodoce mucosa Örsted, 1843	0	0	1	0	0	0	1	16.6	0.12	III
Pisione remota (Southern, 1914)	0	0	1	0	0	0	1	16.6	0.12	I
Polyophthalmus pictus (Dujardin, 1839)	0	6	1	0	0	0	7	33.3	0.85	I
Saccocirrus papillocercus Bobretzky, 1872	0	0	1	0	0	0	1	16.6	0.12	I
Sphaerosyllis taylori Perkins, 1981	0	0	2	0	0	0	2	16.6	0.24	I
Spio decoratus Bobretzky, 1870	1	1	5	0	0	0	7	50.0	0.73	IV
Streblospio shrubsolii (Buchanan, 1890)	0	1	0	0	0	0	1	16.6	0.12	II
Mollusca										
Chiton										
Chiton olivaceus Spengler, 1797	0	0	1	0	0	0	1	16.6	0.12	I
Ischnochiton sp.	0	0	1	5	0	0	6	33.3	0.73	I
Lepidochitona cinerea (Linnaeus, 1797)	0	0	1	0	0	0	1	16.6	0.12	I
Bivalvia										
Acanthocardia tuberculata (Linnaeus, 1758)	0	4	0	0	0	0	4	16.6	0.48	I
Cerastoderma glaucum (Bruguière, 1789)	0	2	0	0	0	0	2	16.6	0.24	II
Chamelea gallina (Linnaeus, 1758)	0	0	1	0	0	0	1	16.6	0.12	I
Fulvia fragilis (Forsskål in Niebuhr, 1775)	0	1	0	0	0	0	1	16.6	0.12	III
Gastrana fragilis (Linnaeus, 1758)	0	0	0	4	0	0	4	16.6	0.48	III
Loripes lacteus (Linnaeus, 1758)	8	0	0	11	0	0	19	33.3	2.31	II
Lucinella divaricata (Linnaeus, 1758)	2	2	3	0	0	1	8	66.6	0.97	I
Mysella bidentata (Montagu, 1803)	0	3	6	0	1	0	10	50.0	1.21	II
Mytilus galloprovincialis Lamarck, 1819	2	0	0	1	0	1	2	50.0	0.24	III
Nucula sulcata Bronn, 1831	0	6	0	0	0	0	6	16.6	0.73	I
Parvicardium exigumm (Gmelin, 1791)	6	0	11	24	4	68	113	83.3	13.76	II
Parvicardium scriptum (Bucquoy, Dautzenberg & Dollfus, 1892)	0	0	0	3	0	0	3	16.6	0.36	II
Pitar rudis (Poli, 1795)	0	2	2	5	0	0	9	50.0	1.09	I
Gastropoda										
Alvania cimex (Linnaeus, 1758)	0	0	0	4	0	0	4	16.6	0.48	I
Bela nebula (Montagu, 1803)	0	0	0	4	1	0	5	33.3	0.60	I
Bittium latreillii (Payraudeau, 1826)	0	0	10	0	0	0	10	16.6	1.21	II
Bittium reticulatum (da Costa, 1778)	2	9	0	9	1	0	21	66.6	2.55	II
Bittium scabrum (Olivi, 1792)	5	10	8	11	2	6	42	100	5.11	II
Calyptreaa chinensis (Linnaeus, 1758)	0	0	0	2	0	0	2	16.6	0.24	I
Cyclope neritea (Linnaeus, 1758)	1	0	3	6	0	3	13	66.6	1.58	I
Gibbula adansonii (Payraudeau, 1826)	0	14	5	21	1	5	46	83.3	5.60	I
Gibbula adriatica (Philippi, 1844)	0	0	0	3	0	0	3	16.6	0.36	I
Jujubinus striatus Shlliotti, 1889	0	0	0	8	0	0	8	16.6	0.97	I
Monophorus perversus (Linnaeus, 1758)	0	0	0	1	0	0	1	16.6	0.12	II
Nassarius reticulatus (Linnaeus, 1758)	0	4	0	0	0	0	4	16.6	0.48	II
Rissoa labiosa (Montagu, 1803)	3	19	4	61	0	64	151	83.3	18.14	II
Rissoa splendida Eichwald, 1830	0	2	0	9	0	5	16	50.0	1.94	II
Rissoa ventricosa Desmarest, 1814	0	1	0	0	0	0	1	16.6	0.12	II
Tricolia pullus *pullus* (Linnaeus, 1758)	0	6	4	52	0	3	65	66.6	7.91	I
Ventrosia ventrosa (Montagu, 1803)	1	0	0	0	0	2	3	33.3	0.36	I
Echinodermata										
Asterina gibbosa (Pennant, 1777)	0	0	3	1	0	0	4	33.3	0.48	I
Total	38	250	128	245	10	161	**832**	100	100	

∑; total number of specimen, *f*; frequency, Di; dominancy index, EG; ecological group.

The results of SIMPER Analysis were presented in Table 2. According to the results of SIMPER Analysis, a total of seven species (*Oligochaeta* sp., *Maera inaquipes*, *Parvicardium exigumm*, *Rissoa labiosa*, *Tricolia pullus pullus*, *Bittium scrabrum*, and *Loripes lacteus*) had a significant degree in terms of the sampling location similarity.

Table 2. Results of simper analysis.

Groups	SIMPER		
	Average Dissimilarity (%)	**Discriminating species**	**Contribution (%)**
Site 1- Site 2	86.81	*Oligochaeta* sp.	30
		Maera inaequipes	12.08
Site 2- Site 6	81.02	*Oligochaeta* sp.	19.84
		Parvicardium exigumm	22.22
Site 3- Site 4	79.09	*Rissoa labiosa*	19.32
		Tricolia pullus pullus	16,27
Site 4- Site 1	81.63	*Rissoa labiosa*	25.11
		Tricolia pullus pullus	22.51
Site 5- Site 1	70.83	*Loripes lacteus*	22.53
		Bittium scrabrum	8.82
Site 6- Site 3	75.78	*Rissoa labiosa*	27.40
		Parvicardium exigumm	26.03

Diversity (H′, J′) and biotic (TUBI) index

The values of diversity/biotic index and ecological quality status of sampling sites were presented in Table 3. TUBI values presented in Table 3 showed that the study area was generally good in terms of ecological quality.

Table 3. Diversity and TUBI index values found at the sites.

	Sampling sites					
	1	2	3	4	5	6
H′	2.38	2.61	3.32	2.41	1.61	1.43
J′	0.77	0.41	0.74	0.53	0.83	0.32
TUBI	3.44	2.95	3.62	3.67	3.30	3.17
EQR	Good	Moderate	Good	Good	Good	Good

EQR: Ecological quality ratio

Discussion

In this study, TUBI values of sampling points were based on H′ values. We have found significant irregularities related to the values of abundance and diversity index at the sampling sites. For example, the abundance was recorded as 161 individuals in a square of 0.09 m^{-2} at site 6 with the lowest diversity index (H′:1.43), the abundance at site 1 was 38 individuals with an average H′ value of 2.38. This irregularity was most likely caused by the bottom structure. However, the analysis of sediment particle size was not performed in this primary study. Briefly, the ecological quality status of the lagoon area was considered on the basis of dominance of macrozoobenthic species. Although the present work includes primary findings, it shows that TUBI Index can be a good determinant when stating the ecological quality status of Turkey's coastal lagoon areas.

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References

Arima, S., Basset, A., Lasinio, G.J., Pollice, A. & Rosati, I., 2013. Ahierarchical Bayesian model for the ecological status classification of lagoons. Ecological Modelling, 263:187-195.

Çınar, M.E., Bakır, K., Öztürk, B., Katağan, T., Dağlı, E., Açık, Ş., Doğan, A. & Bitlis Bakır, B., 2015. TUBI (Turkish Benthic Index): A new biotic index for assessing impacts of organic pollution on benthic communities. Journal of Black Sea Mediterranean Environment, 21:135-168.

Heinz Center., 2002. Human links to coastal disasters. Washington, D.C.: The H. John Heinz III Center for Science, Economics and the Environment.

Norton, R., 2005. More and better local planning: State-mandated local planning in coastal North Carolina. Journal of the American Planning Association, 71: 55-72.

Pravoni, F., da Ponte, F. & Torricelli, P., 2008. Historical changes in the structure and functioning of the benthic community in the lagoon of Venice. Estuari

Diversity of macro invertebrates in the Tonga Lake (northeast Algeria)

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The invertebrate communities colonizing the bottom of streams, lakes and also visible to the naked eye called for this reason benthic aquatic macro invertebrates. The characteristic of polluo-tolerance and polluo-sensitivity allow to them the ability of being a good indicator for the health of the aquatic ecosystem. Our study presents an inventory of macro invertebrates in the shores of Tonga Lake (wetland of international importance – Ramsar Site). The sampling was conducted between January to May 2017. Three stations are chosen in this study (Fad smar, Oued El Hout and Fad El Alig). They were identified to family level. We provide a checklist and some observations on 20 families belonging to 6 Order. The taxonomic richness shows fluctuations between the studied stations, 13 families in Fad smar station, 14 in Oued El Hout station and 17 families in Fad El Alig. The Hemiptera, Coleoptera and Gasteropoda are dominant in this area. Factorial analysis of the correspondences (FAC) revealed significantly different macro invertebrates assemblages among the stations of Tonga Lake.

Keywords: macro invertebrates, Tonga Lake, wetland, Ramsar site.

Density, diversity and habitat use of Herons (Ardeidae) in Tonga Lake North east Algeria

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Wetlands are complex ecosystems that provide habitat for a diversity of water birds, as these have a wide variety of resources in terms of production and productivity. Ardeidae is one of the main water bird families that well represented in the North East of Algeria. The main objective of this study was to determine density, diversity and habitat use of Herons species in the North-East Algeria during different period of the year (2017). The family exhibited a preference to shallow water. We determined seven species of Herons in Tonga Lake. The highest Herons species density was recorded for cattle egret (16.37 herons/km^2) and the lowest was recorded for little bittern (0.07 Herons/km^2). Our results showed *a* significant variation between habitat uses by different species such as: Buttercup aquatic (39.84%), followed by natural lawn (39.09%), Prairie moist (4.81%), Scirpaie and Sparganaie (4%), However, Squacco Heron, Little egret, Cattle egret and Grey heron were occurred in a large identified habitats with different rates (92.3%), (61.53%), (46.15%) and (38.48%) respectively.

Keywords: Avifauna, wetlands, Ardeidae, habitat use, northeast Algeria.

Study about effects of peppermint (*Mentha piperita*) and green tea extract (*Pterophyllum scalare*) supplemented feeds on the growth performance, ammonia excretion and some blood parameters of common carp (*Cyprinus carpio*)

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The study was conducted to investigate the effects of dietary peppermint (*Mentha piperita*) and green tea extract (*Pterophyllum scalare*) supplementation in diet on growth performance, feed utilization, ammonia excretion and some blood parameters in common carp (*Cyprinus carpio*). For this purpose, two medicinal herbal extracts were added to the test diets at the rate of 0.5, 1 and 2%. The fish were fed with trial feed during 90 days. At the end of trial, there were no significant differences in terms of average weight gain, specific growth rate (SGR), protein efficiency ratio (PER), fat retention (FR), energy retention (ER), feed conversion rate (FCR) and protein retention (PR) ($p>0.05$). However, herbal extracts was caused to decreased condition factor (CF) and ammonia excretion ($p<0.05$). The medicinal herbal extracts did not significantly affect the red blood cell count, hematocrit, hemoglobin and mean corpuscular hemoglobin concentration ($p>0.05$). However, mean corpuscular volume and mean corpuscular hemoglobin were found higher in the experimental groups than in the control groups ($p<0.05$). Serum total protein and serum globulin levels were higher in the fish group fed with peppermint and green tea extract diets than in the control group ($p<0.05$). In addition, cholesterol level of fish with fed including green tea and peppermint extract were found lower than in control group ($p<0.05$). The albumin level was found significantly lower in P2 group when compared to others ($p<0.05$). Fish fed medicinal herb exctract diets significant decrease in the serum glucose level ($p<0.05$). However, urea, uric acid and creatinine levels were similar in all the treatment groups and no significant differences were found ($p>0.05$). The results of the present study indicated that dietary supplementations in commercial diets could improve some biochemical status in common carp.

Key words: herbal extract, growth, ammonia excretion, common carp, blood parameter

Introduction

Green tea mainly consists of polyphenols in a ratio of 20-40%.The 60-80% of these polyphenols are catechins (Atılganoğlu, 2002). The polyphenols of catechins have antioxidant, antiinflammatory, anticarcinogenic, thermogenic, probiotic and antimicrobial qualities which have been proven in human, animal and in vitro studies. It was argued that the vital properties of polyphenols are more than vitamin C (Kılıçalp *et al.,* 2008). Studies on animals revealed the antiviral, antifungal and antibacterial activities of peppermint (May *et al.,* 1996).

This study examines the effects of plant extracts of peppermint and green tea on the growth performance, feed utilization, ammonia excretion and blood parameters in common carps.

Materials and Methods

The experiment used 420 common carps (*Cyprinus carpio*) with an average weight of approximately 130.07±0.63 g. *Cyprinus carpio* were obtained from a local private fish farm in İzmir, Turkey. During the experimental period water quality remained as follows: temperature 20.01±0.26°C, pH 7.41±0.31 and dissolved oxygen 6.07±0.41 mg/L. Peppermint extract (*Mentha piperita*) and green tea extract (*Pterophyllum scalare*) were obtained from Talya herbal product. The herbal extract were added to the feed at 0.5% , 1%, 2% peppermint extract and green tea extract Additionally, a control group was fed a diet without herbal extract. The feed components of the diets are presented in Table 1.

Table 1. Commercial trout extruder feed (pellet size:2 mm) ingredients

Parameters	Values
Proximate analyses	
Crude Protein (%)	50
Crude Lipid (%)	16
Crude Cellulose (%)	1.2
Crude Ash (%)	9.7
Moisture (%)	10
Macro elements (%)	
Calcium %	1.9
Total Phosphore %	1.3
Sodium	0.5

Ingredients: Fish meal, fish oil, soybean and by products, wheat and by products, yeast and by products, amino acids, vitamins and minerals.

The fishes used in this study were brought to the Aquaculture Research and Application Unit of The Adnan Menderes University Agriculture Faculty and fed for 15 days with commercial trout feeds to adapt to the experiment environment. Each trial group was carried out with 3 repetitions. During the experiment that lasted 90 days, fishes were manually fed 3 times a day in a ratio of 2% of their body weight. Fish experiments were performed in accordance to the guidelines for fish research from the animal ethic committees at Adnan Menderes University. The relevant analyses were conducted in the Tarbiyomer Laboratory of the Adnan Menderes University Agriculture Faculty and in the private Detay Analysis Laboratory. Proximate analyses of the diets were performed using standard methods (AOAC, 1998). Moisture was detected after drying at 105˚C until a constant weight was achieved. Crude protein was analyzed by the Kjeldahl method, and crude ash by incineration at 525˚C in a muffle furnace for 12 h. Crude fat was analyzed by methanol/chloroform extraction (Folch *et al*., 1957). Total ammonia (NH_{4+} and NH_3) excretion was examined for a total duration of 8 hours by hourly sampling in the tank environment and after each sampling period the amount of ammonia excretion to the water environment by fishes in each tank was calculated according to the following formula (Ergün *et al*., 2008). In each experiment period, 6 fishes from each tank were used for blood analysis. Fishes were anesthetized with clove oil which is a commonly used natural product. The blood samples were put into the K_3EDTA tubes and haematological and biochemical analyses were done. Hematological parameters, such as RBC count, HCT, hemoglobin (Hb) and mean cell hemoglobin concentration (MCHC), were determined by a blok cell counter (Mindray BC-3000 Plus, China) within 2 h. Blood serum was separated by centrifugation (3000g, 20 min). The clear supernatant was aspirated carefully for the estimation of various blood chemical parameters in serum. The total blood chemistry parameters like glucose (GLU), urea, creatinine (CREA), uric acid, total protein, albumin, globulin, serum bilirubin and cholesterol (CHOL) were assessed by the automatic analyzer apparatus (Reflotron plus, Roche, Germany) using commercially available Reflotlon kits (Roche Diagnostics, Germany) fort the above mentioned blood chemical parameters. Mean cell volume (MCV), mean cell hemoglobin (MCH), and mean cell hemoglobin concentration (MCHC) were calculated (Bain *et al.*, 2006). The analyses of the data obtained in the experiment were done by using the SPSS 17 statistics program. One way variance analysis (ANOVA) was applied to the data which were then subjected to Tukey multiple comparison test. The differences between groups were evaluated to be $p<0.05$ (Logan, 2010).

Results

The seven diets were equally accepted by the fish and there was no mortality or disease in any treatment. Data on the growth performance of common carp are shown in Table 2.

Table 2. Fish performance and feed utilization for common carp fed diets containing different herbal extract supplements for 90 days.

	Control	P05	P1	P2	GT05	GT1	GT2
Initial fish weight (g)	129.20±1.14	130.55±0.61	131.15±1.52	130.52±1.09	129.80±0.62	129.64±0.76	129.66±1.10
Final fish weight (g)	200.80±0.54	202.99±2.76	205.36±1.54	203.00±2.36	201.17±1.90	203.34±4.09	202.42±2.03
Weight gain (%)	71.60±0.79	72.43±2.69	74.20±0.44	72.48±3.19	71.37±1.47	73.69±4.83	72.76±3.09
CF	$2.67±0.60^{a}$	$2.55±0.03^{b}$	$2.59±0.01^{ab}$	$2.55±0.03^{b}$	$2.54±0.05^{b}$	$2.55±0.06^{b}$	$2.56±0.11^{ab}$
FCR	1.13±0.00	1.12±0.01	1.10±0.00	1.12±0.01	1.13±0.01	1.11±0.02	1.12±0.01
SGR (%/day)	0.39±0.00	0.39±0.01	0.40±0.00	0.39±0.01	0.39±0.00	0.40±0.02	0.40±0.01
PER	0.65±0.00	0.66±0.02	0.67±0.00	0.66±0.02	0.65±0.01	0.67±0.04	0.66±0.02
PR (%)	29.12±1.21	27.95±2.55	31.34±4.83	25.23±3.72	26.45±4.75	28.62±5.01	22.17±1.99
FR (%)	21.12±2.86	25.79±2.93	23.08±3.71	20.42±2.75	22.63±5.99	21.76±3.50	19.05±2.84
ER (%)	23.99±1.36	24.85±1.44	25.86±3.92	21.58±2.96	22.95±4.58	23.96±3.20	18.37±1.15
Survival (%)	100	100	100	100	100	100	100

Values are mean ±SE (n=6).

The whole-body proximate compositions of fish presented in Table 3.

Table 3. Whole-body proximate composition (%) of common carp fed diets with different levels of peppermint and green tea extract for 90 day

Composition (%)	Control	P05	P1	P2	GT05	GT1	GT2
Crude Protein	12.57±0.19	12.20±0.41	12.68±1.19	11.82±0.53	11.69±1.06	12.41±1.10	10.84±0.80
Crude Lipid	3.30±0.38	3.81±0.56	3.42±0.28	3.48±0.29	3.49±0.64	3.56±0.72	3.33±0.42
Crude Ash	1.79±0.30	2.27±0.14	1.81±0.63	2.30±0.08	2.48±0.42	2.00±0.47	1.78±0.19
Moisture	76.30±0.99	75.27±0.89	75.52±2.59	76.82±1.46	77.01±1.45	76.09±1.24	78.05±0.72

Values are mean ±SE (n=6)

The hematological parameters of fish presented in Table 4.

Table 4. Hematological parameters in common carp that were fed diets containing different levels of peppermint and green tea extract for 90 day.

Blood Parameter	Control	P05	P1	P2	GT05	GT1	GT2
Hb (g/dL)	12.22±0.12	12.56±0.34	12.51±0.22	12.49±0.35	12.66±0.25	12.32±0.11	12.51±0.13
Hct (%)	19.23±0.13	20.00±0.40	20.26±0.74	19.35±0.34	19.41±0.22	19.58±0.97	19.40±0.38
RBC (10^6 mm^3)	1.23±0.02	1.18±0.03	1.11±0.06	1.12±0.04	1.18±0.06	1.12±0.09	1.14±0.03
MCV (µm3)	153.23±7.07^{b}	169.05±6.26^{ab}	183.79±17.11^{a}	173.16±10.62^{ab}	164.89±9.54^{ab}	171.71±14.27^{ab}	164.94±4.83^{ab}
MCH (pg cell $^{-1}$)	99.42±2.04^{b}	107.91±4.72^{ab}	114.31±8.27^{a}	113.46±3.80^{a}	107.50±5.62^{ab}	110.26±8.63^{ab}	109.80±2.12^{ab}
MCHC (%)	64.98±2.96	63.83±1.64	62.34±3.19	65.62±2.42	65.23±1.66	64.24±0.74	66.60±2.07

Values are mean (n=6). Mean ± SE with common superscripts in the same line are not significantly different ($p>0.05$). Hct: hematocrit; Hb: hemoglobin; MCV: mean cell volume; MCH: mean cell hemoglobin; MCHC: mean cell hemoglobin concentration.

The effects of herbal extracts on common carp's biochemical features are presented in Table 5 .

Table 5. Biochemical parameters in common carp that were fed diets containing different levels of peppermint and green tea extract for 90 day.

Parameter	Control	P05	P1	P2	GT05	GT1	GT2
GLU (mg/dL)	122,41±1.56^{a}	110.42±1.17^{b}	103.66±10.13^{bc}	95.58±3.23^{cd}	88.56±2.00^{d}	93.01±3.05^{d}	93.02±2.76^{d}
TPROT (g/dL)	3.74±0.12^{d}	3.85±0.04^{cd}	3.93±0.02^{bc}	3.92±0.02^{bc}	3.76±0.02^{d}	4.06±0.11^{b}	4.62±0.06^{a}
ALB (g/dL)	0,92±0.01^{cd}	0.98±0.01^{bc}	1.07±0.08^{a}	0.88±0.05^{d}	0.92±0.01^{cd}	0.96±0.01^{bc}	1.03±0.00^{ab}
GLO (g/dL)	1.91±0.05^{d}	2.12±0.06^{cd}	2.20±0.06^{bc}	2.16±0.08^{c}	2.24±0.20^{bc}	2.40±0.09^{ab}	2.53±0.09^{a}
CHOL (mg/dL)	146.34±2.93^{a}	136.91±2.53^{b}	131.83±5.39^{b}	124.53±0.90^{cd}	126.20±2.17^{c}	119.36±0.12^{d}	119.36±0.11^{d}
URE (mg/dL)	0.15±0.00	0.14±0.00	0.15±0.00	0.14±0.01	0.14±0.01	0.15±0.00	0.13±0.01
URIC ACID (mg/dL)	0.99±0.01	0.99±0.07	0.95±0.01	0.93±0.03	0.94±0.03	0.95±0.03	0.93±0.02
Creatinine (mg/dL)	0.66±0.01	0.63±0.01	0.60±0.00	0.60±0.04	0.60±0.04	0.63±0.02	0.60±0.06

The total ammonia excretion by fish in an 8 h period is shown in Figure 1.

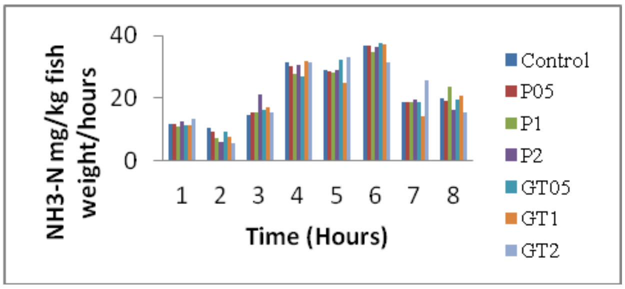

Figure 1. Ammonia excretion rate of common carp fed with control and herbal extract supplementation diets during the experiment. P: Peppermint and G: Green Tea. Values are mean ± SEM (n=3)

Discussion

In this study, peppermint and green tea extract did not change average weight gain, specific growth rate (SGR), protein efficiency ratio (PER), fat retention (FR), energy retention (ER), feed conversion rate (FCR) and protein retention (PR) ($p>0.05$). Similarly, in a study by Cho *et al*., (2007), it was observed that there is no change in the SGR and PER ratios of *Paralichthys olivaceus* fed by a diet containing 5% green tea extract ($p>0.05$). In study, the medicinal herbal extracts used in study did not significantly affect on the red blood cell count, hematocrit, hemoglobin, and mean corpuscular hemoglobin concentration. ($p>0.05$). However, the mean corpuscular volume and mean corpuscular hemoglobin level increased. ($p<0.05$). These results show that fishes are healthy. It was observed that the levels of RBC, haemoglobin and haematocrit increased when different ratios of peppermint were added to the feeds of the Caspian white fishes ($p<0.05$) (Adel *et al.*, 2015). In this study, fish fed medicinal herb exctract diets had significant decrease in the serum glucose level ($p<0.05$). In another study, it was reported that 0,1 g/100g mango in *Labeo rohita* feeds increased glucose while there was a significant decrease in the ratio of 1 g/100g. (Sahu *et al.*, 2007b). From these results, it can be concluded that the less use of plant sources may have an effect which is reverse the desired result. Serum TPROT and GLO levels were higher in the fish group fed with peppermint and green tea extract diets than in the control group ($p<0.05$). In a study by Cho *et al*., (2007), no change was observed in the TPROT level when 5 g/100g green tea was added to the feeds of *Paralichthys olivaceus*. In this study, the ALB level was found significantly lower in P2 group when compared to others ($p<0.05$). In general, it was observed that the albumin level increased in experiment groups compared to the control group. Similarly, it was determined that the plants including bean, mango, nettle and ginseng (extract) increase the albumin ratio (Awad, 2010). In this study, cholesterol level of fish with fed including green tea and peppermint extract were found lower than in control group ($p<0.05$). In a different study conducted by adding green tea to the feed, no change was observed in the quantity of cholesterol (Cho *et al.*, 2007). In this study, urea, uric acid and creatinine levels were similar in all the treatment groups ($p>0.05$). In another study with rainbow trouts, it was reported that bean, mango and nettle reduced urea and creatinine (Awad, 2010). In this study, herbal extracts supplementation decreased ammonia excretion ($p<0.05$). Different results may be caused from the differences of temperature, feed raw material ratio or fish sizes.

In this study, it was found that the plant extracts of green tea and mint did not have any negative effect on the metabolisms of carps. In addition, these plant extracts may be used by the feed companies based on the positive results obtained in carps like in many animals and humans.

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References

Adel, M., Abedian, A., Zorriehzahra, J., Nematolahi, A. & Esteban, M.A., 2015. Effects of dietary peppermint (*Mentha piperita*) on growth performance,chemical body composition and hematological and immune parameters of fry Caspian white fish (*Rutilus frisii kutum*), Fish. Shellfish Immunol. 45(2): 841-847.

AOAC, 1998. Official methods of analysis of AOAC International (16th ed., 4th Rev.). AOAC Int., Gaithersburg, MD.

Atılganoğlu, U., 2002. Green tea in dermatology, Türkderm,36(3):4

Awad, E.S., 2010. Studies on Plantbased Dietary Supplements for Control of *Aeromonas hydrophila* Infections in Rainbow Trout (*Oncorhynchus mykiss* Walbaum). PhD Thesis. Heriot Watt University, UK.

Bain, B.J., Lewis, S.M. & Bates, I., 2006. Basic haematological techniques. In: Lewis SM, Bain BJ, Bates I (eds) Dacie and Lewis practical haematology, 10th edn. Churchill Livingstone, pp. (26–54). Elsevier: Philadelphia.

Cho, S.H., Lee, S.M., Park, B.H., Ji, S.C., Lee, J., Bae, J. & Oh, S.Y., 2007. Effect of Dietary Inclusion of Various Sources of Green Tea on Growth, Body Composition and Blok Chemistry of The Juvenile Olive Flounder, *Paralichthys olivaceus*. Fish Physiology and Biochemistry, 33(1): 49–57.

Ergun, S., Tekesoglu, H. & Yigit, M., 2008. Effects of dietary natural zeolite levels on ammonia excretion rates in young Rainbow trouts (*Oncorhynchus mykiss*). Fresenius Environmental Bulletin, 17(2): 245-248.

Folch, J., Lees, M. & Sladane-Stanley, G.H.A., 1957. Simple Method for the Isolation and Purification of Total Lipids from Animal Tissue. The Journal of Biological Chemistry, 226(1), 497-509.

Kılıçalp, D.,Yur, F. & Değer, Y., 2008. Effects of Green Tea on Serum Levels Cu and Zn of Guinea Pigs Exposed to Electromagnetic Radiation. Journal of Veterinary Faculty, 19(2):53-56.

Logan, M., 2010. Biostatistical design and analysis using r: a practical guide. Wiley-Blackwell, London.

May, B., Kuntz, H.D., Kieser, M., Kohler, S., 1996. Efficacy of a fixed peppermint oil/caraway oil combination in non-ulcer dyspepsia. Arzneimittelforschung, 46(12):1149–1153.

Sahu, S., Das, B.K., Pradhan, J., Mohapatra, B.C., Mishra, B.K. & Sarangi, N., 2007. Effect of Magnifera indica Kernel as a Feed Additive on Immunity and Resistance to *Aeromonas hydrophila* in Labeo rohita Fingerlings. Fish & Shellfish Immunology, 23(1):109-118.

Zaki, M.S., Fawzi, O.M. & El-Jackey, J., 2008. Pathological and Biochemical Studies in Tilapia nilotica Infected with Saprolegnia parasitica and Treated with Potassium Permanganate. American-Eurasian Journal of Agriculture & Environmental Science, 3(5): 677-680.

Effects of different Levels of Dietary Thyme (*Thymus vulgaris*) Oil on Growth of Carp (*Cyprinus carpio*) fry

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In this study, it was aimed to determine the effects of different levels of dietary thyme (*Thymus vulgaris*) oil, 0%, 0.5%, 1% and 1.5%, on growth of the carp (*Cyprinus carpio*) fry (initial average live weights of 0.88±0.36 g). The trial was carried out in 12 tanks for 84 days in 3 replicates. At the end of the experiment, growth parameters, feed conversion ratios, survival rates, proximate compositions, and liver and small intestine histology of the groups were compared. The highest mean live weight was obtained from the group fed with 0.5% thyme oil supplement (6.93±2.23) and the lowest live weight gain was observed in the 1.5% group (6.46±2.56). There was no significant difference between the groups in terms of feed conversion and survival rates ($p>0.05$). The fact that the proximate analyses did not differ between the groups and that the liver and small intestine tissues in all groups were found in normal morphology revealed that thyme oil did not adversely affect the health status of the carp at the rates used in the research.

Keywords: Carp, thyme oil, growth, proximate composition, histology

Introduction

The main goal of aquaculture is to achieve a higher live weight gain with less feed. It is known that one of the most studied topics in aquaculture is the growth parameters. For this reason, the effects of many feed additives on growth and feed conversion ratio have been investigated for many years. In addition, one of the primary purpose in fish production is to reach the desired growth rate at the economic level. Antibiotics, which should only be used in the treatment of diseases in Aquaculture activities, have been used as a growth promoter in low doses until recent years. Due to adverse effects on human and environmental health, restrictions have been placed on the use of antibiotics in the aquaculture. For this reason, scientific studies are being carried out to determine the effects of natural feed additives. Some of these additives are probiotics, prebiotics and other immunostimulants. (Genc *et al*., 2007a; 2007b; Genç *et al*., 2013; Aktaş *et al*., 2014; Gelibolu *et al*., 2018).

In recent years, the use of aromatic essential oils to improve fish growth in aquaculture applications being tested. Essential oils obtained from aromatic plants appear to be a natural alternative to antibiotic growth factors (Calsamiglia *et al*., 2007). Some essential oil compounds in farm animals have a very good potential as a feed additive due to their ability to suppress pathogenic bacterial growth at high levels even at low pH values (Si *et al*., 2006). A region where the effects of plant extracts are examined is the digestive system in animals. This effect is evidenced either by the destruction of pathogens in the digestive tract or by the enhancement of the effectiveness of beneficial microorganisms that help digestion and absorption of nutrients (Wenk, 2000). Although the antimicrobial properties of essential oils are well known, their mechanisms have not been fully understood (Dorman & Deans, 2000). According to the results of previous studies it is thought that mainly most of the essential oils have antimicrobial effect on bacterial cell membrane which disturbed some functions such as ion transport, ion exchange, protein exchange, phosphorylation and enzyme reactions (Ultee *et al*., 1999). One of the most studied aromatic plant is thyme. Thyme is a member of the Labiatea = Laminaceae family. Common species of this family are *Origanum*, *Thymbra*, *Coridothymus*, *Satureja* and *Thymus*. Thyme contains a high level of essential oil and the main components of this essential oil are carvacrol, thymol, β-cymene, γ-terpinene and linalool (Madsen and Bertelsen, 1995). The most important contribution to antimicrobial efficiency is provided by carvacrol and thymol compounds (Sivropoulou *et al*., 1996). The positive effects of using thyme and thyme oil in poultry and livestock feeds have been recorded for many years. However, there is limited research on the use of thyme oil as a feed additive in aquaculture.

ALsafah & AL-Faragi (2017) were investigated on growth and haematological parameters of *Cyprinus carpio* (75.18-75.36 g) fed diets containing thyme leaf *Thymus vulgaris* at different rates (0, 0.5, 1, 1.5, 2) for 56 days. Thyme leaf supplemented groups showed (carp fed with 1.5% supplementation level) the better growth performance compared than the fish fed with control diet ($p<0.05$). They also reported some positive effects on haematological parameters of fish fed with thyme supplemented feed ($p<0.05$). Zheng *et al*. (2009) were added in three different doses of *Origanium vulgare* essential oil (0.05% carvacrol, 0.05% thymol, 0.0485% carvacrol+0.0015 thymol) were tested for the channel catfish (*Ictalurus punctatus*) diet and commercial *Origanum heracleoticum* essential oil (0.05%) as another group. As a result of their research, they found that these compounds, obtained from thyme, improve the growth performance, survival rate (SR) and feed conversion ratio (FCR) in fish. Ekici *et al*. (2010) investigated the effects of essential oils of thyme (*Origanum vulgaris*), balm (*Melissa oleum*), calabash (*Lavandulae romanae oleum*), rosemary (*Rosmarinus officinalis*) and ginger (*Zingiber officinale*) plants on bacterial fish pathogens (*Yersinia ruckeri*, *Aeromonas hydrophila*, *Vibrio anguillarum*, *Vibrio alginolyticus*, *Flavobacterium psychrophilum* and *Lactococcus garvieae*). They reported that thyme leaf and thyme essential oils had a strong antimicrobial effect than other plant oils. Al-Bayati (2008) determined that the extract of *Thymus vulgaris* was a killer effect against many pathogens. They also suggested that plant extracts could be used as an alternative to the current antibiotics in fish farms in the future. Cihangir *et al*. (2016) reported that the effects of growth performance, feed utilization and survival rate on rainbow trout which fish fed with oregano (*Origanum vulgare*) essential oil supplemented diets. They claimed that adding thyme essential oil to fish feeds could increase the growth parameters.

In this study, the effects of thyme (*Thymus vulgaris*) oil added diets on the growth parameters, survival rate, meat nutritional composition, liver and little intestine histology of carp (*Cyprinus carpio*) were investigated.

Material and Methods

The common carp (*Cyprinus carpio*) frys (0.88±0.36 g) were obtained from the Mediterranean Fisheries Research, Production and Training Institute (Ministry of Agriculture and Forestry) and transported in plastic bags to the Aquaculture Research and Application Unit, Faculty of Marine Sciences and Technology, Iskenderun Technical University. In this experiment commercial fish diet (40% crude protein, Camlı Yem, Izmir) was used (Table 1). The commercial pellet is milled in the feed mixer machine. Afterwards, commercial thyme oil (Talya) was sprayed (Table 1) on this feed at different rates of 0%, 0.5%, 1.0% and 1.5%. The same amount of water (300 ml/kg) was added to them and the dough was made. The feeds were passed through a pellet machine and made into 2 mm pellets (dried at 24°C in the shade condition).

Table 1. Proximate analysis of the commercial diet and thyme oil*

Nutrient	**Diet percentage** %
Crude protein	40
Crude cellulose	8
Crude ash	5
Crude lipid	10
Compound	**Thyme oil percentage** %
Carvacrol	74.09
Linalool	5.46
Para Cymen	4.78
Gamma Terpinen	3.17
Beta Bisabolene	2.92
Thymol	2.87
Trans Caryophyllene	2.41
(+) Barneol	1.39
Alpha Pinen	1.00
Alpha Terpinen	14,24
Beta Myrcene	0.91

*Talya®Herbal (Certificate of analysis 2017)

This experiment was carried out in 12 fiberglass cylindrical tanks for 84 days (4 groups each of them were in 3 replicates, stocking rate was 50 fish/250 L, the water flow 1 L/min, water temperature 27.4±0.9°C, dissolved oxygen 6.0±0.3 mg/L and pH 7.8±0.3, performed in ideal conditions after the 15-day acclimation period). During the experiment, fish were fed ad libitum three times a daily (08:00, 13:00, 18:00) and the weight of the feed was calculated by weighing at the end of the period. At the end of the study, live weight gain, daily live weight gain, specific growth rate, feed conversion ratio and survival rates were calculated and the differences between the groups were statistically compared after taking measurements of all fish. Samples for tissues to be used for nutrient component analysis and histological analysis were taken under deep anaesthesia (euthanasia dosage 0.2 ml clove oil/500 ml, appropriate to the ethical rules of the experimental animals) (Fernandes *et al*., 2017). The following formulas were used for the growth parameters, survival rate and feed conversion ratio calculations.

Weight gain= (final weight - initial weight)
Daily weight gain= (final weight - initial weight)/day

Specific growth rate (SGR, % day^{-1}) = (Ln (final weight - Ln (initial weight) / time) × 100

Survival rate (%) = 100× (final number of shrimp / initial number of shrimp)

Feed conversion ratio (FCR) = weight gain (g) / dry feed intake (g)

The crude protein was analysed according to the Kjeldahl method (Mattissek *et al.*, 1988). Lipid analysis was performed according to the methodology of AOAC (1990) based on Bligh and Dyer (1959). Crude ash analyse was done according to AOAC (1990) method. Protein, lipid and ash values were calculated using the following formulas.

Crude protein (%)=[(N/7H_2SO_4xF)-N/7NaOHxF)]-[(N/7H_2SO_4xF)-N/7NaOHxF)]x1.25/sample weight

Lipid (%)= ((balloon tare +lipid weight) -balloon tare) x 100/sample weight

Crude ash (%)= ((cup tare +ash weight]-cup tare x 100/sample weight

Tissue specimens were fixed in 10% buffered formalin solution. Histology protocol was performed on fixed tissues post-fixation 24 hours later. The paraffin-wax tissues were blocked and cut to 5-7 µm using a microtome (Thermo-Shandon). Microphotographs were obtained from the stained tissues (Leica CM40 trinocular, MicroCam) and histological evaluation was performed (Takashima and Hibiya 1995, Genc *et al*. 2007a, 2007b, Genten *et al*. 2009). The SPSS (SPSS Statistics 17.0) package program was used for statistical analysis of the data. Data obtained from replicates were compared with one-way ANOVA and DUNCAN multiple comparison test (significance level 0.05) was performed to determine differences between groups.

Results

At the end of the trial, although there was no statistically difference between the control group, the best group in terms of final weight (FW), weight gain (WG) and feed conversion ratio (FCR) values is the group fed with 0.5% and the worst group 1.5% thyme oil added feed. In point of final weight and weight gain results these two groups were found to be different from each other ($p<0.05$). It was determined that the specific growth rate (SGR) values among the growth parameters showed similarity for all groups. With regard to survival rate (SR) and feed conversion ratio (FCR), the groups were similar to each other. Nutrient component analysis results showed that there was no statistically difference between dry matter, lipid, crude protein and crude ash amounts of all groups (Table 1.)

Table 2. The growth performance and proximate composition of carp

	0%	**0.5%**	**1.0%**	**1.5%**
IW (g)	0.88 ± 0.06^{a}	0.88 ± 0.03^{a}	0.88 ± 0.01^{a}	0.89 ± 0.04^{a}
FW (g)	6.70 ± 2.83^{ab}	6.93 ± 2.23^{b}	6.73 ± 2.34^{ab}	6.46 ± 2.56^{a}
WG (g)	5.82 ± 0.28^{ab}	6.06 ± 0.30^{b}	5.85 ± 0.45^{ab}	5.58 ± 0.20^{a}
DWG (g)	0.069 ± 0.003^{ab}	0.072 ± 0.003^{b}	0.070 ± 0.005^{ab}	0.066 ± 0.002^{a}
SGR (%gday^{-1})	2.41 ± 0.05^{a}	2.45 ± 0.06^{a}	2.42 ± 0.08^{a}	2.36 ± 0.03^{a}
FCR	2.07 ± 0.09^{a}	1.96 ± 0.09^{a}	2.06 ± 0.19^{a}	2.08 ± 0.07^{a}
SR (%)	98.00±2.00	97.33±2.31	97.33±2.31	99.33±1.16

Dry matter	27.04±0.60	27.78±1.40	28.84±0.96	28.37±2.22
Lipid	7.62±0.21	7.52±0.61	6.98±0.76	6.59±0.60
Crude protein	18.50±0.22	18.29±0.41	17.72±0.27	17.90±0.61
Crude ash	1.35±0.27	1.13±0.10	1.08±0.24	1.10±0.11

*The different letters on the lines indicate that differences are important (p<0.05).

In addition, histological examination revealed that liver tissues and little intestine tissues showed normal morphology for all groups. However, 1% and 1.5% groups were shown slightly lipoid accumulation compered the other groups (Figure 1).

0% **0.5%** **1.0%** **1.5%**

Liver*

Little intestine**

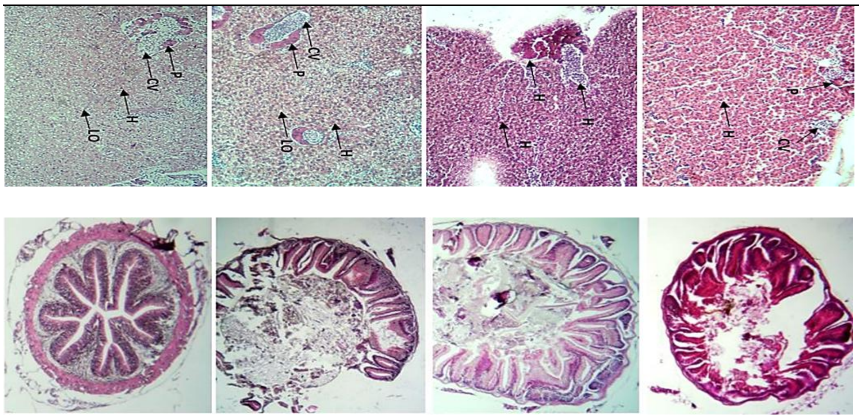

Figure 1. Liver and little intestine histology of carp (*Carp liver sections supplemented with thyme oil: 0% and 0.5% groups: normal morphology, 1.0% and 1.5% groups: micro and macro vesicular lipoid accumulation. P: pancreas, CV: capillary vessel, H: hepatocyte, LO: lipoid accumulation. ** Little intestine sections: normal tissue morphology is seen)

Discussion

In this study thyme oil was used as an alternative feed additive. The addition of 0.5% thyme oil to diet had a positive effect on the growth performance and feed conversion ratio of the carp. There is no research in the literature that thyme oil is used as feed additive in carp. But ALsafah & AL-Faragi (2017) were study on carp (75.18-75.36 g) fed with thyme leaf with different rates for 56 days. Authors stated that 1.5% supplementation level found better growth performance than control diet (p <0.05). Zheng *et al*. (2009) for channel catfish and Cihangir *et al*. (2016) reported similar results for rainbow trout.

According to the results of this study, 0.5% dietary thyme oil group in terms of WG and FCR data showed the better values compared the other groups. It was also that the group containing 1.5% thyme oil showed the worst results. There was no difference between the groups in terms of nutrient component analysis (p>0.05). Liver and small intestine tissues were also found in normal morphology especially examined fish in 0% and 0.5% groups. This results show that thyme oil in the rates used in the trial does not have a significant negative effect on carp health. However, the low dose of thyme oil provides a better growth and feed conversion ratio, while the highest dose has a negative effect on these parameters. Consequently, positive results obtained from the use of low-dose dietary thyme oil in the study are expected to contribute specifically to carp culture and to the research of natural/plant-based feed additives in the culture of other fish species in general.

References

Al-Bayati, F. A., 2008. Synergistic antibacterial activity between *Thymus vulgaris* and *Pimpinella anisum* essential oils and methanol extracts. Journal of Ethnopharmacology, *116*(3), 403-406.

ALsafah, A. H., & AL-Faragi, J. K., 2017. Influence of thyme (*Thymus vulgaris*) as feed additives on growth performance and antifungal activity on *Saprolegnia* spp. in *Cyprinus carpio* L. Journal of Entomology and Zoology Studies, 5(6): 1598-1602.

Calsamiglia, S., Busquet, M., Cardozo, P. W., Castillejos, L., Ferret, A. & Fandiño, I., 2007. Essential oils for modifying Rumen fermentation: a review, Journal of Dairy Science, 90: 2580-2595.

Cihangir, E., Diler, İ. 2016. Yavru ve jüvenil gökkuşağı alabalığı (*Oncorhynchus mykiss*) yemlerine farklı oranlarda ilave edilen kekik yağının (*Origanum vulgare* l.) büyüme performansı ve yemden yararlanma üzerine etkisi. SDU Eğirdir Su Ür. F. Derg., 12(2), 86-96.

Dorman, H. J. D., & Deans, S. G., (2000). Antimicrobial agents from plants: antibacterial activity of plant volatile oils. Journal of Applied Microbiology, 88(2), 308-316.

Ekici, S., Diler, O, Didinen, B.I. & Kubilay, A. 2011. Balıklardan izole edilen bakteriyel patojenlere karşı bazı bitkisel uçucu yağlarının antibakteriyal aktivitesi. Kafkas Univ. Vet. F. Derg., 17, S47-S54, 2011. DOI: 10.9775/kvfd.2010.3224

Fernandes, M., Bastos, Y. F., Barreto, D. S., Lourenço, L. S. & Penha, J. M., 2017. The efficacy of clove oil as an anaesthetic and in euthanasia procedure for small-sized tropical fishes. Braz. J. Biol., 77(3): 444-450.

Genc, M. A., Aktas, M., Genc, E. & Yılmaz, E., 2007a. Effects of Dietary Mannan Oligosaccharide on Growth, Body Composition and Hepatopancreas Histology of *Penaeus semisulcatus* (De Haan 1844). Aquaculture Nutrition, 13(2): 156-161.

Genc, M. A., Yılmaz, E., Genc, E. & Aktas, M., 2017b. Effects of Dietary Mannan Oligosaccharides (MOS) on Growth, Body Composition, and Intestine and Liver Histology of the Hybrid Tilapia (*Oreochromis niloticus* x *O. aureus*). The Israeli J. Aquaculture-Bamidgeh, 59(1): 10-16.

Genten, F., Terwinghe, E. & Danguy, A., 2009. Atlas of fish histology. Boca Raton: CRC Press.

Madsen, H. L., & Bertelsen, G. 1995. Spices as antioxidants. Trends in Food Sci.&Tech., 6(8), 271-277.

Mattissek, R., Shengel, F.M. & Steiner, G., 1988. Lebensmittel-Analytick. Springer Verlag, Berlin, Tokyo, 440 p.

Si, W., Gong, J., Tsao, R., Zhou, T., Yu, H., Poppe, C., Johnson, R. & Du, Z., 2006. Antimicrobial activity of essential oils and structurally related synthetic food additives towards selected pathogenic and beneficial gut bacteria. J. of Applied Microbiol., 100 (2), 296-305.

Sivropoulou, A., Papanikolaou, E., Nikolaou, C., Kokkini, S., Lanaras, T., & Arsenakis, M. (1996). Antimicrobial and cytotoxic activities of *Origanum* essential oils. J. Agric. Food Chem., *44*(5), 1202-1205.

Takashima, F. & Hibiya, T., 1995. An atlas of fish histology: Normal and pathological features. (2nd ed.), Kodansha, Tokyo.

Ultee, A., Kets, E. P. W., & Smid, E. J., 1999. Mechanisms of action of carvacrol on the food-borne pathogen Bacillus cereus. Applied and Environmental Microbiology, *65*(10), 4606-4610.

Wenk, C., 2000. Why all the discussion about herbs?. In *Proc.* Alltech's 16 th Ann. Symp. Biotechnol. in the Feed Industry, (pp. 79-96). Nottingham University Press.

Zheng, Z.L., Tan, J. Y. W, Liu, H. Y., Zhou, X. H., Xiang, X., & Wang, K. Y., 2009. Evaluation of oregano essential oil (*O. heracleoticum* L.) on growth, antioxidant effect and resistance against *Aeromonas hydrophila* in channel catfish (*I.punctatus*). Aquaculture, 292(3-4), 214-218.

Mercury levels in Atlantic mackerel from local fish markets in Istanbul, Turkey

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In this study, levels of mercury (Hg) were determined in Atlantic mackerel (*Scomber scombrus*) sold in the local fish markets in Istanbul, using DMA-1 (Direct mercury analyzer, Milestone Helping Chemist). Fish samples were obtained from the local fish markets located in five main regions (Region I= Eminonu, Region II=Uskudar, Region III= Kadıkoy, Region IV= Karakoy and Region V=Beyoglu) of Istanbul. The mean concentrations (mg/kg) of mercury were found as 0.06 ±0.01 for Region I; 0.06 ±0.02 for Region II; 0.06 ±0.00 for Region III; 0.05 ±0.01 for Region IV; 0.06 ±0.01 for Region V. The mercury concentrations were well below the limit value of 0.1-0.5 mg/kg wet weight, recommended by EC (2006) and Turkish Food Codex (2011) for fish such as mackerel. The estimated weekly intakes (EWI) of the mercury were lower than established provisional tolerable weekly intakes (PTWI). It was shown that there is no health risk to the consumer from Atlantic mackerel consumption on the basis of the consumption amount of the society.

Keywords: Atlantic mackerel, mercury, fish, local market, Turkey

Selenium and Mercury in Commercial Fish Species (Edible fish) from Turkey

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The protective role of selenium against mercury toxicity depends on their molar ratios, having an important role in terms of the risk assessment for fish consumption. Selenium health benefit value (Se-HBV) is the risk assessment criteria based on the molar concentrations of mercury (Hg) and selenium (Se) in seafood. In this study, the mass and molar concentrations of Hg and Se in six fish species from the Sea of Marmara and the Black Sea were analyzed. The mercury and selenium levels were determined using Thermo electron X7 inductively coupled plasma mass spectrometry (ICP-MS, model X series, UK). All analyses were performed according to US EPA (1994). The average concentration of Hg ranged from 0.01 µg/g wet weight (turbot) to 0.45 µg/g wet weight (Atlantic bluefin tuna). As for Se levels, the average concentration ranged from 0.96 µg/g wet weight (thornback ray) to 1.86 µg/g wet weight (turbot). The mean Se/Hg molar ratios were above 1. The ratios were found to be greater than 100 (>100) for turbot, red mullet and whiting. The highest levels of Se-HBV for turbot, red mullet and whiting were determined. Therefore, it was found that these levels were over 1,000 because of their low Hg content. On the other hand, the Se-HBVs were not found over 1,000 for Atlantic Bluefin tuna, thornback ray and spiny dogfish due to their high Hg content, which indicated that the Se-HBVs were positive. Thus, the results indicated a general healthy profile and beneficial Se-HBVs for all samples.

Keywords: Fish, mercury, selenium, mercury: selenium molar ratio, risk assessment

Diversity and Endemism of Lake Skadar: an overview

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Lake Skadar/Shkodra located in the outer part of the Dinaric Alps, is the largest lake in the Balkan with a surface area that fluctuates between 353 and 500 km^2. About 65% of its surface belongs e belong to Montenegro and around 35% to Albania. Based on the available literature an overview of the aquatic flora and fauna of Lake Skadar is given. Approximately 1,900 native species are listed for Lake Skadar, of which 22 species are endemic for the lake itself. The survey of Lake Skadar endemism revealed presence of endemic species in five groups: diatoms, gastropods, oligochaetes, ostracods, and fishes. Only one genus, the monotypic gastropod genus *Karucia* known from the sublacustrine environment of Lake Skadar, is endemic at the lake level. The greatest number of aquatic epigean endemic species belong to gastropods with 12 species being endemic for Lake Skadar and the neighbouring Lake Šas. Recent studies revealed that use as a water supply and ongoing process of eutrophication are the main threats for endemics of the Lake Skadar basin.

Keywords: Diversity, Endemism, flora, fauna, Lake Skadar basin

Alaca Creek (Çorum) Litter - A Preliminary Study to Explore the Extent of Pollution

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This study, which aims to increase public awareness about freshwater pollution by use of local instances, was carried out in April 2018 at Alaca Creek on the basis of 3 sampling points. Litter – the majority of which is from domestic sources – were collected by hand using the large plastic bags to bring them together while classifying the waste under some particular classes: Plastic, metal, paper (paper/wood/fabric) and glass. During the litter collection period, only water body and littoral zone were cleaned out. Sampling points on the creek were chosen to represent litter outputs of pre-urban, mid urban and post-urban areas. Percentages of materials were determined for each litter material as; plastic %79.1, metal %3.65, glass %7.29, and paper %9.96. Litter densities of three sampling points were standardized according to 1000 m^2; plastic 1231 item/1000 m^2 – 182 kg/1000 m^2, metal 61 item/1000 m^2 – 18 kg/1000 m^2, glass 107 item/1000 m^2 – 24 kg/1000 m^2, and paper 148 item/1000 m^2 – 11 kg/1000 m^2.

As results of this preliminary/short-term assessment study, it can be easily said that plastic litter is the predominant type of waste among all others, and the second sampling point – urban area – is the most polluted site by all types of litters mentioned. To increase awareness about environmental pollution, especially water pollution, local governments such as Alaca Municipality will be informed at an institutional level in order to protect and maintain the health of Alaca Creek.

Keywords: Alaca Creek, pollution, litter, public health, water quality, anthropogenic effects

Introduction

As the volume of the human population on Earth increases and demand for more natural resources reaches to an excessive state, as a natural resource, freshwaters are being more and more exploited for numerous anthropogenic uses. During this utilization stage, waste materials of many kinds are being introduced to freshwaters which cause loss of clean water urgent for life on Earth. Sources of pollutants can be categorized as municipal, commercial, industrial, agricultural, construction and demolition or domestic (Barnes *et al*., 2009). Waste materials can change the physical, chemical or/and biological nature of water. In addition to that, aesthetic problems may arise. Following these dramatic changes, the biological diversity of aquatic habitats declines and many species go extinct. It is mentioned that all human activities can multiply the natural rate of extinction by 1000 to 10000 times (Derraik, 2002).

Preventing freshwater habitats from harm requires physical, chemical and biological examination of aquatic environments (Camargo, 1994) and in this manner studies about freshwater and marine toxicology are quite abundant in Turkey (ie. Bat *et al*., 2013; Gülcü-Gür and Tekin-Özan, 2017; Öğlü and Yorulmaz, 2017). But studies about litter composition of Turkey's freshwaters few in numbers (Akanil and Middleton, 1997).

In this one-month study, it was aimed to reveal litter budget of Alaca Creek (Corum: Turkey) in order to inform people of Alaca about the importance of sustaining freshwater resources and take actions for the creek in touch with Alaca Municipality.

Materials and Methods

This preliminary study was carried out in April 2018 at Alaca Creek which flows through a concrete channel (Figure 1). The information on the total length of the creek is absent but the distance between the first and the last sampling points is approximately 1.4 km. Litter collection was conducted in 3 sampling points. These sampling points were chosen to represent the pre-, mid and post-urban areas of Alaca in connectiıon with the creek. Areas of the sampling points are as follows; 1: 306 m^2, 2: 510 m^2, 3: 576 m^2.

Sampling was done by using separate plastic bags for each litter class defined in this study. Litter materials were collected by hand from the water body and the littoral zone to clarify the amount of waste materials directly affecting the water. Litter samples were sorted into some major and relatively rough classes as plastics, glass, metal, paper/fabric. During the collection, each litter numbers and weights were recorded by their materials.

Figure 1. Location of sampling points and the water body studied (image from Google Earth Pro)

Litter densities, for each sampling point, were calculated with the equation below (Zhou *et al*., 2011):

$$D = n/A,$$

where "D" is the density of litters per km^2, "n" is the number of litters collected and "A" is trawled area (km^2). To provide an equalized view for results areas of sampling points were standardized for 1000 m^2.

Results

All materials' weights or numbers varied in total composition.

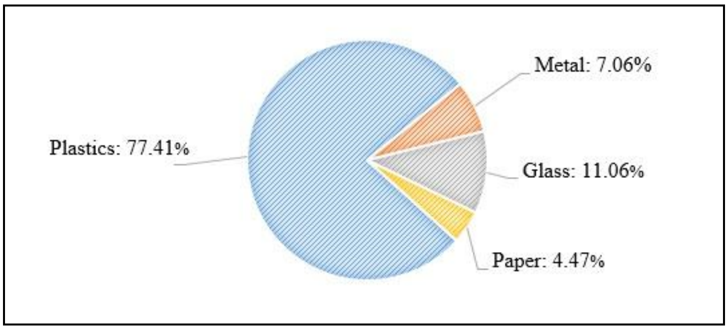

Figure 2. Distribution of litter types by their weights (%)

According to the results, plastics are the dominant type of all litters and they constituted 77.41% of all samples in weight. It was followed by glass (11.06%), metal (7.06) and paper/fabric (4.47), respectively (Figure 2).

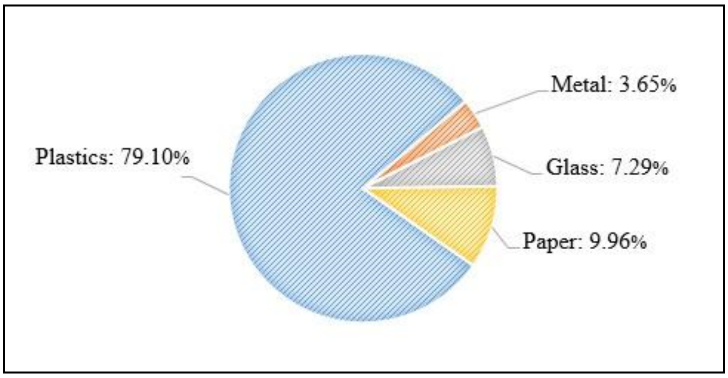

Figure 3. Distribution of litter types by their numbers (%)

On the other hand, the dominance of plastics did not change as they constituted 79.10% of all litters collected in numbers. Percentages for glass, metal and paper/fabric are 7.29, 3.65 and 9.96, respectively (Figure 3).

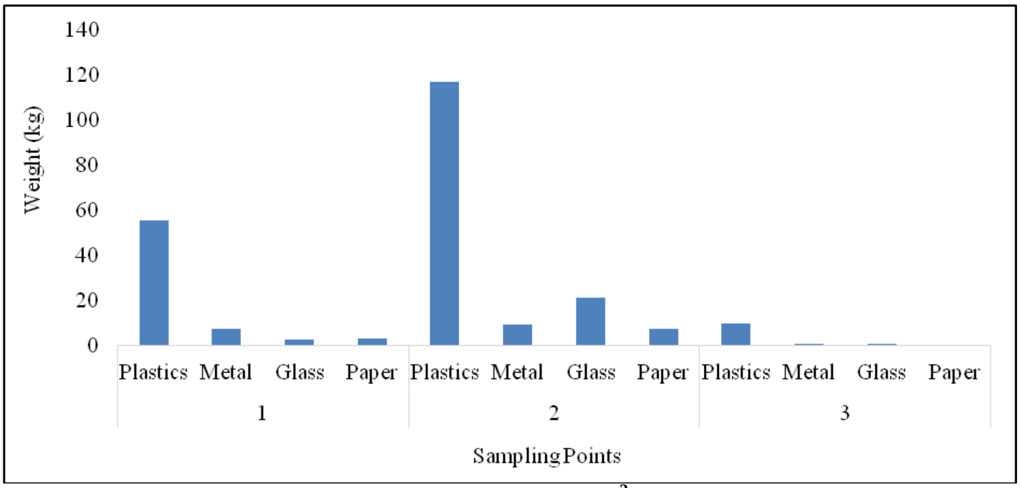

Figure 4. The estimated weight distribution of litter for 1000 m^2 (actual measures of sampling point areas: 1: 306 m^2; 2: 510 m^2; 3: 576 m^2)

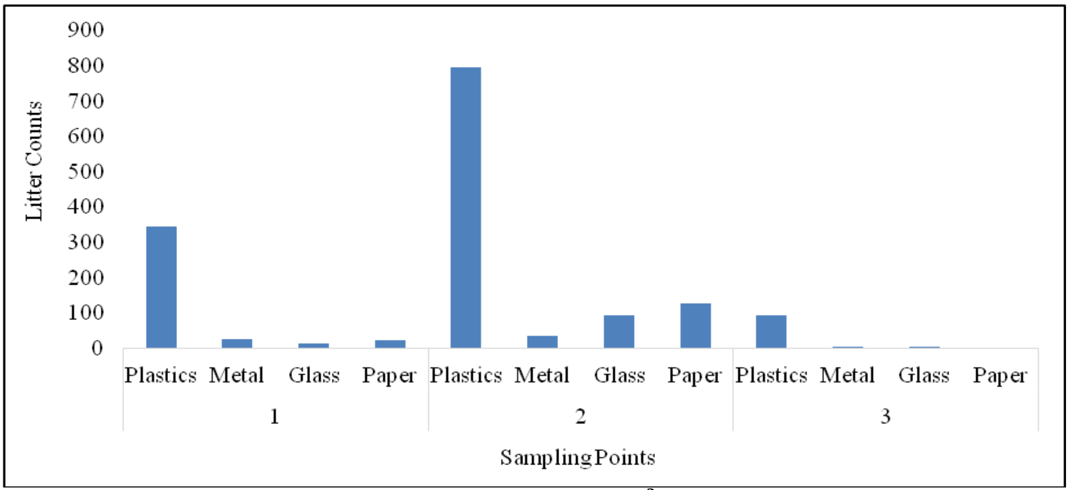

Figure 5. The estimated distribution of litter counts for 1000 m^2 (actual measures of sampling point areas: 1: 306 m^2; 2: 510 m^2; 3: 576 m^2)

Sampling pointwise, the results showed the second sampling point is the spot where the highest weight values of all litter types were recorded (Figure 4, Figure 5). Also, it was seen that the accumulation of paper/fabric (as light litter materials) occurred in the second sampling point.

Table 1 shows the weight values and counts of litter classes as if areas of all sampling points are 1000 m^2. For the first sampling point, the number of plastic litter was determined as *c.* 343 while this amount was almost doubled in the second sampling point as being *c.* 794, and followed by the value of *c.* 93 in the third sampling point.

Table 1. Weight values and litter counts for per sampling point (of 1000 m^2)

Sampling Point	Weight (kg)		Counts	
	Litter Type	Values	Litter Type	Values
1	**Plastics**	55.56	Plastics	343.1373
	Metal	7.35	Metal	26.14379
	Glass	2.45	Glass	13.0719
	Paper	3.27	Paper	22.87582
2	**Plastics**	117.16	Plastics	794.1176
	Metal	9.31	Metal	33.33333
	Glass	21.08	Glass	92.15686
	Paper	7.35	Paper	125.4902
3	**Plastics**	9.55	Plastics	93.75
	Metal	0.87	Metal	1.736111
	Glass	0.43	Glass	1.736111
	Paper	0	Paper	0

Discussion

Because the studies about litter composition of freshwaters are almost absent in Turkey; construction of a comprehensive approach is not easy for figuring the actual situation out. But the massive increase of anthropogenic litter in aquatic environments is quite evident all over the world and situation has been reported since it was recognized as a problem.

Among all other types of litters, as this study shows, plastics are comprising the majority of the problem as pollutants. Because the first sampling point is not covered by vegetation it was observed that most of the litter is being washed away due to currents. But large-sized litter remains at the place they were left.

Second sampling point is densely covered by vegetation so (except the light litter materials) major part of litter is being trapped among the plants. This is why study results present the highest counts and maximum weight values of litter at this point. On the other hand, this sampling point is adjacent to a park of common use which is being another reason for its relatively high polluted state.

Third sampling point was seen to include the least amount of all litter types in terms of both counts and weight values. But the majority of litter is being trapped in the second sampling point. So the actual amount that could be distributed to the lower reaches of the creek is being shaded.

Although an effort to analyse the particle size was not undertaken in this study, it can be said that the majority of the litters can be assigned to the "mega-debris" class which was introduced by Barnes *et al*. (2009). Also, a small portion of collected materials could be placed in "macro-debris" (Ryan *et al*., 2009) class (Table 2).

Table 2. Litter size classes according to Barnes *et al*. (2009) and Ryan *et al*. (2009)

Litter Class	Particle Size (mm)	Source
Mega-debris	> 100	Barnes *et al*., 2009
Macro-debris	> 20 (20 – 100)	Ryan *et al*., 2009
Meso-debris	2 – 20	Ryan *et al*., 2009
Micro-debris	< 2	Ryan *et al*., 2009

From what started as a case study concerning the examination of litter budget soon turned into a declaration of plastic pollution merging in Alaca Creek. Our results showed that Alaca Creek is under the pressure of accumulating litter of many types, especially the plastics. And the main source of litter introduction to the creek is of anthropogenic origin. From a comparative point of view, leaf litter is one of the main energy resources of headwaters that normally involve low-level primary production. In most cases, (it was reported that) leaf litter inputs support the life in aquatic environments and loss of it may cause irreparable consequences (Leroy and Marks, 2006). But plastic, metal, glass or paper/fabric based litter inputs have no positive effect on life in aquatic habitats. As studies suggest primary and secondary microplastics are quite ubiquitous and they are continuing to break into smaller and smaller particles which are harmful to organisms (Horton *et al*., 2017). And "biodegradable" plastics are not an environment-friendly solution to avoid plastic pollution (Klemchuk, 1990) due to their microplastic rich content.

Desultory or unaware litter deposition and excessive dependence on plastic materials may lead to irreversible harms in habitats. Precautions to take should include educating children about the importance of nature and the harmful effects of all kinds of pollutants, practising environment-friendly campaigns governed by local Municipality and supporting the use of fabric bags instead of plastic ones.

References

Klemchuk, P. P. (1990). Degradable plastics: a critical review. *Polymer Degradation and Stability*, *27*(2), 183-202.

Camargo, J. A. (1994). The importance of biological monitoring for the ecological risk assessment of freshwater pollution: a case study. *Environment International*, *20*(2), 229-238.

Akanil, N., & Middleton, B. (1997). Leaf litter decomposition along the Porsuk River, Eskisehir, Turkey. *Canadian Journal of Botany*, *75*(8), 1394-1397.

Derraik, J. G. (2002). The pollution of the marine environment by plastic debris: a review. *Marine pollution bulletin*, *44*(9), 842-852.

Leroy, C. J., & Marks, J. C. (2006). Litter quality, stream characteristics and litter diversity influence decomposition rates and macroinvertebrates. *Freshwater biology*, *51*(4), 605-617.

Barnes, D. K., Galgani, F., Thompson, R. C., & Barlaz, M. (2009). Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *364*(1526), 1985-1998.

Ryan, P. G., Moore, C. J., van Franeker, J. A., & Moloney, C. L. (2009). Monitoring the abundance of plastic debris in the marine environment. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *364*(1526), 1999-2012.

Zhou, P., Huang, C., Fang, H., Cai, W., Li, D., Li, X., & Yu, H. (2011). The abundance, composition and sources of marine debris in coastal seawaters or beaches around the northern South China Sea (China). *Marine pollution bulletin*, *62*(9), 1998-2007.

Bat, L., Ustun, F., Gokkurt Baki, O., & Sahin, F. (2013). Effects of some heavy metals on the sizes of the Mediterranean mussel (Mytilus galloprovincialis Lamarck, 1819). *Fresen Environ Bull*, *22*, 1933-1938.

Gür, B. G., & Tekin-Özan, S. (2017) Işıklı Gölü'nde Yaşayan Turna Balığı (Esox lucius l., 1758)'nın Kas, Karaciğer ve Solungaçlarındaki Ağır Metal Seviyelerinin Mevsimsel Değişimi. *Mehmet Akif Ersoy Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *8*(1), 40-45.

Horton, A. A., Walton, A., Spurgeon, D. J., Lahive, E., & Svendsen, C. (2017). Microplastics in freshwater and terrestrial environments: evaluating the current understanding to identify the knowledge gaps and future research priorities. *Science of the total environment*, *586*, 127-141.

Oglu, B., & Yorulmaz, B. (2017). Accumulation of Metals and Metalloids in Aegean Chub, Inhabiting in Two Middle Sized Streams in Southwest Anatolia. *Turkish Journal of Fisheries and Aquatic Sciences*, *17*(7), 1405-1413.

Riverine nutrient inputs to the Mersin Bay, northeastern Mediterranean

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In this study, biochemical (nutrients, total phosphorus (TP), biological oxygen demand) parameters were determined seasonally at downstream points of the five regional rivers (major/small ones: Ceyhan, Seyhan, Goksu, Berdan, Lamas) flowing into wide shelf zone of the northeastern (NE) Mediterranean. Long-term chemical data obtained seasonally in the 2008-2015 period were examined to assess seasonal variations in the chemical concentrations and annual mass influxes to the studied coastal sites, leading to better understanding of impacts of riverine nutrient inputs on the development of eutrophication in the Mersin Bay coastal regions. Expectedly, seasonal and annual variations were recorded in both volume fluxes and nutrient concentrations of the major rivers (Seyhan, Ceyhan, Goksu). The higher nutrient concentrations were consistently recorded in late winter-spring periods. Silicate concentrations, ranging between 95-140 µM in 2008-2011 period, decreased by about 20-40% to 90-110 µM levels in 2012-2015 as the NO_3 consistently increased by about 20%, leading to apparent decreases in the Si/NO_3 ratio due to new dam constructions on the regional rivers and enhanced fertilization and domestic wastewater discharges to the rivers. The total annual nutrient loads of the regional rivers were calculated as TP: 1990 tonnes/yr, PO_4: 1024 tonnes/yr, NO_3: 19420 tonnes/yr and reactive-Si: 38780 tonnes/yr. This long-term decreasing trends in the reactive silicate loads of the nitrate-laden major rivers are very likely to modify Diatom/Dinoflagellate ratio of algal production and abundance in the phosphorus deficient NE Mediterranean shelf waters.

Keywords: Riverine nutrient inputs, eutrophication, Mersin Bay, northeastern Mediterranean

Introduction

The surface layer water of northeastern Mediterranean is saltier than in the western basin due to limited freshwater inflows but excess evaporation during most of the year (Figure 1). The Eastern Mediterranean is a typical example of oligotrophic sea over the world. However, the wide shelf basin of the NE Mediterranean is fed by nitrate and silicate laden regional rivers (major ones: Seyhan, Ceyhan, Goksu; small ones: Berdan, Lamas) contaminated by inorganic and organic pollutants of different origins mainly by domestic and agricultural wastewater discharges and surface runoff during wet winter-spring period (Dogan-Saglamtimur & Tugrul, 2004; Tugrul *et al.*, 2009; 2011; 2016; 2018; MoEU-DGEIAPI & TUBITAK-MRC, 2015; 2016; 2017). Excess nutrient inputs to the semi-enclosed bays on the wide shelf of NE Mediterranean have enhanced eutrophication in the inner bay surface waters of Mersin Bay (Tugrul *et al.*, 2009; 2011; 2016; 2018). Nutrient concentrations of the major rivers measured seasonally between 1995 and 2008 were used to assess annual mass influxes to the sea (Tugrul *et al.*, 2009). Comparison of river fluxes and the domestic wastewater discharges of the Mersin city clearly show that the NE Mediterranean coastal waters are principally fueled by the riverine nutrient inputs (Tugrul *et al*, 2009). However, wastewater discharges have highly influenced the inner part of the bay due to limited ventilation of the shallow inshore waters by the open sea, leading the development of mesotrophic/eutrophic conditions in the Mersin and Iskenderun inner bay waters (Tugrul *et al*, 2018). Ceyhan River waters flow into the outer part of Iskenderun Bay whereas Seyhan, Berdan, Goksu and Lamas rivers feed the oligotrophic waters of the Mersin bay (Tugrul *et al.*, 2018). For the assessment of eutrophication and action plans to sustain healthy ecosystem for the NE Mediterranean coastal region, quantification of terrestrial (natural+anthropogenic) nutrient and organic matter inputs is essential. This study aims to determine seasonal/annual averages of nutrient concentrations and annual fluxes of nutrients carried by the major regional rivers to the entire Mersin Bay and Iskenderun outer bay (Figure 1) occupied by the NE Mediterranean oligotrophic waters.

Material and Methods

Freshwater samples were collected seasonally at the downstream points of five regional rivers (major ones: Ceyhan, Seyhan, Goksu; small ones: Berdan, Lamas; see Figure 1) in the period of 2008-2015. The concentrations of total phosphorus (TP), inorganic nutrients (nitrate (NO_3), nitrite (NO_2), ammonium (NH_4), phosphate (PO_4), reactive silicate (Si)) and biological oxygen demand (BOD_5) were measured by the conventional chemical methods.

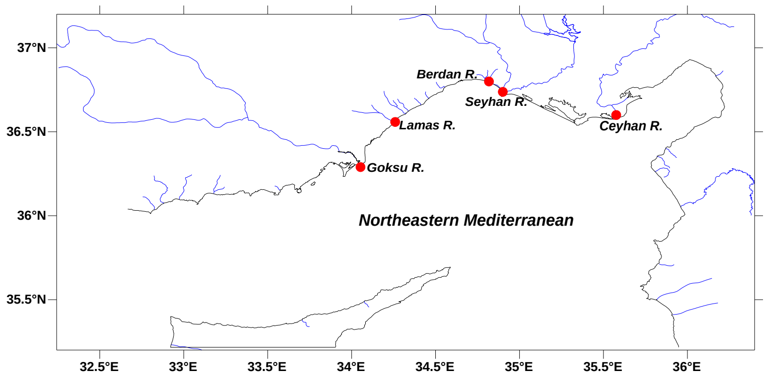

Figure 1. Locations of the studied river stations.

Dissolved inorganic nutrients were determined by the automated colorimetric methods, using a Bran+Luebbe Model four-channel Autoanalyzer (Grasshoff et al., 1983). Water samples for total phosphorus (TP) were digested by perfsulfate oxidation method (Menzel & Corwin 1965). After pH adjustment and reagent addition, the absorbance of each sample was measured manually by the conventional colorimetric method at 880 nm wavelength (Grasshoff et al., 1983). Dissolved oxygen concentrations in river water were measured by a WTW inoLab Oxi 730 Model oxygen meter. Five-day Biological oxygen demand (BOD_5) concentrations, an indicator of biodegradable organic compounds in water, were determined by the changes in dissolved oxygen concentrations of the samples over a five-day period.

Annual chemical (nutrients, TP) fluxes of the monitored rivers were calculated by multiplication of annual averages of chemical concentrations measured seasonally and freshwater discharge rates of the rivers obtained from General Directorate of State Hydraulic Works, Turkey (Kocak et al., 2010).

Results

The seasonal and annual averages of chemical concentrations measured in the five regional rivers for the 2008-2015 period are depicted in Table 1, showing remarkable seasonal variations with the peak values reached in the wet winter-spring seasons. Maximum nutrient concentrations were expectedly recorded in the contaminated Seyhan and Ceyhan Rivers whilst lowest concentrations were determined in the least contaminated Lamas River having the lowest volume flux. Enhanced flow rates and nutrient contents of the major rivers have increased chemical loads of the rivers in late winter-spring periods. Maximum concentrations of seasonal TP (12-33 μM) and PO_4 (3-29 μM) were recorded in Seyhan and Ceyhan Rivers. The least contaminated small Lamas River waters contained lower nutrient concentrations (TP: 0.1-9.6 μM; PO_4: 0.02-1.37 μM). Nitrate and reactive silicate contents of the five rivers are seasonally variable (NO_3: 64.1-167 μM; Si: 84.2-169 μM) with the Si/NO_3 ratio ranging seasonally between 0.73-2.0. Five-day Biological Oxygen Demand (BOD_5) concentrations, an indicator of biodegradable organic matter in water, varied seasonally from 0.95 in the least contaminated Lamas River to 5.89 in the polluted in Seyhan River water in winter-spring periods. The mean annual nutrient loads of the five major rivers in the 2008-2015 period were calculated from the annual nutrient concentrations (Table 2) and annual discharge rates of the rivers as TP: 1990 tonnes/yr, PO_4: 1024 tonnes/yr, NO_3: 19420 tonnes/yr and reactive-Si: 38780 tonnes/yr (Table 3).

Table 1. Concentrations of dissolved inorganic nutrients and BOD_5 values in the five-regional rivers between 2008 and 2015.

River (Discharge; m^3/s*)	Season	TP (μM)	PO_4 (μM)	NO_3 (μM)	NO_2 (μM)	NH_4 (μM)	Si (μM)	Si/NO_3	NO_3/PO_4	BOD_5 (mg/L)
Ceyhan (144)	Autumn	4.61	0.97	118.76	4.18	12.06	145.27	1.27	170.9	1.67
	Winter	6.39	3.23	167.07	3.01	17.28	141.29	1.01	147.0	2.85
	Spring	3.82	1.05	141.05	4.12	18.82	135.30	1.05	218.2	2.72
	Summer	2.55	0.97	125.13	6.42	7.94	169.01	1.45	167.5	2.07
Seyhan (168)	Autumn	8.55	6.32	166.73	16.02	40.00	98.84	0.73	43.5	4.93
	Winter	5.06	2.04	92.80	3.12	39.89	91.23	1.57	75.2	5.89
	Spring	6.08	4.04	117.82	8.75	14.89	93.68	1.28	99.6	4.58
	Summer	8.92	4.31	93.88	6.64	8.72	89.92	1.55	97.7	4.75
Berdan (6)	Autumn	5.09	2.48	95.86	4.57	12.68	87.55	1.01	87.5	2.16
	Winter	4.34	1.57	97.36	2.16	23.03	127.74	1.47	115.8	2.95
	Spring	3.68	1.34	100.44	1.12	12.90	87.35	0.97	113.6	2.87
	Summer	4.14	2.22	84.35	3.60	8.39	88.82	1.12	69.5	2.06
Lamas (3)	Autumn	1.57	0.12	94.46	0.74	1.08	86.28	0.95	932.1	1.11
	Winter	1.56	0.08	102.98	0.60	0.69	99.49	1.04	1631.6	1.08
	Spring	2.15	0.28	93.37	0.25	1.84	84.17	0.96	991.9	1.57
	Summer	1.16	0.11	83.96	0.50	1.54	110.14	1.51	1303.4	0.95
Goksu (45)	Autumn	2.06	0.64	64.11	1.40	10.29	126.94	2.00	140.8	1.68
	Winter	3.35	0.53	66.72	0.60	2.82	101.75	1.74	171.0	1.40
	Spring	3.36	0.69	68.17	0.77	3.77	118.26	1.96	152.9	1.45
	Summer	3.17	1.05	72.97	2.31	4.24	108.46	1.67	237.7	1.23

* Discharge rates were retrieved from Kocak *et al.*, 2010.

Discussion

The majority of the nutrient inputs (>90%) to NE Mediterranean shelf are introduced by the major three rivers. The seasonal fluxes reached the maximum levels in winter-spring periods due to enhanced volume fluxes and nutrient concentrations. It should be noted that Si/NO_3 ratio in the river water was apparently variable with season (Table 1), decreasing to very low levels (about 0.1) in the dry late summer-autumn period in the polluted Seyhan River and reaching levels of 2.5-5.2 in wet winter-spring in Berdan, Lamas and Goksu Rivers. Annual averages of long-term silicate data obtained in the rivers display decreasing trend from 95-140 μM in 2008-2011 to 93-110 μM levels in 2012-2015 (Table 2) whilst the annual NO_3 concentrations have consistently increased by about 18-

20% in the same period, leading to apparent decreases in the Si/NO_3 ratio in the river inflow during the last two decades due to dam constructions on the regional rivers and enhanced fertilization. However, the annual averages of NO_3/PO_4 ratio were consistently high (>40) in the regional river waters, leading to development of P-limited algal production in the NE Mediterranean shelf waters fed by nitrate and silicate laden river inflows.

Table 2. Annual mean nutrient concentrations of the regional rivers flowing to the Mersin Bay coastal zone (4 rivers) and Iskenderun outer bay (Ceyhan River) in 2008-2015 period.

Year	TP (µM)	PO_4 (µM)	NO_3 (µM)	NO_2 (µM)	NH_4 (µM)	Si (µM)	Si/NO_3	NO_3/PO_4	BOD_5 (mg/L)
2008	7.48	5.73	146.83	9.13	23.56	137.29	0.94	25.61	2.58
2009	5.35	2.32	101.49	2.35	7.14	113.74	1.12	43.78	1.63
2010	2.46	0.86	103.98	2.70	5.68	139.92	1.35	120.69	1.40
2011	3.03	0.79	65.63	3.06	11.49	95.47	1.45	82.82	
2012	4.56	1.06	92.24	2.51	6.73	93.20	1.01	87.11	1.90
2013	3.55	1.02	86.33	3.16	11.83	104.52	1.21	84.54	2.13
2014	3.02	1.65	99.64	2.86	15.63	100.65	1.01	60.28	3.98
2015	3.11	1.04	123.82	2.86	14.46	109.77	0.89	119.32	3.46
Average	4.07	1.81	102.49	3.58	12.07	111.82	1.12	78.02	2.44

Table 3. The total annual nutrient loads of the regional rivers entering the entire Mersin Bay (Seyhan, Berdan, Lamas, Goksu) and Iskenderun outer bay (Ceyhan River) in 2008-2015 period.

Year	TP (tonnes/y)	PO_4 (tonnes/y)	NO_3 (tonnes/y)	NO_2 (tonnes/y)	NH_4 (tonnes/y)	Si (tonnes/y)
2008	4453	3504	31701	2561	3551	41129
2009	2511	1391	19984	492	1551	45480
2010	1011	432	20201	727	864	46376
2011	1238	360	11666	838	2470	34133
2012	1756	559	16250	724	1987	33452
2013	1581	501	14468	881	3135	39142
2014	1831	1021	17185	775	4760	34018
2015	1539	429	23895	733	4047	36484
Average	**1990**	**1024**	**19420**	**966**	**2796**	**38780**

In conclusion, significant spatial and annual variations were recorded in both volume fluxes and nutrient concentrations of the regional rivers of NE Mediterranean as previously reported by Kocak *et al.* (2010). Silicate content of the major rivers has decreased in the last decade due to damming of Si-enhanced fresh waters at the upstream points (Table 2), leading to apparent decreases in the Si/NO_3 ratio of the major river inflows to the sea. The long-term change in the Si/NO_3 ratio in the major river discharges is very likely to modify Diatom/Dinoflagellate ratio of algal abundance in the phosphorus deficient NE Mediterranean productive shelf waters. The enhanced nutrient inputs from the terrestrial sources with modified N/P/Si ratios have led to development of mesotrophic/eutrophic conditions in the inner bay waters of NE Mediterranean (Tugrul *et al*., 2018).

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References

Dogan-Saglamtimur., N. & Tugrul, S., 2004. Effect of riverine nutrients on coastal water ecosystems: A case study from the Northeastern Mediterranean Shelf. Fresenius Environmental Bulletin, 13, 1288-1294.

Grasshoff, K., Erhardt, M. & Kremlin, K., 1983. Determination of nutrients. In: Methods of Seawater Analysis (2^{nd} ed.), Verlag Chemie Gmbh, Weiheim, Germany, pp. 125-188.

Kocak, M., Kubilay, N., Tugrul, S. & Mihalopoulos, N., 2010. Atmospheric nutrient inputs to the northern levantine basin from a long-term observation: sources and comparison with riverine inputs. Biogeosciences, 7, 12, 4037-4050.

Menzel, D.W. & Corwin, N., 1965. The measurement of total phosphorus in seawater based on the liberation of organically bound fractions by persulfate oxidation. Limnology and Oceanography, 10, 280-282.

MoEU-DGEIAPI & TUBITAK-MRC, 2015. Integrated Marine Pollution Monitoring Project (2014 – 2016). ECPI 5148704, Report No. ÇTÜE.14.204 (Mediterranean Final Report, 2014), April 2015, Gebze-Kocaeli.

MoEU-DGEIAPI & TUBITAK-MRC, 2016. Integrated Marine Pollution Monitoring Project (2014 – 2016). ECPI 5148704, Report No. ÇTÜE.15.262 (Mediterranean Final Report, 2015), April 2016, Gebze-Kocaeli.

MoEU-DGEIAPI & TUBITAK-MRC, 2017. Integrated Marine Pollution Monitoring Project (2014 – 2016). ECPI 5148704, Report No. ÇTÜE.16.332 (Mediterranean Final Report, 2016), May 2017, Gebze-Kocaeli.

Strickland, J.D.H. & Parsons T.R., 1972. A Practical Handbook of Seawater Analysis, 2nd edition. Bulletin of the Fisheries Research Board of Canada, No. 167, 310 pp.

Tugrul, S., Kuçuksezgin, F., Yemenicioglu, S. & Uysal, Z., 2009. Long Term Biomonitoring, Trend and Compliance Monitoring Program in Coastal Areas from Aegean, Northeastern Mediterranean and Eutrophication Monitoring in Mersin Bay (MEDPOL Phase IV). Ministry of Environment and Forestry, Ankara.

Tugrul, S., Ozhan, K. & Akcay, I., 2018. Environ Sci Pollut Res. https://doi.org/10.1007/s11356-018-2529-6.

Tugrul, S., Uysal, Z., Erdogan, E. & Yucel, N., 2011. Changes of eutrofication indicator parameters (TP, DIN, Chl-a and TRIX) in the cilician basin (Northeast Mediterranean). Ekoloji, 20(80), 33-41.

Tugrul, S., Yucel, N. & Akcay, I., 2016. Chemical oceanography of north eastern Mediterranean. In: The Turkish part of the Mediterranean Sea; Marine Biodiversity, Fisheries, Conservation and Governance. (Turan, C., Salihoglu, B., Ozbek, E.O and Ozturk, B). Turkish Marine Research Foundation (TUDAV), Publication No: 43, Istanbul, Turkey, 15-29.

Biochemical quality elements for the assessment of eutrophication in Mersin & Iskenderun Bays (northeastern Mediterranean)

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Eutrophication-related physical and biochemical parameters were measured in shallow coastal waters of both bays located in northeastern Mediterranean during summer and winter for the period 2014-2018 to assess present trophic status of the coastal areas receiving substantial amount of nutrients and organic matter from the local perennial rivers and direct discharges of domestic wastewaters. For this goal, HELCOM Eutrophication Assessment Tool (HEAT 3.0) widely used in the enclosed Baltic Sea has been adapted to the Çukurova basin shelf waters. This tool is based on the determination of Eutrophication Ratios (ERs) of state (nutrients), direct (biomass; chlorophyll-*a*, phytoplankton composition; Diatom/Dinoflagellate ratio, Secchi Disk Depth) and indirect indicators (deep water dissolved oxygen saturation level) measured at selected sites of the two bays, relative to an average “Eutrophication Quality Target” for each indicator by using data sets obtained from the least contaminated offshore ones. The averages of ER values for each parameter were determined to obtain a final ER level from the state, direct and indirect indicators for each station (site) of the visited regions. The present results clearly show that 8 stations (out of 14 stations) in the inner bay waters of Iskenderun and Mersin have been affected from the eutrophication displaying ER values greater than 1.0 while offshore waters display oligotrophic properties (ER<1.0). This study is an initial attempt to use an integrated multi-metric assessment of trophic status in the NE Mediterranean including both direct and indirect indicators of eutrophication.

Keywords: Trophic status assessment, eutrophication, Mersin Bay, Iskenderun Bay, northeastern Mediterranean

Introduction

Offshore waters of the northeastern Mediterranean (Figure 1) are known as one of the highly oligotrophic basins with limited nutrient supply to its surface waters from internal and external sources (UNEP, 1989; Yılmaz & Tuğrul, 1998; Kress & Herut, 2001; Krom *et al.*, 2004). However, its coastal ecosystems composed mainly of shallower Mersin and Iskenderun inner bays (Figure 1) are highly influenced from nutrient and organic matter inputs of terrestrial origin carried by local perennial rivers. Moreover, pollutants of agricultural and industrial origin as well as municipal domestic waste water discharges add more to development of eutrophic conditions in the shallower inner bays (Dogan-Saglamtimur & Tugrul, 2004; Tugrul *et al.*, 2009; 2011; 2016; 2018; MoEU-DGEIAPI & TUBITAK-MRC, 2015; 2016; 2017). Eutrophication-related physical and biochemical parameters were measured in Mersin and Iskenderun bays in the summer and winter periods of 2014-2018 to assess present trophic status of the coastal waters fed by terrestrial inputs during the year. HELCOM Eutrophication Assessment Tool (HEAT 3.0) (Andersen *et al.*, 2015) developed for the highly eutrophic Baltic Sea has been adapted to the Çukurova shelf basin waters using state (nutrients), direct (biomass;

chlorophyll-*a*, phytoplankton composition; Diatom/Dinoflagellate ratio, Secchi Disk Depth) and indirect indicators (deep water dissolved oxygen saturation level) of eutrophication.

Material and Methods

Field surveys in the Mersin and Iskenderun Bay coastal and offshore regions (Figure 1) were conducted using R/V BILIM-2 of METU-IMS. At the selected stations, physical measurements (*in situ* temperature, salinity, density, fluorescence, turbidity) were carried out by a SEABIRD model CTD probe coupled to a 12-PVC Niskin Bottles Rosette System by which seawater samples were obtained from selected depths by remote-control. The Secchi Disk Depth (SDD), a rough estimation of water transparency, was measured at each station during day time (UNEP/MAP, 2005). Dissolved oxygen measurements were carried out by the automated Winkler titration method (Grasshoff *et al.*, 1983; UNEP/MAP, 2005). Dissolved inorganic nutrients (nitrate, nitrite, ammonium, phosphate, silicate) were determined by the conventional automated colorimetric method using a Bran+Luebbe Model four-channel Autoanalyzer (Grasshoff *et al.*, 1983). Total phosphorus measurements were carried out by the colorimetric method at 880 nm wavelength (Strickland & Parsons, 1972; Grasshoff *et al.*, 1983) after persulfate digestion of samples in pre-cleaned glass bottles under high pressure and temperature (2 atm, 100 ˚C) (Menzel & Corwin, 1965). Chlorophyll-*a* (Chl-*a*) measurements were performed by the conventional spectrofluorometric method after digestion of filter samples by 90% acetone solution (vol/vol) (Strickland and Parsons, 1972; UNEP/MAP, 2005) using a HITACHI model F-2500 Fluorescence Spectrophotometer. Diatom/Dinoflagellate ratio was calculated following qualitative and quantitative inspection of glutaraldehyde fixed phytoplankton samples under a phase-contrast inverted microscope.

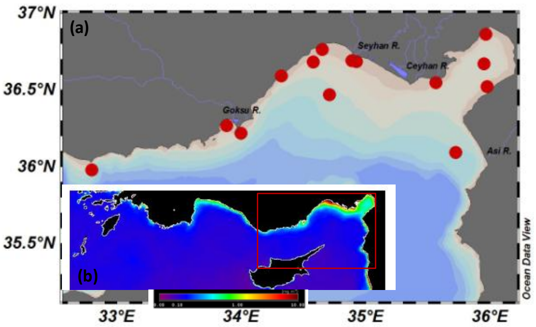

Figure 1. (a) Sampling locations and (b) average surface chlorophyll-*a* (mg/m^3) distribution obtained by Satellite MODIS Aqua in the Cilician basin of the NE Mediterranean in 2009.

Eutrophication status of Mersin and Iskenderun inner bays and offshore regions was determined by the third version of the HELCOM Eutrophication Assessment Tool (HEAT 3.0) (Andersen *et al.*, 2015) in which Eutrophication Ratios (ERs) were calculated using Eutrophication Quality Target (ET) values defined in the studied region of NE Mediterranean. The "good/moderate" boundaries (unaffected/affected by eutrophication) for eutrophication indicators defined for the NE Mediterranean were obtained from the results of Tugrul *et al.* (2018).

Results

Surface layer salinity in the Mersin and Iskenderun Bays varied regionally and seasonally between 37.3 and 39.8 with lower values in the river-fed coastal sites in wet winter periods. Surface salinity values were higher in the offshore during summer due to limited effect of freshwater inflows and increasing evaporation (Table 1). Similar spatio-temporal variations were observed in the SDD measurements, ranging <0.5 m in the nearshore zone to 39 m in the offshore waters in summer (Figure 2). Dissolved inorganic nutrient concentrations measured in surface waters of the visited sites displayed remarkable spatial and temporal variations (Table 1; Figure 2). Peak values were observed in the coastal waters fed by riverine and wastewater inputs. Summer nutrient concentrations were consistently lower than the wet winter values due to apparent decreases in river inflows and atmospheric wet deposition during dry summer period. NO_x (referred to NO_3+NO_2) concentrations varied regionally from 0.04-4.35 µM in summer to 0.07-24.50 µM in wet winter; higher NO_x values were observed in less saline coastal waters (S<39.0). Dissolved inorganic nitrogen (DIN=NO_3+NO_2+NH_4) concentrations ranged between 0.13 to 46.7 µM in surface waters of the two bays, with peak values in the polluted inner bay waters and river-fed less saline shallow zones. Surface PO_4 concentrations displayed similar spatial pattern in the NE Mediterranean shelf waters; lower values in the offshore waters (0.02-0.04 µM) increasing to 0.29 µM in the less saline coastal waters.

Table 1. The winter and summer results of eutrophication-related parameters measured in the Mersin and Iskenderun Bays during the 2014-2018 period.

Winter	Salinity	TP (µM)	PO_4 (µM)	NO_x (µM)	DIN (µM)	Si (µM)	DWDO (% sat.)	Chl-*a* (µg/L)	SDD (m)	Diatom/Dinoflagellate
Mean	38.96	0.19	0.05	1.54	1.87	2.29	99.06	0.42	11.21	52.8
Std. Dev.	0.40	0.10	0.03	3.21	3.33	3.08	2.69	0.38	6.28	55.1
Min.	37.27	0.08	0.02	0.07	0.23	0.62	87.39	0.09	0.10	0.3
Max.	39.43	0.85	0.29	24.50	25.24	24.07	106.22	1.70	28.00	233.1
N	113	113	113	113	113	113	113	113	112	36

Summer	Salinity	TP (µM)	PO_4 (µM)	NO_x (µM)	DIN (µM)	Si (µM)	DWDO (% sat.)	Chl-*a* (µg/L)	SDD (m)	Diatom/Dinoflagellate
Mean	39.33	0.19	0.04	0.41	1.10	1.78	98.30	0.33	12.80	15.4
Std. Dev.	0.28	0.08	0.03	0.61	3.78	1.40	7.00	0.48	8.09	20.3
Min.	38.31	0.06	0.02	0.04	0.13	0.50	74.96	0.02	1.00	0.5
Max.	39.78	0.65	0.21	4.35	46.72	7.98	113.27	4.65	39.00	96.0
N	158	156	158	158	158	158	158	157	155	47

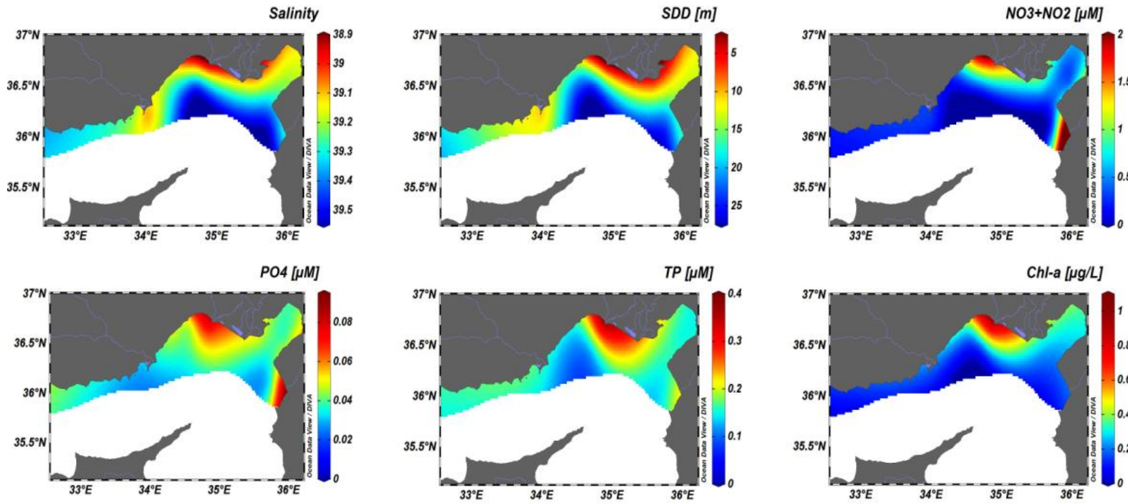

Figure 2. Surface layer (0-10 m average) distributions of summer-winter average values of eutrophication indicator parameters in the Cilician Shelf including two bays for the 2014-2018 period.

Surface Si concentrations were markedly low in the offshore (0.50-1.0 µM) reaching peak values (8-24 µM) in the river-fed delta waters. Expectedly, dissolved inorganic nutrients and TP values measured within the study period displayed similar spatio-temporal variations; increasing apparently in wet winter period (Table 1). Nutrient inputs from external sources enhanced algal biomass (in terms of Chl-*a*) in the coastal waters. Chl-*a* values varied from 1.0-4.65 µg/L in less saline coastal waters to 0.02-0.10 µg/L in the offshore waters of the two bays. No oxygen deficiency (suboxic condition) was observed in the bottom waters of Mersin and Iskenderun Bays (Table 1; Figure 2). Diatom/Dinoflagellate ratios based on individual cell counts varied between a summer minimum of 3.3 and a winter maximum of 116.6 in the region indicating direct role of changes in nutrient concentrations relative to each other as well as temperature regulating spatial and temporal heterogeneity in phytoplankton group assemblages in the area (Figure 3).

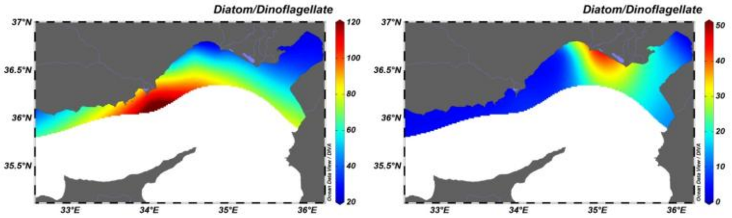

Figure 3. Winter (left) and summer (right) average values of Diatom/Dinoflagellate ratios at surface waters of both bays for the 2014-2018 period.

Discussion

Surface layer concentrations of eutrophication-related biochemical parameters displayed apparent decreases from inner bay/river delta to offshore waters (Figure 2). The present results are in agreement with the recent studies conducted in these bays and wide shelf waters of NE Mediterranean (Dogan-Saglamtimur & Tugrul, 2004; Tugrul *et al.*, 2009; 2011; 2016; 2018; MoEU-DGEIAPI & TUBITAK-MRC, 2015; 2016; 2017). Impacts of terrestrial inputs on nutrient and Chl-*a* concentrations were markedly high in the less saline coastal zone and inner bay waters of Mersin and Iskenderun Bays, leading to apparent decrease in SDD values.

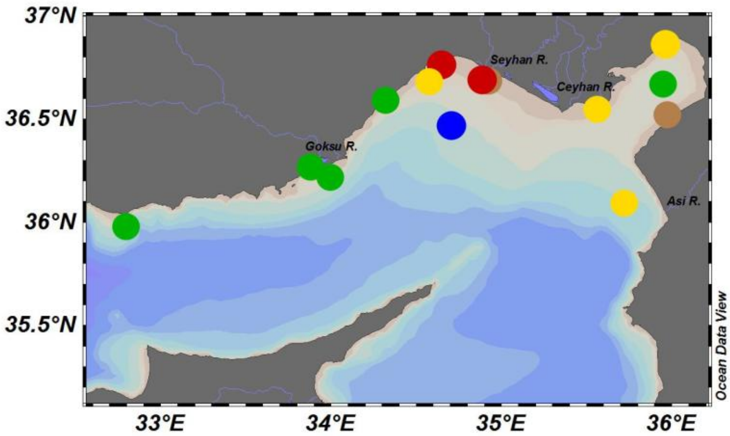

Figure 4. Present eutrophication status of the Cilician shelf including Mersin and Iskenderun Bays, NE Mediterranean, assessed by the HEAT 3.0 (color codes; Blue: High, Green: Good (unaffected by eutrophication), Yellow: Moderate, Brown: Poor, Red: Bad (affected by eutrophication).

These results show the development of eutrophication in the coastal and inner bay waters of the studied sites. For this goal, HELCOM Eutrophication Assessment Tool (HEAT 3.0) was used to assess the current trophic status of the studied regions. The averages of calculated ER values for each parameter are depicted in Figure 4, exhibiting the “bad” trophic conditions developed in the inner bay waters of Mersin Bay and coastal waters polluted by Asi River inflow enhancing markedly in winter period.

In conclusion, the present classification results clearly show that 8 stations (out of 14 stations) in the inner bay waters of Iskenderun and Mersin have been affected by eutrophication (both natural and human-induced nutrient inputs) having ER greater than 1.0 while offshore waters display oligotrophic properties (ER<1.0) (Figure 4). This study is an initial attempt to use an integrated multi-metric assessment of trophic status in the NE Mediterranean including both direct and indirect indicators of eutrophication.

Acknowledgements

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References

Andersen, J.H., Carstensen, J., Conley, D.J., Dromph, K., Fleming-Lehtinen, V., Gustafsson, B.G., *Josefson, A.B., Norkko, A.,* Villnäs, A. & Murray, C., 2015. Long-term temporal and spatial trends in eutrophication status of the Baltic Sea. Biological Reviews. doi: 10.1111/brv.12221.

Dogan-Saglamtimur., N. & Tugrul, S., 2004. Effect of riverine nutrients on coastal water ecosystems: A case study from the Northeastern Mediterranean Shelf. Fresenius Environmental Bulletin, 13, 1288-1294.

Grasshoff, K., Erhardt, M. & Kremlin, K., 1983. Determination of nutrients. In: Methods of Seawater Analysis (2^{nd} ed.), Verlag Chemie Gmbh, Weiheim, Germany, pp. 125-188.

Kress, N. & Herut, B., 2001. Spatial and seasonal evolution of dissolved oxygen and nutrients in the Southern Levantine Basin (Eastern Mediterranean Sea). Chemical characterization of the water masses and inferences on the N:P ratios. Deep-Sea Research I, 48, 2347-2372.

Krom, M. D., Herut, B. & Mantoura, R.F.C., 2004. Nutrient budget for the Eastern Mediterranean: Implications for phosphorus limitation. Limnology and Oceanography, 49(5), 1582-1592.

Menzel, D.W. & Corwin, N., 1965. The measurement of total phosphorus in seawater based on the liberation of organically bound fractions by persulfate oxidation. Limnology and Oceanography, 10, 280-282.

MoEU-DGEIAPI & TUBITAK-MRC, 2015. Integrated Marine Pollution Monitoring Project (2014 – 2016). ECPI 5148704, Report No. ÇTÜE.14.204 (Mediterranean Final Report, 2014), April 2015, Gebze-Kocaeli.

MoEU-DGEIAPI & TUBITAK-MRC, 2016. Integrated Marine Pollution Monitoring Project (2014 – 2016). ECPI 5148704, Report No. ÇTÜE.15.262 (Mediterranean Final Report, 2015), April 2016, Gebze-Kocaeli.

MoEU-DGEIAPI & TUBITAK-MRC, 2017. Integrated Marine Pollution Monitoring Project (2014 – 2016). ECPI 5148704, Report No. ÇTÜE.16.332 (Mediterranean Final Report, 2016), May 2017, Gebze-Kocaeli.

Strickland, J.D.H. & Parsons T.R., 1972. A Practical Handbook of Seawater Analysis, 2nd edition. Bulletin of the Fisheries Research Board of Canada, No. 167, 310 pp.

Tugrul, S., Kuçuksezgin, F., Yemenicioglu, S. & Uysal, Z., 2009. Long Term Biomonitoring, Trend and Compliance Monitoring Program in Coastal Areas from Aegean, Northeastern Mediterranean and Eutrophication Monitoring in Mersin Bay (MEDPOL Phase IV). Ministry of Environment and Forestry, Ankara.

Tugrul, S., Ozhan, K. & Akcay, I., 2018. Environ Sci Pollut Res. https://doi.org/10.1007/s11356-018-2529-6.

Tugrul, S., Uysal, Z., Erdogan, E. & Yucel, N., 2011. Changes of eutrofication indicator parameters (TP, DIN, Chl-a and TRIX) in the cilician basin (Northeast Mediterranean). Ekoloji, 20(80), 33-41.

Tugrul, S., Yucel, N. & Akcay, I., 2016. Chemical oceanography of north eastern Mediterranean. In: The Turkish part of the Mediterranean Sea; Marine Biodiversity, Fisheries, Conservation and Governance. (Turan, C., Salihoglu, B., Ozbek, E.O and Ozturk, B). Turkish Marine Research Foundation (TUDAV), Publication No: 43, Istanbul, Turkey, 15-29.

UNEP, 1989: State of the Mediterranean Marine Environment. MAP Technical Series No. 28, UNEP, Athens.

UNEP/MAP, 2005: Sampling and analysis techniques for the eutrophication monitorıng strategy of MED POL, MAP Technical Reports Series No. 163, Athens.

Yılmaz, A. & Tuğrul, S., 1998. The effect of cold- and warm- core eddies on the distribution and stoichiometry of dissolved nutrients in the northeastern Mediterranean. Journal of Marine Systems, 16, 253-268.

System-scale Environmental Research Approach to Varna Lake, Varna Bay and the Coastal Area of the Black Sea in front of Cape Galata

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One certain amount of water resources can support the social, economic, ecological, and environmental system in a certain region. Conservation and management of water resources generally balance the benefits of preservation and economic exploitation of resources. Governing an environmental medium, such as water may also conserve the recreational value of water bodies. The challenges related to natural system Varna Lake, Varna Bay, and coastal area in front of Cape Galata imply to be taken into consideration the interaction of humans and the natural environment toward the purpose of reducing the impacts of human activity, both on the natural environment and humans itself. A study on water environment in the 5-mile Black Sea area on the Bulgarian coast along Galata transect, in the Varna Bay and in the Varna Lake was performed in 2017, framing the challenge under a system-scale approach. Better environmental protection is necessary to achieve the most sustainable development of the natural system in the future. Improvements must be teamed with realising the unexplored potential that lies in better water management, along with changes in policy and production techniques.

Keywords: water environment, Black Sea, Cape Galata, Varna Bay, Varna Lake, Bulgaria

Introduction

Many sciences use a range of spatial, temporal, and thematic scales in their analysis (Perveen, 2012). Real risk on the ground is the end result of many factors in a dynamic complex system (Beck, 2015). Examples of the emergence of new spatial and temporal scales have been demonstrated in surface hydrology (Gentine *et al.*, 2012.). To improve water management and measure the achievement of internationally agreed goals on water, countries and organizations need access to relevant information and these data can be integrated.

Recent water characteristics variability in the Varna region of the Black Sea was reflected on some publications (Dineva, 2013a; Dineva, 2013b; Dineva, 2014; and Dineva, 2015a).

In the context of water-related global challenges and as an important aspect of ecology, a study on the water environment in the 5-mile Black Sea area on the Bulgarian coast along Galata transect, in the Varna Bay, and in the Varna Lake was performed in 2017, framing the challenge under a system-scale approach.

The purpose of this study will first be to raise awareness on the current state of the natural water system at national and transnational levels and a need for adequate diplomatic solutions to stimulate cooperation around the way the resource is managed to protect both the natural water environment and human health.

From an economic perspective, such water-related research may be understood as concerned with the present and future benefit by the natural water system.

Material and Methods

Study area maps (Figure 1) display a location of the stations where water environment research in the 5-mile Black Sea area on the Bulgarian coast along Galata transect, in the Varna Bay, and in the connected by two canals nearby area of Varna Lake was accomplished twice a year in 2017.

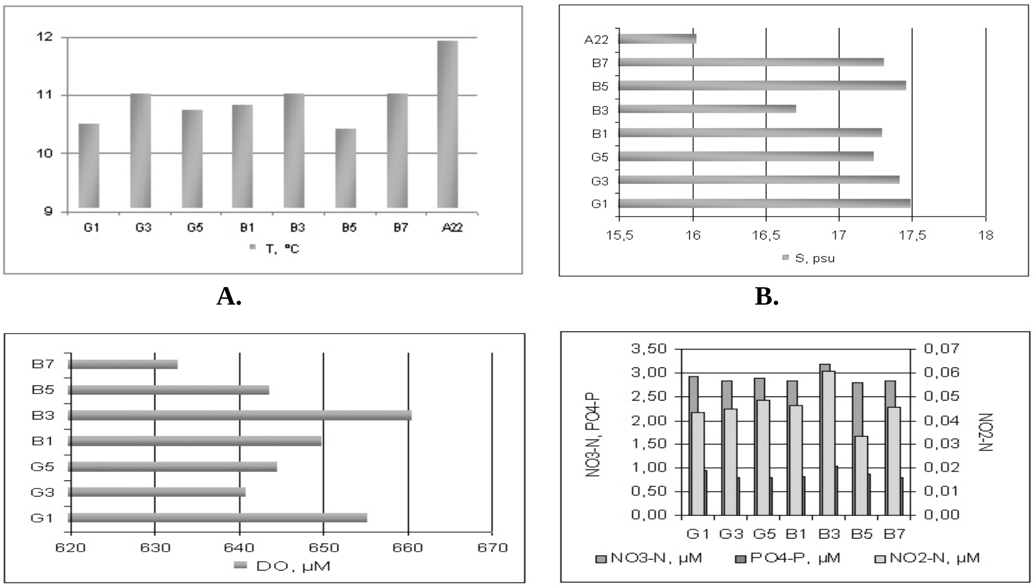
A. B.

Figure 1. Maps of sampling stations: (A) Varna Bay and the connected by two canals nearby area of the Varna Lake. (B) Galata transect of the Black Sea.

In April and September, surface waters were investigated in the 5-mile zone (Station (St.) G1, Station G3, and Station G5) in front of Cape Galata (Figure 1 B), in the Varna Bay (Station B1, Station B3, Station B5, and Station B7), and in the Varna Lake (Station A22). Measurements of temperature, salinity, dissolved oxygen, and oxygen saturation were performed by Multi-meter (Oakton, 2010). Processing of water samples for nitrite nitrogen, nitrate nitrogen, phosphate phosphorus, and chemical oxygen demand (COD)-Mn was done by unified methods for marine waters. Nutrient concentrations were ascertained by HITACHI UV / Vis Spectrophotometer.

Results

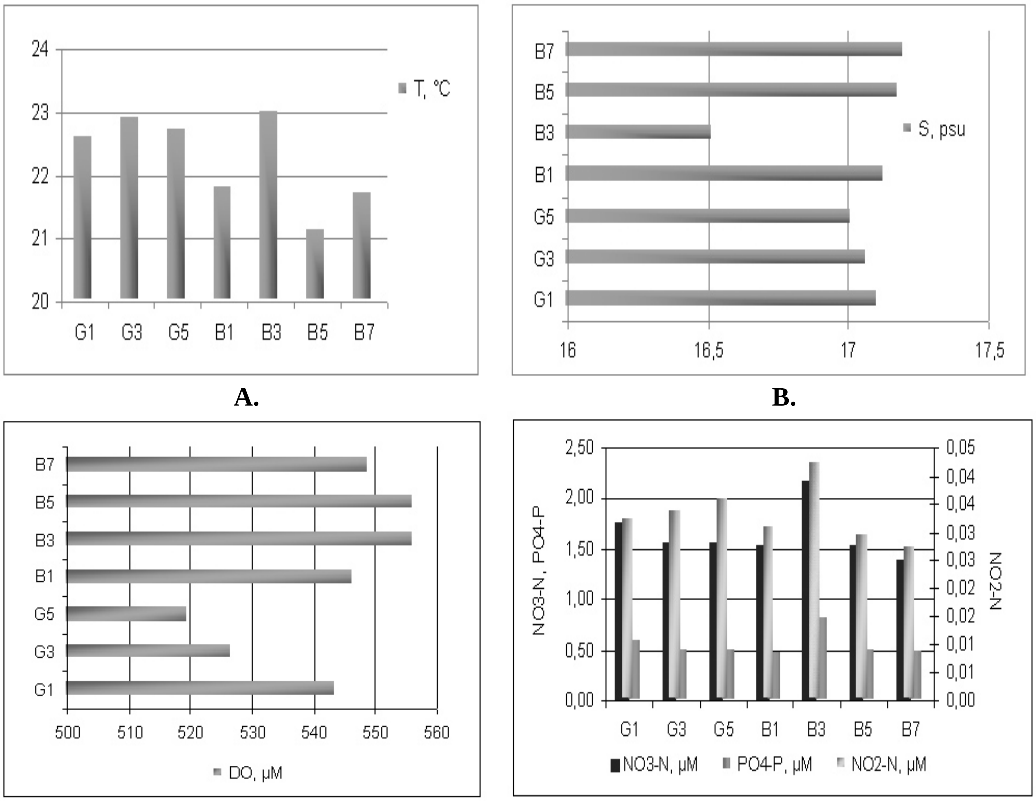
The results here presented are original and have allowed an integrated water environment analysis of the investigated natural system.



A. B. C. D.

Figure 2. Temperature (A), salinity (B), dissolved oxygen (C), and nitrite nitrogen, nitrate nitrogen, phosphate phosphorus (D) on 1, 3, and 5 miles offshore of Cape Galata, in the Varna Bay, and in the nearby area of the Varna Lake in April 2017.

Temperature and salinity are important for the changes in the regional environmental characteristics, especially sea surface temperature (SST) and sea surface salinity (SSS) in terms of their relationship to climate change. Data distribution in Fig. 2 A. indicates SST range of 10.4°C (St. B5) - 11.9 °C (St. A22) in April 2017. SSS is also a factor in water mass formation and SSS variability can affect the intensity of the thermohaline circulation. SSS (Fig. 2 B.) has varied from 16.04 psu (St. A22) to 17.51 psu (St. G1) in the investigated water system. Overall, near-normal dissolved oxygen (Fig. 2 C.) and oxygen saturation (100.28 % - 104.23 %) were ascertained. Nutrient concentrations (Fig. 2 D.) have reached up to 0.06 µM nitrite nitrogen, 3.18µM nitrate nitrogen, and 1.05 µM phosphate phosphorus. Chemical oxygen demand (COD)-Mn was at an average of 1.36 mg.l^{-1}.



A. B.

C. D.

Figure 3. Temperature (A), salinity (B), DO (C), and nitrite nitrogen, nitrate nitrogen, phosphate phosphorus (D) on 1, 3, and 5 miles offshore of Cape Galata, in the Varna Bay, and in the nearby area of the Varna Lake in September 2017.

SST has varied from 21.1°C (St. B5) to 23.0 °C (St. B3) in September (Fig. 3 A.). SSS (Fig. 3 B.) was lowest at St. B3 - 16.52 psu, while it was above 17 psu and similar in the other areas. Oxygen super-saturation of surface water has occurred throughout in the investigated water system – up to 109.30 %. Nutrients (Fig. 3 D.) were at a highest level at St. B3: 0.04 µM nitrite nitrogen, 2.18 µM nitrate nitrogen, and 0.80 µM phosphate phosphorus. Organic matter (OM) exceeded the concentrations in April, with COD-Mn above 1.7 mg.l^{-1}.

Discussion

The observations in the 5-mile Black Sea area on the Bulgarian coast along Galata transect, in the Varna Bay, and in the Varna Lake in 2017 were accomplished by analyzing also other related previous data sources (Dineva, 2007; Dineva, 2014; Dineva, 2017).

Water temperature varies seasonally with air temperature. SST analysis reveals a decrease in 2017 compared to 2014-2016 (Dineva, 2014; Dineva, 2017) but 2017 SST was generally above the 1990s (Dineva, 2007) in the investigated natural water system.

The low salinity of the surface waters is maintained by fresh water inputs into the Black Sea. The Black Sea has a positive water balance, in which the inputs from freshwater sources exceed losses by evaporation (Bolshakov, 1970; Adrianova & Ovchinnikov, 1991; Rjabinin *et al.*, 1991).

The level of salinity in aquatic systems is important to aquatic plants and animals as species can survive only within certain salinity ranges. Although some species are well-adapted to surviving in saline environments, growth and reproduction of many species can be hindered by increases in salinity.

SSS in the water system in 2017 was above both 1990s (Dineva, 2007) and 2014-2016 (Dineva, 2014; Dineva, 2017). Values of SSS in 2017 along with SSS data for 1990s and 2014-2016 periods indicated that when SST increases, SSS decreases and vice versa. Water mass forming of the Varna Lake was mainly by seawater.

In the upper layer, the oxygen dynamics is mainly governed by photosynthesis and respiration processes as well as by air–sea exchanges. ≈71% of the oxygen produced by phytoplankton (photosynthesis + nitrate reduction) is lost through respiration, ≈21% by outgasing to the atmosphere, ≈5% through nitrification and only ≈2% in the oxidation of reduced components (e.g. Mn^{2+}, Fe^{2+}, H_2S) (Grégoire & Soetaert, 2010). If the supply of organic matter is increased to a point where the consumption of O_2 is greater than the supply then de-oxygenation begins (Topping, 1976).

Localized depression of oxygen was not detected in the investigated areas in 2017.

Varna Lake, as an anthropogenic factor (Rozhdestvensky, 1986; Dineva, 2015b), has strongly affected the south area of the Varna Bay about nutrients which led to highest level of nitrite nitrogen, nitrate nitrogen, and phosphate phosphorus at St. B3 compared to the other areas in 2017.

COD is a common measure of water quality that reflects the degree of organic matter pollution of a water body. COD is a measure of the oxygen equivalent of the organic matter in a water sample that is susceptible to oxidation by a strong chemical oxidant (Chapman, 1996).

COD-Mn in the Varna Bay was slightly higher than in front of Cape Galata in 2017. Organic matter in the Varna Lake has exceeded the level in the other areas.

Better environmental protection is necessary to achieve the most sustainable development of the natural system in the future. Improvements must be teamed with realising the unexplored potential that lies in better water management, along with changes in policy and production techniques.

References

Adrianova, O.P. & Ovchinnikov, I.M., 1991. Peculiarities in the transformation of fresh waters in the western part of the Black Sea. Meteorology and Hydrology, 7: 57-64.

Beck, M.B, 2015. Applying Systems Thinking: An Outreach Paper. International Water Association (IWA).

Bolshakov, V., 1970. Transformation of river waters in the Black Sea. Naukova dumka, Kiev. 322 P. (in Russian).

Chapman, D. (ed.), 1996. Water Quality Assessments: A Guide to the Use of Biota, Sediments and Water. Environmental Monitoring. Second Edition. UNESCO, WHO, and UNEP. E&FN Spon, London UK.

Dineva, S., 2007. Long-term evolution of hydrochemical parameters in the Bulgarian Black Sea. PhD thesis. Burgas Prof. Dr. Assen Zlatarov University, Bulgaria. (In Bulgarian).

Dineva, S., 2013 a. Black Sea water environment along the Bulgarian coast. BJAS, 19 (1): 6-11.

Dineva, S., 2013 b. Hydrological and Hydrochemical Features of the Coastal, Bay, and Lake Waters in the Varna Region. *In*: Proceedings of International Conference "New technologies in the offshore industry", 3-5 October 2013, Varna, Bulgaria, pp.173-177.

Dineva, S., 2014. Seawater-related survey in the Varna region. *In*: Proceedings of Union of Scientists, Marine Sciences Series, Varna, Bulgaria. pp.94-100.

Dineva, S., 2015a. Reliable seawater resources: a factor for development of the growing Varna region. BJAS, 21 (1): 116-120.

Dineva, S., 2015b. The system of the Beloslav and the Varna lakes: an evolving water environment. BJAS, 21 (1): 111-115.

Dineva, S., 2017. Study of waters across the Varna Black Sea area. Proceedings of the Institute of Fish Resources - Varna, Bulgaria, 28: 101-107.

Gentine, P., Troy, T.J., Lintner, B.R. & Findell, K.L., 2012. Scaling in Surface Hydrology: Progress and Challenges. Universities Council on Water Resources / Journal of Contemporary Water Research & Education, 147: 28-40.

Grégoire, M. & Soetaert, K., 2010. Carbon, nitrogen, oxygen and sulfide budgets in the Black Sea: A biogeochemical model of the whole water column coupling the oxic and anoxic parts.Ecological Modelling, 221: 2287-2301.

Oakton, 2010. Integrated Instruction Manual. WP 600 Series Meters. USA.

Perveen, S., 2012. Scale Interactions and Implications for Water Resources, Hydrology, and Climate. Universities Council on Water Resources, Journal of Contemporary Water Research and Education, 147: 1-7.

Rjabinin, A., Gubanov, V., Kravets, V., Lazareva, E., Malahova, L., Savina, L. & Tarasova, L., 1991. Hydrometeorology and hydrochemistry of the USSR's seas. *In:* Simonov, A. & Altman, E. (Eds.), Black Sea. Vol. IV, issue 1, Gidrometeoizdat, Peterburg, Russia. 358 P. (in Russian).

Rozhdestvensky, A., 1986. Hydrochemistry of the Bulgarian Black Sea. BAS, Sofia, Bulgaria. 190 P. (In Bulgarian).

Topping, G., 1976. Sewage and the sea. *In:* Marine Pollution, R. Johnston (ed.), Academic Press Inc. (London) Ltd, T.&A. Constable Ltd, Edinburgh, Great Britain, pp. 303-319.

A new record of *Sphyraena sphyraena* (Linnaeus, 1758) from the Bulgarian Black Sea coastal area

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Sphyraena sphyraena (Linnaeus, 1758), is an Atlanto-Mediterranean range extending in the Black Sea species. Till present European barracuda was reported in Bulgarian waters only once, in Sozopol Bay (Southern coastal area). In August 2014 a single specimen with total body length 345.74 mm and a weight of 148 g was caught in Varna Bay. This is a first record for the Bulgarian Northern coastal area.

Keywords: Black Sea, Varna Bay, non-native, barracuda

Introduction

Sphyraena sphyraena (Linnaeus, 1758) is an epipelagic piscivore species, dwelling coastal and off shore waters with commercial importance for the Mediterranean countries (de Morais et al. 2015).

According to Fischer et al. (1981) the European barracuda is widely distributed along the Eastern Atlantic, Northern Atlantic to the Bay of Biscay, in the Western Atlantic from the Bermuda Islands to Brazil, and the Mediterranean and adjacent seas. For the Black Sea, in particular, single specimens are recorded since the beginning of the past century (Boltachev et al., 2009). Distribution of European barracuda in Ukrainian waters was mentioned for Crimean coastal zone and bays (Eremeev et al. 2012, Boltachev et al., 2009). Historical information for records of this species near Odessa, in Balaklava Bay in 1905 and near Sevastopol are to be found in Svetovidov (1964), and more recently *S. sphyraena* was reported for Streletskaya and Balaklava Bays (Boltachev et al.,2009). Presence of European barracuda for the Turkish coastal region is reported by Fricke et al. (2007) and Keskin (2010). Borcea (1927, 1933) recorded single specimens from Agigea and Constanta (Romanian coastal area).

For the Bulgarian waters, *Sphyraena sphyraena* was found for first time by Drenski (1931, 1951) in the Bay of Sozopol (Southern Coastal area) and is included in the species list by Karapetkova &Zhivkov, 2006. Contemporary investigations of Yankova et all. (2014) summarized the available information for fish in the Black Sea basin and assigned to European barracuda VU conservation status according to IUCN Red List categories and criteria. Recently for Bulgarian Black Sea area LC status was assigned to European barracuda (Yankova, 2016).

The aim of the present publication is to report a finding of *S. sphyraena* from a new locality in Bulgarian waters.

Material and methods

A single individual of *Sphyraena sphyraena*, caught in Varna Bay was examined (fig.1). The specimen was offered by a fisherman, who found it in his stake trap net set on 28th of September 2014 and kindly presented for the Aquarium life collection.

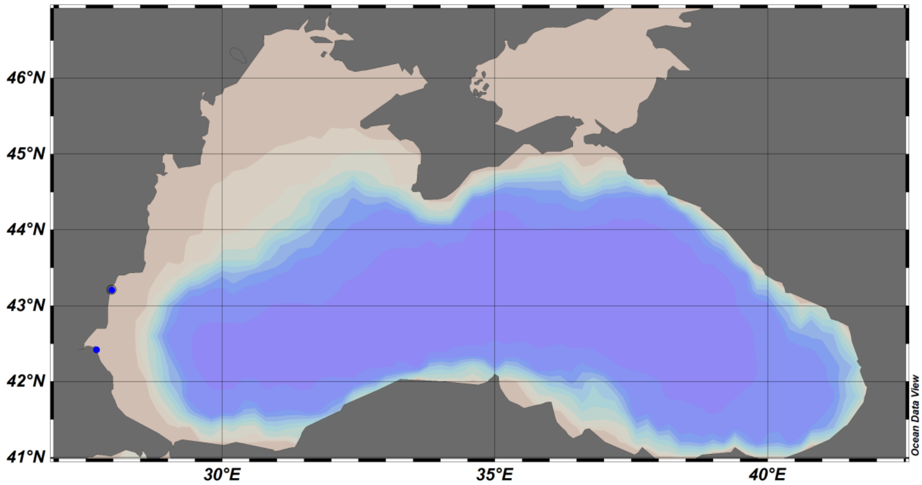

Figure 1. Map of sampling localities of *Sphyraena sphyraena* from Bulgarian coastal area. The southern point is Sozopol Bay, where was the first record of the species and the upper point is the new record locality

The following designations were used in the text (Smirnov, 1986, after Boltachev et al., 2009): TL for total body length; SL for standard length, as the distance from the snout tip (in barracudas *Sphyraena* spp., from the anterior point of the protruding lower jaw) to the beginning of the insertion of the middle rays of the caudal fin; squ. for the number of transverse series of scales; ll for the number of perforated scales in lateral line; D for the number of rays in the dorsal fin (D1, in the first, D2, in the second); A, P, V, and C for the number of rays in the anal, pectoral, ventral, and caudal fins, respectively. For plastic characteristics: H for the maximum body depth; h for the minimal body depth; aD for the antedorsal distance; pD for the postdorsal distance; aV for the anteventral distance; aA for the anteanal distance; VA for the ventroanal distance; lpc for the length of caudal peduncle; lD for the length of the dorsal fin insertion (lD1 is the length of the first fin insertion; lD2 is the length of the second fin insertion); hD for the dorsal fin depth (hD1 is the first fin depth; hD2 is the second fin depth); *lA* for the length of the anal fin insertion; hA for the anal fin depth; lP for the pectoral fin length; lV for the length of the ventral fin (sucker);lC for the caudal fin length (lC1 is the length of the upper lobe; lC2 is the length of the lower lobe); c for the head length; cH for the head depth near the occiput; ic for the maximum head thickness; ao for the snout length; hr for the snout depth; lmx for the upper jaw length; lmd for the lower jaw length; j for the orbit diameter; o for the eye diameter (o1 is vertical; o2 is horizontal); po for the length of the postorbital head region.

Fish length and weight was measured with accuracy to 0.01 mm and 0.1 g, respectively, using electronic caliper. Plastic characteristics were expressed in percent of the standard body length and in percent of the head length.

Results and discussion

The observed individual has a total body length (TL) of 345,74 mm and standard length (SL) of 305.05 mm and weight of 148 g. (pic.1) Typical size for this species is between 250 to 600 mm, with a maximum length of 1500 mm (de Morais et al., 2015). Same authors summarized the mean size for Greek waters to be 394 mm and for Turkish waters – 271 mm in 2009. In Eastern Adriatic length ranged from 826 to 932 mm and the maximum recorded size is 1500 mm (Ozturk et al. 2006). From this point of view our specimen is closer by length to the individuals from Turkiey and Greece.

Figure 2. ***Sphyraena sphyraena*** **from Varna Bay, caught in 2014**

Morphologic characters, according to Fischer et al., 1981, respond to the typical diagnosis: body elongate and cylindrical, back is green-blue coloured, dark transverse stripes are observed laterally not reaching lateral line, abdomen is silvery white, bony edge of oppercle ending in a single point, number of perforated scales on the lateral line is 146, D1 V, D2 II 8, A III 8, P12, V6. Plastic characters are presented as a percentage of the standart body length (table 1).

Table 1. Plastic characteristics of ***Sphyraena sphyraena*** **from Varna Bay**

Characters		Characters		Characters	
	in % of SL		in % of SL		In % of c
H	10.7	lD2	7,7	ic	24,3
h	5.0	hD1	8,0	ao	39,8
ch	17.77	hD2	6,4	hr	15,7
aD	46,4	D1D2	19,0	lmx	31,9
pD	45,9	lA	8,2	lmd	38,3
aA	70,0	hA	6,5	o1	13,7
aV	46,3	lP	5,4	o2	15,7
aP	31,1	lV	6,0	po	36,6
PV	15,4	lC1	9,6		
VA	27,7	lC2	9,2		
lpc	16,5	c	30,6		
lD1	6,6				

This new record of *Sphyraena sphyraena* in Bulgarian waters gives evidence of the presence of this Atlanto-Mediterranean species expanding its areal in Bulgarian Black Sea waters from the South to the North.

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References

Boltachev A.R., E.P. Karpova, O.N. Danilyuk, 2009. Findings of New and Rare Fish Species in the Coastal Zone of the Crimea (the Black Sea), Journal of Ichthyology, Vol. 49, 4: 277–291.

Borcea 1., 1927. Données sommaires sur la faune de la mer Noire (Littoral de Roumanie), Ann. sci. Univ. Jassy, 14, 3-4: 536-581.

Borcea 1., 1933. Nouvelles observations sur les migrations et sur la période de ponte des espèces de Poissons migrateurs de la mer Noire. Ann. sci. Univ. Jassy, 17: 503-564.

de Morais, L., Smith-Vaniz, W.F., Kara, M., Yokes, B., Pollard, D., Carpenter, K.E. & de Bruyne, G. 2015. *Sphyraena sphyraena*, The IUCN Red List of Threatened Species 2015:e.T198565A15596165http://dx.doi.org/10.2305/IUCN.UK.20154.RLTS.T198565A15596165.en

Drensky, P., 1931. To our knowledge of ichtyofauna of the Bulgarian Black Sea coastal area, Reports on Agriculture, XII, 7and 8, 10. (from Drensky, 1951) [in Bulgarian].

Drensky, P., 1951. Fish in Bulgaria, Fauna of Bulgaria, 2, BAS,.269 p.

Eremeev V.N., A.R. Boltachev, B.G. Aleksandrov, S.V. Alyomov, Yu.A. Zagorodnya, E.P. Karpova, L.A. Manzhos, V.V. Gubanov. 2012. Biological diversity of the coastal zone of the Crimean peninsula: problems, preservation and restoration pathways. Eds: V.N. Eremeev & A.R. Boltachev NAS Ukraine, Institute of Biology of the Southern Seas. – Sevastopol, 92 p.

Fischer, W., Bauchot, M.-L. and Schneider, M. 1987. Fiches FAO d'identification des espèces pour lesbesoins de la pêche. (Révision 1). Méditerranée et mer Noire. Zone de Pêche 37, FAO, Rome [In French].

Fricke R., M. Bilecenoglu, H. Musa Sari, 2007. Annotated checklist of fish and lamprey species (Gnathostomata and Petromyzontomorphi) of Turkey, including a Red List of threatened and declining species, Stuttgarter Beitr. Naturk, Ser. A, 706, 169 S., 3 Abb., 8 Tab, 172 p.

FAO Species Identification Sheets for Fishery Purposes, 1981. Eastern Central Atlantic. Fishing Area 34 and Part of 47. 6–7, Eds. W. Fischer, G. Bianci, and W. B. Scott (Dept. Fish. Oceans Canada, Ottawa).

Karapetkova & Zhivkov, 2006. Fish in Bulgaria, Gea-Libris, 215 p. [in Bulgarian].

Keskin, Ç., 2010. A review of fish fauna in the Turkish Black Sea. Journal Black Sea Mediterranean Environment, 16,2: 195-210.

Öztürk, B, Golani, D., Basusta, N. 2006. Fishes of the Eastern Mediterranean. Turkish Marine Research Foundation, Istanbul, 260 p., ISBN: 9758825127

Svetovidov A. N., 1964. Fish of the Black Sea (Nauka, Moscow), 533 p. [in Russian].

Yankova M., D. Pavlov, P. Ivanova, E. Karpova, A. Boltachev, B. Öztürk, L. Bat, M. Oral and M. Mgeladze, 2014. Marine fishes in the Black Sea: recent conservation status, Mediterranean Marine Science, 15, 2: 366-379.

Yankova M., 2016. Alien invasive fish species in Bulgarian waters: An overview, International Journal of Fisheries and Aquatic Studies 2016; 4(2): 282-290.

A focus on illegal, unreported and unregulated fishing in the Aegean Sea

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Fishery resources are one of the most exploited and traded food sources in the world and threatened by overfishing. Besides it is not known exactly how much fish resources catches by illegal, unreported and unregulated (IUU) fishing, it is considered to be an important component contributing to overfishing. This study aims to examine the methods of IUU fishing along the Turkish coast of Aegean Sea and to determine the content and especially forms of illegal fishing along Izmir coast. Republic of Turkey Ministry of Food, Agriculture and Livestock General Directorate of Fisheries and Aquaculture data from 2017 and illegal fishing records of Turkish Coast Guard Command are examined in the study. Additionally, 14 fishery cooperatives were visited and interviewed 74 fishermen on IUU fishing activities. Images in five different zones where illegal fishing activities were performed heavily were recorded via field studies at sea. According to General Directorate of Fisheries and Aquaculture data, 604 IUU fishing activities were detected and in total, a fine of 696616 TL was imposed in 2017. In addition, according to Turkish Coast Guard Command data 1778 illegal fishing activities were detected and 3621631 TL fine was imposed. Out of the total 2382 illegal fishing activities that were detected, 2.8% were blast fishing (use of explosive and hazardous materials), 81.4% were violation of ban on season, size or species via purse-seine fishing, 15.8% were illegal trawl fishing. It was determined that there was a direct correlation between the method of IUU fishing used and the pattern of coastline and seabed and the habitat choice of fish species. The results of this study will be able to provide an insight on the efforts to control and fight against illegal fishing in line with the intensity of the illegal fishing methods used in the region and the distribution of these methods.

Keywords: IUU fishing, Aegean Sea, Fisheries management.

Introduction

IUU fishing is one of the major problems in undeveloped and developing countries. Catching large quantity of fish with high economic value in short time, with low cost and low labour is utilized in all countries where the government authority is weak. Illegal fishing not only causes the loss of fish resources, but also the irreversible or long-term habitat loss. Nowadays, Metuzals et al., (2010) has addressed that illegal fishing is one of the most severe factors affecting world fisheries. Illegal or pirate fishing occurs in almost all fisheries and can take up significant amount of global catches (Agnew et al., 2008; FAO, 2002; Metuzals et al., 2010). In today's world, IUU fishing is a wide spreading problem not only for the high seas but also for the coastal waters and causing overfishing. According to EU (2017), there is 19% of the worldwide reported value of catches corresponding to €10 billion every year and it has also been reported that IUU threats seriously to sustainable fishing, damages the marine environment and affects socio-economic conditions (Göktürk and Deniz, 2017).

IUU fishing's is abbreviation of illegal, unreported and unregulated (IUU) fishing which is described by FAO (2001) as follows.

1. Illegal Fishing: Illegal fishing is conducted by vessels in violation of national laws or international obligations.

2. Unreported Fishing: Unreported fishing refers to fishing activities that have not been reported, or have been misreported, to the national authority or regional fisheries management organization.

3. Unregulated Fishing: Unregulated fishing refers to fishing activities by vessels without nationality, or by those flying the flag of a state not party to a fisheries management organization, and where such fishing activities are conducted in a manner inconsistent with state responsibilities under international law.

It is well known that overfishing is increasingly threatening the world's marine capture fisheries (Jackson et al. 2001; Myers and Worm 2003). According to Metuzals et al (2010), large catches from small scale unregulated artisanal fisheries generally go unreported in developing countries. Described above, illegal fishing which is a part of IUU fishing is widely known in the coastal part of the Turkey although a comprehensive study on this issue have not been conducted. According to national laws and regulations in Turkey the most breaking the bans are observed as prohibited area, closed season and fishing gear restrictions. From this point of view the objective of this study is to enlighten the illegal fishing along İzmir coast, Aegean Sea.

Material and Methods

Aegean Sea coast is the longest coastline of Turkey spanning over 2805 kilometres which is consisting of numerous bays, peninsulas and islands, and also the migratory path of many fish species. For this reason Turkish coast of Aegean Sea is an active and productive fishing area where illegal fishing activities take place. The study was performed and supported by official statistical data for Aegean Sea and Izmir coasts and field studies which carried out at Izmir coast (Figure 1). During the field studies 74 fishermen working with 14 fishery cooperatives in Izmir province were interviewed, total 12 days of field study was conducted in five different fishing boats.

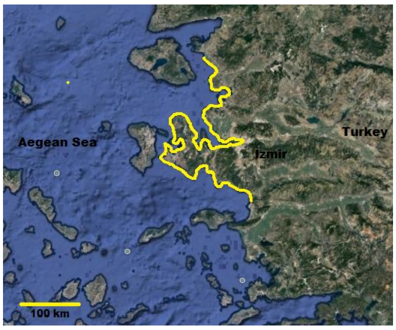

Figure 1. Study area: Izmir coast, Aegean Sea.

In order to present the data of fisheries landings used in this study was taken from Republic of Turkey Ministry of Food, Agriculture and Livestock, and Turkish Coast Guard Command are concerning on IUU fishing activities. This study also includes our field observations about IUU fishing in Aegean Sea coast in Turkey.

Results and Discussions

According to Republic of Turkey Ministry of Food, Agriculture and Livestock General Directorate of Fisheries and Aquaculture data, 604 illegal fishing activities were detected in Aegean Sea coasts and a total fine of 696.616 TL was imposed in 2017. According to Turkish Coast Guard Command data 1778 illegal fishing activities were detected and 3.621.631 TL fine was imposed. Out of the total 2382 illegal fishing activities that were detected, 2.76% were blast fishing (use of explosive and hazardous materials), 81.44% were violation of ban on season, size or species via purse-seine fishing, 15.81% were illegal trawl fishing. Distribution of illegal fishing activities by number between 2012 and 2016 according to the years are given in Figure 2 and related to IUU issues in Figure 3, respectively, in total. 74 fishermen from 14 fishery cooperatives in Izmir were interviewed and field missions were conducted on 12 days on five different fishing boats as part of field studies.

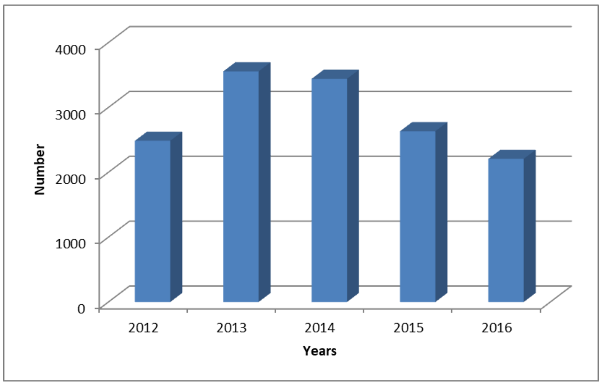

Figure 2. The number of litigation and other judicial, arbitral, administrative or other proceedings between 2012 and 2016 in total.

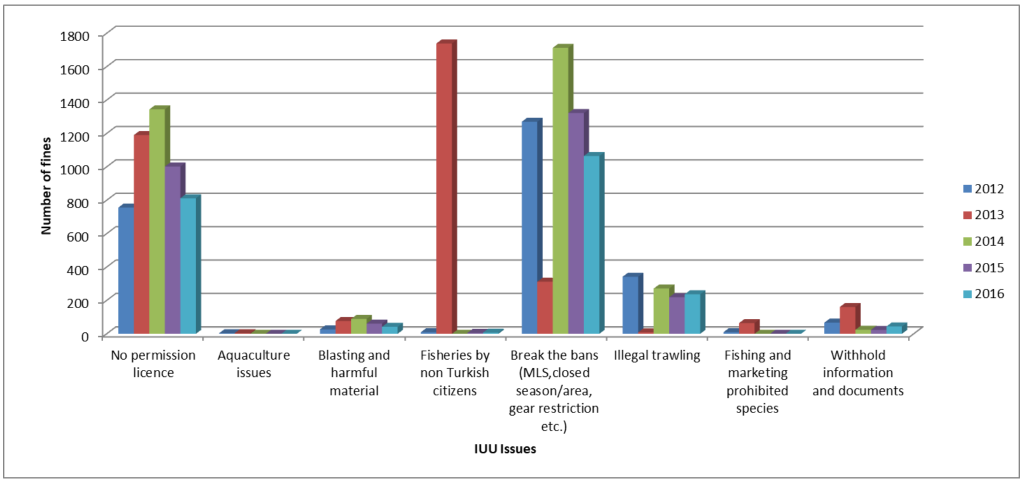

Figure 2. The number of fines related to IUU issues between 2012 and 2016 in total.

There are closed areas, closed season and depth limit prohibitions for purse seine fisheries (Figure 4) based on regulation in force. Among them, the depth limit which has been banned fishing less than 24 m in shallow areas is the most breaking prohibition in the study area. The fact that schools of fish are dense in shallow and biologically rich cause seine ships to fish intensely in these areas. When conducted in waters shallower than 24 meters, the lights used in light-purse seining not only affect pelagic fish but also many species of bottom fish thus making fishing more profitable. Purse seine operations are easy to control and to be caught on the act, as the net is collected where it was set and fishing scene can not be left for some time. Occasionally violation of species-regulations occur when species, fishing of which is prohibited (Bluefin Tuna) are also trapped in the net.

Figure 3. Purse seine fishery

Trawl fishing is an active fishing method which is used for catching highly commercial fish species. Due to the fact that mooring lines are totally on the seabed while sweeping, no obvious visual sign of trawl fishing can be seen on the surface. The main indicators of a trawl fishing vessel are, high water flow around the propeller are despite slow speed of the trawl boat and ropes connected at the stern or sides of the boat. In the event of a Coast Guard raid or control, the ropes are cut and it is claimed that the boat is just cruising. In order to initiate legal action against this type of illegal fishing, surveillance camera footage or recovery of the trawl net from the seabed is required. Images recorded by night vision cameras captured at the time of illegal fishing (Figure 5).

Figure 5. Illegal trawl fishery.

Blast fishing is an illegal fishing practice which allows easy collection of economically high-value fish in short time with the use of explosive materials (Alcala and Gomez, 1987). Performed in short time with low-cost and few people, this method causes to irreversible damage to the habitat where it is practiced. The explosives are made by the fishermen by mixing agricultural fertilizers potassium nitrate (KNO_3) or ammonium nitrate (NH_4NO_3), sulphur and diesel oil in certain proportions and equipping it with a fuse and time-detonator. The practice is performed early in the morning places where fish gather for spawning migration. Blast fishing can be done on a vessel or high coastal areas where the movements of schools of fish can be observed (Figure 6).

Figure 6. Dynamite fishing

In order to confirm and penalize the crime at the controls or inspections, explosives must be found on the vessel or the operation must be caught in the act. These factors make illegal blast fishing a particularly hard to detect. Today, the analysis results of the fish affected by explosives can be used as legal evidence. Apart from these illegal fishing practices, in recent years, collection of some species exported in the aquaculture sector provides high economic benefits. For instance, area-ban and night-diving prohibitions are the most commonly violated restrictions about sea cucumber collection. The fact that sea cucumbers go out of the sand burrows to feed themselves especially at night makes the collection of this species possible by diving at night.

IUU fishing has an unfavourable effect on conservation and management in all fisheries activities due to its seriously diminishing effects on fish stocks. This is also caused trouble for monitoring of fish stock assessment and misleading national fisheries management.

Acknowledgements

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References

Agnew D., Pearce J., Peatman T., Pitcher T.J., Pramod G., 2008. The Global Extent of Illegal Fishing. Vancouver and London: FERR (Fisheries Ecosystems Restoration Research) Fisheries Centre, University of British Columbia, and Marine Resources Assessment Group.

Alcala A. C. and Gomez E.D. 1987. Dynamiting coral reefs for fish: A resource destructive fishing method, in human impacts in coral reefs: facts and recommendations, ed. B. Salvat, pp. 51-60. Antene Museum EPHE. Moorea. French Polynesia.

EU Press Office 2017. Tackling Illegal, Unreported and Unregulated (IUU) Fishing https://ec.europa.eu/fisheries/tackling-illegal-unreported-and-unregulated-iuu-fishing_en [Accessed December 2017].

FAO 2001. International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing, Rome, 24p.

FAO 2002. Stopping Illegal, Unreported and Unregulated Fishing. Food and Agriculture Organization of the United Nations Rome, ISBN: 92-5-104760-X. 20p.

Göktürk D. and Deniz T., 2017. Illegal, Unreported, and unregulated fishing in Turkey: Effects on Marine Ecosystem and sustainable fisheries. *In*: Researches on Science and Art in 21st Century Turkey, Arapgırlıoglu H., Atık A., Elliott R., Turgeon E., Eds., Volume 2 Chapter 293, Gece Publishing, Ankara, pp.2629-2638.

Guard M. and Masaiganah M., 1997. Dynamite Fishing in Southern Tanzania, Geographical Variation, Intensity of Use and Possible Solutions. Marine Pollution Bulletin Vol. 34, No. 10 pp.758-762. 1997.

Jackson J. B. C., Kirby M. X., Berger W. H., Bjorndal K. A., Botsford L. W., Bourque B. J., Bradbury R. H., Cooke R., Erlandson J., Estes J. A., Hughes T. P., Kidwell S., Lange C. B., Lenihan Hunter S., Pandolfi J. M., Peterson C. H., Steneck R.S., Tegner M. J., Warner R. R., 2001. Historical Overfishing and the Recent Collapse of Coastal Ecosystems. Science ,Vol. 293, Issue 5530, pp. 629-637.

Metuzals K., Baird R., Pitcher T., Sumaila R., Pramod G., 2010. One Fish, Two Fish, IUU and No Fish: Unreported Fishing World-Wide. *In:* Q.R. Grafton, R. Hilborn, D. Squires, M. Tait, M. Williams, (eds) Handbook of Marine Fisheries Conservation and Management. Oxford University Press, Chapter 12, 165-181pp, ISBN:9780195370287.

Myers R.A. and Worm B., 2003. Rapid worldwide depletion of predatory fish communities. Nature 423: 6937.

Taxonomic and Cytotaxonomic Examinations of Fish Species Detected in Two Rivers in Ordu for the First Time

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In terms of biodiversity, Turkey has a rich fauna and flora source. Fish also have an important place in these. Especially when viewed locally, endemic species not found elsewhere in the world can be encountered. In Turkey there are many faunistic as yet undiscovered inland water resources. The province of Ordu also has a rich water regime and in most of the cases the fish fauna is not quite clear. In the same way, if the chromosome numbers and structures of ninety percent of the fish species in our country are thought to be unknown, the cytotaxonomy of these species were also determined for the first time in this study. The first taxonomic and cytotaxonomic findings of fish species living in the Bolaman and Elekçi Rivers, which were taken for the first time in this current study, have been reported. In the study, samples were taken from Bolaman and Elekçi Rivers using electroshock from a total of 15 pre-determined stations between September 2017 and May 2018. Specimens were brought to the laboratory and their metric and meristic characteristics were determined. The samples were then stored in formaldehyde solution (7%) for further examination. Species assignments were made using reference sources. Traditional methods have been used to identify and paint chromosomes. As a result of the samples made in both rivers, total eight species were found in Bolaman River and ten species in Elekçi River. Eight species were identified in both rivers, including *Alburnus derjugini*, *Rhodeus amarus*, *Squalius orientalis*, *Capoeta banarescui*, *Alburnoides fasciatus*, *Barbus tauricus*, *Ponticola turani* and *Neogobius fluvatilis*, which are common to the Cyprinidae and Gobiidae families. However, *Vimba vimba* from the Cyprinidae family in Bolaman River, and *Oxynoemacheilus* sp. and *Oncorhynchus mykiss* from the Nemacheilidae and Salmonidae families in Elekçi River were detected. *Alburnoides* and *Oxynoemacheilus* species have been discovered for the first time and the species of *Oxynoemacheilus* has not yet been identified. Chromosome structures and numbers were also determined for the first time in approximately 10 different species. There has been only one similar work that has been done before in the Elekçi River. The vast majority of species found in both rivers were new records, and one species obtained from the Elekçi River was likely to be a new species. But there has been no definite result yet. According to previous work done in Elekçi, other species except *B. tauricus* and *N. fluviatilis* have been new records. It has been reported for the first time that species identified in the Bolaman River constitute the fish fauna of the river. Together with this, their cytotaxonomy of all ten species except for the rainbow trout detected in this study was made first.

Keywords: Biodiversity, Taxonomy, Cytotaxonomy, Chromosome, Elekçi River, Bolaman River
Acknowledgemends
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Note:
The decision of the Local Ethics Committee for Animal Experiments of the Ordu University No. 82678388 and the Ethics Committee Compatibility Certificate were obtained for this research.

Effects of thyme (*Tyhmus vulgaris*) leaf and oil on growth and hepatopancreas histology of white shrimp, *Litopenaeus vannamei*

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In this study it was aimed to evaluate the efficacy of different dietary levels of thyme leaves and thyme oil as feed additives for white shrimp, *Litopenaeus vannamei*. In the experiment, five groups with three replicates were formed as 1% and 2% thyme leaf, 0.5% and 1% thyme oil and control group. Juveniles (initial weight: 6.67±1.52 g) were stocked as 15 shrimp/250 L tank (100% water exchange day-1) for 84 days. At the end of the experiment, growth parameters were determined and proximate analysis was performed to evaluated the effect of thyme supplementations on body contents and also hepatopancreas tissues were examined in histologically to determine its effects on shrimp health. The better growth parameters were determined in the 1% thyme oil applied group (final weight: 14.90±2.77 g, weight gain: 8.22±0.72 g) while it compared with the control group (FW: 13.54±3.37 g, WG: 6.87±0.54 g). In terms of the proximate composition of shrimps; dry matter, crude protein and crude ash levels there were not detected significantly differences among the groups. Additionally, the significantly highest lipid content (1.64) was only found in the 1% thyme oil group with. Histological examination showed that there were no differences with regards to tissue morphology between the groups. In conclusion the thyme leaf and thyme oil does not have an adverse effect on shrimp health. The positive results from the study are expected to contribute to shrimp culture in the future.

Keywords: Shrimp, aquaculture, *Tyhmus vulgaris*, essential oil, histology

Alien Plant Species of Skadar/Shkodra Lake in Montenegro

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Lake Skadar/Shkodra is the largest lake in the Balkan Peninsula, located in the Western Balkans at 40^0 10’ North latitude, 19^0 15’ East longtude with approximately 65% of its surface belonging to Montenegro and around 35% to Albania. The surface area of the Lake water fluctuates seasonally from approximatelly from 370 to 600 km^2. Montenegrian part of the Lake is National park with surface of 400 km^2.

This work is based on the all known literature data as well as our systematic field research in the area of the Lake (from the year 2002 to 2015). Research on the vascular flora of the Lake Skadar basin started in the middle of the 19th century when the German botanist Wilhelm Ebel visited this area in 1841.

Based on the available literature and our unpublished data, a total of 1397 taxa from 131 families and 588 genera have been reported from the area of the Lake Skadar National Park. Of that number of total flora of the Skadar Lake National Park 133 taxa belonging to alien flora (species and subspecies).

Among the 133 taxa, 59 (44.4%) are classified as naturalized but not invasive, 42 (31.6%) as invasive and 32 (24%) as casuals. Among naturalized taxa, 50.8% are archaeophytes and 49.2% neophytes, the corresponding figures being 37.5 and 62.5%, respectively, for casual, and 2.4 and 97.6% for invasive taxa. From this it follows that naturalized taxa are over-represented among archaeophytes, and invasive among neophytes.

In this work all the alien flora of the basin of Skadar Lake were assessed (aquatic, semi aquatic, terrestrial).

Keywords: alien flora, archaeophyte, casual, invasive, Montenegro, naturalized, neophyte, Skadar/Shkodra Lake.

Analysis of Gas Seepages in the Mud Volcanoes Located of the Eastern Mediterranean Sea

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In the Eastern Mediterranean Sea, approximately more than 200 mud volcanoes have been detected. Gas seepages and gas hydrate existence near these mud volcanoes (MV) were observed. However, there is not any study investigating the behavior of gas seepages and the possibility of gas reaching to the sea surface. In this study, the mud volcanoes in the South of Crete (Napoli MV and Milano MV), in the Anaximander Mountain (Thessaloniki MV, Kazan MV, Amsterdam MV, and Kula MV) and in the Nile Deep Sea Fan (Amon MV, Osiris MV, Isis MV and North Alex MV) were analyzed. Especially, gas seepages due to anthropogenic gas hydrate dissociation are big concerns recently. For this reason, the analysis of these gas seepages are essential in terms of environmental aspects. The gas seepages on the seafloor of the mud volcanoes selected were investigated by using the bubble rise theory with the help of Fortran code developed in this study. It was found that the effect of gas bubble diameter is high on the height of gas flare in the study area. Moreover, the height of gas flares increases with anthropogenic affects, which might reach to seafloor in 100s of years.

Keywords: methane, gas hydrate, gas seepages, Mediterranean Sea, Mud Volcano

Introduction

Climate change is a problem in the world. Countries try to reduce its negative effects. The consumption of hydrocarbons is one of the reasons of climate changes (IPCC, 2001). Global warming causes the increase in the temperature of oceans and seas. As well as the melting of glaciers, global warming might cause the dissociation of gas hydrates (Zhao *et al*., 2017). The reasons of these gas hydrate dissociations and gas seepages in oceans, seas or lakes might be antropogenic or not (Mestdagh *et al*., 2017). Gas hydrates are ice-like structures formed by methane (CH_4) molecules at low temperature and high conditions. They exist in shallow marine environment (Max & Johnson, 2016). Therefore, small changes in the seafloor temperature might cause gas hydrate dissociation and release of gas from seafloor to sea. In the Eastern Mediterranean Sea, the potential of gas hydrate existence is high. Hence, the possibility of gas seepages due to gas hydrate dissociation is also high (Merey & Longinos, 2018). In the Mediterranean Sea, there are hundreds of mud volcanoes (Praeg *et al*., 2011). Mud volcanoes (MV) are the structures formed in the seafloor while fluid seepages through seafloor (Anka *et al*., 2012). Most of these CH_4 seepages are oxidized near seafloor but it changes some chemical properties of sea. This might affect other lives (Tinivella, 2016). Moreover, it is important to predict whether gas seepages reach to sea surface from sea floor or not. The release of CH_4 to the atmosphere is at least 20 times more potent than carbon dioxide (CO_2) as a greenhouse gas (Ruppel, 2011). In this study, it is aimed to analyze gas seepages in the South of Crete (Napoli MV and Milano MV), in the Anaximander Mountain (Thessaloniki MV, Kazan MV, Amsterdam MV, and

Kula MV) and in the Nile Deep Sea Fan (Amon MV, Osiris MV, Isis MV and North Alex MV) in the Eastern Mediterranean Sea by using the bubble rise theory of Degterev (2017). Furhermore, the reason of gas seepages in these mud volcanoes are investigated.

Material and Methods

Fig.1 indicated the locations of mud volcanoes in the Eastern Mediterranean Sea. It is possible to see mud volcanoes in the Anaximander Mountain (AM): Thessaloniki MV, Kazan MV, Amsterdam MV, and Kula MV. Amon MV, Osiris MV, Isis MV and North Alex MV are located in the Nile Deep Sea Fan in Fig.1. Napoli MV and Milano MV belong to Olympos mud volcano (OMV) group in the south of Crete in Fig.1.

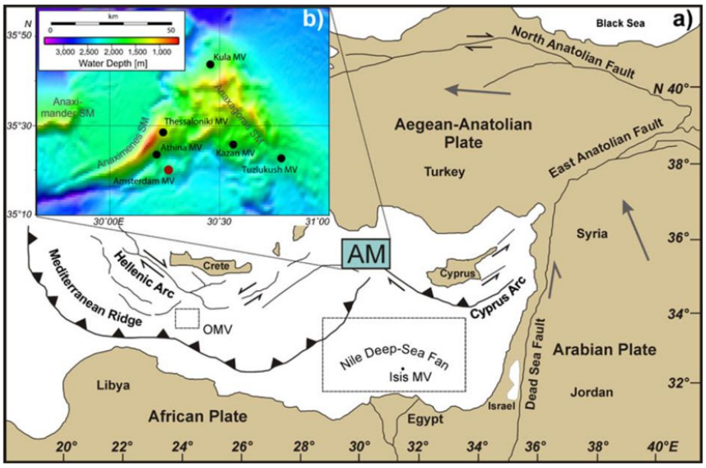

Figure 1. Locations of the mud volcanoes in the Eastern Mediterranean Sea (Pape *et al*., 2010).

Table 1 lists the temperature of gas seepages in some of the mud volcanoes in the Eastern Mediterranean Sea. These values are essential while evaluating the height of gas seepages by using bubble rise theory.

Table 1. The temperature and depth of some mud volcanoes in the Eastern Mediterranean Sea.

Region	Mud Volcano	Temperature (ºC)	Sea Depth (m)
Anaximander Mountain	Thessaloniki	13,7	1260
	Kazan	14	2000
	Amsterdam	14	2022
South of Crete	Napoli	14	2000
	Milano	14	2000
Nile Deep Sea Fan	Amon	45,3	1118
	Osiris	20,3	747
	Isis	41,4	991
	North Alex	21,8	501

The bubble rise theory improved by Degterev (2017) includes mathematical modelling to estimate the height of gas flares. As input data, sea water density, sea water depth, seafloor temperature, pressure, gas type and gas bubble diameter are essential. In this study, fortran code was developed by using the equations proposed by Degterev (2017). For the mud volcanoes listed in Table 1, the height of gas flares was estimated in this study to predict whether these gas seepages reach to sea surface or not. In this model, it is assumed that only one gas component (CH_4) exists inside gas bubble. Moreover, the bubble rise is related with the action of buoyancy and viscous drag of water. During the numerical simulation of bubble dynamics, the changes in the variable Δr (radius of bubble), ΔV (volume of bubble), Δz (coordinate), Δm_g (mass of gas in bubble), and Δm_h (mass of hydrate in bubble) were calculated for each time step. In the simulations, rates of the gas exchange (q) at a water temperature are calculated. When these values (q) are equal to zero, it means that this depth is the top point where gas flare can reach.

Results

Fig.2 indicated the rates of the gas exchange for different bubble sizes in Thessaloniki MV, Kazan MV and Amsterdam MV. These rates were estimated by using the fortran code developed by applying the bubble rise theory of Degterev (2017).

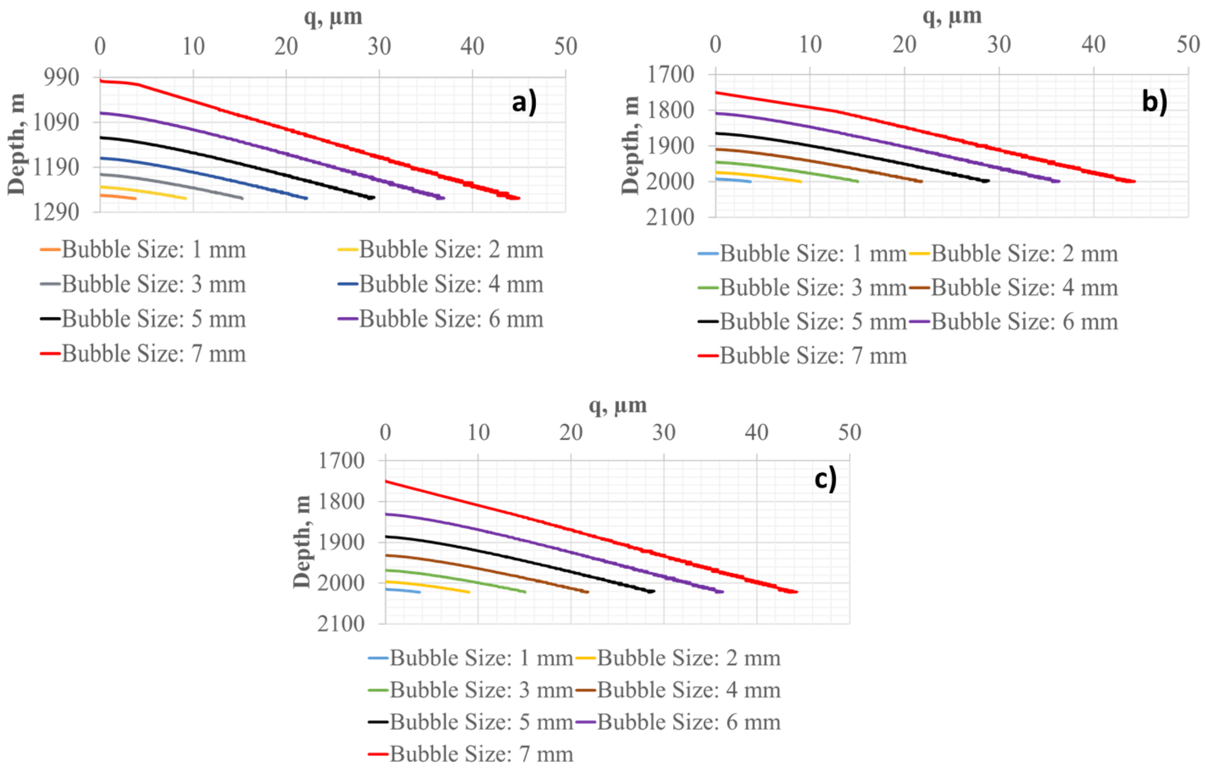

Figure 2. Rate of the gas exchange (q) at different bubble sizes for a) Thessaloniki MV b) Kazan MV c) Amsterdam MV.

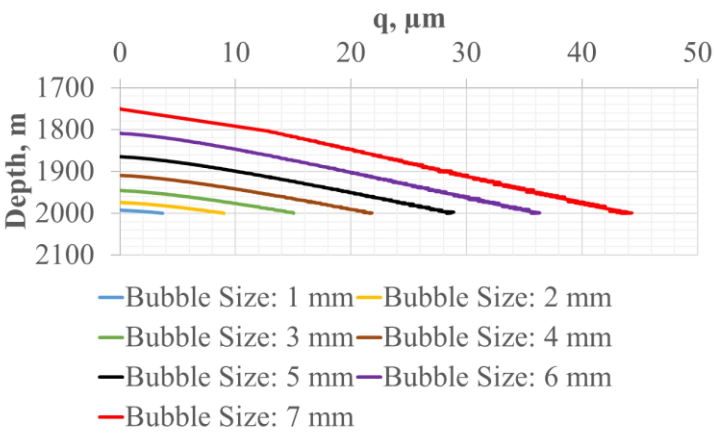

Figure 3. Rate of the gas exchange (q) at different bubble sizes for Napoli MV and Milano MV.

Fig.3 indicated the rates of the gas exchange for different bubble sizes in Napoli MV and Milano MV. They are same because the properties of these MVs are similar as seen in Table 1. These rates were estimated by using the fortran code developed by applying the bubble rise theory of Degterev (2017).

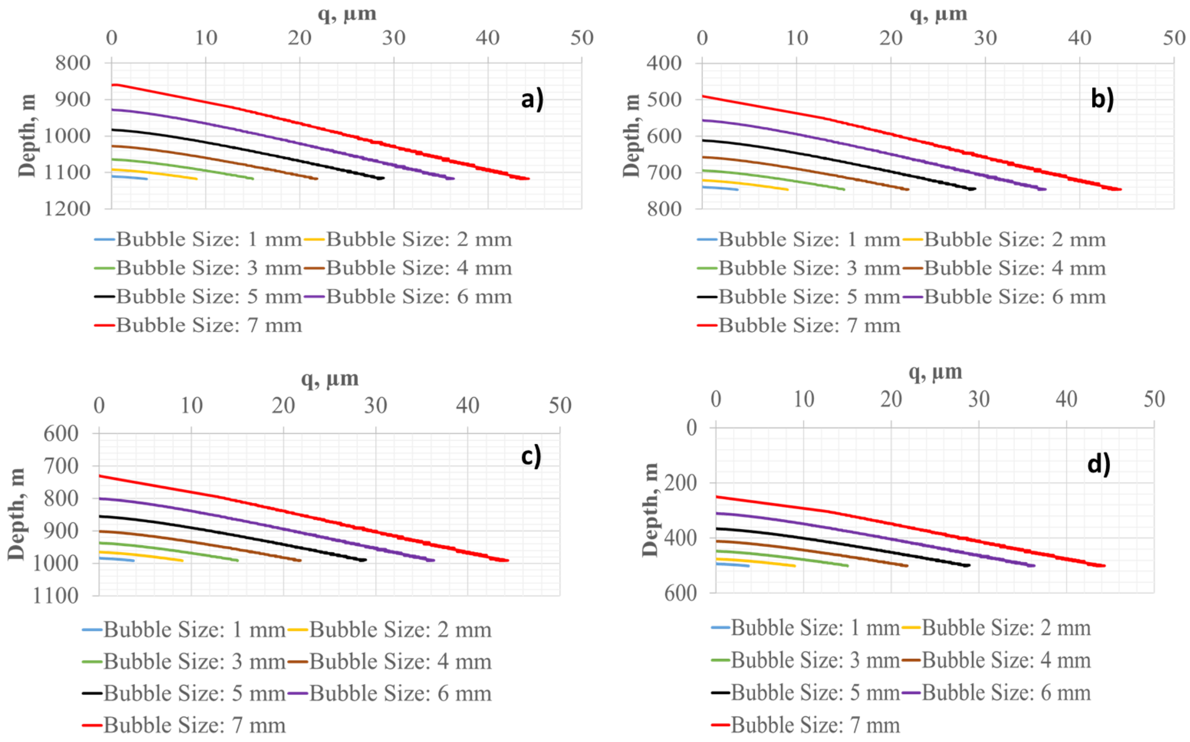

Figure 4. Rate of the gas exchange (q) at different bubble sizes for a) Amon MV b) Osiris MV c) Isis MV d) North Alex MV.

Fig.4 indicated the rates of the gas exchange for different bubble sizes in Amon MV, Osiris MV, Isis MV and North Alex MV. These rates were estimated by using the fortran code developed by applying the bubble rise theory of Degterev (2017).

Discussion

The depth in Fig. 2, Fig. 3 and Fig. 4 are the depths below sea surface. When gas bubble rises from sea floor, they reach to certain levels. When the rate of the gas exchange becomes zero, this means that gas flare disappears at this depth. Hence, the rate of the gas exchange values (q) are important to predict the height of gas flares. According to simulation results in Figure 2, Figure 3 and Fig. 4, it is clearly seen that the gas bubble size affects the height of gas flares significantly. When bubble size increases, gas flare height increases. The dominant reason of this is that with larger bubbles, the rate of gas exchange will be higher so the bubble will disappear late. The gas seepages in Amon MV, Osiris MV, Isis MV and North Alex MV of the Nile Delta Fan in Fig.4 are not due to gas hydrate dissociation because temperature values in Table 1 for these MVs are quite high for gas hydrates. These gas seegapes come from deeper sediments instead of shallow marine sediments where gas hydrate exists at low temperature and high pressure conditions. The sea depth of North Alex MV is approximately 501 m and gas flare might reach until 250 m below sea surface for 7 mm bubble diameter. Differently, the conditions in Anaximander Mountain's MVs are close to gas hydrate stability conditions. Moreover, gas hydrate samples were collected in seafloor near these MVs. Therefore, possible gas seepages are likely due to gas hydrate dissociations in this region. The increase in seafloor temperature possibly causes gas hydrate dissociation. As seen in Fig.2, in these MVs, gas do not reach to atmosphere but the height of gas flares reaches to 300 m. Similar results with Anaximander Mountain's MVs were obtained for Napoli MV and Milano MV in the south part of

Crete as seen in Fig.3. Furthermore, one of the reason of gas seepages in these MVs are possibly gas hydrate dissociation.

The present study shows that gas seepages in the selected MVs of the Eastern Mediterranean Sea cannot reach to the atmosphere. However, the heights of gas flares reach to 300 m so the oxidized CH_4 might affect marine life negativelty and some environmental and biological studies are essential, which are the out of topic of this study.

References

Anka, Z., Berndt, C., Gay, A., 2012. Hydrocarbon leakage through focused fluid flow systems in continental margins. Marine Geology, 332–334 (2012): 1–3.

Degterev, A.K., 2017. Influence of gas hydrate formation on methane seeps at the bottom of water reservoirs. Russian Geology and Geophysics, 58 (2017): 1101–1105.

IPCC (Intergovernmental Panel on Climate Change). Climate Change, 2001. The Scientific Basis. New York, NY: Cambridge University Press, 2001.

Max, M.D. & Johnson, A.H. (2016). Exploration and Production of Oceanic Natural Gas Hydrate. Springer, Switzerland. ISBN 978-3-319-43384-4.

Merey, S. & Longinos, S., 2018. Does the Mediterranean Sea have potential for producing gas hydrates? Journal of Natural Gas Science and Engineering, 55 (July 2018): 113-134.

Mestdagh, T., Poort, J. & De Batista, M., 2017. The sensitivity of gas hydrate reservoirs to climate change: Perspectives from a new combined model for permafrost-related and marine settings. Earth-Science Reviews, 169 (2017): 104–131.

Pape, T., Kasten, S., Zabel, M., Bahr, A., Abegg, F., Hohnerg, H-J. & Bohrmann, G., 2010. Gas hydrates in shallow deposits of the Amsterdam mud volcano, Anaximander Mountains, Northeastern Mediterranean Sea.Geo-Mar Lett. V. 30: 187-206.

Praeg, D., Geletti, R., Wardell, N., Unnithan, V., Mascle, J., Migeon, S. & Camerlenghi, A. (2011). The Mediterranean Sea: A Natural Laboratory to Study Gas Hydrate Dynamics? Proceedings of the 7th International Conference on Gas Hydrates (ICGH 2011), Edinburgh, Scotland, United Kingdom, July 17-21, 2011.

Ruppel, C. D., 2011. Methane Hydrates and Contemporary Climate Change. Nature Education Knowledge 3(10):29.

Tinivella, U., 2016. https://www.migrate-cost.eu/documents/1134909/1134981/Report_WG3_26feb2016.pdf/9d12d6d4-659b-426c-991a-bdb17f775259 [Accessed July 2018]

Zhao, J., Song, Y., Limb, X.L. & Lamb, W.H., 2017. Opportunities and challenges of gas hydrate policies with consideration of environmental impacts. Renewable and Sustainable Energy Reviews, 70 (2017): 875–885.

The International Commission for the Conservation of Atlantic Tuna (ICCAT) controls in the bluefin tuna (*Thunnus thynnus* L., 1758) fishing in Turkey

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The main institution in the International Commission for the Conservation of Atlantic Tuna (ICCAT) controls is the Ministry of Agriculture and Forestry (MAF). ICCAT inspections are essentially executed by Coast Guard Command (CGC) at sea. The landing places, sales outlets and farms are inspected mainly by MEFAL. ICCAT joint international inspections are performed in Turkey since 2010. In international waters, a fishing vessel flagged to a Contracting Government and fishing for BFT or tuna-like fishes are inspected by a control boat flying the ICCAT pennant and carrying two inspectors

In addition to the CGC ships/boats, CGC airplanes and helicopters were used in ICCAT inspections in 2017. Given that the using of airplanes, helicopters and unmanned aerial vehicles in bluefin tuna fishing and transshipment of dead fish at sea are prohibited, using of the airplanes and helicopters within the capabilities of the Contracting Parties will be beneficial in the ICCAT inspections. It may be advisable to include an arrangement in this regard in the ICCAT recommendation.

Keywords: ICCAT, bluefin tuna, control, inspection, monitoring.

Introduction

The International Commission for the Conservation of Atlantic Tunas (ICCAT) which depend on the United Nations Food and Agriculture Organization aims to project more than 30 tuna like fish species in the Atlantic Ocean and Mediterranean Seas. At present, ICCAT is an international regional fisheries management organization composed of 52 contracting parties.

It was established in the context of the International Convention for the Conservation of Atlantic Tuna Fish, which entered into force in 1969. Turkey had been ICCAT Contracting Party with dated 28 May 2003 and the Law no 4859 (ICCAT, 2018).

Bluefin tuna (*Thunnus thynnus* L., 1758) (BFT) fishing inspections are conducted in the Mediterranean in line with the 17-07 ICCAT Recommendation.

The scope of this recommendation consists of prohibits catching of fishes that are smaller than a certain size, catching by certain fishing gear at definite times and prohibitions not supporting for catching by airplane, helicopter or unmanned aerial vehicle in the Mediterranean and management plans for the growth of bluefin tuna.

BFT is caught in Turkey's 20-120 miles from the southern regions open (Antalya Gulf openings 40-60 miles, Antalya province Gazipaşa district and the region between Cyprus) (Dağtekin, 2009). The fishing is done with purse seine nets. The caught live BFT are transferred to the cages. The live BFT are transported to the farms very carefully and slowly (at a speed of 1 to 1.5 miles per hour) with the tug vessels. The BFT are fed on farms until reaching market size (Dağtekin, 2009 and Başaran & Özden, 2004).

The total amount of catchable quota (TAC) is determined by the ICCAT Commission. The TAC to be determined under the allocation plan for the years 2019-2020 is explained in the 17-07 recommendation. Turkey's quota was set at 1,414 tonnes for 2018. For the years 2019 and 2020, Turkey's quota will be determined as 1824 tons and 2.240 tons. (17-07 Recommendation (R), part II 5). Also, every year, Turkey 0,5'n% of the quota allocates to amateur fishing (Communiqué (C) no 4/2, article 16/1).

Başaran & Özden (2004) and Dağtekin (2009) briefly cited on ICCAT inspections in their works. No extensive research had been done on ICCAT inspections.

In this study, the inspections principles of the BFT fishing will explain within the context of the 17-07 ICCAT Recommendations and answer questions about what to do against the illegal, unreported and unregulated fishing.

Material and Methods

Auditor Institutions

The main responsible body of the ICCAT controls is the Ministry of Food, Agriculture and Livestock (MFAL). ICCAT inspections are mainly carried out at sea by the Coast Guard Command (CGC) (CGC, 2017). In addition, the ICCAT inspections are also carried out at sea by the Naval Forces Command (MEU, 2011).

The inspections of the landing places, the sales places and the farms are mainly carried out by MFAL and joint inspections are carried out with CGC when necessary.

Implementation of the "ICCAT International Joint Audit Scheme", which was originally established in 1975 and aims to carry out an effective fishing audit activity in the international waters of the Atlantic Ocean and its connected seas, has been put into effect by the ICCAT Commission 08-05 Recommendation. Therefore, the joint ICCAT inspections are carried out in international waters since 2010 in Turkey (Tiftikçioğlu, 2012).

Under the joint ICCAT inspections, a fishing vessel flagged to a Contracting Government and fishing for BFT or tuna-like fishes are inspected in international waters by a control boat flying the ICCAT pennant and carrying two inspectors

Bluefin Tuna Fishing Monitoring Tools

It is necessary to take the permit documents for catching, tug and support vessels to be used in BFT fishing (Communiqué (C) no 4/1, article 21). The vessels that are taken catching, transport and support permissions for the BFT fishing must have the vessel monitoring system (VMS) and be kept it open for 7/24 hours during the fishing season (Communiqué (C) no 2016/18, article 5, Circular (C) no 2018/2, article 3). The position and speed information of foreign fishermen vessels allowed under ICCAT on VMS is also available in Turkey. In addition, there must be an automatic identification system (AIS) on the fishing vessels 15 meters' length or more (AIS Communiqué (C), article 6). The position and speed information of the fishing vessels is controlled by these systems. All allowed vessels must have both the paper and electronic fishing logbooks (C no 4/1, article 47/9, C no 2016/18, articles 5 and 6). The caught products and transfer operations are recorded in the fishing logbook by the master. The live BFT transfers are saved by steroscopic cameras and video recording is found on both the catching and tug vessels (C no 2018/2, articles 9, 10). In the accompanied by the ICCAT Transfer Declaration (ITD) and the first copy of the fishing logbook, the live BFT is transported to the farm with the tug vessels. In the case of the non-live BFT, the BFT must be landed the port specified by C no 2018/2. Also, the information of permit and transshipment regarding the BFT fishing is checked on the Animal Information System. In addition, the information of vessels and farms belonging to the party countries under ICCAT is also monitored and controlled on the www.iccat.int website.

Bluefin Tuna Fishing Controls

The BFT fishing inspections are exercised pursuant to ICCAT 17-07 recommendations decision in Turkey. The regulations on the said recommendation decision were harmonized with our national legislation. Within this scope, necessary regulations were made Fishery Products Regulation issued based on the Fishery Products Law no 1380, Regulation of Aquaculture Production, C no 4/1 and 4/2. Every year, they are published that application generalizations related to Determination of the Vessels to Make BFT Fishing and the Quota to be Given to these Vessels, and the Importation, Exportation, Fattening, Transhipment, Catching, Applications of the BFT Fishing Vessels.

The boats and inspectors who will be ICCAT inspectors are notified to ICCAT every year by the MFAL. Each inspector is taken an ICCAT inspector's Card that will be valid for 5 years. The inspectors are trained in the MFAL prior to the fishing season according to ICCAT 17-07 recommendation rules. ICCAT inspections are carried out by inspectors who have ICCAT inspector card and a control boat flying the ICCAT pennant within the ICCAT 17-07 Recommendation.

The BFT fishing is carried out with purse seine between May 26 and June 24. (C no 4/1, article 21/1). The live BFT must be transhipped to the BFT farms until 15 August (C no 2018/2, article 10).

The master of the fishing vessel shall permit the inspectors to board it and must provide a boarding ladder (ICCAT 17-07 Recommendation, annex 1).

The following points are inspected on the catching vessel: the permit document, the VMS is open position, the ICCAT regional observer, the card of the observer, the sufficient quality video record to estimate the number of bluefin tuna being transferred, the fishing gears, the fishing loogbook, if any electronic Bluefin Catch Document (eBCD) output and if any ITD copy. Then, the inspectors are caried out cross-check on these documents/devices. In case the vessel is actually carrying out fishing operations, it shall stop immediately and inspected once it has finished such operations.

The following points are inspected on the tug vessel: the permit document, the VMS is open position, the ICCAT national observer, the card of the observer, the sufficient quality video record to estimate the number of bluefin tuna being transferred, the fishing loogbook, the first copy of the fishing logbook and the original ITD. Then, the inspectors are caried out cross-check on these documents/devices. The tug vessel will never be stopped. The inspection is carried out when the vessel is transported at approximately one mile.

The following points are inspected on the support vessel: the permit document, the VMS is in the open position and the fishing logbook.

The inspections are performed by verifying ICCAT inspections report, the observer reports, all monitoring systems, the fishing logbooks, the ITD and the permit documents.

The landing or caging, the fishing logbooks, the ITD, bills and/or crosses are carried out cross check.

If a infringement is determined during the inspections, the infringement is registered in the ICCAT inspection reports. The green copy of the inspection reports is given to the captain of the fishing vessel, the white copy remains in the inspector's institution and the yellow copy is sent by the GTHB to the ICCAT Commission at the end of the calendar month in which the catches were made (ICCAT 17-07 Recommendation, 67).

In the event of the detection of an infringement, the legal procedure is also applied according to national legislation. When the illegal, unreported and unregulated or more than the quota of the BFT is caught, the live-BFT are released to the fishing area. The non-lives were seizured and donated to the social aid institutions without being subject to the commercial (C no 4/1, article 21, C no 2018/2, 8-ç).

If no quota has been allocated to the CPC of the fishing vessel or trap concerned or if it has already been consumed, the catching of bluefin tuna as by-catch is not permitted and CPCs shall take the necessary measures to ensure their release. If however such bluefin tuna dies it must be landed, whole and unprocessed, where it shall be subject to confiscation and the appropriate follow-up action. CPCs shall report information on such quantities on an annual basis to the ICCAT Secretariat who shall make it available to SCRS.

In the CCAT 17-07 Recommendation (Part II, 29), Contracting Parties shall take the necessary measures to ensure their release. If however such bluefin tuna dies it must be landed, whole and unprocessed, where it shall be subject to confiscation and the appropriate follow-up action.

The CGC carried out ICCAT inspections with 50, 51, 55, 57, 58, 56 the CGC Ships / Boats and 179, 182, 183, 207, 203, 201 inspectors in 2012, 2013, 2014, 2015, 2016, 2017, respectively. In addition, 16 the CGC aircraft and helicopters were used in 2017. The control/inspections of 64, 58 and 62 catching vessels were carried out in 2015, 2016 and 2017 by the CGC, respectively. The ICCAT inspection reports were sent to the ICCAT Commission under the coordination of the MFAL (CGC Activity Reports, 2012, 2013, 2014, 2015, 2016 & 2017).

Results and Discussion

It was determined that the ICCAT inspections were performed in accordance with ICCAT Recommendation 17-07 in Turkey.

In the direction of ICCAT 17-07 Recommendation, the using of airplanes, helicopters and unmanned aerial vehicles in bluefin tuna fishing and transhipment of non-live BFT at sea are prohibited. The non-live BFT can only be landed from the port that are legally determined.

It was found that BFT were caught in Turkey's 20-120 miles from the southern regions open (Antalya Gulf openings 20-60 miles, Antalya province Gazipaşa district and the region between Cyprus)

When all these are assessed, the use of airplanes and helicopters in ICCAT inspections will be beneficial. ICCAT inspections had already been carried out by the CGC aircrafts and helicopters in 2017.

Given that the using of airplanes, helicopters and unmanned aerial vehicles in bluefin tuna fishing and the transhipment of non-live BFT at sea are prohibited, using of the aircrafts and helicopters within the capabilities of the Contracting Parties will be beneficial in the ICCAT inspections. It may be advisable to include an arrangement in this regard in the ICCAT recommendation.

References

Aquatic Products Law, 1971. http://www.mevzuat.gov.tr/MevzuatMetin/1.5.1380 [Accessed July 2018].

The fishing vessels monitoring system communique (Communiqué No: 2016/18), 2016. http://www.resmigazete.gov.tr/eskiler/2016/05/20160518-8.htm [Accessed July 2018].

Animal Information System, 2018. https://hbs.tarbil.gov.tr/ [Accessed July 2018].

Automatic Identification System (AIS) Communiqué Pertaining to their properties and the Equipping of KLAS-B CS Device to vessels, 2007. http://www.resmigazete.gov.tr/eskiler/2007/09/20070911-2.htm [Accessed July 2018].

Coast Guard Command 2012 administrative activity report, 2012. http://www.turkishcoastguard.eu/orta/2012idare.pdf [Accessed July 2018].

Coast Guard Command 2013 year administrative activity report, 2013. http://www.sahilguvenlik.gov.tr/orta/2013idare.pdf [Accessed July 2018].

Coast Guard Command 2014 year administrative activity report, 2014. http://www.sg.gov.tr/orta/2014idare.pdf [Accessed July 2018].

Coast Guard Command 2015 year administrative activity report, 2015. http://www.sahilguvenlik.gov.tr/orta/2015_%C4%B0dare_Faaliyet_Raporu.pdf [Accessed July 2018].

Coast Guard Command 2016 year activity report, 2016. http://www.sahilguvenlik.gov.tr/2016_FAALIYET_RAPORU.pdf [Accessed July 2018].

Coast Guard Command 2017 year ydministrative activity report, 2017. http://www.sahilguvenlik.gov.tr/2017_%C4%B0dare_faaliyet_raporu.pdf [Accessed July 2018].

Communiqué on the Regulation of Commercial Aquatic Products Fishing Authority No. 4/1 (Communiqué No: 2016/35), 2016. http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=9.5.22750&MevzuatIliski=0&sourceXmlSearch=2016/35 [Accessed July 2018].

Communiqué on the Regulation of Amateur Aquatic Products Fishing Authority No. 4/1 (Communiqué No: 2016/36), 2016. http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=9.5.22751&MevzuatIliski=0&sourceXmlSearch=mat%C3%B6r%20ama%C3%A7l%C4%B1 [Accessed July 2018]. ICCAT, 2018. www.iccat.int [Accessed July 2018].

F. Başaran & O. Özden, 2004. The investigation of the rearing of bluefin tuna (*Thunnus thynnus* L., 1758) on culture conditions. E.U. Journal of Fisheries & Aquatic Sciences, 21 (3-4): 343– 348.

M. Dağtekin, 2009. Tuna fishing and culture in our country (fattening), Yunus Research Bulletin, 9:2. Regulation of Aquaculture Production, 2004. http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.5217&sourceXmlSearch=&MevzuatIliski=0 [Accessed July 2018].

The Ministry of the European Union, 2011. Progress Report on Turkey, https://www.ab.gov.tr [Accessed July 2018].

The application generalization related to determination of the vessels to make Bluefin Tuna fishing and the quota to be given to these vessels (Circular no. 2018/1), 2018. https://www.tarim.gov.tr/BSGM/Duyuru/88/2018-Yili-Mavi-Yuzgecli-Orkinos-Avciligi-Yapacak-Gemilerin-Belirlenmesi-Ve-Bu-Gemilere-Yapilacak-Kota-Tahsisine-Iliskin-Genelge_2018_1_-Yayimlanmistir [Accessed July 2018].

The application generalization related to the Importation, Exportation, Fattening, Transportation, Catching, Applications of the Bluefin Tuna Fishing Vessels. (Circular no. 2018/2), 2018. https://www.tarim.gov.tr/BSGM/Lists/Duyuru/Attachments/94/2018-YILI-UYGULAMA-GENELGESi.pdf [Accessed July 2018].

Tiftikçioğlu, S.E., 2012. Blue Vatan's protective shield is the Coast Guard Command, Coastguard magazine , 16:10-22.

Water Products Regulation, 1995. http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.4988&sourceXmlSearch=&MevzuatIliski=0 [Accessed July 2018].

08-05 BFT Recommendation Amending the Recommendation by ICCAT to Establish a Multiannual Recovery Plan For Bluefin Tuna in the Eastern Atlantic and Mediterranean, 2008. https://www.iccat.int/Documents/Recs/compendiopdf-e/2008-05-e.pdf [Accessed July 2018].

17-07 BFT Recommendation by ICCAT Amending the Recommendation 14-04 on Bluefin Tuna in the Eastern Atlantic and Mediterranean, 2017. https://www.iccat.int/Documents/Recs/compendiopdf-e/2017-07-e.pdf [Accessed July 2018]. 75-02 GEN lCCAT Scheme of Joint international inspection, 1975. https://www.iccat.int/Documents/Recs/compendiopdf-e/1975-02-e.pdf [Accessed July 2018].

Development of Commercial Molecular Diagnostic Kit for Bacterial Fish Pathogens

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Rapid detection of bacterial fish pathogens is crucial for effective disease control in a country like Turkey which has total production capacity of about 240 thousand tons of cultured fish. Conventional microbiological methods are time consuming and lack sensitivities to detect latent pathogens. The application of modern molecular biotechnological methodologies for detection will make a significant impact on the development of such rapid diagnostic approach to aquaculture. In this study, we have used gene based PCR methods to developed rapid diagnostic kit for fast detection of bacterial infection in marine fish. To do this we; 1) isolated *Vibrio spp.*, *Aeromonas spp*. *Pseudomonas spp*. and *Mycobacteria spp.* from marine fish. 2) designed 10 different oligonucleotid primers (*rpoD, whA, Aero, Fst, gyrB, hsp70*) 3) developed multiplex PCR amplification to detection of those target genes 4) designed and constracted a single tube of diagnostic kit for these bacterial infection. At the end of this study, we identified 4 different bacterial species which cause fish diseases with using 10 primers in same PCR tube in very short time. Our designed product showed that a capacity of detection of more than 10 bacterial infection in several hours.

Keywords: Fish diseases, PCR

Introduction

In recent years, aquaculture production in Turkey is developing rapidly with in the addition of the dam, lakes and ponds established in cage systems as well as farms and the number of them has reached to 2377 (TUIK, 2016). Growing the desired level of commercial production and contribute to the country economy are depends on factors such as culture on suitable conditions, prevent, protection and fast detection from diseases.

The most commonly observed diseases in marine fish are furunculosis caused by *A. salmonicida*, vibriosis caused by *Vibrio* spp., *Pseudomonas* infection by *Pseudomonas* spp. and mycobacteriosis *Mycobacateria* spp. (Austin&Austin, 2007; Sudheesh *et.al.*, 2012). These diseasase causes economically devastating losses in cultivated salmonids in fresh and marine waters. It also affects a variety of non-salmonid fish and shows a widespread distribution (Toranzo *et al.*, 1991; Hiney&Oliver, 1999).

Microbiological, biochemical, immunological and histopathological methods were used for identification and determination of the causative agents of fish disease in aquaculture in the past (Toranzo *et.al.*, 1991; Diler, 2000). These time-consuming and highly labor-demanding methods are based on the laboratory transfer of sample and microbial cultivation of bacteria for several weeks and then biochemical tests and the phenotypic diagnosis (Austin&Austin 2007; Hidalgo *et.al*., 2010).

Rapid isolation, identification and detection of causative pathogens through sensitive and strain specific methods are required and essential for controling bacterial diseases in aquaculture. The amplification of molecular genetic techiques can now use to detect disease agents in suspected fish samples. These alternative molecular approaches such as PCR, based on virulence genes or 16SrDNA genes are used for identification of fish pathogens (Altınok *et.al*., 2008; Rajabzadeh *et.al*., 2017).

In this study we focused on four bacteria of great concern for marine fish aquaculture in Turkey. Previous studies applying traditional single-PCR for the detection of these bacteria have been described (Del Cerro *et.al*., 2002; Mata *et al*., 2004). However, this is the first time that a multiplex PCR method was developed to detect these four bacteria simultaneous diagnosis of multiple bacteria that cause disease in marine fish.

Material and Methods

Reference Bacteria Culture Conditions. The bacteria used in this work as positive controls were *A. salmonicida* ATCC 33658 (22 to 25°C/24 to 48 h), were cultured on tryptone yeast extract agar (BBL, USA), *M. marinum* ATCC 927 (22 to 25°C/5 to 10 days) were cultivated on Middlebrook 7H11 medium (BBL, USA), *V. anguillarum* and *P. anguilliseptica* from our isolates were incubated at 22-25 ^{o}C for 2-4 days in trypticase soy broth (BBL, USA) (Austin&Austin, 2007).

DNA Extraction from Bacteria. All tested bacteria were grown suitable broth at optimum conditions. Cells from overnight cultures were washed and resuspended in 10 mM Tris-HCl buffer (pH 8.0) containing 0.1 mM EDTA (Amplichem, Germany). Chromosomal DNAs of bacteria were performed by using Qiagen miniprep DNA extraction kit based on manufacturer's instruction (Qiagen, USA).

Primers. The primers sets used in this work were designated according to the references presented in Table 1. Primers for PCR were synthesized by Metabion (Germany).

Table 1. Primer List for PCR Amplification

Bacteria Name	Primers	Primer Sequences (5'-3')	Size (bp)
Aeromonas salmonicida	Aero F	AGCGGCAGAGCCCGTCTATCCA	424
	AeroR	AGTTGGTGGCGGTGTCGTAGCG	
A.salmonicida	FstA F	CGCTCGCCCATCCCCCTCTG	452
	FstA F	GCCCCTTGCACCCCCACCATT	
Vibrio anguillarum	WhyA F	CCGCGGTACAGGTTGGCGC	519
	WhyAR	CGCCACCCACTTTCGGGCC	
Pseudomonas spp.	gyrB F	GCTGTCCGAAGAACTGGTACTGAC	200
	gyrB R	ATTCTTGAAGGTGTCAGCCGATGG	
Pseudomonas anguilliseptica	rpoD F	GGCTGACGACGCCGAGGA	450
	rpoD R	GGATGATATCCGGCTGAACACG	
Mycobacterium marinum	hsp70 F	CGAAGACTCAATGGCTGATCTT	581
	hsp70 R	TTGCTCAATTTTGCATCACGTAA	

Multiplex PCR Amplification. Multiplex PCR mixtures (50 µl volume) each contained 50 to 100 ng of purified genomic DNA, 200 µM each deoxynucleoside triphosphate (fermantas, Germany), 400 nM each primer (Metabion, Germany), 2.5 mM $MgCl_2$, 1x reaction buffer, and 2U of Taq polymerase (Thermo, USA). Thermal cycling was performed with a Teche (Germany) and included an initial incubation at 95°C for 3min followed by 30 amplification cycles. Cycling included denaturation for 30 s at 95°C followed by annealing for 1 min at 52, 54, 56, 58, 60, or 62°C. Extension was for 45 s at 72°C, and cycling was concluded with a final elongation for 5 min at 72°C. All multiplex products were checked by electrophoresis on 1% agarose (Thermo, Germany) gels and stained with 0.5 μgml^{-1} ethidium bromide (Amplichm-em, Germany).

Results

In this research, six pairs of oligonucleotide primers were designed to simultaneously detect four different types of marine fish pathogens by m-PCR in a single tube. They are targeted at a species-specific region of the *A. salmonicida* Aero and FstA gene, *M. marinum* hsp70 gene, *V. anguillarum* WhyA gene and *P. anguilliseptica* rpoD gene. The genomic DNAs of the four bacterial pathogens were mixed to see whether single or multiple species of pathogen were effectively amplified. The results demonstrated that all combinations of the pathogenic DNA could be detected successfully (Fig.1.)

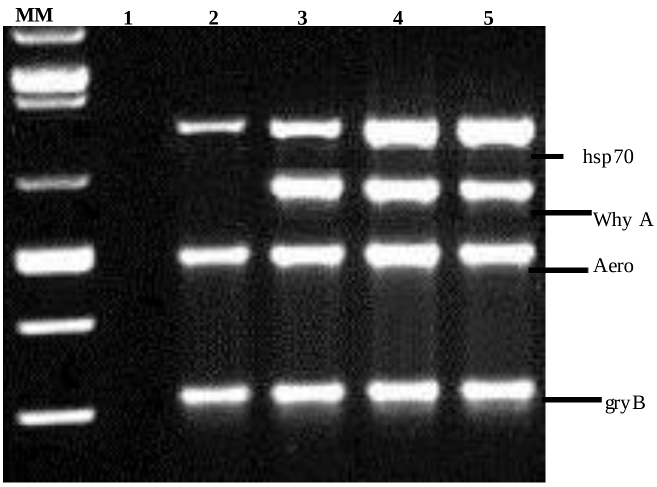

Figure 1. Detection of *A. salmonicida, M. marinum, V. anguillarum* and *P. anguilliseptica* by mPCR. Molecular Marker, 1. Negative control, 2, 3, 4, 5. mPCR amplicons.

Discussion

The early detection of aquatic pathogens is essential for disease management and fish welfare in aquaculture worldwide (Kong *et.al.* 2002. The detection of multiple pathogens in a single test tube in routine diseases monitoring procedures in aquaculture facilities constitutes a step further in the development of techniques for rapid, specific, cost reduced and effective diagnosis. (Del Cerro *et.al*., 2002; Mata *et.al*., 2004; Balcázar *et.al*., 2007).

The remaining six sets of specific primers, which are directed at the Aero, FstA, WhyA, gyrB, hsp70, rpoD virulence genes yielded amplimers of 424, 452, 520, 200, 450, 581 bp in bacterial strains belonging to *Aeromonas salmonicida*, *Vibrio anguillarum*, *Pseudomonas anguilliseptica* and *Mycobacterium marinum* respectively. These results were supported by Izumi&Suzuki (2018), Gonzalez *et.al.* (2004), Sanjuan&Amora (2007) and Tsai *et.al.* (2012).

In this reseacrh, a multiplex PCR method that amplified specific target genes for each bacterium has been developed for *A. salmonicida*, *M. marinum*, *V. anguillarum* and *P. anguilliseptica* in a single reaction in 3 to 4 hours. Our research results showed that the mPCR developed in this study could overcome some difficulties in tradiotional methods such as low densities and slow growth and time, and increase the sensitivity of the multiple detection. There results would be the first and preliminary results for devoloipng high throughput and sensitive diagnostic kits of aquacultural diseases in the marine environment in future.

References

Altinok, I., Capkin, E., Kayis, S. 2008. Development of multiplex PCR assay for simultaneous detection of five bacterial fish pathogens. Veterinary microbiology, 131(3-4):332-338.

Austin, B. & Austin, D.A. 2007. Bacterial fish pathohens: Diseases of farm and wild fishes. Springer publishing U.K.

Del Cerro, A., Marquez, I., Guıjarro, J.A., 2002. Simultaneous detection of *A. salmonicida*, *F. psychrophilum* and *Y. ruckeri*, three major fish pathogens, by multiplex PCR, Appl. Env.. Microbiol. 68:5177-5180.

Diler, Ö. Altun, S., Çalıkuşu, F., Diler, A., 2000. Gökkuşağı Alabalığı (*Oncorhynchus mykiss*)'nin Yaşadığı Ortam ile İlişkili Kalitatif ve Kantitatif Bakteriyel Florası Üzerine Bir Araştırma, Turk J. Vet. Anim. Sci., 24:251–259.

Gonza´lez, S. F., Krug, M. J., Nielsen, M. E., Santos, Y., Call, D. R. 2004. Simultaneous Detection of Marine Fish Pathogens by Using Multiplex PCR and a DNA Microarray. J. Cli. Mic, 42:1414-419.

Hidalgo, R., Alperi, A.A., Bujan, N., Romalde, L.J., Figueras, M.A., 2010. Comparison of phenotypical and genetic identification of Aeromonas strains isolated from diseased fish, Sys. App. Mic. 3**3:**149-153.

Hiney M. & Oliver G. 1999. Chapter 10. Furunculosis (Aeromonas salmonicida). In: Fish Diseases and Disorders. Vol 3. Viral, Bacterial and Fungal Infections (ed. by P.T.K. Woo & D.W. Bruno),.341-425. CABI Publishing, New York.

Izumi, S.&Suzuki, K., 2018. Simultaneous Detection of *Flavobacterium psychrophilum, Pseudomonas plecoglossicida*, and *Vibrio anguillarum* by a Multiplex PCR Targeting the gyrB Region,TJFAS, 18:417-423.

Kong, R. Y. C., Lee, S. K. Y., Law, T. W. F., Law, S. H. W., Wu, R. S. S. 2002. Rapid detection of six types of bacterial pathogens in marine waters by multiplex PCR. Water Research, 36(11):2802-2812.

Mata, A. I., Blanco, M.M., Domínguez, L., Fernández-Garayzábal , J.F., 2004. Development of a PCR assay for **S.iniae** based on the lactate oxidase (***lctO***) gene with potential diagnostic value. Vet. Micro.101 (2): 109-116.

Rajabzadeh, N., Naeemipour, M., Seyedabadi, M. (2017). Multiplex PCR assay for the simultaneous detection of bacterial pathogens in rainbow trout. *Aquaculture International*, *25*(4), 1569-1575.

Sanjuan, E.&Amora, C., 2007. Multiplex PCR Assay for Detection of *Vibrio vulnificus* Biotype 2 and Simultaneous Discrimination of Serovar E Strains , App. Envıro.Mıcr.o, 73:. 2029–2032

Sudheesh, P. S., Al-Ghabshi, A., Al-Mazrooei, N., Al-Habsi, S. 2012. Comparative pathogenomics of bacteria causing infectious diseases in fish. Inter. J. of Evolut. Biol., 2012:1-16.

Toranzo A.E., Casal J.F., Barreiro, S., Figueras A., Batja J.L., 1991. Pasteurellosis in cultured gilthead seabream (***S. aurata***): first report in Spain. Aquaculture, 99:1-15.

Tsai, M.A., Ho, P.Y., Wang, P.C.,Chen, S.C., 2012. Development of a multiplex polymerase chain reaction to detect five common Gram-negative bacteria of aquatic animals,J. Fish Diseas.35:489-495.

TUİK, 2016. Türkiye İstatistik Kurumu http://www.tuik.gov.tr. Alıntı tarihi: 2017

Immune Status and Growth Response of Nile Tilapia, *Oreochromis niloticus* towards Oxytetracycline Supplemented Feed

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Among many antibiotics used in the field of aquaculture, oxytetracycline is extensively supplemented in feed with the aim of diseases prevention and growth promotion. The current experiment was therefore designed to evaluate the effectiveness of two levels of oxytetracycline i.e. 100 and 200 mg/ Kg of feed supplementation on growth and immune status of Nile tilapia (*Oreochromis niloticus*). Twenty fish per aquaria were randomly divided into three experimental treatments as control T_0 (without oxytetracycline), T_1 and T_2 with 100 and 200 mg oxytetracycline/ Kg of feed respectively. The experiment was designed in completely randomized design along with three replicates. The experimental feed having 35% crude protein and selected levels of antibiotic was used at the rate of 7% of body weight given twice a day. Parameters of development/ growth for example total weight (g) and total length of body (cm) were noted down every week. Immune response in terms of different hematological parameters such as RBCs (10^6/µL), WBCs (10^3/µL), Platelets, Hematocrit (%), Hb (g/dL), MCV (fl), MCH (pg), MCHC (g/dL) of the sampled fish of each treatment were evaluated at the end of experiment. Different physico-chemical parameters of water like pH, DO and temperature ^oC (mg/L) were also monitored every week. The response towards growth remained significant between the values of weight gain (g) for T_0, $T_1$and T_2 at the end of experiment. Total weight gain's (g) mean average values in T_2 was 1.96±0.02g followed by T_1 1.64±0.03g and T_0 0.83±0.06g. The deviation among length gain (cm) of treatments was also significant in T_0, $T_1$and T_2. Total length gain's (cm) mean average value in T_0 at the end of trial was 0.22±0.02cm in T_1 and T_2 was 0.36±0.01cm and 0.57±0.02cm respectively. The results of immune response after blood analysis at the end of trial revealed that the concentration of RBCs (10^6/µL) in T_0 was 0.11±0.01 (10^6/µL) while concentration was higher in T_1 0.79±0.01 (10^6/µL) and T_2 0.36±0.02 (10^6/µL). The WBCs (10^3/µL) concentration in T_0 was 9.14±0.02 (10^3/µL) while increased in T_1 42.85±0.20 (10^3/µL) but decreased in T_2 18.23±0.25 (10^3/µL). Platelets concentration was increased in T_1 845±2.89 and T_2 279±1.73 as compared to T_0 90±0.85, Hematocrit (%) concentration also increased in T_1 3.39±0.34% and T_2 4.09±0.06% as compared to T_0 0.91±0.01%. Hemoglobin (g/dL) counts decreased in T_1 9±0.03 (g/dL), and T_2 4±0.29 (g/dL) as compared to T_0 12.50±0.20 (g/dL). MCV (fl) decreased in T_1 43.03±0.55 (fl), as compared to T_0 86±0.58 (fl) and $T_2$115±1.73 (fl). MCH (pg) count increased in T_0 24.50±1.26 (pg), but decreased in T_1 23.05±0.04 (pg) followed by T_2 22.90±0.63 (pg). MCHC (g/dL) concentration increased in T_1 46±2.31 (g/dL) and T_2 44.83±1.42 (g/dL) as compared to control T_0 33.17±1.01 (g/dL). By the results of experiment it is evident that inclusion of oxytetracyclin in feed showed a significant and positive effect on growth and immune response in Nile tilapia. Although the highest growth is shown in T_2 (200 mg oxytetracyclin/ Kg of feed) but better immune parameters along with good growth was exhibited by T_1 (100 mg oxytetracyclin/ Kg of feed).

Keywords: antibiotics, immune status, *Oreochromis niloticus*, Nile tilapia

Changes of waterbirds communities structure as response of habitat modification in an arid region of Algeria (Lac Boughezoul)

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Our study aims to assess the effect of habitat degradation on the of waterbird communites, we studied the changes of structure and composition of bird populations over a 40–year period (1972–2012) in an Important Bird Area (IBA) (Lac Boughezoul-Algeria). The statistical analyses of the avifauna biodiversity and its status reported by former studies comparatively with our monitoring carried out in the same region during the period 2009 to 2012 by using non-parametric tests shows a significant change in bird communities in response to temporal habitat variation. These changes have affected waterbirds differentially with some species increasing and decreasing in numbers 8.4 and 14 % respectively, and others species have disappeared at the site 33 % (with a net loss of 24 species) many of them 6 breeding species. However, the phenological status of many species has been changed (26.7 %).Observation and analyze the spatial evolution of natural habitats shows important modifications affected their qualities In fact, several causes of degradation were assesed such as: agricultural expansion, overgrazing, waste water disposal in the wetland and the work of planning in the context of the implementation of the new city of Boughzoul (new capital of Algeria). As perspective, it is urgent to understand the impacts of anthropogenic disturbance on the quality of habitats and the biodiversity of wetlands in Algeria and especially in arid regions which are highly sensitive.

Keywords: Wetland, Diversity, Habitat, Changes, Lac Boughzoul, Algeria.

Introduction

Change in species distribution and population dynamics is one of important problematic interesting ecologists and land managers last time (Parmesan and Yohe,2003; Parmesan,2006).

Climate change, exacerbated by anthropogenic pressures have substantial effects on species and communities (IPCC, 2007). Climate change and destruction of natural habitats and are considered greatest threats to terrestrial biodiversity (Parmesan, 2003).

The aim of this paper is to describe and discuss long–term changes in species richness in a natural Mediterranean lac located in arid climate, to derive information of conservation interest.

Birds are considered good indicator of environmental quality and are frequently being used to monitor environmental and ecosystem change. Numerous ecological aspects of waterbirds make them useful as bioindicators. Birds have a high sensitivity to environmental changes over many spatial scales (Carignan & Villard, 2002). While, the birdfauna of North Africa, particularly of Algeria is relatively well known, there are still substantial gaps in knowledge concerning the status and distribution of many species in majority of wetlands (Samraoui and Samraoui, 2008) especially those affected by high anthropogenic pressures.

One of the aims of monitoring is to provide information for ecological assessment, which can provide early warning of changes that could negatively affect species or ecosystems (Burger 2006), and to evaluate a long terms changes of waterbird communities structure and diversity in one of important wetlands of Algeria (Lac Boughzoul).

The present study aimed also to assess the changes of diversity, phenology and status of waterbirds in continental Lac affected by heavy anthropogenic pressures caused many habitat modifaction last decades.

Material and Methods

Study area

The Central Hauts Plateaux located in the North of Algeria, in an area consisting of mountains, valleys and plateaus between the Mediterranean Sea and the Sahara Desert. The Central Hauts Plateaux contain more than ten wetlands, all in the three northern wilayas (provinces) of Algeria: M'sila, Djelfa and Media. Lac Boughzoul (35 ° 37.191'N 02 ° 52.604'E) is located at 175 km south of Algiers. It is located at 01 km north of the city of Boughzoul. This site is surrounded by several important wetlands such as: Chott Zehrez Gherbi, to the east; Zehrez Echergui (Fig.1).

This region is dominated by a semi-arid climate with cold winters and an average annual precipitation of between 200 and 400mm. The lake is a standing body of water, which leaves the wadi Chelif, the site was surrounded by a number of temporary water body are Daiet Kerfa El El El Kahla and Kisria. The latter two sites have remblaie during development works within the framework of the new city of Boughzoul.The site is bordered by halophytic vegetation consists mainly of Chenopodiaceae such *Atriplex halimus, Sueda fruticosa, Salsola fruticosa Salicornia fruticosa*.

Methodology

To determine the changes in the status and composition of waterbirds population at Lac Boughzoul between the period (1975-1981 and 2009-2012), we used data collected from these scientific work previous (Jacob & Jacob, 1980; Ledant *et al* .,1981; Francois, 1975) then compared to those we have gathered during our monitoring carried out during the period from September 2009 until August of 2012. Monitoring of birds was carried by direct observation through a telescope (Optolyth 20x80) and a pair of binoculars with a team of 2 to 3 observers from observation points around wetlands. These surveys were carried out bimonthly basis, from September 2009 to August of 2012. We conducted individual counts of waterbirds if the group had fewer than 200 individuals and was at a distance not exceeding 200 m. Otherwise, if the waterbird group was away and had more staff, we proceed to visual estimates (Blondel, 1975).

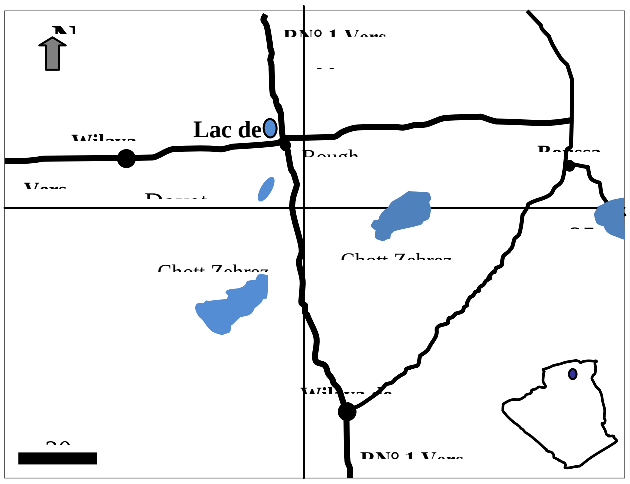

Figure 1. Map of the study area location (Lac Boughezoul)

Results

A total of 52 waterbird species represent 16 bird families, were recorded in monitoring undertaken during the period from September 2009 until August of 2012 (Fig. 2). The species richness was varied from season to other, where the winter period is the highest richness season. Scolopacidae family was the best represented with 11 species, followed by Anatidae with 10 species, then by Ardeidae with 6 species. Charadriidae, Sternidae and Laridae were represented by 4, 4 and 3 species respectively. However other families were low represented (Fig. 2).

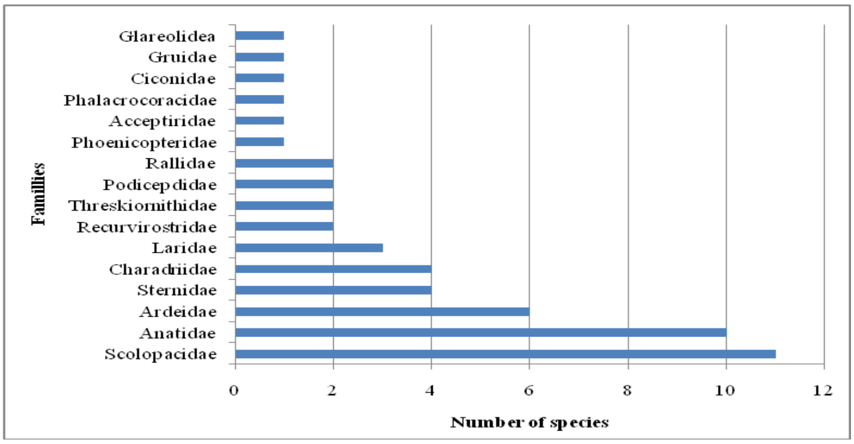

Figure 2. Distribution of families following their waterbird species richness (2009-2012)

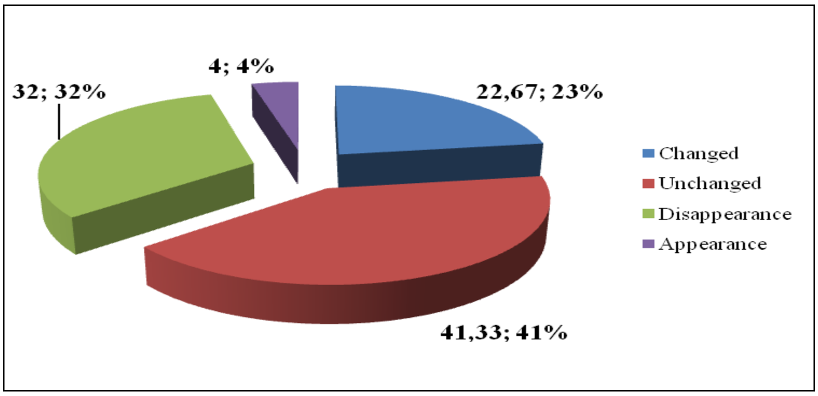

Figure 3. Proportion of status modification of waterbird species between 1975-1981 and 2009-2012

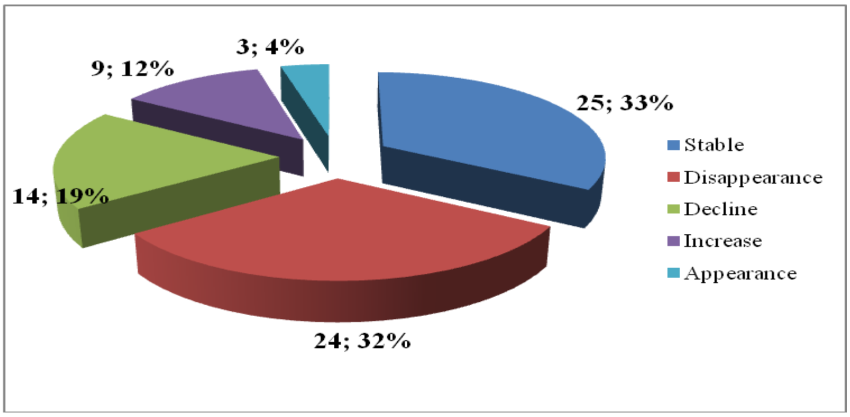

Figure 4. Variation of waterbird species numbers between 1975-1981 and 2009-2012.

Through comparison of the former data collected between 1975 and 1981 and our study undertaken between 2009-2012, a number of changes were identified that affected the specific richness,

phenological status, abundance, as well as appearance and disappearance of many species in the study site. Although, the specific richness was declained from 72 species in the former studies to 52 species in our study. However, an important renewal rate was estimated around 36 % whose 32 % of species were disappeared with a net loss of 24 species and a gain of 4 species over 30 years (Fig.3).
These modification were significantly affected many species of different phonological status (χ^2 = 10.05, P <0,05) over two periods. Many species had a stable status (41%), while 23% of species were changed their status.

A total of 20 migrant passage species (Purple Heron *Ardea purpurea*, Garganey *Anas querquedula,* Tufted Duck *Aythia fuligula,* Sanderling *Calidris alba*) and 04 resident breeder species are locally extincted including (Black-necked Grebe *Podiceps nigricollis*, Western Swamphen *Porphyrio porphyrio*, Little Tern *Sterna albifrons*), whereas 7 winter migrant species are appeared such as: Great Egret, Glossy Ibis, Yellow-legged Gull*).*

Our results showed that the phenological status of many species has been changed such as (Gadwall Anas strepera, Common Shelduck, Little Grebe, Ruddy Shelduck, Black-headed Gull) and moved from winter migrant to resident breeder species. However, other species important for conservation have been disappeared at the site (Black-Necked Grebe, Common Pochard). In contrast, other species have kept the same status with declining or increasing in numbers (Black-Tailed Godwit, Avocet).From point of view numbers trend, a total of 25 species were stable 33%, while 14 species (19%) their abundances were declined. Otherwise, 09 species increased their numbers (Fig.4). (Gadwall Anas strepera, Shelduck Tadorna tadorna) as response to the habitat modification and degradation. In addition, many other species have disappeared at the site (Black-necked Grebe Podiceps nigrocollis, Common Pochard Aythya ferina). However, other species have retained the same status with a decreasing or increasing in the abundance (Black-tailed Godwit, Avocet).

Discussion

By its strategic situation in the center of the country, Lac Boughzoul, plays a key role as wintering ground, stopover post and breeding area of many waterbirds (Jacob and Jacob, 1980; Ledant, et al .,1981 and Francois, 1975). Birds are popular subjects for research and monitoring, and Waterbirds do not merely respond to environmental change, they can also be the cause of change as their populations increase (Amat & Green, 2000). Operationally, species richness is frequently selected as a variable reflecting system state, and is often used in investigations of the effects of human development and disturbance on biodiversity (Conroy & Noon, 1996). In all, 52 of the 99 species of waterbirds reported by Samraoui *et al.*, (2009). Estimation of rates of change in biodiversity and investigation of factors responsible for change have been identified as important ecological research topics. The analyses of the avifauna biodiversity and their status reported by former studies (1975-1981) and our monitoring carried out in the same region showed an important decrease in the species diversity and changes of numbers and phenological status of several species.While, available literatures reported a substantial changes in the status of waterbirds of Algeria have occurred over the last 180years Samraoui *et al.*, (2011).

Local factors (i.e. habitat loss, competitive or predatory exclusion) are known to reduce diversity, either by removing species or preventing the invasion of new species (Martínez–Abraín, 2005). In addition, it is expected that some breeding and migrant species will be lost as a result of climate change. Overall in the Mediterranean region, population dynamics and distribution patterns of many species have been shaped more by human activities. Martínez–Abraín, 2005). However, human disturbance is an important component to understand patterns of species diversity, especially in the Mediterranean basin (Blondel & Aronson, 1999).

The study area is composed of different habitats by their characteristics are preferred by some fauna and flora. The analysis of habitat heterogeneity basing on description of previews studies and actual situation display a reel transformation of natural habitats particularly halophyte vegetation lands, that constitutes the loss on the spot of a vegetation considered by (Ozenda, 2004) very rare in Africa such as *Atriplex halimus, suaeda fruticosa, salsola siebere, halocnemum strobilaceum* and replaced by olive trees and natural grasslands by farming lands of cereals. Is the same situation in our study where bird species diversity decreased in correlation with the amount of woody vegetation in natural habitats, the scarcity of woody species reduces bird species richness (Oindo *et al.,* 2000)

Although, plannig works undertaken during the project to create the new city were affected directly the species richness and phenology structure of waterbirds of this wetland throughout habitat fragmentation and modification as well as : water depth raising, water surface reduce, road construction, sound disturbance by and site drying for irrigation. Comparatively to the vegetation structure described by (Jacob & Jacob, 1980; Francois, 1975) of this Lac, a great modification were carried out by moving to the woody plants used as breeding support of many species. Specific studies of response to changes of local environmental conditions have found a good relationship between patterns of changes in environmental conditions and change in phenology (Dunn & Winkler, 1999). This modification was led to disappear and appear of species adopted on these new habitat characteristics.

These disappeared habitats were the ideal refuge of breeding species and migrant passage species, which may justify the extinction of many species known breeder previously and use this site as halt during their trans-Saharan journey. Some exotic and opportunistic species were appeared in the site (Western Cattle, Yellow-legged Gull). McKinney (2006) confirmed that many exotic species establish in highly modified habitats.

References

Amat, J.A.,& Green, A.J., 2005. Waterbirds as Bioindicators of Environmental Conditions. Conservation Monitoring in Freshwater Habitats: C. Hurford et al. (eds.).

Blondel, J., 1975. Analyse des peuplements d'oiseaux d'eau. Élément d'un diagnostic écologique.I:La méthode des échantillonnages fréquentiels progressifs (E.F.P.). Terre Vie,29, 533-589.

Blondel, J. & Aronson, J., 1999. Biology and wildlife of the Mediterranean region. Oxford Univ. Press,Oxford

Burger, J.2006. Bioindicators: Types, development, and use in ecological assessment and research. Environ Bioindicators 1:22–39

Carignan, V. & Villard, M.A., 2002. Selecting indicator species to monitor ecological integrity: a review. Environmental Monitoring and Assessment,78:45-61.

Conroy, M. J. & Noon. B. R., 1996. Mapping of species richness for conservation of biological diversity: conceptual and methodological issues. Ecological Applications 6: 763–773.

Dunn, P. O. & Winkler, D.W., 1999. Climate change has affected the breeding date of tree swallows throughout North America. Proceedings of the Royal Society of London. Series B: Biological Sciences.

François,J.1975. Contribution à la connaissance de l'avifaune d'Afrique du Nord. Alauda 43: 279-293.

IPCC2007. Climate change 2007. Synthesis report. Intergovernmental Panel on Climate Change. Geneva: IPCC.

Isenmann, P. & Moali, A. 2000. Birds of Algéria. Paris: Société d'Etudes Ornithologiques de France.

Jacob, J.P. & Jacob, A.1980. Nouvelles données sur l'avifaune du lac de Boughzoul (Algérie). Aves 16: 59–82.

Ledant,J.P., Jacob,J.P., Jacobs,P., Malher,F., Ochando,B., & Roche, J., 1981.Mise à jour de l'avifaune algérienne. Gerfaut, 71: 295-398.

Martínez–Abraín, A., Oro, D., Belenguer, R., Ferrís, V. & Velasco, V., 2005. Long–term changes of species richness in a breeding bird community of a small Mediterranean archipelago. Animal Biodiversity and Conservation, 28.2: 131–136.

McKinney, M. L., 2006 Urbanization as a major cause of biotic homogenization. Biol. Conserv. 127, 247–260.

Oindo O. Boniface., Andrew,K., Skidmore & Rolf A.de BY., 2000. Interannual variability of NDVI and species richness in kenya. International Archives of Photogrammetry and Remote Sensing. Vol. XXXIII, Part B7. Amsterdam

Parmesan, C., & Yohe, G., 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421: 37-42

Parmesan, C. 2006. Ecological and evolutionary responses to recent climate change. Annual Review of Ecology, Evolution and Systematics, 37:637-669.

Samraoui, F., Alfarhan,A. H., AL-Rasheid, K.A.S. & Samraoui, B.2011. An appraisal of the status and distribution of water birds of Algeria: indicators of global changes? Ardeola 58 (1), 137-163

Samraoui,B. & Samraoui, F. 2008. An ornithological survey of Algerian wetlands: Important Bird Areas, Ramsar sites and threatened species.Wildfowl,58:71-96.

Temple, S.A. & Wiens, J.A., 1989. Bird populations and environmental changes: can birds be bio-indicators? American Birds, 43:260-270.

Macrophytes in the Red Data Books of Black sea states and criteria for their conservation

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In total, 347 macrophytes species are known for the Black Sea, among them, 60 species are included in the Red Data Books of Black sea states and the Red Data Book of the Black Sea, and 53 species are listed in the Red List of Romania. Despite a significant number of protected species, among them there are many typical and opportunistic species, with a short life cycle, and epiphytes. The inclusion of macrophyte species occurs mainly without accounting for IUCN and MSFD criteria, they are differ significantly in Black sea states, and only 4 species are common for them. In this case, it is extremely difficult to develop effective measures to protect macrophytes and their habitats, especially those listed as Critically Endangered (CR) or Endangered (EN). Therefore, a scale of unified qualitative and quantitative characteristics of macrophyte species on the basis an IUCN criteria for their inclusion in Red Data Books of the Black sea states was proposed. This scale includes two types of characteristics that reflect the biological features of the species, namely its sensitive or tolerance to the environment conditions, and the habitat properties. The protocol for the application of this scale can be created by experts of the Black sea states with the support of the Commission on the Protection of the Black Sea Against Pollution.

Keywords: criteria, IUCN, macrophytes, Red Book, Black Sea

Rebuilding of European hake stock in the Sea of Marmara

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European hake (*Merluccius merluccius*, (Linnaeus, 1758)) is one of the most important demersal fish species in the Sea of Marmara. According to national catch statistics, decreasing started in mid-2000s while its catch was over 10 thousand tonnes and drastically deteriorated below 100 tonnes in recent years. Stock assessment estimations performed by CMSY analysis, its stock is outside of safe biological limits between the years 2000 and 2015. Current biomass estimation over maximum sustainable biomass is below the threshold level of 1 and after 2003 the values are estimated below the critical point of 0.5. Fishing pressure estimation is over 1.5 between the years 2000 and 2012 which implies the over-fishing. After 2012, fishing pressure was below 0.5; however, it has been considered that its stock is severely declined in the Sea of Marmara. Within this study, several case scenarios with different fishing pressure values were analyzed. In order to rebuild hake stock fishing pressure must be lowered 50% percent. By those prevention, hake can reach "healthy stock" status again within 15 years from now on.

Keywords: *Merluccius merluccius*, fishing pressure, rebuilding.

Varna Bay: Environmental Focus on Urban Coastal Area

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The global population continues to increase, industries to grow and urban areas to expand. With increasing concentration of population in urban coastal areas, authorities and urban planners are faced with the very real challenge of navigating "new normal", balancing the needs of growing urban populations with increasing pressures on coastal waters and the impacts of climate change. A challenge for basin organizations, urban authorities, and water resource managers is to explore viable pathways for the sustainable economic, social and environmental development of urban coastal areas that have played an essential role in the development of humanity. With concern for water environment and responding to these key challenges in terms of science, hydrological and hydrochemical research on resort urban coastal area of the Varna Bay was fulfilled. There needs to be more emphasis on integrated urban water management in the coastal areas to achieve better solutions into the future, driving sustainability and promoting development well beyond the water sector. The resilient city has to balance the capacity of the environment against the growing needs of a growing population. Improving water management to cope with both an ever-increasing urban population in the coastal area and the impacts of climate change can deliver multiple benefits.

Keywords: water environment, Black Sea, Varna Bay, Varna, urban coastal area, Bulgaria

Introduction

The pressures of rapid urbanisation and climate change are driving water to the top of the global agenda (Dineva & McKay, 2012; Beck & Walker, 2013a; Beck & Walker, 2013b; IPCC, 2014; Thompson & Beck, 2014; Dineva & McKay, 2016). Because of increasing impacts by multiple users, cities themselves, and the industry on the water environment, there is a need to focus on water solutions that address these challenges to achieve sustainability for urban coastal areas and the cities that connect to them.

The international community has recognized the important links between natural water environment, human health and well-being, particularly as human populations expand and place ever greater pressures on the natural water environment. Ongoing monitoring of the water environment in the urban coastal areas is a necessary activity at all governing levels: local, national, and international.

With concern for water environment and responding to these key challenges in terms of science, hydrological and hydrochemical study on resort urban coastal area of the Varna Bay (First jetty) was carried out during 2016-2017.

Recent water environment research in the Varna region of the Black Sea during 2012-2015 was reflected on some publications (Dineva, 2013a; Dineva, 2014; Dineva, 2015; and Dineva, 2017).

Effective protection of urban coastal water resources is necessary so as to ensure sustainable development of economy and society based on the sustainable use of the water resources.

Material and Methods

Fig. 1 reflects a location where hydrological and hydrochemical research in resort urban coastal area of the Varna Bay was fulfilled in 2016-2017.

As the area is shallow, samples were taken from the surface water.

Measurements of temperature, salinity, dissolved oxygen, and oxygen saturation were done by Multi-meter (Oakton, 2010).

A. B. C.

Figure 1. (A) Black Sea. (B) First jetty in the Varna Bay and nearby urban area of Varna. (C) Sampling area – closed to First jetty.

Concentrations of nitrite nitrogen, nitrate nitrogen, phosphate phosphorus, and chemical oxygen demand (COD)-Mn were established by unified methods for marine waters.

Nutrient concentrations were determined by HITACHI UV / Vis Spectrophotometer.

Results

The below displayed Figures give an understanding of important hydrological and hydrochemical properties that drive ecosystem functioning and the result of interplay between physical, chemical and biological processes.

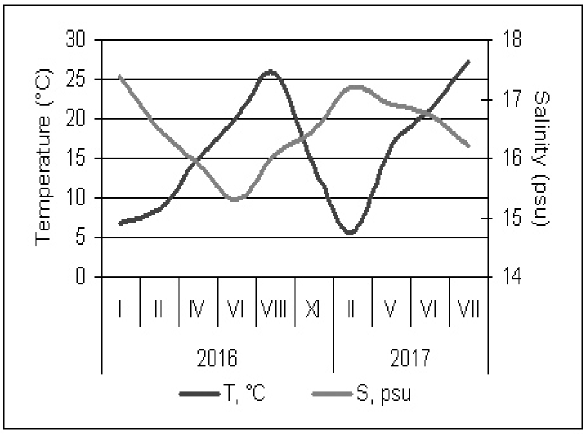

Figure 2. Temperature (°C) and salinity (psu) in the urban coastal area of the Varna Bay in 2016-2017.

Water temperature fluctuates naturally seasonally. Fig. 2 allows us to reflect on the temperature conditions. Sea surface temperature (SST) has varied from 5.70 °C to 27.30 °C during the study in 2016-2017.

The discharge of freshwater from coastal sources drives an important coastal dynamic of salinity. Sea surface salinity (SSS) variability (Fig. 2) has indicated a range of 15.29 psu – 17.39 psu.

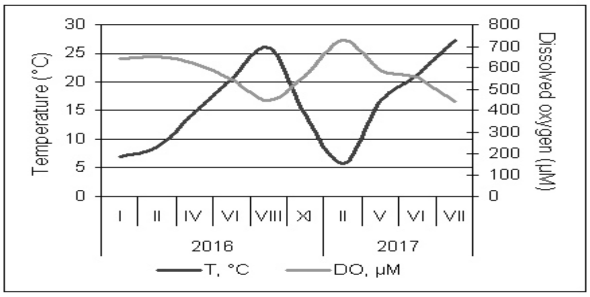

Figure 3. Dissolved oxygen (µM) and temperature (°C) in the urban coastal area of the Varna Bay in 2016-2017.

Oxygen that is dissolved in the water column is one of the most important components of seawater. Dissolved oxygen (DO) concentration (Fig. 3) was from 441.09 µM to 729.50 µM.

The monthly dynamics of oxygen saturation (Fig. 4) has characterised by fluctuations from 91.19% to 105.44 %.

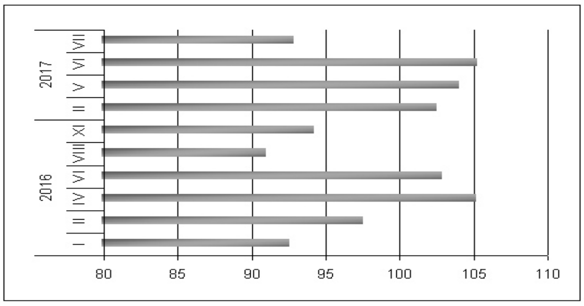

Figure 4. Oxygen saturation (%) in the urban coastal area of the Varna Bay in 2016-2017.

Nutrients are elements essential to life. The major nutrients, required for metabolism and growth of organisms. Phosphorus and nitrogen are considered to be the primary drivers of eutrophication of water ecosystems, where increased nutrient concentrations lead to increased primary productivity. In 2016-2017, nitrite nitrogen concentration was 0.02 µM – 0.06 µM, nitrate nitrogen has varied from 1.32 µM to 3.75 µM, and phosphate phosphorus – from 0.29 µM to 1.93 µM (Fig. 5) in the investigated area.

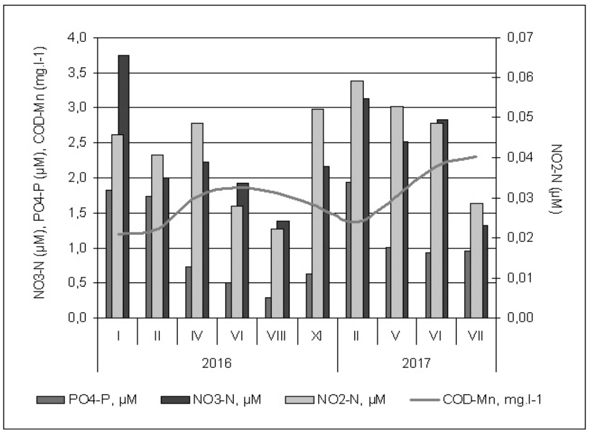

Figure 5. Nitrite nitrogen (µM), nitrate nitrogen (µM), phosphate phosphorus (µM), and chemical oxygen demand (COD)-Mn (mg.l^{-1}) in the urban coastal area of the Varna Bay in 2016-2017.

Chemical oxygen demand (COD)-Mn has fluctuated between seasons (Fig. 5), with a range from 1.19 mg.l^{-1} to 2.30 mg.l^{-1}.

Discussion

With two thirds of the world's population expected to be concentrated in urban areas in 2030, water environment is challenged more and more by climate change, urbanization, population growth, life style changes, etc.

Temperature affects the speed of chemical reactions, the rate at which algae and aquatic plants photosynthesize, the metabolic rate of other organisms. Also, temperature is important because it can cause mortality and it can influence the solubility of DO and other materials in seawater. Temperature fluctuation in the urban coastal area of the Varna Bay was bigger with 2.6 °C in 2017 than in 2016. During the study, SST minimum was in February 2017 and SST maximum - in July 2017. A comparison with investigations in this area during the 1990s (Dineva, 2013b) reveals that 2017 SST minimum was with 0.97 ˚C above the 1992-2000 SST minimum, and 2017 SST maximum was with 2.95 ˚C above the 1992-2000 SST maximum, i.e. 2017 SST was generally above the 1992-2000 mean.

The discharge of freshwater from coastal sources is highly dynamic process and has several effects on the coastal zone, such as reducing salinity, changing continuously distribution of parameters, such as dissolved matters, nutrients. During the investigations in the urban coastal area of the Varna Bay, a strong annual drop in SSS has come in June 2016 and SSS maximum was in January 2016. SSS fluctuation range was within 2.1 psu in 2016-2017. The variability of SSS and SST in 2016-2017 indicated that when SST increases, SSS decreases and vice versa. In 2016, SST maximum was in August but SSS minimum was in June due mainly to increased river runoff and rains.

Oxygen is required for the metabolism of aerobic organisms. Oxygen enters surface by aeration, or as a by-product of photosynthesis. The amount of dissolved oxygen gas depends highly on temperature. The amount of oxygen, dissolved in water is inversely proportional to the temperature of the water; as temperature increases, the amount of dissolved oxygen decreases. This is depicted for the urban coastal area of the Varna Bay, in Fig. 3. If the supply of organic matter is increased to a point where the consumption of O_2 is greater than the supply then de-oxygenation begins (Topping, 1976). Oxygen saturation was with variations of lower and higher 100% in the investigated area during 2016-2017. The depression of oxygen in some months was not at a level to threaten the marine life.

Nutrients enter water environment by river runoff, from the natural weathering of minerals, from biological decomposition, and as runoff from human activities in urban areas. The nutrient concentrations in water are a result of inputs from different sources and consumption by phytoplankton (Leonov, 1980). Highest level of nitrite nitrogen, nitrate nitrogen, and phosphate phosphorus has occurred in January 2016 and February 2017 and the nutrient minimum was in July-August in the urban coastal area of the Varna Bay in 2016-2017.

Chemical Oxygen Demand (COD) is a common measure of water quality that reflects the degree of organic matter pollution of a water body. COD is a measure of the oxygen equivalent of the organic matter in a water sample that is susceptible to oxidation by a strong chemical oxidant (Chapman, 1996). COD-Mn fluctuation has revealed that organic matter was generally increasing along with sea temperature increasing, with a maximum in July 2017.

City, industry and water sector leaders have a critical role to play in preserving natural water resources. They should have a leading role in the planning, management of water resources and responding to the challenges of climate variability and change. There needs to be a balance between meeting basic needs of Varna and the capacity of the water environment which implies research to be applied, science and technology leaders to be engaged by effective ways towards improved impact, and close partnerships between research institutions, industry agencies, and technology providers.

References

Beck, M.B. & Walker, R.V., 2013a. On Water Security, Sustainability, and the Water-food-energy-climate Nexus. Frontiers of Environmental Science & Engineering, 7 (5): 626-639.

Beck, M.B. & Walker, R.V., 2013b. Nexus Security: Governance, Innovation and the Resilient City. Frontiers of Environmental Science & Engineering, 7 (5): 640-657.

Chapman, D. (ed.), 1996. Water Quality Assessments: A Guide to the Use of Biota, Sediments and Water. Environmental Monitoring. Second Edition. UNESCO, WHO, and UNEP. E&FN Spon, London UK.

Dineva, S., 2013a. Hydrological and Hydrochemical Features of the Coastal, Bay, and Lake Waters in the Varna Region. *In*: Proceedings of International Conference "New technologies in the offshore industry", 3-5 October 2013, Varna, Bulgaria, pp.173-177.

Dineva, S., 2013b. Long-Term Environmental Survey of the Varna Bay. Proceedings of International Conference "New technologies in the offshore industry", 3-5 October 2013, Varna, Bulgaria, pp. 178-182.

Dineva, S., 2014. Seawater-related survey in the Varna region. *In*: Proceedings of Union of Scientists, Marine Sciences Series, Varna, Bulgaria. pp.94-100.

Dineva, S., 2015. Reliable seawater resources: a factor for development of the growing Varna region. BJAS, 21 (1): 116-120.

Dineva, S., 2017. Study of waters across the Varna Black Sea area. Proceedings of the Institute of Fish Resources - Varna, Bulgaria, 28: 101-107.

Dineva, S. & McKay, J., 2012. Institutional Governance and Regulation / Water resources management in the conditions of global climate change: set-up, trends and challenges. Hong Li (Ed.), Global Trends & Challenges in Water Science, Research and Management, 1st edition, Published by International Water Association (IWA), London, United Kingdom, The Clyvedon Press Ltd, Cardiff, UK, pp.33-36.

Dineva, S. & McKay, J., 2016. Institutional Governance and Regulation / Water Resources Management and Climate Change. H. Li (Ed.), Global Trends & Challenges in Water Science, Research and Management, Second edition, Published by International Water Association (IWA), London, United Kingdom, The Clyvedon Press Ltd, Cardiff, UK, pp. 56-61.

IPCC, 2014. Climate change: Synthesis Report. Summary for Policymakers.

Leonov, A., 1980. The chemical-ecological modeling of equatic nitrogen compound transformation processes. Odesa, Ukraine, 121 P.

Oakton, 2010. Integrated Instruction Manual. WP 600 Series Meters. USA.

Thompson, M. & Beck, M.B., 2014. Coping with Change: Urban Resilience, Sustainability, Adaptability and Path Dependence. Working Paper 13, Foresight Future of Cities, UK Government, Office for Science (GOS), December, p 45.

Topping, G., 1976. Sewage and the sea. *In:* Marine Pollution, R. Johnston (ed.), Academic Press Inc. (London) Ltd, T.&A. Constable Ltd, Edinburgh, Great Britain, pp. 303-319.

Science with and for Society: Introducing the MARINA Project

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The MARINA Project has launched at May 2016, which is supported by EU-Horizon 2020 under the call "Science with and for Society". The overall aim of the project is to create an all-inclusive Knowledge Sharing Platform (KSP) catalyzing and organizing the convergence of already existing networks, communities, on-line platforms and services providing an online sociotechnical environment that facilitates and stimulates the direct engagement of researchers, Civil Society Organizations (CSOs), citizens, industry stakeholders, policy and decision makers, research funders and communicators for improving Responsible Research and Innovation.

As a Turkish participant of this project, we perform several dissemination and spillover activities, such as organizing workshops, and presenting project outputs in various events. In particular, the project will establish, curate and experiment a Responsible Research and Innovation platform involving societal actors working together during the whole research and innovation process for aligning better both the process and its outcomes, with the values, needs and expectations of society, integrating citizens visions, needs and desires into science and innovation, promoting RRI with focus on marine issues and pressures that have important effects on the societies. The expected outcome of the Work Programme is a clear improvement of the integration of society in science and innovation.

Keywords: Responsible Research and Innovation, Knowledge Sharing Platform, Integrated society

Seasonal differences in preference of aquatic macroinvertebrates as food for *Barbus cyclolepis* Heckel, 1839 in an endorheic stream (Istanbul, Turkey)

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The aim of this study was to find the answers to the following questions: 1) are there any macroinvertebrates that benthic *Barbus cyclolepis* Heckel, 1839 did not consume as food in the feeding environment? 2) is there a relationship between the proportion of consumed food groups in the digestive tracts of fish and the ratios in the environment? The study was conducted in Istranca Stream located in Istanbul (Turkey) between spring and summer months in 2012. The diet composition of the fish was determined by relative important indices (IRI% and MI%). Specimens of each macroinvertebrate taxon counted for the determination of the percentage of food items in the environment (N_e%). The electivity index (E) was calculated to evaluate prey preference of the fish. Diet analyses of *B. cyclolepis* showed that food composition of the species was comprised of 11 different food types in 5 major groups: insect (Diptera, Ephemeroptera, Plecoptera, Odonata, Trichoptera, Coleoptera, Hymenoptera), crustacean (Gammaridae), arachnids (Acaridae), plant (algae), and detritus (organic detritus), and the species was found to feed on insects, mainly Diptera (IRI% = 92.26%). The most abundant macroinvertebrate organisms were Diptera and Gastropoda in the environment. In spring, *B. cyclolepis* showed positive selectivity for Diptera but the electivity value was not high ($E < 0.6$). The other macroinvertebrate groups consumed in low proportions by the fish showed negative electivity. In summer, the fish were selective to Diptera, Plecoptera and Trichoptera but high electivity was estimated only for Trichoptera ($E > 0.6$). The results showed that *B. cyclolepis* did not consume Gastropoda as food.

Keywords: Diet, selectivity, benthic insects, stream, fish.

Threatened cartilaginous fishes (Chondrichthyes) of the Turkish Seas

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The Red Lists of the IUCN (RL), relevant international agreements (IA) signed by Republic of Turkey and national legislations (NL) were reviewed in order to list the threatened cartilaginous fishes distributing throughout the Turkish Seas (TS). The RL (global and regional) and IA (Barcelona, Bern and CITES) indicated the presence of 54 (81.8% of 66 reviewed sp.) threatened cartilaginous fishes in TS. Twenty (37.0% of the 54 threatened sp.) were presently under protection by national legislations. Previous experiences have shown that it can only be effective if species conservation and habitat protection done together.

Keywords: Turkey, Threats, Chondrichthyes, Conservation

Introduction

Chondrichthyans (sharks, rays, and chimaeras) are evolutionarily conservative group that has functioned successfully in diverse aquatic ecosystems for over 400 million years. Despite their evolutionary success, many species are increasingly threatened with extinction as a result of their very conservative life-history traits (grow slowly, mature relatively late, have a small number of young, and low natural mortality) and anthropogenic activities. These characteristics result in very low rates of population increase with little capacity to recover from overfshing (either direct or indirect) and other impacts, including habitat loss and degradation. However, knowledge of the population status of most of the known species of chondrichthyans remains limited (Jabado *et al*., 2017).

This study provided an overwiew of the threatened cartilaginous species (sharks, rays, and chimaeras) in Turkish Seas and emphasized the recent situation in the number of species protected by national laws.

Material and Methods

The conservation status of all sixty-six chondrichthyans species (according to Bilecenoğlu *et al*., 2014) were gathered at global (IUCN, 2018), regional (IUCN, 2016) and national (Fricke *et al*., 2007; Anonymous, 2016a, b) scale. Threatened categories were Critically Endangered (CR; a species facing an *extremely high* risk of extinction in the wild), Endangered (EN; a species facing *a very high* risk of extinction in the wild), and Vulnerable (VU; a species facing *a high* risk of extinction in the wild). At the end of the evaluation, a list of threatened cartilaginous fish species obtained.

Results

Overall, results indicated that 42.5% (28 species) of the 66 chondrichthyans assessed are considered threatened in global scale (Table 1). In regional (Mediterranean) and national scale, it increased to 53.0% (35 species) (Table 1). The RL (global, regional and national), IA (Bern, Barcelona and CITES) and NL indicated the presence of 54 (81.8% of 66 reviewed sp.) threatened cartilaginous fishes in TS (Table 2).

Table 1. The number and proportion of Turkish cartilaginous fish species in each Red List Category (CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; DD, Data Defcient; NE, Not Evaluated), three threatened categories (CR, EN, VU) showed as bold and italic. [RL1: Global Red List (IUCN, 2018); RL2: Mediterranean Red List (IUCN, 2016); RL3: National Red List (Fricke *et al*., 2007)].

The IUCN Red List Categories	RL1	RL2	RL3
CR	***4 (6.1%)***	***16 (24.2%)***	***9 (13.6%)***
EN	***7 (10.6%)***	***11 (16.7%)***	***14 (21.2%)***
VU	***17 (25.8%)***	***8 (12.1%)***	***12 (18.2%)***
NT	14 (21.2%)	7 (10.6%)	-
LC	10 (15.2%)	11 (16.7%)	-
DD	13 (19.7%)	7 (10.6%)	16 (24.2%)
NE	1 (1.4%)	6 (9.1%)	3 (4.5%)
Total Number (N) of Assessed Species		66	
N (and %) of Threatened Species	28 (42.5%)	35 (53.0%)	35 (53.0%)

Table 2. Threatened cartilaginous fish species of the Turkish marine ichthyofauna. Description of BERN Convention Annex-An.II: strictly protected fauna species; An.III: protected fauna species. Description of Barcelona (BCN) Convention Annex-An.II: List of endangered or threatened species; App.III: List of species whose exploitation is regulated. Description of CITES Convention-An.II: Species not currently threatened with extinction but trade must be controlled in order to avoid utilization incompatible with the survival of the species. Ar.: Article. TM: Threatened Migrant.

Species	RL1	RL2	RL3	IA	NL
Heptranchias perlo	NT	DD	DD	BCN(An. III)	-
Hexanchus griseus	NT	LC	VU	-	-
Carcharias taurus	VU	-	CR	BCN(An. II)	-
Odontaspis ferox	VU	CR	CR	BCN(An. II)	-
Carcharodon carcharias	VU	CR	CR	BERN(An.II);BCN(An. II);CITES(An. II)	-
Isurus oxyrinchus	VU	CR	CR	BERN(An.III);BCN(An. II)	4/1(Ar.16)
Lamna nasus	VU	CR	CR	BERN(An.III);BCN(An. II);CITES(An. II)	4/1(Ar.16);4/2(Ar.7)
Cetorhinus maximus	VU	EN	TM	BERNAn(An.II); BCN(An. II);CITES(An. II)	4/1(Ar.16);4/2(Ar.7)
Alopias superciliosus	VU	EN	EN	CITES(An. II)	-
Alopias vulpinus	VU	EN	EN	BCN(An. III);CITES(An. II)	4/1(Ar.16)
Galeus melastomus	LC	LC	VU	-	-
Scyliorhinus canicula	LC	LC	VU	-	-
Scyliorhinus stellaris	NT	NT	EN	-	-
Galeorhinus galeus	VU	VU	DD	BCN(An. II)	4/1(Ar.16);4/2(Ar.7)
Mustelus asterias	LC	VU	DD	BCN(An. III)	-
Mustelus mustelus	VU	VU	DD	BCN(An. III)	-
Mustelus punctulatus	DD	VU	DD	BCN(An. III)	-
Carcharhinus altimus	DD	DD	EN	-	-
Carcharhinus brevipinna	NT	-	EN	-	-
Carcharhinus limbatus	NT	DD	EN	-	-
Carcharhinus plumbeus	VU	EN	EN	BCN(An. III)	4/1(Ar.16);4/2(Ar.7)
Prionace glauca	NT	CR	TM	BERN(An.II);BCN(An. III)	-
Sphyrna zygaena	VU	CR	TM	BCN(An. II);CITES(An. II)	-
Dalatias licha	NT	VU	DD	-	-
Etmopterus spinax	LC	LC	VU	-	-
Oxynotus centrina	VU	CR	VU	BCN(An. II)	4/1(Ar.16)
Centrophorus granulosus	-	CR	VU	BCN(An. III)	-

Centrophorus uyato	DD	-	VU	-	-
Squalus acanthias	VU	EN	EN	BCN(An. III)	4/1(Ar.16);4/2(Ar.7)
Squalus blainville	DD	DD	EN	-	4/1(Ar.16)
Echinorhinus brucus	DD	EN	DD	-	-
Squatina aculeata	CR	CR	CR	BCN(An. II)	4/1(Ar.16)
Squatina oculata	CR	CR	CR	BCN(An. II)	4/1(Ar.16)
Squatina squatina	CR	CR	CR	BERN(An.III);BCN(An. II)	4/1(Ar.16)
Torpedo nobiliana	DD	LC	VU	-	-
Torpedo marmorata	DD	LC	VU	-	-
Torpedo torpedo	DD	LC	VU	-	-
Glaucostegus cemiculus	EN	EN	EN	BCN(An. II)	4/1(Ar.16)
Rhinobatos rhinobatos	EN	EN	EN	BCN(An. II)	4/1(Ar.16)
Dipturus batis	CR	CR	CR	BCN(An. II)	-
Leucoraja circularis	EN	CR	DD	BCN(An. I)	-
Raja asterias	NT	NT	EN	-	-
Raja clavata	NT	NT	VU	-	4/1(Ar.16)
Raja radula	EN	EN	VU	-	-
Raja undulata	EN	NT	EN	-	-
Rostroraja alba	EN	EN	EN	BERN(An.III);BCN(An. II)	-
Bathytoshia centroura	LC	VU	TM	-	-
Dasyatis pastinaca	DD	VU	TM	-	-
Gymnura altavela	VU	CR	TM	BCN(An. I)	-
Myliobatis aquila	DD	VU	TM	-	4/1(Ar.16)
Pteromylaeus bovinus	NT	CR	TM	-	4/1(Ar.16)
Rhinoptera marginata	NT	DD	TM	-	4/1(Ar.16)
Mobula mobular	EN	EN	TM	BERN(An.II); BCN(An. II);CITES(An. II)	4/1(Ar.16)
Mobula japanica	NT	-	-	-	4/1(Ar.16)

Discussion

According to the IUCN (2018), over one-querter of the world's cartilaginous species are threatened with extinction. In support of this argument, several chondrichthyan species that once were widespread and abundant are now uncommon and rare in Turkish waters (Filiz *et al*., 2018). Turkish fisheries targeted some shark species until 1990, after that chondrichthyans have not been and are not currently targeted by commercial fisheries operating along the coast of Turkey, but are taken as bycatch in the coastal fishery (Filiz *et al*., 2018). Currently, four main threats for the cartilaginous species listed in TS, (i) as bycatch in trawl, trammel nets and purse seines, (ii) unreported and unregulated fishing, (iii) marine pollution, and (iv) habitat loss (Öztürk, 2018). Laws are important to protect threatened and endangered species, and Turkey has signed a couple of important agreements, such as the Barcelona, Bern and CITES conventions. By the recent revisions made, the Barcelona Convention (BCN) included 28 sp. (51.9% of 54 species). Eight (14.8% of 54) and seven (13.0%) species were currently covered by the Bern Convention and CITES, respectively. In the review, it can be seen that 30 species protected by IA. Recently, the number of species protected by NL increased to 20 (from 5) (see Table 2), where 62.5% of Bern, 50.0% of BCN and 57.1% of CITES species are now covered.

Regarding to subject, the following recommendations can be made in the light of Jabado *et al*. (2017) and Öztürk (2018):

- Make provisions for the full protection of chondrichthyan remained 34 species considered as threatened (CR, EN, and VU) in the TS;
- Take immediate measures to reduce incidental catches of species assessed as threatened and encourage proper handling techniques and live release;

- Ensuring the implementation and compliance with requirements from international agreements;
- Continuing the development of National Action Plan for the Corservation of Cartilaginous Fishes in TS;
- Establish and enforce Marine Protected Areas with notake zones;
- Develop and facilitate training, particularly in the felds of taxonomy, monitoring methods, and stock assessment;
- Collect fisheries-dependent data on artisanal and commercial fsheries, especially data on catch composition, bycatch, landings, discards, and Catch Per Unit Effort;
- Conduct basic biological research for deepsea and DD species, especially those that are commercially exploited; and,
- Encourage research aimed at identifying and mapping critical habitats in the TS.

Evaluating the conservation status of cartilaginous species in TS is needed and the IUCN requires that the status of a species be re-evaluated, in the least, every 10 years. According to Jabado *et al*. (2017), key challenges for the future are to improve monitoring and data quality, and to further develop data openness and dissemination so that the information and analyses presented here can be updated and improved, and conservation actions can be given as solid a scientifc basis as possible.

References

Anonymous (2016a) Notification 4/1. Republic of Turkey Ministry of Agriculture and Rural Affairs, Notification 4/1 Regulating Commercial Fishing. Notification Number: 2016/35, Published in the Official Gazette date: 13.08.2016-29800, Ankara (in Turkish).

Anonymous (2016b) Notification 4/2. Republic of Turkey Ministry of Agriculture and Rural Affairs, Notification 4/2 Regulating Sporting Fishing. Notification Number: 2016/36, Published in the Official Gazette date: 13.08.2016-29800, Ankara (in Turkish).

Bilecenoğlu, M., Kaya, M., Cihangir, B., & Çiçek, E., 2014. An updated checklist of the marine fishes of Turkey. Turkish Journal of Zoology, 38: 901-929.

Filiz, H., Yapıcı, S., & Bilge, G., 2018. Chondrichthyan fishes in catch composition of the bottom trawl fishery on the coast of Didim, Turkey. J. Black Sea/Mediterranean Environment, 24(1): 28-37.

Fricke, R,. Bilecenoğlu, M., & Sarı, H.M., 2007. Annotated checklist of fsh and lamprey species of Turkey, including a Red List of threatened and declining species. Stuttg Beitr Nat Biol 706: 1–169.

IUCN, 2016. The Conservation Status of Sharks, Rays and Chimaeras in the Mediterranean Sea. IUCN Centre for Mediterranean Cooperation, Campanillas (Malaga), 14 pp.

IUCN, 2018. www.iucnredlist.org. [Accessed on 14 August 2018].

Jabado, R.W., Kyne, P.M., Pollom, R.A., Ebert, D.A., Simpfendorfer, C.A., Ralph, G.M., & Dulvy, N.K., 2017. The Conservation Status of Sharks, Rays, and Chimaeras in the Arabian Sea and Adjacent Waters. Environment Agency – Abu Dhabi, UAE and IUCN Species Survival Commission Shark Specialist Group, Vancouver, Canada 236 pp.

Öztürk, B., 2018. National action plan for the conservation of cartilaginous fishes in the Turkish water of the eastern Mediterranean Sea. J. Black Sea/Mediterranean Environment, 24(1): 91-96.

Impact of acute fonofos exposure on skeletal muscle of zebrafish: Histopathological and biometric analyses

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It's widely known that pesticides generally do not show target specificity and off-target species are strikingly effected by these chemicals. In the current work, histological changes in skeletal muscles of zebrafish (*Danio rerio*) caused by the acetylcholinesterase (AChE) inhibitor organophosphate insecticide fonofos were examined. Zebrafish were treated with 1 mg/L, 2 mg/L and 4 mg/L fonofos for 96 hours. Skeletal muscle samples were removed from the pectoral region and embedded in paraffin. Sections were stained with hematoxylin-eosin, Gomori's trichrome and periodic acid Schiff techniques. Histopathological alterations were investigated by light microscopy. Fibrosis, intramuscular degeneration, splitting of myofibres, vacuole formation in the fibres, atrophic and disappeared fibres, hypertrophic nuclei, severe deformation of tissue integrity and progressive decrement in glycogen content were noted. Muscle fibre diameter measurements were also performed. Statistical analysis showed that measured fibre diameters of all fonofos exposed groups were significantly different from the control group and they shrank in a concentration-dependent manner. The results indicated that fonofos was not only an AChE inhibitor but also a myotoxic agent for non-target freshwater fish.

Keywords: Fonofos, skeletal muscle, histopathology, muscle fibre, biometry, zebrafish.

Genetic Analysis Based on Mitochondrial DNA D-loop Sequences of *Cyprinion macrostomum* (Heckel, 1843) populations

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The Tigris kingfish, *Cyprinion macrostomus* (Heckel, 1843), is a commercially valuable fish species naturally distributed in Tigris and Euphrates river basins. In this study genetic diversity of *C. macrostomus* populations was determined based on gene sequencing analysis of mitochondrial DNA D-loop Sequences locus. 42 polymorphic sites and 27 haplotypes were detected taking 50 samples from two populations. Mean haplotype diversity (Hd) and nucleotide diversity (π) were calculated to be Hd=0.962 and π =0.02314; respectively. All values obtained from two populations after neutrality tests were calculated and were statistically insignificant ($p>0.05$). Results obtained with this research are the data noted for the first time for *C. macrostomum* species thriving in Turkey. Some haplotypes determined for mtDNA D loop locus are the new results to the literature and created a novel data set for genetic diversity of this species.

Keywords: Tigris kingfish, Population genetic, polymorphism, Haplotype, Euphrates River, Tigris River

Introduction

Cyprinion macrostomum (Heckel, 1843) is a species from the family Cyprinidae and distributed in river systems and tributaries of Euphrates, Tigris, and Asi in Turkey (Cengiz et al., 2010; Birecikligil and Çiçek, 2011). Numerous studies were conducted on *C. macrostomum* Heckel, 1843, some are as follows; total fatty acid and lipid content in gonads of the species (Metin and Akpınar, 2000), determination of age (Aydın et al., 2009), Hematology (Duman and Şahan, 2014), phylogenetics (Daştan et al., 2012), comparison of body formation using geometric and morphometric parameters (Nasri et al., 2013), morphometric and meristic characteristics (Dağlı, 2013;, Kara and Güneş, 2015), histology of pancreas, liver, and intestines (Taysı, 2014). Since this species is consumed by local people, it possesses economic importance. Fresh water fish have been an alternative resource of protein against terrestrial products that remain insufficient to meet protein demand. The fish are accepted as the cheapest resource of animal derived protein and mineral for millions of poor families across the world (Wu and Yang 2012).

It is considerably important to know genetic structure of fish populations for sustainable fishing and conservation strategies. Populations with rich genetic diversity are capable of adapting to environmental changes and finding cures for disease. A good number of DNA based genetic markers are available for studies of genetic diversity, developments in sequence analysis techniques in recent years have made mtDNA studies popular (Liu et al., 2015). mtDNA is a significant and widely used molecular marker which allows to estimate genetic structure of several organisms (Xu et al., 2011).

The present study aimed to provide some part of preliminary information needed for management and conservation studies creating genetic data after sequence analysis of mtDNA Dloop gene site in *C. macrostomum* populations.

Material and Methods
Collection of fish samples:

The fish samples used in our study were collected from two different localies of 2 different river systems in Euphrates and Tigris (Figure 1). These samples were supplied from the fish caught by local fishermen in between 2017 and 2018. Samples were transferred in to Zoology Laboratory of Department of Biology, Faculty of Science & Arts, Harran University, placing them in the ice container immediately after sampling. Individuals were chosen randomly among the specimens which were decided to be the target species following identification. About 1 gr of muscle tissue which was dissected from a part closer to dorsal fin of the samples placed in the microcentrifuge tubes containing 95% ethanol and kept at -20°C until DNA extraction.

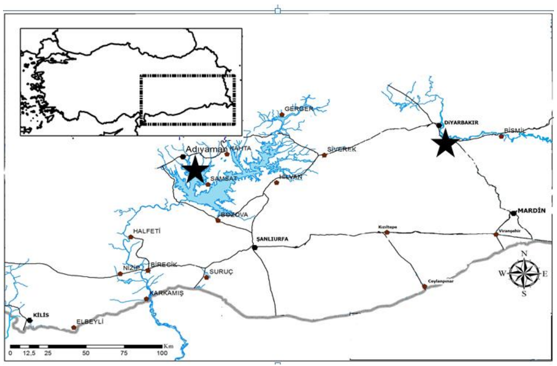

Figure 1. Localities where samples were taken from (Parmaksız and Batan, 2017)

Total DNA Isolation, Amplification of D-loop Site

In this survey, total DNA isolation from muscle tissue was practiced using Bu Gene JET Genomic DNA Purification Kit (Thermo Scientific). Total DNAs were obtained by applying the protocol for this kit. In order to control the existence of DNA, 2 µl was taken from DNA samples of each individual, placed in to tank including 0.8% agarose gel, 0.5xTBE (Tris/Boric acid/EDTA Buffer) solution with the addition of 2 µl stain (3x Loading dye) and SYBR Green, run in electrophoresis at 120 Volts for 30 minutes, then viewed in device giving off ultraviolet (UV) light.

Primer sequences used for amplification of mtDNA D-loop site were as follows;
L15923: 5'-TTAAAGCATCGGTCTTG-TAA-3' (Iguchi et al., 1997);
H16500: 5'-GCCCTGAAATAGGAACCAGA-3' (Inoue et al., 2000).

The PCR amplification was carried out in a BIO-RAD T100TM Thermal Cycler under the following conditions in a total number of 35 cycles; 3 min initial denaturation at 95 °C, denaturation at 95°C for 30 seconds, annealing at 51°C for 30 seconds, and extension at 72 °C for 45 seconds, and a final extension at 72 °C for 10 minutes, and terminated keeping specimens at 72°C for 5 seconds. PCR mixture used for amplification of this site included 13.9µl of dH_2O, 2.5 µl of 1x PCR buffer, 2 µl $MgCl_2$, 0.5 µl of dNTPs, 1 µl of primer (F+R), 0.1 µl of Taq polymerase and 50 ng of template all of which equals 25 µl in total. 1,5% agarose gel was utilized to check final products occurring after PCR process. Sequencing was done by a commercial company with an automated DNA sequencer 3500 XL Genetic Analyzer (Thermo Fisher Scientific).

Analysis of mtDNA D loop

Raw data of mtDNA sequences, which were delivered to us by commercial company, were evaluated and converted in to FASTA format by using Chromas Pro v 2.0.1 (Technelysium Pty Ltd). Resulting sequences of all samples in FASTA format were ranked utilizing BioEdit software version 7.2.5 program.

The number of polymorphic sites and haplotypes, diversity of haplotypes and nucleotides, Tajima D and Fu's statistics for the populations were identified by using DNA SP5.10.01 program. The phylogenetic relationship between haplotypes was identified via Network version 5.0 program.

Results

Genetic Variation

Performing sequence analysis for about 380 bp of mtDNA Dloop site of a total number of 50 *C. macrostomus* from Euphrates and Tigris Rivers, 42 polymorphic sites and 27 haplotypes were obtained. Haplotype diversity (h), nucleotide diversity (π), and neutrality tests were given for each population on Table 1.

Table1. Genetic diversity and neutrality test results for *C. macrostomus* populations (n: number of individuals, Nh: number of haplotyeps, h: haplotype diversity, π:nucleotide diversity)

Locality	N	Nh	h	π	Tajima's D	Fu's Fs
Adıyaman	20	8	0.972	0.01818	0.23726	-1.864
Diyarbakır	30	20	0.952	0.02276	-0.44168	-6.234
Total	**50**	**27**	**0.962**	**0.02314**	**-0.53009**	**-11.692**

In the present study, haplotype H3 was found in 12 individuals and haplotype H14 in 5 individuals, they are the common haplotypes of the both populations. Haplotypes H1 and H25 were also represented with 5 individuals. Remaining haplotypes were represented only with 1 individual. Mean haplotype diversity was calculated as (h=0.962); mean nucleotide diversity as (π=0.02314). Diyarbakır population and Adıyaman population had similar values in terms of both haplotype diversity and nucleotide diversity.

Figure 2 shows evolutionary network for 27 haplotypes identified on the Median-Joining Network of haplotypes created for 50 samples analyzed.

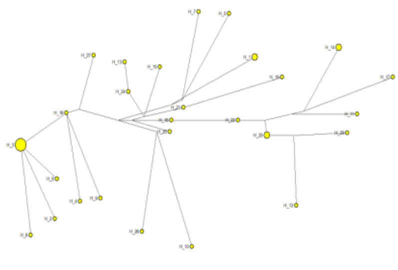

Figure 2. Network model for mtDNA Dloop haplotypes of *C.macrostomum*

Neutrality Tests

Tajima's D were 0.23726 and -0.44168 for Adıyaman and Diyarbakır populations respectively, all results including the total were found to be statistically insignificant ($p>0.05$). After Fu' Fs tests, Adıyaman (-1.864) and Diyarbakır (-6.234) populations had negative values, were not statistically significant remaining to be in negative (-11.692) again ($p>0.05$).

Discussion

Because Adıyaman province is close to Atatürk Dam, Diyarbakır province to Tigris river, fishing activities are carried out by the people who live in these regions. Fish species such as *C. macrostomum*caught by local fishermen are both consumed as food by local people and has commercial value the local market. Despite it was not much preferred to consume this fish last years, it is bought and used for food by people today. Populations of shabout (*Arabibarbus grypus*) which is one of the most delicious fish species have been considerably decreased and therefore the prices have increased comparatively. Hence, people oriented to *C. macrostomum* which is smaller in size and sold cheaper, it has become a popular species particularly for low income people. The fact that people prefer this species may lead to fishing it more and variations in its populations. Therefore, necessary precautions needed to be taken to stop genetic loss for this species and to protect future of it. It is firstly required to have genetic data of populations to make plans for conservation. Analysis of population genetics is an effective tool to conserve a species and to acquire information for its management (Ryman, 1991; Ward, 2000). Molecular markers are functional methods to identify genetic diversity and population structure (Englbrecht et al. 2000; Whitehead et al., 2003).

The present study evaluated genetic diversity of populations via mtDNA D-loop site sequence analysis for 50 of *C. macrostomum* samples in total. 42 polymorphic sites and 27 haplotypes were identified for this site studied. Compared to the genetic studies on fish that were consumed more in the same river systems; Parmaksız and Ekşi (2017) indetified 6 polymorphic sites and 7 haplotypes for *Capoeta trutta* populations, Parmaksız and Şeker (2018) 2 polymorphic sites and 3 haplotypes for *Arabibarbusgrypus* populations. The number of polymorphic sites and haplotypes in the present study were greater than two other studies, genetic diversity was also higher. Higher genetic diversity indicates strong capability for adaptation and survival of populations (Barrett and Schluter, 2008).

Results extracted from the present study represent current genetic data of *C. macrostomum*, will contribute its conservation and reasonable fishing rate. Therefore, conservation needs to be the priority based on genetic diversity data. It is mandatory to avoid overfishing and not to destruct reproduction areas of the fish, especially to prevent fishing them during reproductive period.

Acknowledgements

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References

Aydın, R., Şen, D., Çalta, M., ve Canpolat Ö. 2009. *Cyprinion macrostomus* (HECKEL, 1843)'un Kemiksi Yapılardaki Magnezyum Elementinin Birikim Düzeylerine Bağlı olarak yaş halkalarının Okunabilirliği. *Ulusal Su Ürünleri Sempozyumu*, Elazığ

Barrett, R, &Schluter, D. (2008).Adaptation from standing genetic variation. *Trends in Ecology & Evolution*, 23, 38–44.

Birecikligil, S., Çiçek, E., 2011. Gaziantep İli Sınırları İçindeki Fırat ve Asi Havzası Akarsuları Balık Faunası. Biyoloji Bilimleri Araştırma Dergisi 4 (2) : 29-34.

Cengiz, E.I., Ünlü, E. andBashan, M., 2010. Fattyacidcomposition of total lipids in muscle tissues of nine freshwaterfishfromtheRiverTigris (Turkey). Turk. J. Biol. 34 : 433-438.

Dağlı, M. 2013. *Barbus lacerta* Heckel, 1843 ve *Cyprinion macrostomum*Heckel, 1843'un Morfolojik Özellikleri. Düzce Üniversitesi Bilim ve Teknoloji Dergisi, 1: 88–95.

Daştan, S., Bardakcı, F. and Deger, N. 2012. Genetic Diversity of *Cyprinion macrostomus* Heckel, 1843 (Teleostei:Cyprinidae) in Anatolia, *Turkish Journal of Fisheries and Aquatic Sciences*, 12: 651- 659.

Duman, S.,and Şahan, A. 2014. Kangal (Sivas) Balıklı Çermik Termal Kaplıcası İle Topardıç Deresi'nde (Sivas) Yaşayan Benekli Sezen *Cyprinion macrostomus* (Heckel, 1843) de Bazı Hematolojik Parametreler ve Non-Spesifik İmmün Yanıtın Belirlenmesi. *Yunus Araştırma Bülteni*, (4): 21-28.

Englbrecht, C.C., Freyhof, J., Nolte, A., Rassmann, K., Schliewen, U., & Tautz, D. 2000. Phylogeography of thebullhead Cottus gobio (Pisces: Teleostei: Cottidae) suggests a pre-Pleistocene origin of the majorcentral European populations. Molecular Ecology, 9: 709-722.

Iguchi, K., Tanimura, Y., & Nishida, M. (1997). Sequence divergence in the mtDNA control region of amphidromous and landlocked forms of ayu. Fisheries Science, 63:901-905.

Inoue, J.G., Miya, M., Tsukamoto, K., & Nishida, M. (2000). Complete mitochondrial DNA sequence of the Japanese sardine, Sardinops melanostictus. Fisheries Science, 66:924-932.

Kara, C. ve Güneş, H. 2015.Adıyaman Bölgesi Akarsu ve Göllerinde *Cyprinion macrostomum*Heckel, 1843 bireylerinin Dağılımı ve Bazı Morfometrik Özellikleri. Yunus Araştırma Bülteni, (4): 13-19.

Li, W., Chen, X., Xu, Q., Zhu, J., Dai, X., & Xu, L. (2015). Genetic Population Structure of *Thunnusalbacares* in the Central Pacific Ocean Based on mtDNA COI Gene Sequences. *Biochemical Genetics,* 53: 8-22. http://dx.doi.org./10.1007/s10528-015-9666-0.

Metin, K. ve Akpınar, M. A. 2000. *Cyprinion macrostomus* (Heckel, 1843)'un Gonatlarında Total Lipid ve Yağ Asidi Miktarının Mevsimsel Değişimi. Turk. J. Biol. 24: 627–634.

Nasri, M., Eagderi, S., Farahmand, H. veSegherloo, I. H. 2013. Body shape comparison of Cyprinion macrostomum (Heckel, 1843) and *Cyprinion watsoni* (Day, 1872) using geometric morphometrics method. International Journal of Aquatic Biology , 1(5): 240-244.

Parmaksız, A., Ekşi, E. 2017.Genetic diversity of the cyprinid fish *Capoetatrutta*(Heckel, 1843) populations from Euphrates and Tigris rivers in Turkey based on mtDNA COI sequences.– Indian J. Fish. 64(1): 18-22.

Parmaksız, A., Batan, B. 2017. Cyprinion macrostomus (Heckel, 1843) TürününAdıyaman ve Diyarbakır Populasyonlarının Mikrosatellit DNA Varyasyon Analizi. YunusAraştırmaBülteni. 2017 (4): 521-529.

Parmaksız, A., & Şeker, Ö. 2018. Genetic Diversity of the Endemic Species Shabbout (*Arabibarbus grypus* (Heckel, 1843)) Based on Partial Cytochrome b Sequences of Mitochondrial DNA. *Aquatic Research*, 1 (3), 103-109.

Ryman, N. (1991). Conservation genetics considerations in fishery management. *Journal of Fish Biology*, 39:211-224.

Taysı, M. R. 2014.Investigation of theproperties of histologicalandhistochemical in the spottedcarp's (*Cyprinion macrostomum* Heckel, 1843) intestines, liverandpancreas. Master Thesis, Fırat University, Elazığ.

Ward, R.D. 2000. Genetics in fisheries management. Hydrobiologia, 420:191-201.

Whitehead, A., Anderson, S.L., Kuivila, K.M., Roach, J.L., & May, B. 2003. Genetic variation among interconnected populations of *Catostomus occidentalis*: implications for distinguishing impacts of contaminants from biogeographical structuring. *Molecular Ecology*, 12: 2817-2833.

Wu, L., & Yang, J. 2012. Identifications of captive and wild tilapia species existing in Hawaii by mitochondrial DNA control region sequence.*PLoS One*, 7:e51731.

Xu, Z.H., Chen, J.L., Cheng, D.F., Liu, Y., Eric, F. 2011. Genetic variation among the geographic population of the Grain Aphid, Sitobionavenae (Hemiptera: Aphididae) in China inferred from mitochondrial COI gene sequence. *Agricultural Sciences in China*, 10, 1041-1048.

Genetic analysis based on mitochondrial DNA D loop sequences of *Arabibarbus grypus* (Heckel, 1843) populations

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The shabout, *Arabibarbus grypus* is a cyprinid fish naturally rdistributed in river systems of Euphrates and Tigris and has commercial value in the region. In this study genetic diversity of *A. grypus* populations was determined based on gene sequencing analysis of mitochondrial DNA D-loop sequences locus. 4 polymorphic sites and 3 haplotypes were detected taking 30 samples from two populations. Mean haplotype diversity (h) and nucleotide diversity (π) were calculated to be h=0.425 and π =0.00404; respectively. Results obtained with this research are the data noted for the first time for *A. grypus* species thriving in Turkey. Some haplotypes determined for mtDNA D loop locus are the new results to the literature and created a novel data set for genetic diversity of this species.

Keywords: Shabout, Population genetic, polymorphism, Haplotype, Euphrates River, Tigris River

Introduction

In recent years, freshwater fish have become an important alternative protein source in meeting the growing population's protein requirement in the Southeastern Anatolia Region. Many species belonging to the family of Cyprinidae are consumed especially by the people living in Adiyaman and Diyarbakır. Among these fish, *A. grypus* (Shabut) is the most preferred species because of its delicious taste. Due to its economic importance, there is excessive hunt on these populations and causes the resources to decrease day by day. In order to compensate for the declining resources, this crop has gained considerable importance. In order to obtain the desired result in the aquaculture production genetic structure should be suitable especially in the rootstock individuals. (Salihoğlu et. al., 2013). To identify the genetic structure of available stocks is important to get long term results (Karahan, 2009). Populations with rich genetic diversity can adapt to environmental changes and produce solutions to diseases.

It is considerably important to know genetic structure of fish populations for sustainable fishing and conservation strategies. Populations with rich genetic diversity are capable of adapting to environmental changes and finding cures for disease. A good number of DNA based genetic markers are available for studies of genetic diversity, developments in sequence analysis techniques in recent years have made mtDNA studies popular (Liu and Zhou, 2016). mtDNA is a significant and widely used molecular marker which allows to estimate genetic structure of several organisms (Xu et al., 2011).

The present study aimed to provide some part of preliminary information needed for management and conservation studies creating genetic data after sequence analysis of mtDNA D loop gene site in *A. grypus* populations.

Material and Methods

Collection of fish samples:

The fish samples used in our study were collected from two different localies of 2 different river systems in Euphrates and Tigris. These samples were supplied from the fish caught by local fishermen in between 2017 and 2018. S The fish were supplied by fishermen in Adıyaman and Diyarbakır where fishing is very popular. Samples were transferred in to Zoology Laboratory of Department of Biology, Faculty of Science & Arts, Harran University, placing them in the ice container immediately after sampling. Individuals were chosen randomly among the specimens which were decided to be the target species following identification. About 1 gr of muscle tissue which was dissected from a part closer to dorsal fin of the samples placed in the microcentrifuge tubes containing 95% ethanol and kept at -20℃until DNA extraction.

Total DNA Isolation, Amplification of D-loop Site

In this survey, total DNA isolation from muscle tissue was practiced using Bu Gene JET Genomic DNA Purification Kit (Thermo Scientific). Total DNAs were obtained by applying the protocol for this kit. In order to control the existence of DNA, 2 µl was taken from DNA samples of each individual, placed in to tank including 0.8% agarose gel, 0.5xTBE (Tris/Boric acid/EDTA Buffer) solution with the addition of 2 µl stain (3x Loading dye) and SYBR Green, run in electrophoresis at 120 Volts for 30 minutes, then viewed in device giving off ultraviolet (UV) light.

Primer sequences used for amplification of mtDNA D-loop site were as follows;
L15923: 5'-TTAAAGCATCGGTCTTG-TAA-3' (Iguchi et al., 1997);
H16500: 5'-GCCCTGAAATAGGAACCAGA-3' (Inoue et al., 2000).

The PCR amplification was carried out in a BIO-RAD T100TM Thermal Cycler under the following conditions in a total number of 35 cycles; 3 min initial denaturation at 95 °C, denaturation at 95°C for 30 seconds, annealing at 51°C for 30 seconds, and extension at 72 °C for 45 seconds, and a final extension at 72 °C for 10 minutes, and terminated keeping specimens at 72°C for 5 seconds. PCR mixture used for amplification of this site included 13.9µl of dH_2O, 2.5 µl of 1x PCR buffer, 2 µl $MgCl_2$, 0.5 µl of dNTPs, 1 µl of primer (F+R), 0.1 µl of Taq polymerase and 50 ng of template all of which equals 25 µl in total. 1,5% agarose gel was utilized to check final products occurring after PCR process. Sequencing was done by a commercial company with an automated DNA sequencer 3500 XL Genetic Analyzer (Thermo Fisher Scientific).

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Raw data of mtDNA sequences, which were delivered to us by commercial company, were evaluated and converted in to FASTA format by using Chromas Pro v 2.0.1 (Technelysium Pty Ltd). Resulting sequences of all samples in FASTA format were ranked utilizing BioEdit software version 7.2.5 program.

The number of polymorphic sites and haplotypes, diversity of haplotypes and nucleotides were identified by using DNA SP5.10.01 program. The phylogenetic relationship between haplotypes was identified via Network version 5.0 program.

Results

Genetic Variation

Performing sequence analysis for about 380 bp of mtDNA Dloop site of a total number of 30 *A. grypus* from Euphrates and Tigris Rivers, 4 polymorphic sites and 3 haplotypes were obtained. Haplotype diversity (h), nucleotide diversity (π) given for each population on Table 1.

Table1. Genetic diversity and neutrality test results for *A. grypus* populations (n: number of individuals, Nh: number of haplotyeps, h: haplotype diversity, π: nucleotide diversity)

Lokalite	N	Nh	h	π
Adıyaman	15	3	0.600	0.00549
Diyarbakır	15	1	0.000	0.00000
Toplam	**30**	**3**	**0.425**	**0.00404**

In our study, H1 haplotype was found in 22 individuals, H2 haplotype in 6 individuals and H3 haplotype in 2 individuals. The mean haplotype and variability nucleotide diversity were calculated as 0.425 and 0.00404 respectively.

Figure 2 shows evolutionary network for 3 haplotypes identified on the Median-Joining Network of haplotypes created for 30 samples analyzed.

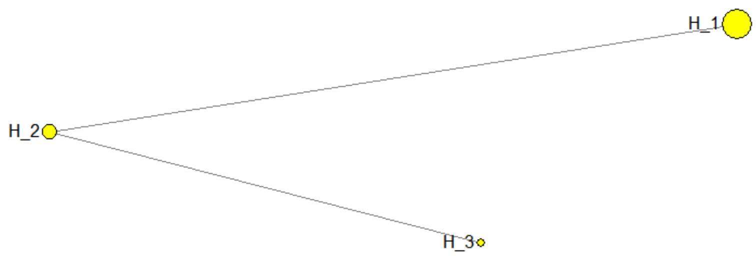

Figure 2. Network model for mtDNA D loop haplotypes of *A. grypus*

Discussion

As all localities in our study are close to settlement centers, Shabout is hunted by fishermen and local people. Hunted fish are consumed both by the people of the region and sold to neighboring places. Due to high hunting, It causes a decrease in the number of individuals in populations of Shabout. Although Oymak (2009) said that Shabut is abundant in the Euphrates River, the number of individuals has recently decreased considerably due to overfishing. This fish is considered as an option for carp or salmon trout in the breeding of inland water fish (Gokçınar, 2010), the genetic diversity must be well known in order to ensure the continuation of stocks and to obtain high yields from these stocks. Measures must be taken to protect this species and in order to make conservation plans, populations must have genetic data.

The present study evaluated genetic diversity of populations via mtDNA Dloop site sequence analysis for 30 of *A. grypus* samples in total. 4 polymorphic sites and 3 haplotypes were identified for this site studied. Compared to the genetic studies on fish that were consumed less in the same river systems; Parmaksız and Oymak (2018) indetified 42 polymorphic sites and 27 haplotypes for *Cyprinion macrostomum* populations. The number of variable regions and haplotypes in our study was lower than in both studies. High level of genetic diversity demonstrates strong adaptation and survival of populations (Barrett ve Schluter, 2008). The low rate of genetic diversity of this fish will cause the ability to adapt to time to decrease and cause a great risk of survival under changing environmental conditions, perhaps leading to the depletion of the strain.

For this species, it is necessary to prevent excessive hunting and to prevent the breeding areas of fishes from being destroyed, especially in the prevention of hunting during reproduction period.

References

Barrett, R, &Schluter, D. 2008. Adaptation from standing genetic variation. Trends in Ecology & Evolution, 23, 38–44.

Gokcinar, N.C. (2010). Effect of partially replacing fishmeal with azolla (Azolla sp.) on growht parametres of shabbout fish (Tor grypus H. 1843). MSc thesis, Ankara University. 51p.

Iguchi, K., Tanimura, Y., Nishida, M. 1997. Sequence divergence in the mtDNA control region of amphidromous and landlocked forms of ayu. Fish Sci 63:901-905.

Inoue, J.G, Miya, M., Tsukamoto, K., Nishida, M. 2000. Complete mitochondrial DNA sequence of the Japanese sardine, *Sardinops melanostictus*. Fish Sci 66:924–932.

Karahan, B. 2009. Doğal levrek (Dicentrarchus labrax) Anaçlarında Mikrosatelit Polimorfizmi. E.Ü. Su Ürünleri Dergisi, 26 (2) :101-104.

Liu, G., and Zhou, L. 2016. Population genetic structure and molecular diversity of the red swamp crayfish in China based on mtDNA COI gene sequences, Mitochondrial DNA Part A, 28 (6): 860-866.

Oymak, S. A., Karadede, H., Dogan, N. 2009. Heavy metal in tissues of *Tor grypus* from Ataturk Dam Lake, Euphrates River-Turkey, Biologia, 64, 1, 151-155.

Parmaksız, A., Oymak, A. 2018. Genetic Analysis Based on Mitochondrial DNA D-loop Sequences of Cyprinion macrostomum (Heckel, 1843) populations . First International Marine & Freshwater Sciences Symposium. 18-21 October, Antalya-Turkey

Salihoğlu, H., Melek, H., Bayçelebi, H., Aksungur, M., Çakmak, E., Akhan, S. 2013. Doğu Karadeniz Bölgesi Alabalık işletmelerinde Anaç Stok Yönetim Sistemi Oluşturulması. Yunus Araştırma Bülteni, 2: 21-33.

Xu, Z. H., Chen, J. L., Cheng, D. F., Liu, Y. and Eric, F. 2011. Genetic variation among the geographic population of the Grain Aphid, Sitobion avenae (Hemiptera: Aphididae) in China inferred from mitochondrial COI gene sequence. Agr. Sci. China., 10. 1041-1048.

A new species of *Enhydrosoma* Boeck, 1872 (Copepoda: Harpacticoida: Cletodidae) from the Black Sea Coast of Turkey with some remarks on the taxonomic status of *E. wellsi* Bodin, 1968

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During a survey that was conducted at the South East Black Sea Coast of Turkey at 10 March 2015, undefined *Enhydrosoma* specimens were encountered in the samples that were taken from 30 m depth of Çamburnu Harbour and described as new to science in detail. The new species differs from all of the known species of the genus by having 4 elements on the distal segment of Periopods(P)3 and P4 exopod (exp) except *E. wellsi* and *E. longifurcatum* but can easily be differentiated from *E. wellsi* by lacking an inner seta on P2-P4 exp-2; by having 2 setae instead of 3 on P1 endopod(enp)-1, 2 setae at antenna (A2) exp instead of one and having a mandibular palp with 3 setae instead of 5. The new species also differs from *E. longifurcatum* by having 4 elements on the distal segment of P3-P4 expand with the form of female P5. On the other hand, it has been concluded that the report of *E. longifurcatum* from the Black Sea given by Apostolov and Marinov (1988) is conspecific with the new species and considered as a synonym of the new species..

Keywords: Taxonomy, New species, Meiofauna.

Recreational boat angling around Çeşme Peninsula, Turkey; methods and valuable catches

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The present study was carried out to determine the catch composition of main recreational angling methods around Çeşme Peninsula. Data were based on the catch records of two recreational boats from 2003 to 2018. Main recreational angling methods were bottom angling, trolling and setlining including many technical varieties for each method. A total of 37 species belonging to 3 taxonomic groups and 19 families were determined. Sparidae was the leading family with 14 species. Fish targeted bottom angling method had the highest variety in the catch composition with 24 species. Total number of retained specimen was calculated to be 26493 corresponding to 4766 kg during the above mentioned period. Among those, the highest number belonged to *Boops boops* (n=7185) and the greatest weight to *Pagellus erythrinus* (847.6 kg). It was found that recreational angling around Çeşme Peninsula included very valuable species such as *Sparus aurata, Dentex dentex, Dicentrarchus labrax* and *Loligo vulgaris*. Squid targeted bottom angling and trolling were determined to be the most species selective methods.

Keywords: Recreational fishing, Çeşme, Fishing tourism

Introduction

Recreational fishing is defined as fishing of aquatic animals (mainly fish) that do not constitute the individual’s primary resource to meet basic nutritional needs and are not generally sold or otherwise traded on export, domestic or black markets (FAO, 2012). Among various methods of recreational fishery, angling is by far the most common one over the world and therefore recreational fishing (RF) is frequently used similarly with angling (Arlinghaus & Cooke, 2009). Globally, number of recreational fishermen was estimated between 220 million and 700 million (World Bank, 2012). Thus, negative effects of RF on marine ecosystems have reached up to serious levels (Ünal & Kıraç, 2013). In addition, it was reported that more than 10% of the total fishery in the Mediterranean was composed by amateur fishery (GFCM, 2010).

Despite its ecological and economical effects, studies focusing on different aspects of angling are scarce. Kaykaç *et al.* (2003) studied the catch efficiency of straight and kirbed hooks in İzmir Bay, Ceyhan & Akyol (2005) reported bluefish angling and the tackles in Marmara region. Ünal *et al.*, (2010) stated the characteristics of marine recreational fishing in the Çanakkale Strait (Turkey). Also, effects of different baits on length and condition of fish in the recreational fishery were investigated by Aydın (2011) in İzmir Bay. Moreover, Tunca *et al*. (2012) exposed the economic value of recreational fishing in Izmir Bay. Soykan and Kınacıgil (2013) reported the technical features and bait preference for European seabass setlining. Soykan & Cerim (2018) stated the general aspects of recreational angling and gave some estimations on catch amounts for Turkey.

Narrow continental shelf of the Aegean Sea with hilly and jagged bottom structures limits the industrial fishing activities in the area (Soykan *et al*., 2016). This case creates a positive oppurtunity for small scale and recreational fishing. Therefore angling becomes an important recreational activity in the Aegean Sea. Çeşme is located in Turkey's westernmost end, on a promontory on the tip of the peninsula that also carries the same name. It is a popular holiday resort and the district center, where two thirds of the district population is concentrated. Çeşme is located 85 km west of İzmir, the largest metropolitan center in Turkey's Aegean Region. It was declared that 5800 boats including yatches and other types of special purpose boats were registered to Çeşme Port Authority in 2018 (pers comm.) which most of them are considered to perform any kind of recreational fishing at least in the summer period.

The aim of the study was to determine the main methods and valuable catch composition of recreational boat angling in Çeşme, Turkish coast of the Aegean Sea.

Material and Methods

Data of the study was based on catch records of two recreational angling boats from 2003 to 2018 from the surrounding waters of Çeşme Peninsula (Figure 1). Bottom fishing, trolling and setlining were personally performed with the participation of other anglers to the fishing practices. A total of 616 fishing cruises were done and 302 of those were participated directly and the catch data were recorded onboard. Data of nonparticipated 314 trials were taken from the catch records of the boats. Length and engine power of the boats were 8 and 10 meters and 45 and 70 hp respectively. Altough the number of anglers on each boat differs depending on the sea-weather conditions and avaliability of anglers, most of the angling trials were peformed by 2 or 3 anglers on each boat. At the end of each cruise, species were counted and weighed due to angling technique used. Discarded species were not included in the study because they were thrown back to the sea immediately as soon as the hook removed from the fish. Depth of bottom angling trials ranged from 20m to 100m, setlining form 2m to 10m and trolling was performed on surface waters (0-10m). Baits were sardine (*Sardina pilchardus*), razor Shell (*Solen vagina*) and mud shrimp (*Upogebia pusilla*) for bottom angling in general. Many types of artificial lures were used in trolling and live baits, commonly annular sea bream (*Diplodus annularis*) and flathead grey mullet (*Mugil cephalus*) were used for setlining. Technical plans of the main angling techniques were given in Figure 2. Squid targeted bottom angling and trolling have the same technical features with only one exception which is the substitution of artificial lures instead of hooks.

Figure 1. Map of the angling area around Çeşme Peninsula covering the period between 2003 and 2018 (White spots illustrate the angling areas).

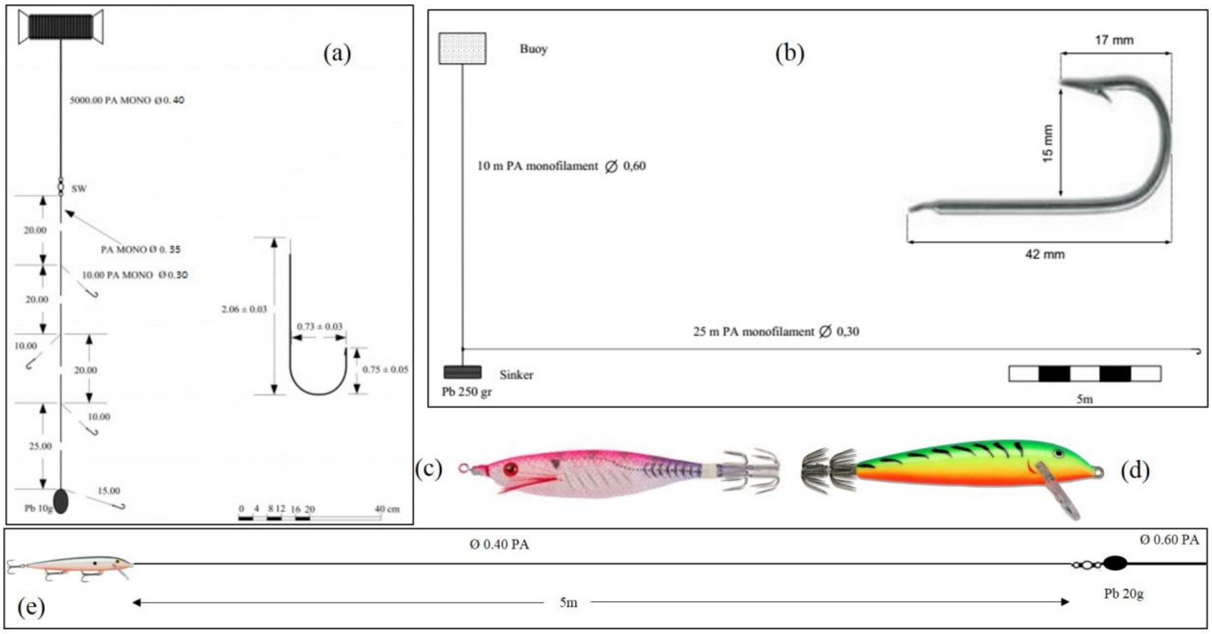

Figure 2. Technical figures of main recreational boat angling methods in Çeşme; a) Bottom angling (Aydın, 2011), b) Setlining (Soykan & Kınacıgil, 2013), c) Squid targeted Yo-Zuri artificial lure (for bottom angling), d) Squid targeted rapala artificial lure sq11 (for trolling) e) Fish targeted trolling (Illustrated lure is Rapala Husky Classic Collection H13 SD / 130mm (Melina) which is one of the most popular lures in trolling around Çeşme).

Results

A total of 26493 individulas belonging to Arthropoda, Mollusca and Chordata correspoding to 4766 kg was captured by two recreational boats from 2003 to 2018. Annual catch of each boat was calculated to be 158 kg. It was found that 37 species were retained by the anglers. These species belonged to 3 taxonomic groups and 19 families. Sparidae was the leading family with 14 species followed by Carangidae with 4 speices. Among the retained species, *Boops boops* had the highest number of individuals (n=7185) and *Pagellus erythrinus* had the greatest weight with 847.6 kg. *Mullus barbatus* was determined to be the least encountered catch with 2 individuals in the study period. Fish targeted bottom angling included the biggest diversity in the catch composition with 24 species while fish targeted trolling and setlining had 14 and 2 species respectively. Squid targeted bottom angling and trolling were found the most species selective methods. Moreover, almost 60% of fish targeted trolling catch composition was composed by *Dicentrarchus labrax*. Retained species of the study including numbers and weights according to angling technique presented in Table 1.

Table 1. Retained species of main angling techniques in Çeşme Peninsula from 2003 and 2018 with number of individuals and species based weights

	Bottom angling				Trolling				Setlining	
	Fish targeted		Squid targeted		Fish targeted		Squid targeted			
	n	W (g)	n	w(g)	n	w(g)	n	w	n	w(g)
ARTHROPODA										
Palinuridae										
Palinurus elephas	3	2600	-	-	-	-	-	-	-	-
MOLLUSCA										
Octopodidae										
Octopus vulgaris	90	131700	-	-	-	-	-	-	-	-
Eledonidae										
Eledone sp.	3	1700	-	-	-	-	-	-	-	-
Loliginidae										
Loligo vulgaris	-	-	1239	316500	-	-	138	34350	-	-

Sepiidae										
Sepia officinalis	21	4800	9	2400	-	-	8	2600	-	-
CHORDATA										
Sparidae										
Pagrus caeruleostictus	3	7500	-	-	-	-	-	-	-	-
Sparus aurata	687	223500	-	-	3	1350	-	-	-	-
Pagellus acarne	4305	459960	-	-	-	-	-	-	-	-
Pagrus pagrus	954	270150	-	-	-	-	-	-	-	-
Spondylisoma cantharus	666	133650	-	-	-	-	-	-	-	-
Diplodus annularis	165	14700	-	-	-	-	-	-	-	-
Spicara sp.	630	62100	-	-	-	-	-	-	-	-
Diplodus vulgaris	3855	628200	-	-	-	-	-	-	-	-
Boops boops	7185	657000	-	-	-	-	-	-	-	-
Dentex macrophthalmus	192	42900	-	-	-	-	-	-	-	-
Pagellus erythrinus	4863	847590	-	-	-	-	-	-	-	-
Diplodus sargus	39	14250	-	-	-	-	-	-	-	-
Dentex dentex	9	4050	-	-	78	101850	-	-	3	4100
Oblada melanura	-	-	-	-	24	6840	-	-	-	-
Scombridae										
Sarda sarda	-	-	-	-	68	88050	-	-	-	-
Scomber japonicus	153	21900	-	-	-	-	-	-	-	-
Scomber scombrus	54	7800	-	-	-	-	-	-	-	-
Scorpaenidae										
Scorpaena sp	30	15600	-	-	-	-	-	-	-	-
Carangidae										
Lichia amia	-	-	-	-	9	39900	-	-	-	-
Trachurus mediterraneus	177	31800	-	-	-	-	-	-	-	-
Trachinotus ovatus	-	-	-	-	15	17400	-	-	-	-
Seriola dumerili	-	-	-	-	18	39000	-	-	-	-
Triglidae										
Chelidonichthys lucerna	3	12900	-	-	-	-	-	-	-	-
Mullidae										
Mullus barbatus	2	300	-	-	-	-	-	-	-	-
Zeidae										
Zeus faber	6	4200	-	-	-	-	-	-	-	-
Moronidae										
Dicentrarchus labrax	-	-	-	-	537	296550	-	-	87	97400
Pomatomidae										
Pomatomus saltatrix	-	-	-	-	66	27900	-	-	-	-
Belonidae										
Belone belone	-	-	-	-	57	9000	-	-	-	-
Sphyraenidae										
Sphyraena sphyraena	-	-	-	-	15	18300	-	-	-	-
Coryphaenidae										
Coryphaena hippurus	-	-	-	-	12	16500	-	-	-	-
Xiphiidae										
Xiphias gladius	-	-	-	-	5	37500	-	-	-	-
Serranidae										
Epinephelus sp	-	-	-	-	6	7800	-	-	-	-

More than 90% of the individuals were captured by fish targeted bottom angling corresponding to 75% of the total weight. It was found that 89% of the total catch in terms of number and 73% in terms of weight belonged to Sparidae family.

Discussion

Recreational angling techniques differed acording to many factors such as region and targeted species. In this study the most common boat angling methods used in Çeşme Peninsula were emphasized and valuable catch composition showed variety including high commercial species such as *Sparus aurata, Dentex dentex, Dicentrarchus labrax* and *Loligo vulgaris*. This case is considered to create a conflict between recreational anglers and small scale fishers as they both target the same species. Lack of scientific studies on recreational angling obstructs to make comprehensive discussions. One of the most highlighted result of the study was the dominancy of sparids in the bottom angling catch composition indicating that members of the family are the most preferred fishes. Trolling was found to be considerably effective on *Dicentrarchus labrax* but size of the species was bigger when capured with setline. Altough the majority of the catch was retained by bottom angling, heavy bait consumption during angling is the negative side of this method. While the main disadvantage of trolling was high fuel consumption, difficulty in setlining was dependence to live bait. During the trials it was observed that anglers were not aware of 5 kg daily catch allowance which is one of the fundamental limitations of Turkish amateur fishery regulation. At this point, education of the anglers with the control and survellience of recreational angling by the relevant authority becomes very crucial in order to maintain sustainable recreational fishery. This is the first study focusing on recreational boat angling in Çeşme Peninsula reporting the methods, catch composition and catch amounts. Further studies are urgently required with reliable and scientific methodologies for conservation of the species and sustainability of recreational angling.

References

Arlinghaus, R. & Cooke, S.J. 2009. “Recreational fisheries: socioeconomic importance, conservation issues and management challenges,” in Recreational hunting, conservation and rurallivelihoods: science and practice, 2009, p. 39–58.

Aydın, İ., 2011. Is natural bait type a stochastic process for size and condition of fishes in the recreational fishery of İzmir Bay?, Mediterranean Marine Science, 12(2):390-400.

Ceyhan, T. & Akyol, O. 2005. The hand lines used in bluefish (*Pomatomus saltatrix* L., 1766) fishery in Marmara Region. Ege Journal of Fisheries and Aquatic Sciences, 22(3-4): 351-355.

FAO, 2012. Recreational Fisheries, FAO Technical Guidelines for Responsible Fisheries, no. 13. Rome, 2012, pp. 176.

GFCM, 2010. Report of the transversal workshop on the monitoring of recreational fisheries in the GFCM area. General Fisheries Commission for the Mediterranean, Rome, Italy, 2010.

Kaykaç, H., Ulaş, A., Metin, C., & Tosunoğlu, Z. 2003. A study on catch efficiency of straight and kirbed hooks at hand line fishing. Ege Journal of Fisheries and Aquatic Sciences, 20(1-2):227-231.

Soykan, O & Kınacıgil, H.T. 2013. Setlining for European Seabass (*Dicentrarchus labrax*, Linnaeus, 1758); Technical features and bait preference. Ege Journal of Fisheries and Aquatic Sciences, 30(2):45-62

Soykan, O. & Cerim, H. 2018. General Aspects of Recreational Angling and Some Estimations on Catch Amounts in Turkey. Düzce Üniversitesi Bilim ve Teknoloji Dergisi, 6(4):1441-1452.

Soykan, O., Akgül, Ş.A. & Kınacıgil, H.T., 2016. Catch composition and some other aspects of bottom trawl fishery in Sığacık Bay, central Aegean Sea, Eastern Mediterranean. Journal of Applied Ichthyology, 32: 542-547

Tunca, S., Ünal, V. & Miran, B., 2012. A preliminary study on economic value of recreational fishing in İzmir Inner Bay, Aegean Sea (Turkey). Ege Journal of Fisheries and Aquatic Sciences, 29 (2):55-62.

Ünal, V. & Kıraç, C, O. 2013. Sorumlu Amatör Balıkçılığa Geçiş. Türkiye’de Sorumlu Amatör Balıkçılığın Geliştirilmesi Kaş Pilot Projesi, Ankara, Turkey: Sualtı Araştırmaları Derneği, pp. 80.

Ünal, V., Acarlı, D. & Gordoa, A., 2010. Characteristics of Marine Recreational Fishing in Çanakkale Strait (Turkey). Mediterranean Marine Science, 11(2):315-330.

World Bank 2012. Hidden Harvest: The global contribution of capture fisheries. Washington, DC, Report number 66469- GLB.

Evidence of eukaryotic (Protozoan and Metazoan) life in the deep-water zone of the Black Sea: A revision of the well-known axiom about "lifelessness" of the permanent hydrogen sulfide zone of the Black Sea

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Deep-water zone of the Black Sea is a unique environment. Unlike shallow-water Black Sea benthic communities, little is known about life in this vast extreme habitat. The purpose of this presentation is to demonstrate modern data of the bathymetric distribution of the benthic fauna (macro -, meio- and microbenthos) along the oxic/anoxic gradient (80-375 m depth) in the North-Western part of the Black Sea and at the outlet area of Istanbul Strait (Bosphorus) down to maximum depths. Several studies have been conducted regarding the changes in the taxonomic structure of the meiobenthic communities, their taxonomic richness and specificity, the distribution of Protozoan and Metazoan taxa, and the presence of benthic organisms in hypoxic/ anoxic bottom conditions containing hydrogen sulfide. All the results form the basis of a new scientific concept: eukaryotic life is possible under strong extreme conditions in the Black Sea. Impressively, representatives of eukaryotic micro - and meiobenthos, which formerly not known for this area, were found at the bottom of the continental slope and at the bathyal zone of the Black Sea. Synthesis of the new data with the already available information on the distribution of benthic fauna along the bathymetric gradient contradicts with the conventional ideas about the absence of life other than microbial availability at great depths in the Black Sea. These data show the need to conduct further large-scale interdisciplinary research at this unique basin environment focusing on the adaptations of its inhabitants to extreme conditions.

Keywords: hypoxia, anoxia, hydrogen sulfide, benthos, bathymetric distribution, Black Sea.

Survey on awareness and attitudes of citizens regarding plastic pollution in Hatay/Samandağ Turkey

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Plastics' low cost, durability, and versatility have earned them a place in every aspect of our lives. The amount of manufactured plastics reached 355 million tons by 2016.. Since 1940s, plastic pollution is becoming a global reality. Although the impact of plastic pollution on the environment has been documented, especially in marine ecosystems, the public's view of this issue has not been adequately documented. In this study, we examined society's point of view on plastic pollution. In addition, we examined the level of consumption of plastic bags that one of the most commonly found plastic waste in the environment. For this purpose, a face-to-face survey was conducted with randomly selected 194 people. It was found that the vast majority of participants (96.4%) continued to use plastics in market and grocery (88.7%) shopping, although they knew that plastics were harmful to the environment. The usage of plastic bags of participants were found to 4.19 plastic bags per shopping day. In addition, considering household size and population of Samandağ, it was found that the annual consumption of plastic bags is around 46 million, of which only 26% is separated for recycling. As a result, participants had a high level of awareness of plastic pollution and they are aware that the plastics is harmful to the environment. However, on the contrary, it was determined that the participants were not willing to transform their awareness to act.

Keywords: Plastic pollution, Public Awareness, Plastic Consumption, Nature Protection

Introduction

In the recent past, plastics have become an industrial product, used in many areas of life, and discarded after use. Their ability to remain in nature without deteriorating for a very long time also makes plastics a pollutant. The amount of manufactured plastics reached 355 million tons by 2016. By 2015, approximately 6300 Mt of plastic waste had been generated 9% of which had been recycled, 12% had been incinerated, and 79% had accumulated in either landfills or the natural environment. If current waste production and management trends continue, approximately 12,000 Mt of plastic waste will be in either landfill or the natural environment by 2050 (Derraik, 2002; Clapp & Swanston, 2009; Gundogdu & Çevik 2017; PlasticEurope, 2017; Gündoğdu *et al.*, 2018).

Negative impacts of plastics were documented as a problem in the marine environment since the 1970s (Hammami *et al.*, 2017). Although the impact of plastic pollution on the environment has been documented, especially in marine ecosystems, the public's view of this issue has not been adequately documented.

In this study, we examined public’s opinion and plastic consumption level in order to fill this knowledge gap. In this context, we conducted a questionnaire-based survey to measure the relationship between plastic consumption of society and its aspects of environmental protection and plastic pollution in Hatay/Samandağ. Samandağ is located northeast Mediterranean Sea (Figure 1). Sandy beaches located in Samandağ are a very important nesting site for *Chelonia mydas*. For this reason, many nature conservation actions is being carried out with focus on *C. mydas* in the region. However, none of these studies has examined the nature conservation, plastic pollution, and its impact. Therefore, for this context, this study is the first study conducted in in the region and even in Turkey

Material and Methods

Study Area

Samandağ is located northeast Mediterranean Sea (Figure 1).

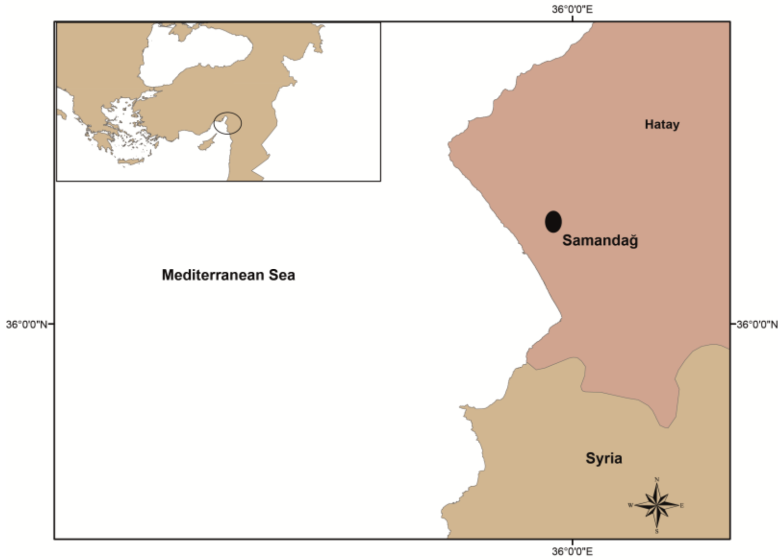

Fig. 1. Study Area

Questionarie Survey

Two separate visits were conducted in June and July 2018 as part of the sampling efforts. A face-to-face survey was conducted with randomly selected people. Within the scope of the survey, 48 questions were directed to participants under three modules. These modules are as follows; 1- Demographic information, 2- Behavioral trends, 3- Nature protection perceptions.

Statistical Analysis

Data was gathered in MS Excel spreadsheet and analyzed using SPSS version 22 software. Chi-squared test was used for identifying statistical difference between categorical variables. All assumptions were tested and met using SPSS. A p value of less than 0.05 was considered statistically significant.

Results and Discussion

A total of 200 questionnaires were completed by individuals that randomly selected. The response rate was 97% (194 of them are used for the analysis). Demographics of the participants are presented in Table 1.

When behavioral trends were examined, it was found that the vast majority of participants (96.4%) continued to use plastics in market and grocery (88.7%) shopping, although they knew that plastics were harmful to the environment (Table 2).

Table 1. Demographics of the participants

		Respondent	Percentage
Gender	**Female**	83	42.78%
	Male	111	57.22%
Age Group	**16 - 24**	56	28.87%
	25 – 34	58	29.90%
	35 -44	27	13.92%
	45-54	29	14.95%
	>55	24	12.37%
Educational background	**Uneducated**	6	3.09%
	Elemantary	67	34.54%
	Secondary	50	25.77%
	University	65	33.51%
	Post Graduate	6	3.09%
Monthly income	**Low**	108	55.67%
	Medium	42	21.65%
	High	32	16.49%
	NR*	12	6.19%

*Not responded

Table 2. Relationship between plastic usage behavior and its effect on environment

		I think plastic waste is harmful to the environment					
		Agree		Not Agree		NR	
I use plastic bags in market and grocery shopping	**Agree**	168	86.6%	0	0.0%	4	2.1%
	Not Agree	15	7.7%	2	1.0%	1	0.5%
	NR	4	2.1%	0	0.0%	0	0.0%
When I buy anything, I take care that the packaging is plastic or not	**Agree**	57	29.4%	1	0.5%	2	1.0%
	Not Agree	113	58.2%	1	0.5%	3	1.5%
	NR	17	8.8%	0	0.0%	0	0.0%
I sort my garbage in my house	**Agree**	52	26.8%	0	0.0%	0	0.0%
	Not Agree	125	64.4%	2	1.0%	5	2.6%
	NR	10	5.2%	0	0.0%	0	0.0%

The usage of plastic bags of participants were found to 4.19 plastic bags per shopping day (Fig. 2). In addition, considering household size and population of Samandağ, it was found that the annual consumption of plastic bags is around 46 million, of which only 26% is separated for recycling. In terms of membership/volunteerism to nature conservation associations, participants were found not to be very enthusiastic (Table 3). However, although participants did not tend to be members of nature conservation associations, they noted that they participated in many clean-up campaigns and nature conservation training (Table 3).

Table 3. Response of some questions

		Frequency
Do you have membership or voluntary participation in any nature conservation association / foundation?	**Yes**	6
	No	188
Have you participated in any nature / environmental education / meeting or seminar-like event before? (Including course)	**Yes**	75
	No	119
Have you participated in any environmental / beach / marine cleanup campaign?	**Yes**	109
	No	85

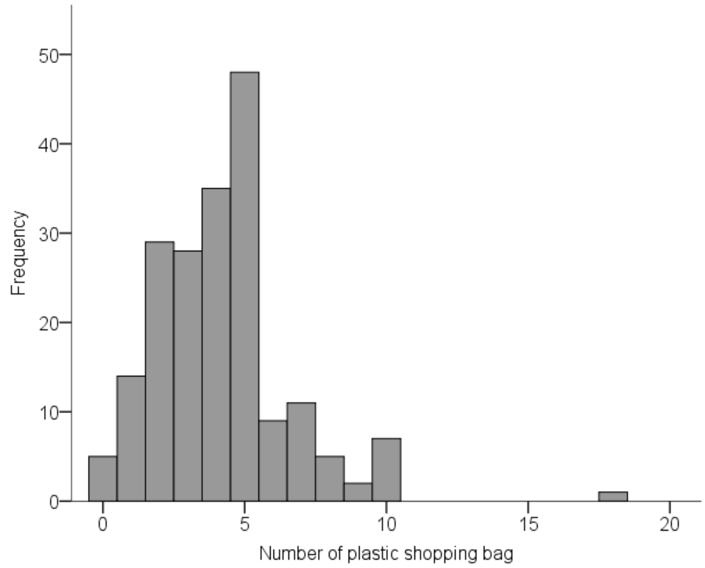

Fig. 3. Nuber of plastig bag usage of participants per shopping day

No statistically significant difference was found between the demographic characteristics and the answers given to the questions (chi-square; p>0.05; Table 4).

Table 4. Relationships between demographics and some statetments

		Pearson Chi-Square Test Value	p
I use plastic bags in market and grocery shopping	Gender	0.901	0.635
	Age Group	8.421	0.39
	Educational Background	4.49	0.81
	Montly Income	4.498	0.81
When I buy anything, I take care that the packaging is plastic or not	Gender	0.872	0.647
	Age Group	10.66	0.221
	Educational Background	8.197	0.414
	Montly Income	7.952	0.242
I sort my garbage in my house	Gender	1.826	0.401
	Age Group	5.489	0.704
	Educational Background	14.626	0.067
	Montly Income	7.468	0.28
I think plastic waste is harmful to the environment	Gender	3.868	0.145
	Age Group	7.538	0.48
	Educational Background	10.729	0.218
	Montly Income	3.598	0.731

As a result, participants had a high level of awareness of plastic pollution and they are aware that the plastics is harmful to the environment. However, on the contrary, it was determined that the participants were not willing to transform their awareness to act.

Acknowledgements

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References

Clapp, J., & Swanston, L., 2009. Doing away with plastic shopping bags: international patterns of norm emergence and policy implementation. Environmental Politics, 18(3), 315-332.

Derraik, J. G., 2002. The pollution of the marine environment by plastic debris: a review. Marine Pollution Bulletin, 44(9), 842-852.

Gündoğdu, S., & Çevik, C., 2017. Micro-and mesoplastics in Northeast Levantine coast of Turkey: the preliminary results from surface samples. Marine Pollution Bulletin, 118(1-2), 341-347.

Gündoğdu, S., Çevik, C., Ayat, B., Aydoğan, B., & Karaca, S., 2018. How microplastics quantities increase with flood events? An example from Mersin Bay NE Levantine coast of Turkey. Environmental Pollution, 239, 342-350.

Hammami, M. B. A., Mohammed, E. Q., Hashem, A. M., Al-Khafaji, M. A., Alqahtani, F., Alzaabi, S., & Dash, N., 2017. Survey on awareness and attitudes of secondary school students regarding plastic pollution: implications for environmental education and public health in Sharjah city, UAE. Environmental Science and Pollution Research, 24(25), 20626-20633.

PlasticsEurope, 2017. PlasticsEurope: Plastics – the Facts 2015/2016.

Relationship of Otolith Size to Standard Length of the Tigris Bream (*Acanthobrama marmid* Heckel, 1843) in Tigris River, Şırnak, Turkey

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The relationships between standard length (SL) and otolith length (OL), width (OWi) and weight (OWe) were examined for Tigris bream (*Acanthobrama marmid* Heckel, 1843) from Güçlükonak Location of Tigris River. In total, 143 specimens collected from every month using nets from January to December 2015. There were no significant differences between left and right otolith ($p>0.05$). Samples consisted of fish varying in standard length from 8.8 to 14.8 cm, otolith length from 1.49 to 2.86 mm and otolith weight from 0.0015 to 0.0048 g. While the relationships between fish length and otolith length had the highest coefficient of determination (R^2=0.7114) and the relationships between fish length and otolith weight had the lowest coefficient of determination (R^2= 0.6063). This research provide a reliable tool in feeding studies and prey identification.

Keywords: Otolith, *Acanthobrama marmid*, Tigris bream, Tigris River, Şırnak

Introduction

Acanthobrama marmid Heckel, 1843, the main distribution areas of the Tigris and Euphrates river systems, is a species that is not economically important as human food. (Geldiay ve Balık, 1999). Biological properties of *A. marmid* and age determination studies are available (Kelle, 1978; Çolak, 1982; Özdemir, 1982; Polat, 1986; Aydın ve Şen, 1995; Ünlü vd. 1994).

Studies on determining growth rate using the relationship between growth in bony structures and fish size in fish are quite common. The relationship between the length of the otoliths and the length of the fish from the bony structures in the fish can be confirmed by estimating the fish size by the length of the otoliths and a value different from the expected when the otolith is aged. It also reported that the weight of otoliths can be used to determine the fish age. (Samsun and Samsun, 2006).

Otolith structures show great differences between fish species, especially sagittal otoliths, and are considered to be species-specific (Furlani et al., 2007). There are many studies on otolith biometry of fish species. *Capoeta capoeta umbla* (Şen et al., 2001), *Carassius gibelio* (Bostancı, 2005), *Scophthalmus maeoticus* (Samsun and Samsun, 2006), *Trachurus mediterraneus* (Bostancı, 2009), *Lutjanus bengalensis* (Jawad et al., 2011), *Deltentosteus quadrimaculatus, Gobius niger, Lesueurigobius friesii* (İlkyaz et al., 2011), *Scorpaena porcus* (Bostancı et al., 2012a), *Arnoglossus laterna* (Bostancı et al., 2012b), *Citharus linguatula* (Cengiz et al., 2012a), *Lepidorhombus boscii* (Cengiz et al., 2012b), *Salmo truta macrostigma* (Başusta et al., 2013a), *Lepidotrigla dieuzeidei* (Başusta et al., 2013b), *Pagrus pagrus* (İşmen et al., 2013), *Capoeta umbla* (Dörtbudak and Özcan, 2015) Some studies have been carried out on otolith biometry of the species.

In this study, the relationship between *Acanthobrama marmid* total length (TL) and otolith length (OL) and width (OW) was investigated and it was aimed to provide a reliable tool in nutrition studies and hunting studies.

Material and Methods

The fish samples were collected monthly using nets between January and December 2015 in Tigris River, Şırnak. The fish were measured for standard length (SL) to the nearest 1 mm and weighed to the nearest 0.01 g for. Sagital otoliths were removed, cleaned and preserved dry in labeled boxes. Otolith length and otolith width were measured to the nearest 1 µm using (Olympus SZ61TR+Olympus LC20). Otolith weights were measured to the nearest 0.0001 g. The rigth and left otoliths were dealt with separately. Broken and damaged otoliths were excluded from the calculations.

Differences between the lengths of the right and left otoliths for each species were tested using paired t-test. The relationships between otolith length and fish length were calculated using least squares regression equations to predict the standard length and and weight of the original fish from otolith length. The otolith dimensions-standard length relationships were examined by using the following equation: ($y=a+b*x$), where *y* is otolith length, *x* is fish standard length, *a* is intercept value, *b* is coefficient value (Basusta et al., 2013a).

Otolith samples for analysis were obtained from 145 specimens (96 female and 49 male). Standard length and otolith length measured to the nearest 1 mm and 1 µm, respectively. Sex was identified macroscopically following the examination of gonads.

Results

The minimum and maximum otolith length and weight are 1.49, 2.86 mm; and 0.0015, 0.0048 g, respectively. There were no significant differences between left and right otolith ($p>0.05$). Samples consisted of fish varying in standard length from 8.8 to 14.8 cm. The relationship between fish length and otolith length was as $y=5.261x+0.302$ ($R^2=0.7114$), between fish length and otolith width was as $y=5.567x+0.320$ ($R^2=0.6565$), between fish length and otolith weight was as $y=0.0004x -0.0016$ ($R^2=0.6063$).

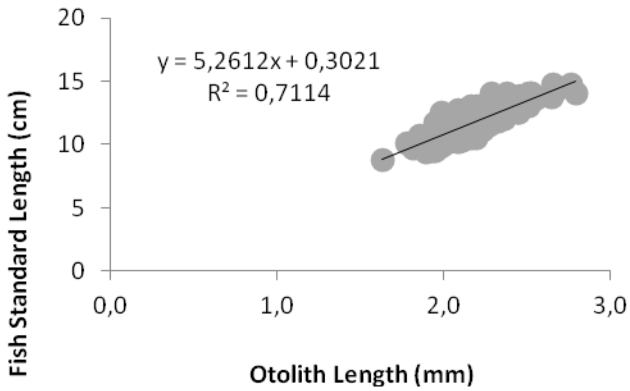

Figure 1. Relationship between stnadard length and otolith length

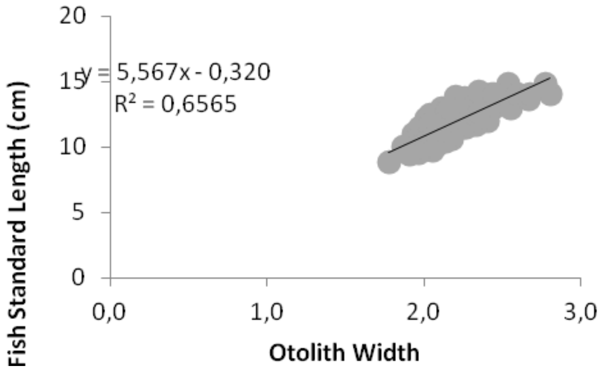

Figure 2. Relationship between stnadard length and otolith width

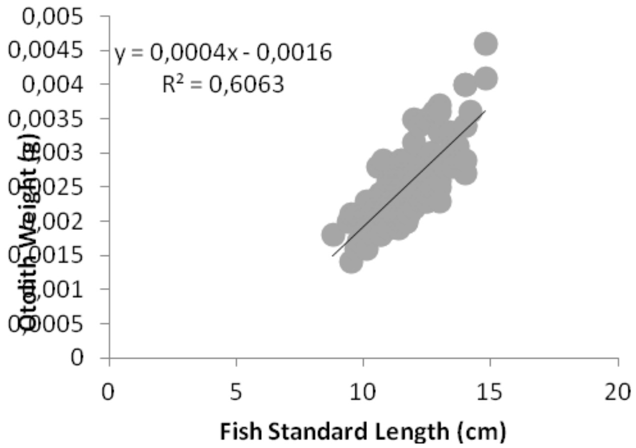

Figure 3. Relationship between stnadard length and otolith length

While the relationships between fish length and otolith length had the highest coefficient of determination (R^2=0.7114) and the relationships between fish length and otolith weight had the lowest coefficient of determination (R^2= 0.6063).

Discussion

This is the first information on otolith biometry of *Acanthobrama marmid* from Şırnak. Otolith length and otolith width were found to highly reliable measurement for determining the fish length. The maximum size of Tigris Bream was 14,8 cm standard length, while the heaviest individual was 55,45 g weight in all individuals.

Former studies were generally focused on the relationship between otolith length or otolith height and fish length (Şen et al., 2001; Bostanci, 2009; Jawad et al., 2011a; Cengiz et al., 2012a-b; Başusta et al., 2013b; İşmen et al., 2013; Dörtbudak and Özcan, 2015). Although studies on the relationship between otolith weight and fish length have not been studied (Jawad et al., 2011b; Düşükcan et al., 2015; Dehghani et al., 2016; Mat-Piah et al., 2017; Sayın and Çalta, 2017). So, in this study on the relationship between otolith weight and fish length of Tigris bream were examined and there was a strong positive correlation (R^2=0.6063). İlkyaz et al., 2011; Jawad et al., 2011b; Düşükcan et al., 2015; Dehghani et al., 2016; Mat-Piah et al., 2017; Sayın and Çalta, 2017 reported similar patterns.

Consequently, studies on the otolith biometry of Tigris Bream are generally unavailable.

Hence, relationship between fish length and otolith size of *Acanthobrama marmid* in Tigris River given in this study provides some tools for the study of food habits of piscivores and size of fish in archaelogical samples.

References

Aydın, R. ve Şen, D. 1995. Keban Baraj Gölü Ova Bölgesi Balıklarından *Acanthobrama marmid* Heckel, 1843'ün Biyolojik Özelliklerinin İncelenmesi, Fırat Üniversitesi Fen ve Mühendislik Bilimleri Dergisi, 7, 1, 11-23.

Başusta, A., Özer, E.İ., Girgin, H., 2013a. Otolith Dimensions-Fish Length Relations Between Of Red-Spotted Trout (*Salmo trutta macrostigma* (Dummeril, 1858)) in Munzur River. Journal of FisheriesSciences.com, 7(1): 22-29. DOI: 10.3153/jfscom.2013003.

Basusta, A., Bal, H., Aslan, E., 2013b. Otolith biometry- total length relationships in the population of hazar bleak, *Alburnus heckeli* (Battalgil, 1943) inhabiting Lake Hazar, Elazığ, Turkey. Pakistan J. Zool., 45(4): 1180-1182.

Bostancı, D. 2005. Bafra Balık Gölü ve Eğirdir Gölü'nde yaşayan balık populasyonunda opak birikim analizi ile yaş doğrulaması. Doktora Tezi. Ondokuz Mayıs Üniversitesi.

Bostancı, D. 2009. Sarı kuyruk İstavrit *Trachurus mediterraneus* (Steindachner, 1868)'un Otolit Özellikleri ve Bazı Populasyon Parametreleri. Fırat Üniv. Fen Bilimleri Dergisi, 21(1): 53-60.

Bostancı, D., Yılmaz, S., Polat, N. ve Kontaş, S. 2012a. İskorpit *Scorpaena porcus* L. 1758'un otolit biyometri özellikleri. Karadeniz Fen Bilimleri Dergisi, 2(6): 59-68.

Bostancı, D., Uçkun-İlhan, D. ve Akalın, S. 2012b. Küçük pisi balığı, *Arnoglossus laterna* (Walbaum, 1792)'nın otolit özellikleri, Karadeniz Fen Bilimleri Dergisi, 2(6): 1-10.

Cengiz, Ö., İşmen, A., Özekinci, U., Öztekin, A., 2012a. Relationship between total length-otolith size of Atlantic Spotted Flounder, *Citharus linguatula* (Linnaeus, 1758), from Saros Bay (Northern Aegean Sea, Turkey). Marmara Üniversitesi Fen Bilimleri Dergisi, 24(3): 68-76. http://dx.doi.org/10.7240/mufbed.v24i3.299

Cengiz, Ö., İşmen, A., Özekinci, U., Öztekin, A., 2012b. Relationship between total length-otolith size of four-spotted megrim, *Lepidorhombus boscii* (Risso, 1810), from Saros Bay (Northern Aegean Sea, Turkey). Erciyes University Journal of the Institute of Science and Technology, 28(5): 429-434.

Çolak, A. 1982. Keban Baraj Gölü'nde Bulunan Balık Stoklarının Populasyon Dinamiği. Doğa Bilim Dergisi, Seri D, 6, 1, 1-14.

Dehghani, M., Kamrani, E., Salarpouri, A., Sharifian, S., 2016. Otolith dimensions (length, width), otolith weight and fish length of *Sardinella sindensis* (Day, 1878), as index for environmental studies, Persian Gulf, Iran. Marine Biodiversity Records, 9: 44.

Dörtbudak, M.Y., Özcan, G., 2015. İkizce Çayı'ndaki (Şırnak) siraz balığının [*Capoeta umbla* (Heckel, 1843)] otolith biyometrisi- balık boyu arasındaki ilişki. Yunus Araştırma Bülteni, 1: 67-72.

Düşükcan, M., Çalta, M., Eroğlu, M., 2015. Otolith biometry-fish length relationship in *Barbus grypus* Heckel, 1843 inhabiting Keban Dam Lake (Elazığ, Turkey). Yunus Araştırma Bülteni, 3:21-29.

Furlani, D., Gales, R., & Pemberton, D. (2007). Otoliths of Common Australian Temperate Fish : A Photographic Guide. Collingwood, VIC, Australia: CSIRO Publishing.

Geldiay, R. ve Balık, S., 1999. Türkiye Tatlısu Balıkları, Ege Üniversitesi Basımevi, Bornova, İzmir, S:242, 330, 334, 336.

İlkyaz, A.T., Metin, G., Kınacıgil, H.T., 2011. The use of otolith length and weight measurements in age estimations of three Gobiidae species (*Deltentosteus quadrimaculatus*, *Gobius niger*, and *Lesueurigobius friesii*). Turk J Zool., 35(6): 819-827.

İşmen, A., Arslan, M., Gül, G., Yığın, C.Ç., 2013. Otolith morphometry and population parameters of red porgy, *Pagrus pagrus* (Linnaeus, 1758) in Saros Bay (North Aegean Sea). Ege J Fish Aqua Sci., 30(1): 31-35.

Jawad, L., Ambuali, A., Al-Mamry, J.M., Al-Busaidi, H.K., 2011a. Relationship between fish length and otolith length and width in the lutjanid fish, *Lutjanus bengalensis* (Lutjanidae) collected from Muscat City coast on the Sea of Oman. J. Black Sea/Mediterranean Environment, 17(2): 116-126.

Jawad, L., Al-Mamry, J., Al-Busaidi, H., 2011b. Relationships between fish length and otolith length, width and weight of the Indian Mackerel *Rastrelliger kanagurta* (Cuvier, 1817) collected from Sea of Oman. Ribarstvo, 69(2): 51-61.

Kelle, A. 1978. *Ligula intestinalis* (L.)'in Bazı Balık Türlerinin (*Acanthobrama marmid* Heckel, 1843; *Chalcalburnus mossulensis* Heckel, 1843) Boy-Ağırlık İlişkileri ve Biyometrik Karakterleri Üzerine Etkileri, Ege Üniversitesi Fen Fakültesi Dergisi, Seri B, 2, 2, 95-108.

Mat-Piah, R., Kamaruddin, S.A., Abdul-Kadir, N.H., Ambak, M.A., 2017. Relationship between otolith measurements with the size of Areolate grouper, *Epinephelus areolatus* in Terengganu Waters, Malaysia. Journal of Fisheries and Aquatic Science, 12(2): 90-94. Özdemir, N. 1982. Keban Baraj Gölü'nde Avlanan *Acanthobrama marmid*'in Et Verimi ile İlgili Özellikler. Fırat Üniversitesi Fen Fakültesi Dergisi, 1, 1, 58-62.

Polat, N. 1986. Keban Baraj Gölündeki Bazı Balıklarda Yaş Belirleme Yöntemleri ile Uzunluk Ağırlık İlişkileri. Fırat Üniversitesi Fen Bilimleri Enstitüsü, Elazığ (Doktora Tezi, yayınlanmamış).

Samsun, N., Samsun, S., 2006. Kalkan (*Scophthalmus maeoticus* Pallas, 1811) balığının otolit yapısı, yaş ve balık uzunluğu- otolit uzunluğu ilişkilerinin belirlenmesi. Fırat Üniv. Fen Müh. Bilim Derg., 18: 181- 187.

Sayın, B., Çalta, M., 2017. Otolith biometry of mirror carp (*Cyprinus carpio* Linnaeus, 1758) living in Keban Dam Lake. Fırat Univ. Journal of Science, 29(1): 27-32.

Şen, D., Aydin, R., Çalta, M., 2001. Relationships between fish length and otolith length in the population of *Capoeta capeta umbla* (Heckel, 1843) inhabiting Hazar Lake, Elazig, Turkey. Arch. Pol. Fish., 9(2): 267-272.

Ünlü, E., Balcı, H. ve Akbayın, H. 1994. Some Biological Charakteristics of the *Acanthobrama marmid* Heckel, 1843 in the Tigres River (Turkey) Tr. J. Of Zoology, 18, 131-139.

Guitarfishes in Cyprus: shedding light on the occurrence and the distribution of two endangered species in the Eastern Mediterranean

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Two guitarfish species exist in the Mediterranean, the common guitarfish (*Rhinobatos rhinobatos* (Linnaeus, 1758)) and the blackchin guitarfish (*Glaucostegus cemiculus* (Geoffroy Saint-Hilaire, 1817)). Both species are listed as Endangered in the global, as well as the Mediterranean, assessment of the IUCN Red List of Threatened Species due to the steep decline of their populations, primarily by fisheries overexploitation. The present study was carried out in the context of the citizen science Project of iSea “Sharks and Rays in Greece and Cyprus”, which aim to advance our knowledge regarding elasmobranchs in the two countries, utilizing citizen science and local ecological knowledge. Overall a total of 15 guitarfish records with 23 specimens from the coastline of Cyprus were obtained, sixteen of them identified as *G. cemiculus*, while four of them identified as *R. rhinobatos*. In all cases, reports and specimens were obtained from recreational fishers and they were mostly caught and released (C&R). In addition, by utilizing the local ecological knowledge of sea users in the country we discuss the potential of the Cypriot waters as an important area for the guitarfish population in the Eastern Mediterranean.

Keywords: Common guitarfish, Blackchin guitarfish, Cyprus, Citizen science

Introduction

Guitarfishes are characterized by special life history traits, inhabiting soft bottoms in generally shallow coastal waters, often entering estuaries and freshwater zones (Abdel-Aziz *et al.*, 1993). In the Mediterranean Sea, two species of guitarfish are present, namely the common guitarfish (*Rhinobatos rhinobatos* (Linnaeus, 1758)) and the blackchin guitarfish (*Glaucostegus cemiculus* (Geoffroy Saint-Hilaire, 1817)). Both species occur in all Mediterranean countries with the exception of Malta and France, where only *R. rhinobatos* is present (Newell, 2016). Up till now, there is not much data regarding these species occurrence, abundance, life history, and biology in the Mediterranean, but both species are found more easily in warmer waters of the southern and eastern Mediterranean countries (Newell, 2016). They are also found on literature reports regarding research studies for cartilaginous fishes in general in the European Mediterranean countries, like southern France (Capapé *et al.*, 2006), Italy (Psomadakis *et al.*, 2009) and Greece (Giovos *et al.*, 2018).

In the Cypriot waters information is scarce about the occurrence, distribution and abundance of these species (Hadjichristophorou, 2006), compared to the other countries of the Levantine Sea, like Turkey (Ismen *et al.*, 2007, Filiz *et al.*, 2016), Syria (Saad *et al.*, 2006), Lebanon (Lteif, 2015), Israel (Golani, 2006) and Egypt (Abdel-Aziz *et al.*, 1993). In most cases, findings of guitarfish specimens, are part of an excessive study regarding commercial fisheries, as the specimens were provided from fisheries landings, either targeted or bycatch (Newell, 2016).

The aim of this study is to shed light on the distribution of these two endangered guitarfish species, utilizing citizen science and local ecological knowledge, which are frequently used when other data are not available.

Material and Methods

In the context of this study, citizen science reports accompanied by photographic evidence were collected between February and May 2018, as a part of the project "Sharks and Rays in Greece and Cyprus" coordinated by iSea under the Mediterranean Elasmobranch Citizens Observations (M.E.C.O.) initiative. For this purpose, an open call was posted on the social media platforms of the organisation, calling for reports of guitarfish specimens. People reporting sightings were requested to provide photographic evidence and information on the specimens' size (total length, TL) and/or weight, depth of the observation (when applicable), date of the observation, the exact location (if possible with coordinates) and the number of the observed individuals. All pictures retrieved, were checked for their authenticity using the automatic image recognition tool of Google. Original images were photo-identified to the lowest possible taxonomic level by a taxonomic expert of this taxa, using the identification guide of FAO (Serena, 2005).

Results

A total of 15 guitarfish observations, with 23 specimens from the coastline of Cyprus were obtained; 14 of which were accompanied with photographic evidence (Figure 1). Sixteen of the observed animals were identified as *G. cemiculus* (≈69.5%; N=16), four as *R. rhinobatos* (≈17.3%; N=4), while the rest were not possible to be identified at a species level (recorded as Guitarfish) (Table 1). In all cases, the observations were reported by recreational fishers. In most cases (≈91.3%, N=21), the individuals were caught and released (C&R), while two of them were retained. Most of the observed specimens were recorded in the south coast of Cyprus, with the majority found in Larnaca Bay (≈78.2%, N=18), while in three cases the exact location of the record was not identified.

Figure 1. ***Rhinobatos rhinobatos*** **(a, b, d) and** ***Glaucostegus cemiculus*** **(f, g). Some of the specimens reported in the context of this study. Pictures c and e were not possible to be identified at the species level.**

Table 1. Citizen science observations of guitarfish specimens reported from Cyprus (N: number of specimens)

#	Date	Location	Species	N	TL (cm)	Depth (m)	Substrate
1	-	-	*R. rhinobatos*	1	-	-	Sandy
2	03.10.17	Perivolia, Larnaca	Guitarfish	1	-	-	Sandy
3	07.10.17	Perivolia, Larnaca	*R. rhinobatos*	1	35	0.8	Sandy
4	09.10.17	-	*R. rhinobatos*	1	-	-	Sandy
5	07.09.17	Pafos	Guitarfish	1	-	-	Sandy
6	01.11.15	-	*G. cemiculus*	1	-	-	Sandy
7	05.08.13	Argaka	*G. cemiculus*	1	-	-	-
8	08.02.18	Perivolia, Larnaca	*G. cemiculus*	1	-	-	-
9	30.04.18	Perivolia, Larnaca	Guitarfish	1	-	-	-
10	26.06.18	Perivolia, Larnaca	Guitarfish	1	-	1.5	-
11	20.06.18	Perivolia, Larnaca	*G. cemiculus*	1	-	1.5	-
12	15.07.18	Larnaca	*G. cemiculus*	1	25	-	-
13	18.08.18	Mazotos, Larnaca	*R. rhinobatos*	1	70	2	Rocky
14	21.09.18	Perivolia, Larnaca	*G. cemiculus*	9	15-35	0.3-0.5	Sandy
15	22.09.18	Finikoudes, Larnaca	*G. cemiculus*	1	35	1.5	Sandy

Discussion

Our work aims to contribute to advancing the conservation of elasmobranchs in the Eastern Mediterranean by providing additional information regarding the occurrence of guitarfishes in Cyprus. The population of guitarfishes in the Mediterranean has declined drastically in the last decades, as a result of the fisheries overexploitation and the habitat degradation of the nursery grounds (Newell, 2016). Therefore, both guitarfish species are listed as Endangered in the IUCN Red List of Threatened Species (Bradai & Soldo, 2016; Soldo & Bradai, 2016) and their fishing, in the EU countries, has been prohibited (GFCM/36/2012/3; Council Regulation 2017/1275) while international conservation measures are also in place.

Guitarfish used to be part of commercial fisheries landings, especially of the bottom-trawls. In this study all observations were obtained from recreational fishers, stating that these species can also be a part of the multispecies recreational fisheries pattern of the Mediterranean (Giovos *et. al*, 2018). To this extent, it is important to raise the awareness of the recreational fishing community regarding the conservation status and the applied legislation measures in order to advance their conservation in the Mediterranean basin.

Cyprus may be an important area for the Eastern Mediterranean guitarfishes' population, given that most fishers reported us that they are a common catch in their fishing areas. In addition, we suspect that the Cypriot sea is a spawning ground for guitarfish in the Mediterranean, due to the similarity of our observations with those from Israel (a newly discovered spawning ground of guitarfish), namely the observations of newborn individuals (25-35 cm; observations 3, 14 and 15) reported between late September-October (unpublished data by Barak Azrieli).

This claim about the abundance of guitarfishes in Cyprus must be further investigated. Future research should focus on utilizing more the ecological knowledge of sea users along with biological sampling, for outlining the species distribution and the connectivity with the population found in the coasts with proximity to Cyprus, namely Israeli (Golani, 2006) and southeastern Turkish coasts (Ismen *et al.*, 2007), known nursery grounds for guitarfish species (Newell, 2016).

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References

Abdel-Aziz, S.H., Khalil, A.N, Abdel-Maguid, S.A., 1993. Reproductive cycle of the common guitarfish, *Rhinobatos rhinobatos* (Linnaeus, 1758), in Alexandria waters the Mediterranean Sea. Aust. J. Mar. Freshwater Res., 44: 507-517.

Bradai, M.N., Soldo, A., 2016. *Rhinobatos rhinobatos*. The IUCN Red List of Threatened Species 2016: e.T63131A16527789.

Capapé, C., Guélorget, O., Vergne, Y., Marquès, A., Quignard, J.P., 2006. Skates and rays (Chondrichthyes) from waters off the Languedocian coast (southern France, northern Mediterranean). Ann Ser Hist Nat, 16pp.

Council Regulation (EU) 2017/127 of 20 January 2017 fixing for 2017 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, Official Journal of the European Union L 24/1, 28.1.2017.

Filiz, H, Bilge, G., Giannetto, D., Yapıcı, S., 2016. New sighting of the endangered species blackchin guitarfish, *Rhinobatos cemiculus*, in the South Aegean Sea. Marine Biodiversity Records, 9:1-4.

General Fisheries Commission for the Mediterranean Recommendation GFCM/36/2012/3 on fisheries management measures for conservation of sharks and rays in the GFCM area.

Giovos, I., Chatzispyrou, A., Doumpas N., Stoilas, V.O., Moutopoulos, D.K., 2018. Using unconventional sources of information for identifying critical areas for the endangered guitarfish in Greece. Journal of the Black Sea/ Mediterranean Environment, 24(1): 38-50.

Giovos, I., Keramidas, I., Antoniou, C., Deidun, A., Font, T., Kleitou, P., Lloret, J., Matic-Skoko, S., Said, A., Tiralongo, F., Moutopoulos, D.K., 2018. Identifying recreational fisheries in the Mediterranean Sea through social media. Fisheries Management and Ecology, 25: 287–295.

Golani, D. 2006. Cartilaginous fishes of the Mediterranean coast of Israel. In: N. Başusta, Ç. Keskin, F. Serena & S. Bernard (eds.) International workshop on Cartilaginous fishes in the Mediterranean. Istanbul, Turkey: Turkish Marine Research Foundation, 95-100.

Hadjichristophorou, M., 2006. Chondrichthyes in Cyprus. In: N. Başusta, Ç. Keskin, F. Serena & S. Bernard (eds.) International workshop on Cartilaginous fishes in the Mediterranean. Istanbul, Turkey: Turkish Marine Research Foundation, 162-168.

Ismen, A., Cigdem, Y., Ismen, P., 2007. Age, growth, reproductive biology and feed of the common quitarfish (*Rhinobatos rhinobatos* Linnaeus, 1758) in Iskenderun Bay, the eastern Mediterranean Sea. Fisheries Research, 84(2): 263-269.

Lteif, M., 2015. Biology, distribution and diversity of cartilaginous fish species along the Lebanese coast, eastern Mediterranean. Ecology, environment. HAL: Université de Perpignan Via Domitia. 262pp.

Newell, B.N., 2016. Draft Status Review Report of Two Species of Guitarfish: Rhinobatos rhinobatos and Rhinobatos cemiculus. Draft Report to National Marine Fisheries Service, Office of Protected Resources. September 2016. 62 pp.

Psomadakis, P.N., Maio, N., Vacchi, M., 2009. The chondrichthyan biodiversity in the Gulf of Naples (SW Italy, Tyrrhenian Sea): A historical overview. Cybium, 33: 199-209.

Saad, A., Ali, M., Seret, B., 2006. Shark Exploitation and Conservation in Syria. In: N. Başusta, Ç. Keskin, F. Serena & S. Bernard (eds.) International workshop on Cartilaginous fishes in the Mediterranean. Istanbul, Turkey: Turkish Marine Research Foundation, 202-208.

Serena, F., 2005. Field Identification Guide to the Sharks and Rays of the Mediterranean and the Black Sea. Food and Agriculture Organisation of the United Nations, Rome 2005.

Soldo, A., Bradai, M.N., 2016. *Glaucostegus cemiculus*. The IUCN Red List of Threatened Species 2016: e.T63132A81165103.

Commercial Polychaetes found in Turkish Seas

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This study is on the present status polychaeta species which have commercial values in the Turkish Seas and alternative species. A total of 12632 species of polychaetes which has dense populations, high meat yield and long life are known in the world. These polychaetes are also used as fish prey and among these, 32 species have commercial value. 709 of a total of 11200 species are known in the Mediterranean are distributed on the Turkish coast. The commercial species in the Turkish Seas are *Diopatra neapolitana*, *Hediste diversicolor*, *Perinereis cultrifera*, and *Ophelia bicornis*. When the distributions of these species on Turkish coast are considered, 4 species from the Aegean Sea, 3 in the Turkish Straits System, 2 from Anatolian coast of the Black Sea, and 1 species in the Mediterranean are known. 4 species cited above have high catch rates and are used as a fish feed. Therefore, it is necessary the presence of alternative species in Turkish Seas. These alternative species in the Mediterranean are *Eunice oerstedi*, *Marphysa sanguinea*, *Sabella spallanzani*, and *Pseudonereis anomala*. *Pseudonereis anomala* is an species and recently, has been sold with the name blue worm in fish markets. Moreover, the sale of *Perinereis aibuhitensis*, a species called ocean worm and imported from abroad, is no longer allowed in our country.

Keywords: Commercial polycheata, fish bait, exotic, distribution, Turkish Seas.

Introduction

Sportive fishing causes an increase in demand for live fish food. Several of species used as live fish prey in Turkish Seas are madya (*Borinus brandaris*, *Hexaplex trunculus)*, tube worm (*Diopatra neapolitana*), lettuce / red wolf (*Hediste diversicolor*), green crab (*Carcinus aestuarii*), palaemonid shrimp (*Palaemon serratus*), penaeid shrimp (*Parapenaus longirostris*), sulunes (*Solan marginatus*), and a calf (*Sepia officinalis*). These species are collected from their natural habitats but they aren't cultivated. In amateur fishing, the type of swearing, freshness and abundance play a very important role. In İzmir, where has a very important place in fish feed, annual minimum fish meal sales is 442.652 TL and maximum is 769.210 TL (Aydın & Ölçek, 2017). Pipe worm (*Diopatra neapolitana*) which is found only in İzmir Bay is the most valuable live feed (Aydın & Ölçek, 2017).

A total of 4 species with economic value (*Diopatra neapolitana*, Nereis *diversicolor*, *Perinereis cultrifera*, *Ophelia bicornis*) are distributed on the Turkish shores (Dagli et al., 2005, Öztürk & Ergen, 1994, Doğan et al., 2007). In this study, the knowledge on the evaluation forms, alternative types, and the distribution of polychetes in Turkish Seas are given.

Material and Methods

In order to identify the alternative evaluation forms, types, distributions, and production quantities of polychetes with commercial value in Turkey the relevant literature were considered. For obtaining the information on several species sold which are not included in the statistics and imported from abroad it have been discussed with those who collect and import these species.

Results

A total of 4 species of polychetes by commercial value in Turkish Seas were recorded up to date. The number of species known has been updated as 6 species by this study (Figure 1; Table 1).

Table 1. Distribution of polychetes with commercial value in Turkish Seas (* new economical species).

Species	Mediterranean	Aegean	The Turkish Straits System	Black Sea
Diopatra neapolitana Delle Chiaje, 1841		+		
Hediste diversicolor (O. F. Müller, 1776)	+	+	+	+
Ophelia bicornis Savigny, 1818		+	+	+
Perinereis cultrifera (Grube, 1840)	+	+	+	
**Pseudonereis anomala* Gravier, 1899	+	+		
**Perinereis aibuhitensis* (Grube, 1878)		?		?

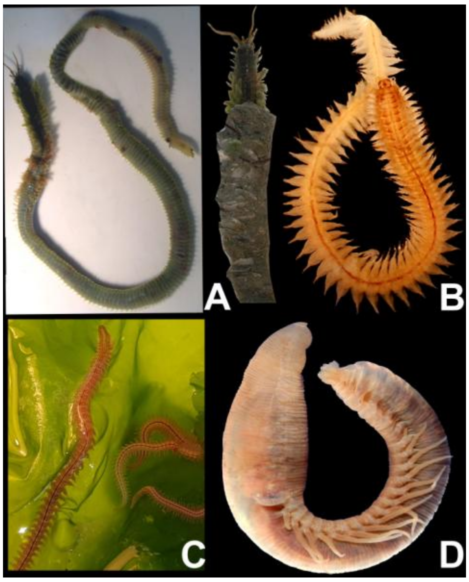

Figure 1. General view of commercial polychaetes (A: Whole animal and anteriör end, dorsal view of *Diopatra neapolitana*; B: Whole animal, dorsal view of *Perinereis cultrifera*; C: Anteriör and posteriör end, dorsal view of *Hediste diversicolor*; D: Whole animal, lateral view of *Ophelia bicornis*).

Disscussion

The increasing demand for amateur and professional fishing together with the increasing population has increased the demand for fish prey. With the blocking of import of *P. aibuhitensis* that is brought from abroad 5 polychaeta species are sold as live fish prey in Turkey. Sulunes is the highest selling value (35%) in İzmir where is center of the live fish feed (Aydin & Ölçek, 2017) and it is followed by pipe worm (%32), ghost crab (%11), palaemonid shrimps (%6) and red worm (%3).

In order to meet increasing demand, domestic species must present in the markets. *Eunice oerstedii* Stimpson, 1854, *Marphysa sanguinea* (Montagu, 1815), and *Sabella spallanzani* (Viviani, 1805) are several of the species to be suggested.

As a result, polychates which have a large share in live fish feed, contribute to the national economy. This continuity will be ensured by the efficient use of existing stocks. For this purpose, economically important species should be fished as conscious and controlled. In addition, aquaculture studies should be considered.

References

Aydin C. & Ölçek Z. S. 2017. İzmir Amatör Olta Balıkçılığında Canlı Yemler, İzmir Balıkçılığı, Kınacıgil T, Tosunoğlu Z, Çaklı Ş, Bey E, Öztürk H, Ed., Kristal Reklam ve Matbaacılık, İzmir, ss.107-112.

Dağlı, E., Ergen, Z., & Cınar, M.E., 2005, One-year observation on the population structure of Diopatra neapolitana Delle Chiaje (Polychaeta, Onuphidae) in Izmir Bay (Aegean Sea, eastern Mediterranean). Marine Ecology, 26 : 265-272.

Doğan, A., Dağlı, E., Özcan,T., Bakır,K., Ergen,Z., Önen,M., Katağan,T. 2007, Türkiye denizlerinde dağılım gösteren ekonomik öneme sahip omurgasızlar. Türk sucul yaşam dergisi. (Turkish journal of aquatic life), yıl:3-5 sayı: 5-8, 36-44

Öztürk, B., Ergen, Z., 1994, Türkiye'nin Orta Ege sahillerindeki kumluk mediolittoral zonda yaşayan makrozzobentik canlıların populasyon yoğunluğu, E. Ü. Fen Fakültesi Dergisi, seri B, 16/1, 1037-1046.

High-density culture potential of the microalga *Haematococcus pluvialis* (Chlorophyceae)

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In the study, high-density culture potential of a locally isolated *Haematococcus pluvialis* strain was examined. The cells were basically grown with BG11 medium but also different strategies were applied such as light intensity, Fe-EDTA replacement, trace elements, $CaCl_2$ dosage, initial cell density and fed-batch. The best growth was achieved in the group irradiated by 150 µmol photons m^{-2} s^{-1} but the other applications such as Fe-EDTA, trace elements and $CaCl_2$ were also considered growth supporting.

Keywords: *Haematococcus pluvialis*, high-density, growth, local isolation

Introduction

Astaxanthin, a highly valuable commercial pigment, is mostly used in aquaculture sector (Higuera-Ciapara *et al*., 2006) and more than 95% is produced synthetically (Koller *et al*., 2014). Currently, *Haematococcus pluvialis* (Chlorophyceae) is the richest source of the natural secondary carotenoid astaxanthin and this pigment is one of the most powerful antioxidants among the pigments (Guerin *et al*. 2003). For human consumption as a health food, the natural astaxanthin from *H. pluvialis* has been preferred in the market due to the higher antioxidant effect and the health concerns about the synthetic one.

Haematococcus is an airborne organism and distributed to water bodies by wind (Genitsaris *et al*., 2011) and birds. By this reason, *H. pluvialis* can easily be isolated from any location in the world. The isolation and characterization of new *Haematococcus* species in terms of growth and astaxanthin accumulation is of great significance (Noroozi *et al*., 2012). Each strain may have different abilities such as fast growth, high astaxanthin accumulation, resistance to high light in vegetative stage, cell diameter etc. By this respect, the vegetative growth characteristics of the locally isolated *H. pluvialis* cultures were investigated in the study. In addition, different strategies were applied to the cultures to increase the cell density.

Material and Methods

Haematococcus pluvialis was locally isolated from a small pool in a field in Çanakkale, Turkey. The stock cultures were grown phototrophically in standard BG11 medium (Rippka *et al*., 1979) at 75 µmol photons m^{-2} s^{-1} light intensity provided by a cool white fluorescent lamp. The experiments were carried out in 0,5 L cylindrical glass bottles in batch cultures and aerated by air+CO2 mixture. The temperature and pH were kept constant at 25±0.5ºC and 7,5, respectively. Photosynthetically active radiation (PAR) was measured with a LI-250A light-meter (Li-Cor, USA).

In the experiment, the vegetative cells were basically grown in BG11 medium with 75 µmol photons m^{-2} s^{-1} of cool white fluorescent lamps (0,04 g L^{-1} DW). Some other applications such as higher cell densities (0,10 and 0,15 g L^{-1}), Fe-EDTA replacement instead of ferric ammonium citrate, $CaCl_2$ dosage (0,022 and 0,050 g L^{-1}), fed-batch (addition of 0,5 g L^{-1} $NaNO_3$ every three day), higher irradiation (150 µmol photons) and replacement of trace elements (A5) by OHM trace elements were also evaluated.

For dry weight (DW) measurements, 25 ml sample was filtered through a pre-dried and pre-weighed GF/F Whatman filter papers (Whatman, UK) in duplicate and dried in an oven at 80 ºC overnight. Chlorophyll *a* and carotenoids were found spectrophotometrically according to Lichtenthaler (1987). The cells were counted in an improved Neubauer haemocytometer by triplicate.

Results and Discussion

At the end of the trials, the best growth was seen in the group irradiated with 150 µmol photons. However, it was clear from the cell count that the growth was strongly suppressed until the day 5 most likely due to the photoinhibition caused by the combination of high light and low cell density. From this point, the cells started to increase very fast (from 3,1 x 10^4 to 23,7 x 10^4 cells mL^{-1} in 4 days).

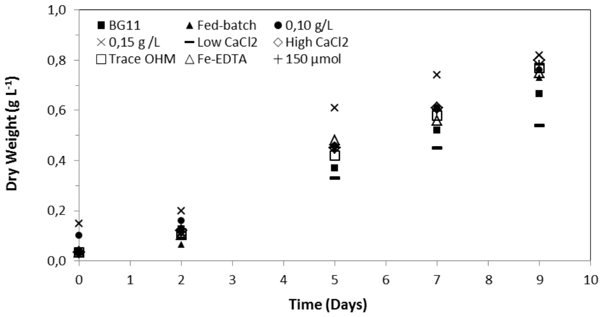

Figure 1. Changes in dry weights of the groups.

The lowest cell number and DW were seen in 0,022 g L^{-1} $CaCl_2$ group, which was 0,014 g L^{-1} lower than the original medium (0,036 g L^{-1}). In contrast, the growth was better than the original BG11 group in 0,05 g L^{-1} $CaCl_2$ group (Fig.1 and Fig.2). Similarly, $CaCl_2$ amount in the culture was found to be an important factor for the strain tested as in the study of Fabregas *et al*. (2000). On the other hand, Fe-EDTA group was among the best groups at the end of the experiment. In our opinion, the chelated Fe compound was utilized by the cells more efficient than ferric ammonium citrate in the original medium. Another group supporting growth was the trace elements replacement. The replacement especially was effective in the first 6 days of the culture.

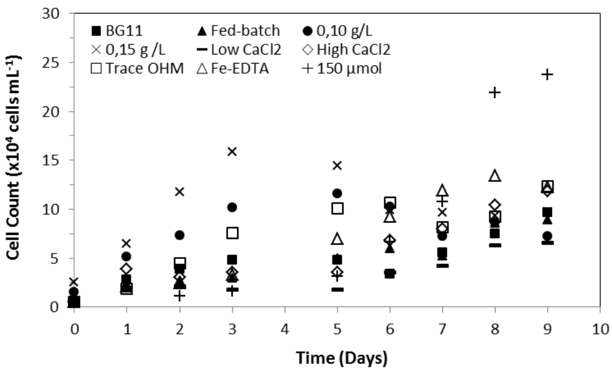

Figure 2. Cell counts of the groups.

The plot of absorbance values measured at 680 nm wavelength showed similarity with the dry weight values rather than the cell counts (Fig.3). Accordingly, the correlation between the data may help to estimate the dry weight value.

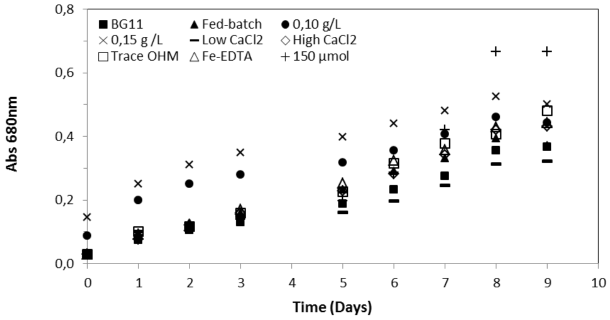

Figure 3. Cell counts of the groups.

The isolation of new *H. pluvialis* strains from different locations is important for various reasons (Noroozi *et al*., 2012). In this study, different strategies on the vegetative cultures of a locally isolated *H. pluvialis* strain were examined. Most of the applications were found effective but the efficacy was unsteady, i.e., some were efficient in the first half but the rest were in the second half of the culture period. A more comprehensive study is needed to document the whole characteristics of the new strain. However, it is clear that the strain is a promising candidate for the commercial astaxanthin production.

References

Fábregas, J., Domínguez, A., Regueiro, M., Maseda, A. & Otero, A., 2000. Optimization of culture medium for the continuous cultivation of the microalga *Haematococcus pluvialis*. Applied Microbiology and Biotechnology, 53(5): 530-535.

Genitsaris, S., Moustaka-Gouni, M. & Kormas, A., 2011. Airborne microeukaryote colonists in experimental water containers: diversity, succession, life histories and established food webs. Aquat. Microbial. Ecol. 62: 139-152.

Guerin, M., Huntley, M.E. & Olaizola, M., 2003. *Haematococcus* astaxanthin: applications for human health and nutrition. Trends Biotechnol., 21: 210-216.

Higuera-Ciapara, I., Lix-Valenzuela, L. & Goycoolea, F.M., 2006. Astaxanthin: A Review of its Chemistry and Applications. Crit. Rev. Food. Sci. Nutr., 46: 185-196.

Koller, M., Muhr, A. & Braunegg, G., 2014. Microalgae as versatile cellular factories for valued products. Algal Res., 6: 52-63.

Lichtenthaler, H.K., 1987. Chlorophylls and carotenoids: pigments of photosynthetic membranes. Methods Enzymol., 148: 349-382.

Rippka, R., Deruelles, J.B., Herdman, M., Waterbury, B. & Stanier, R.Y., 1979. Generic assignments, strain history and properties of pure cultures of Cyanobacteria. J. Gen. Microbiol., 111: 1-61.

Noroozi, M., Omar, H., Napis, S., Hejazi, M.A. & Tan, S.G., 2012. Comparative biodiversity and effect of different media on growth and astaxanthin content of nine geographical strains of *Haematococcus pluvialis*. African Journal of Biotechnology, 11(84): 15049-15059.

Growth characteristics of a locally isolated microalga *Haematococcus pluvialis* (Chlorophyceae)

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In this work, the growth and carotenoid accumulation characteristic of a locally isolated *Haematococcus pluvialis* strain was studied. By this respect, the cells were grown in vegetative stage with two growth mediums (BG11 and OHM) and two different light intensities (50 and 100 μmol photons m^{-2} s^{-1}). The growth at 50 μmol photons m^{-2} s^{-1} was better in OHM medium. In addition, in OHM medium, the dry weight almost doubled while the cell count increased about 4 times by the increase of the light from 50 to 100 μmol photons m^{-2} s^{-1}. The cells in reddening stage were exposed to white, blue and red LEDs at 200 μmol photons m^{-2} s^{-1}. The best growth and carotenoid accumulation were achieved with the white light. It can be concluded that the new strain require higher light intensities in vegetative stage.

Keywords: *Haematococcus pluvialis*, growth, local isolation, LED light

Introduction

The demand to natural pigments has increased in recent years due to the health concerns. Among the pigments, astaxanthin, one of the most powerful antioxidants, could be used in health sector in various fields (Guerin *et al*. 2003; Higuera-Ciapara *et al*., 2006). Today, the microalga *Haematococcus pluvialis* (Chlorophyceae) is the most potential source of secondary carotenoid astaxanthin. The species rapidly start to accumulate astaxanthin under stress conditions, such as nitrate deficiency or high light (Torzillo *et al*., 2003).

Haematococcus is an airborne organism and can be distributed to water bodies by wind (Genitsaris *et al*., 2011). The isolation of new *Haematococcus* species is of great significance since each strain may show great variability in growth and astaxanthin accumulation. Hence, in this study, the growth and carotenoid accumulation characteristics of the locally isolated *H. pluvialis* cultures were investigated.

Material and Methods

Haematococcus pluvialis was locally isolated from the ornamental pond in spring time in front of the Marine Science and Technology Faculty of Onsekiz Mart University in Çanakkale, Turkey. The stock cultures were grown phototrophically in standard BG11 medium (Rippka *et al*., 1979) and OHM medium (Fabregas *et al*., 2000) at 50 μmol photons m^{-2} s^{-1} light intensity provided by a cool white fluorescent lamp. The experiments were carried out in 0,5 L cylindrical glass bottles in batch cultures and aerated by air+CO2 mixture. The temperature and pH were constant at 25±0.5ºC and 7,5, respectively. Photosynthetically active radiation (PAR) was measured with a LI-250A light-meter (Li-Cor, USA).

In vegetative stage, the cells were grown in BG11 and OHM mediums with 50 μmol photons m^{-2} s^{-1} of cool white fluorescent lamps. Another OHM group was irradiated with 100 μmol photons m-

^{2} s^{-1} to see the effect of higher light intensity. In the red stage, three groups were established and exposed to 200 μmol photons m^{-2} s^{-1} by white, blue and red LEDs. The cultures were kept in BG11 medium without $NaNO_3$ to trigger the stress in the cells.

For dry weight (DW) measurements, 25 ml sample was filtered through a pre-dried and pre-weighed GF/C Whatman filter papers (Whatman, Maidstone, UK) in duplicate and dried in an oven at 80 ºC overnight. Chlorophyll *a* and carotenoids were found spectrophotometrically according to Lichtenthaler (1987). The cells were counted in an improved Neubauer haemocytometer by triplicate.

Results and Discussion

In vegetative stage, the effects of different growth mediums were investigated. At the end of the experiment, dry weight (DW) and cell count of the OHM group were higher than BG11 group (0,12 g L^{-1} and 2,2 x 10^4 cells mL^{-1} respectively). When the light intensity increased in OHM group from 50 to 100 μmol photons m^{-2} s^{-1}, DW and cell count were also increased to 0,2 g L^{-1} and 8,9 x 10^4 cells mL^{-1} respectively. The effect of higher irradiation was clearly seen after the day 4 since the values were almost the same for the first 4 days (Fig.1, Fig.2).

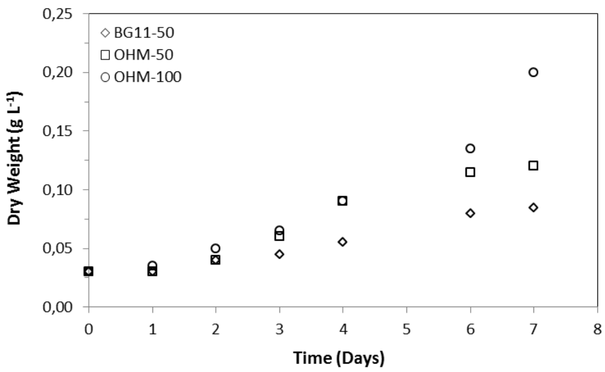

Figure 1. Dry weights of the groups in vegetative stage.

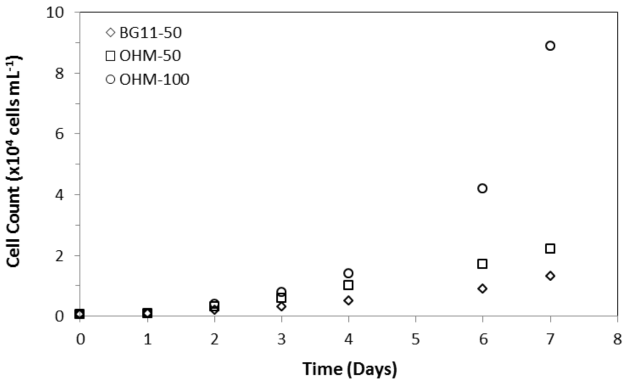

Figure 2. Cell counts of the groups in vegetative stage.

In red stage, the groups were exposed to white, blue and red LEDs at 200 μmol photons m^{-2} s^{-1} irradiation. In the previous studies, especially blue light was more effective to induce astaxanthin accumulation (Lababpour *et al*., 2005; Xi *et al*., 2016) but this was not the case in our study. The highest cell density and carotenoids were reached in white LED group (Fig.4, Fig.5). The values at the end of the 5^{th} day were 0,16, 0,14 and 0,09 g L^{-1} for the white, blue and red LED groups respectively (Fig.3). The maximal cell densities for both of the green and red stages were lower than most of the previous reports. However, the vegetative palmellas were morphologically distinctive and much bigger than normal cells ranging between 15-30 μm.

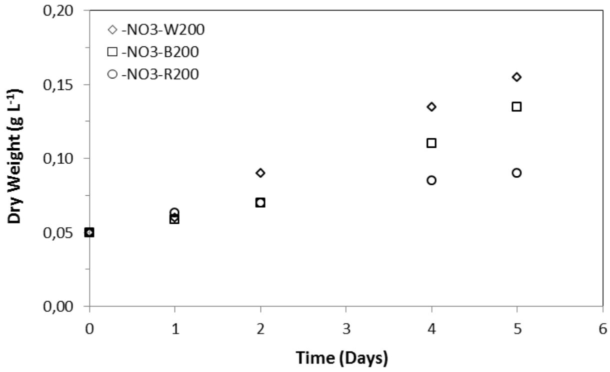

Figure 3. Dry weights of the groups in red stage.

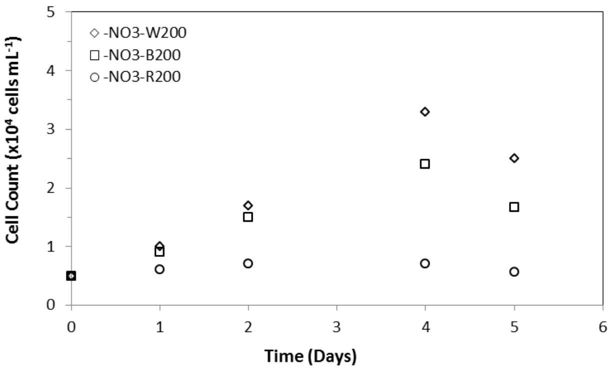

Figure 4. Cell counts of the groups in red stage.

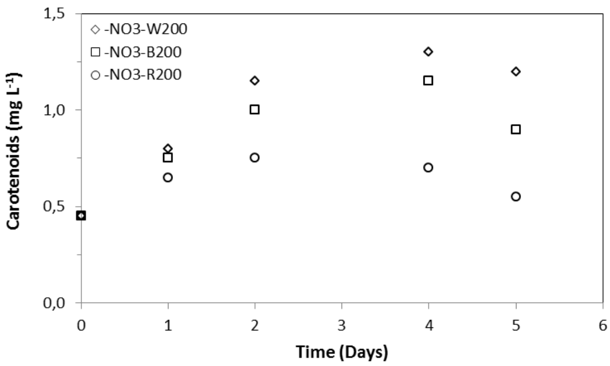

Figure 5. Changes in the carotenoids of the groups in red stage.

This study examined the growth and carotenoid accumulation of locally isolated *H. pluvialis* strain. The isolation and biodiversity characterization of the new strains is an important and promising way of discovering potential strains since each one may possess different properties such as high growth and astaxanthin accumulation (Noroozi *et al*., 2012). It was seen that the growth of the new strain in vegetative stage is supported by higher illuminations than usually used such as 50 µmol photons m^{-2} s^{-1}. A more comprehensive study would be necessary to see the growth and astaxanthin accumulation potential of the strain, such as higher light intensities and organic carbon additions.

References

Fábregas, J., Domínguez, A., Regueiro, M., Maseda, A. & Otero, A., 2000. Optimization of culture medium for the continuous cultivation of the microalga *Haematococcus pluvialis*. Applied Microbiology and Biotechnology, 53(5): 530-535.

Genitsaris, S., Moustaka-Gouni, M. & Kormas, A., 2011. Airborne microeukaryote colonists in experimental water containers: diversity, succession, life histories and established food webs. Aquat. Microbial. Ecol. 62: 139-152.

Guerin, M., Huntley, M.E. & Olaizola, M., 2003. *Haematococcus* astaxanthin: applications for human health and nutrition. Trends Biotechnol., 21: 210-216.

Higuera-Ciapara, I., Lix-Valenzuela, L. & Goycoolea, F.M., 2006. Astaxanthin: A Review of its Chemistry and Applications. Crit. Rev. Food. Sci. Nutr., 46: 185-196.

Lichtenthaler, H.K., 1987. Chlorophylls and carotenoids: pigments of photosynthetic membranes. Methods Enzymol., 148: 349-382.

Lababpour, A., Shimahara, K., Hada, K., Kyoui, Y., Katsuda, T. & Katoh, S., 2005. Fed-Batch Culture under Illumination with Blue Light Emitting Diodes (LEDs) for Astaxanthin Production by *Haematococcus pluvialis*. J. Bioscience Bioeng., 100: 339-342.

Noroozi, M., Omar, H., Napis, S., Hejazi, M.A. & Tan, S.G., 2012. Comparative biodiversity and effect of different media on growth and astaxanthin content of nine geographical strains of *Haematococcus pluvialis*. African Journal of Biotechnology, 11(84): 15049-15059.

Xi, T., Kim, D.G., Roh, S.W., Choi, J.-S. & Choi, Y.-E., 2016. Enhancement of astaxanthin production using *Haematococcus pluvialis* with novel LED wavelength shift strategy. Appl. Microbiol. Biotechnol. 100: 6231-6238.

Torzillo, G., Goksan, T., Faraloni, C., Kopecky, J. & Masojidek, J., 2003. Interplay between photochemical activities and pigment composition in an outdoor culture of *Haematococcus pluvialis* during the shift from the green to red stage. J. Appl. Phycol., 15: 127-136.

The effects of growth medium and LED lights in different colors on *Haematococcus pluvialis* (Chlorophyceae) cultures

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The present study was carried out to see the effects of two growth mediums and LED lights in three different colors on *Haematococcus pluvialis*. The cells were exposed to blue, red and white colors for both vegetative and reddening stages of the species. In vegetative stage, the cells showed the best growth at the light intensity of 50 μmol photons m^{-2} s^{-1} with the BG11+Vitamin growth medium. The growth was better in BG11 medium than OHM medium. In addition, white light, in general, supported higher cell densities compared to blue and red lights. Similarly, higher cell density and carotenoid accumulation were achieved with the white light in the red stage. Consequently, white light was superior under the experimental conditions in both vegetative and red stages for the *Haematococcus* strain.

Keywords: *Haematococcus pluvialis*, growth, LED light, astaxanthin

Introduction

Haematococcus pluvialis (Chlorophyceae) is one of the richest sources of astaxanthin, a commercially marketable secondary carotenoid synthesized under stress conditions, such as nitrate deficiency or high light (Torzillo *et al*., 2003). The main market for astaxanthin is salmon culture in aquaculture industry (Christiansen *et al*., 1995), which mostly prefers the astaxanthin in cheaper synthetic form. However, in recent years, the demand for natural astaxanthin extracted from *H. pluvialis* has increased mostly due to the antioxidant effect of the pigment (Guerin *et al*. 2003).

Astaxanthin production from *H. pluvialis* is generally achieved through a two-stage culture, i.e., vegetative and red stages. The vegetative stage is a problematic part due to the slow growth rate, low cell concentration and susceptibility to contamination (Lee & Zhang, 1999). Hence, in this study, the effects of growth medium and LED illuminations in different colors especially on vegetative stage of *H. pluvialis* cultures were investigated.

Material and Methods

Haematococcus pluvialis culture (strain NIES-144) was obtained from the Microbial Culture Collection at the National Institute for Environmental Studies (NIES Collection, Tsukuba, JAPAN). Two stock cultures were grown phototrophically separately in standard BG11 medium (Rippka *et al*., 1979) and OHM medium (Fabregas *et al*., 2000) at 50 μmol photons m^{-2} s^{-1} light intensity provided by a cool white fluorescent lamp. The cells were grown in batch cultures in 0,5 L cylindrical glass bottles and aerated by air+CO2 mixture under constant temperature at 25±0.5ºC. The pH was kept constant at 7,5. Photosynthetically active radiation (PAR) was measured with a LI-250A light-meter (Li-Cor, USA).

In vegetative stage experiments, three growth medium groups were established, e.g., BG11, OHM and BG11+vitamins. All the groups were illuminated with 50 μmol photons m^{-2} s^{-1} by cool white fluorescent lamps. In addition, the groups with OHM medium were exposed to blue and red

LED lights at the same light intensity. Another group with OHM medium was illuminated by 100 μmol photons m^{-2} s^{-1}. The total number of the groups in vegetative state was six.

As for the red stage experiments, three groups were established. All the groups contained BG11 medium except for the $NaNO_3$. The cells were exposed to stress conditions by nitrate deficiency and relatively higher illumination with LED lights at 200 μmol photons m^{-2} s^{-1}. The effects of the white, blue and red colors in red stage were investigated.

For dry weight (DW) measurements, 25 ml sample was filtered through a pre-dried and pre-weighed GF/C Whatman filter papers (Whatman, Maidstone, UK) in duplicate. DWs were calculated in g L^{-1} after the filtrates were dried in an oven at 80 ºC overnight. Chlorophyll *a* and carotenoids were found spectrophotometrically according to Lichtenthaler (1987). The cells were counted in an improved Neubauer haemocytometer by triplicate samples.

Results and Discussion

In vegetative stage trials, the effects of the growth medium contents and the irradiances at different colors were investigated. The best growth was achieved in the BG11+Vitamin among all the 6 experimental groups, reaching 1,24x10^5 cells/mL and 0,3 g L^{-1} dry weight (DW) on day 6. Original BG11 without vitamins was the 2nd best growing group. Both of the best two groups were illuminated by white fluorescent lamp. It can be concluded from this point that the content of the BG11 was superior to that of the OHM medium for the strain used. However, the cell numbers of OHM groups until 3rd day were in general higher than the BG11 groups, which mean that OHM medium supported cell growth better than the BG11 at the beginnings of the cultures. In addition, the DW of another white irradiated OHM group increased almost parallel to the BG11+Vitamin group until day 4 (Fig.1, Fig.2). Therefore, it would be misleading to make a decision just taking the end results into consideration. The cell numbers of the four OHM groups started to decrease except the one irradiated by red LED after day 4. In contrast, DWs of almost all the groups except for blue irradiated group increased after day 4. In our opinion, this phenomenon is a sign of cell stress. In the previous similar studies, in which higher initial cell densities were used, red and especially blue light was more effective to induce astaxanthin formation *in vivo* (Lababpour *et al*., 2005; Xi *et al*., 2016). By this reason, the stress might be due to the combination of low cell density and specific wavelength of the colors.

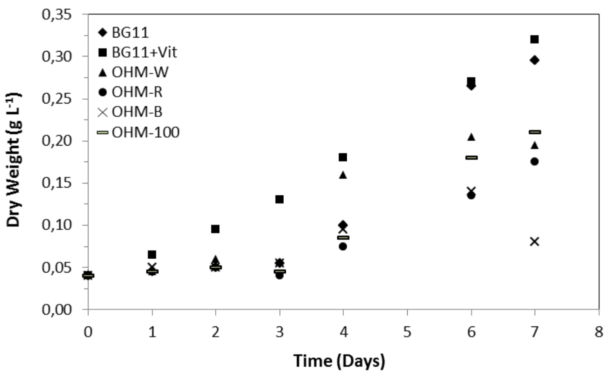

Figure 1. Dry weights of the groups in vegetative stage.

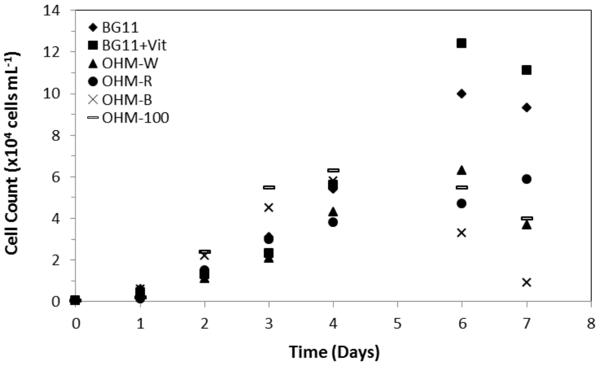

Figure 2. Cell counts of the groups in vegetative stage.

In red stage, under 200 µmol photons m^{-2} s^{-1} irradiation, the highest value was reached by the white light again. The dry weights and cell counts were shown in Fig.3 and Fig.4. DW values at the end of the 5th day were 0,27, 0,23 and 0,19 g L^{-1} for the white, red and blue irradiations respectively.

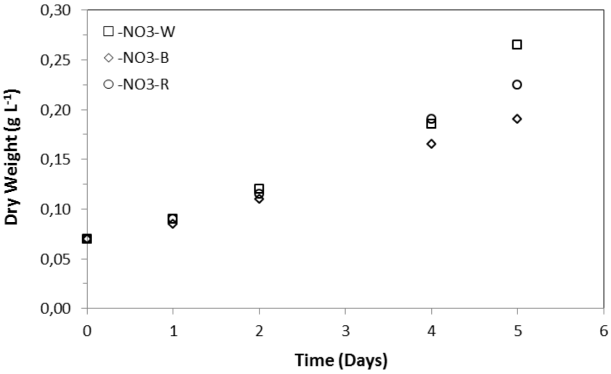

Figure 3. Dry weights of the groups in red stage.

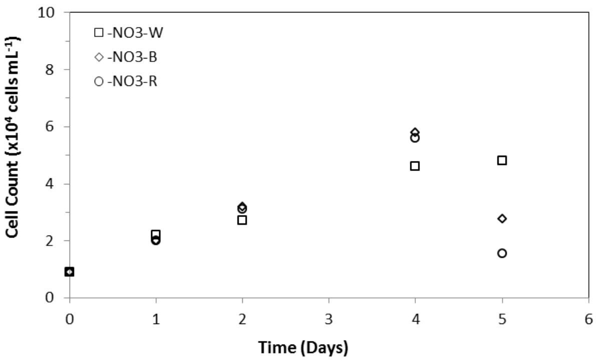

Figure 4. Cell counts of the groups in red stage.

Consequently, white light was found to be more effective in the experimental conditions but the use of higher initial cell densities would be useful to see the effects of red and blue colors on the cultures. The mutual shading of the cells by the increase in cell concentration may reduce the inhibition effect of the blue and red wavelengths, which are at the end parts of the visible light.

References

Christiansen, R., Lie, O. & Torrissen, O.J., 1995. Growth and survival of Atlantic salmon, *Salmo salar* L., fed different dietary levels of astaxanthin. First-feeding fry. Aquacult. Nutr., 1: 189-198.

Fábregas, J., Domínguez, A., Regueiro, M., Maseda, A. & Otero, A., 2000. Optimization of culture medium for the continuous cultivation of the microalga *Haematococcus pluvialis*. Applied Microbiology and Biotechnology, 53(5): 530-535.

Guerin, M., Huntley, M.E. & Olaizola, M., 2003. *Haematococcus* astaxanthin: applications for human health and nutrition. Trends Biotechnol., 21: 210-216.

Lee, Y.-K. & Zhang, D.-H., 1999. Production of astaxanthin by *Haematococcus*. *In*: Cohen, Z., ed. Chemicals from Microalgae, Taylor and Francis, London. pp. 173-190.

Lichtenthaler, H.K., 1987. Chlorophylls and carotenoids: pigments of photosynthetic membranes. Methods Enzymol., 148: 349-382.

Lababpour, A., Shimahara, K., Hada, K., Kyoui, Y., Katsuda, T. & Katoh, S., 2005. Fed-Batch Culture under Illumination with Blue Light Emitting Diodes (LEDs) for Astaxanthin Production by *Haematococcus pluvialis*. J. Bioscience Bioeng., 100: 339-342.

Xi, T., Kim, D.G., Roh, S.W., Choi, J.-S., Choi, Y.-E., 2016. Enhancement of astaxanthin production using *Haematococcus pluvialis* with novel LED wavelength shift strategy. Appl. Microbiol. Biotechnol. 100: 6231-6238.

Torzillo, G., Goksan, T., Faraloni, C., Kopecky, J. & Masojidek, J., 2003. Interplay between photochemical activities and pigment composition in an outdoor culture of *Haematococcus pluvialis* during the shift from the green to red stage. J. Appl. Phycol., 15: 127-136.

Reception of ship-generated waste and the cargo residues, and control and the management of ballast water and the sediments from ships pass in transit through the Canakkale Strait: The Canakkale (Kepez) Port as an exemplary

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The present study was carried out to explain the importance of the reception of ship generated waste and cargo residues from vessels which pass in transit through Canakkale Strait. Since there is no obligation for transit vessels to declare to Turkish authorities about the quantity and type of waste onboard, that brings the risk of marine pollution in case of maritime accidents of which some of the most commons are the collision or contact, capsize, foundering, breaking up, grounding, breakdown of the ship engine, stranding and fire or explosion. In addition, another purpose of the study is to indicate for the risk of harmful aquatic organisms and pathogens carried by ballast water in the ships which are passing through the Canakkale Strait, and to determine the precautions against those risks. In the study, statistics obtained from Ministry of Transport and Infrastructure about the vessel passages through Canakkale Strait are matched with the statistics about waste reception services provided by Canakkale (Kepez) Port for the period of 2015 to 2017 in order to indicate the importance of the activities against the high risk of a possible marine pollution may be caused by a possible maritime accident.

Keywords: Ship-generated waste, cargo residues, Canakkale Strait, Canakkale (Kepez) Port, slop, marine pollution, transit vessels, ballast water.

Introduction

Ship-generated waste includes any kind of waste other than cargo residues, including sewage, garbage, bilge water, waste including oil products and oil from the engine room or cargo tank and waste, which are generated during the operation of a ship and fall under the scope of international convention for the prevention of pollution from ships 73/78 annexes I, IV, V and VI (Hereinafter: MARPOL), and cargoassociated waste as defined in the guidelines for the implementation of annex V to MARPOL 73/78.

Cargo residues include the remnants of any cargo material on board in cargo holds or tanks, which remain after completion of loading, unloading procedures and cleaning operations, including loading/unloading excesses.

The Turkish Straits, connecting Mediterranean with Black Sea are the most important sea pathways of the World and play a vital role for the fish migration. Canakkale Strait is one of the busiest waterways in the world, handling annually 44,615 ships in a year of which 26,087 ships are transit vessels (non call in vessels) (Republic of Turkey, Ministry of Transport and Infrastructure, Directorate General of Merchant Marine, 2017 Statistics).

According to the 'Reception of Wastes from Ships and Waste Control Regulation' (Date of the OG: 26 December 2004; Issue of the OG: 25682), ships which are determined not to have enough storage volume in their existing waste tanks for the wastes that will be generated before reaching the next port at the end of the checks and inspections conducted by Port Authorities shall not be allowed to set off until their wastes are received.

On the other hand, although the environmental rules should be applied strongly due to heavy sea traffic in the region, unfortunately there is no enforcement for the transit vessels since the Turkish Straits are natural waterways. Therefore, transit vessels just have to declare for the type and the quantity of waste kept onboard when they have a need to discharge during their transit voyage.

All transit and non-transit vessels, aiming to pass through Canakkale Strait are instructed to send their Sailing Plan 1 (SP1) Reports to The Turkish Straits Vessel Traffic Services (VTS) which is under commandment of Directorate General of Coastal Safety. On the report, despite all information such as vessel particulars, the last port and the next port of call, pilotage request, information for cargo and the dangerous cargo if exists, fuel and oil quantity onboard and etc, there is no notification about the type and the quantity of waste kept onboard.

However, even in the ballast condition of a Suezmax oil tanker with the capacity of 165,000 deadweigt tonnage (Hereinafter: DWT), vessel can store up to 4,500 m^3 of slop (Slop means oily water residues accumulating in the slop tanks, including tank washing waters, as a result of washing of the cargo tanks in ships. ('Reception of Wastes from Ships and Waste Control Regulation' (Date of the OG: 26 December 2004; Issue of the OG: 25682)) that may has a respectable oil content which comes from itself of the cargo been carried. That means an environmental disaster in case of a maritime accident in the Straits.

Locating in the Canakkale Strait, Canakkale (Kepez) Port is serving for vessels' waste disposal requests with its port (waste) reception facility that is the largest in Turkey (ISTAC Sector Report, 2013). With a barge fleet consists of 5 waste collection barges with a capacity of 10,500 DWT (Canakkale Liman Isletmesi San. Ve Tic. A.S., 2017), ship-generated waste and cargo residues are collected from all transit and non-transit vessels passing through the Strait.

Canakkale (Kepez) Port, where is about 11 NM (nautical mile) away from the south entrance of the Strait, provides the waste reception services at the designated anchorage areas around the Bozcaada Island where is about 30 NM away to the Port. A vessel which intend to deliver the waste onboard has to send a waste notification to the Port and upon arrival of the vessel to the rendezvous position, waste collection barge is ready to collect the waste to be discharged.

The first aim of the study is indicating the importance of reception of ship-generated waste and especially the cargo residues from transit vessels (non call in vessels) by matching the quantity of collected waste with the number of the vessels which passed through the Canakkale Strait. In addition to this, another purpose of the study is to indicate for the risk of harmful aquatic organisms and pathogens carried by ballast water in the ships which are passing through the Canakkale Strait, and to determine the precautions against those risks.

Since the introduction of steel-hulled vessels, water has been used as ballast to stabilize vessels at sea. Ballast water is pumped in to maintain safe operating conditions throughout a voyage. This practice reduces stress on the hull, provides transverse stability, improves propulsion and manoeuvrability, and compensates for weight changes in various cargo load levels and due to fuel and water consumption. While ballast water is essential for safe and efficient modern shipping operations, it may pose serious ecological, economic and health problems due to the multitude of marine species carried in ships' ballast water. These include bacteria, microbes, small invertebrates, eggs, cysts and larvae of various species. The transferred species may survive to establish a reproductive population in the host environment, becoming invasive, out-competing native species and multiplying into pest proportions (International Maritime Organization, Ballast Water Management).

The transported ballast water is approximately 20 to 40% of the carrying capacity of a ship (deadweight tonnage). However, this capacity can be increased up to 60% under some conditions (Turkish National Ballast Water Management Strategy, Prime Ministry Undersecretariat for Maritime Affairs, 2010). In this way, millions of different aquatic organisms and microorganisms are transported from one ecosystem to another. These species can invade the region irreversibly, while they are multiplying uncontrollably where they move. Therefore, ballast water is one of the most important vectors that allows the transport of invasive aquatic organisms.

Material and Methods

Statistics for the period of 2015 to 2017 about the waste reception services provided by Canakkale (Kepez) Port (Fig. 1) are classified according to the vessel types, numbers in being a transit or non-transit vessel and the waste types that are divided to ship-generated waste and cargo residues. Then the sorted information is matched with the statictics obtained for the same period from Ministry of Transport and Infrastructure, Directorate General of Merchant Marine.

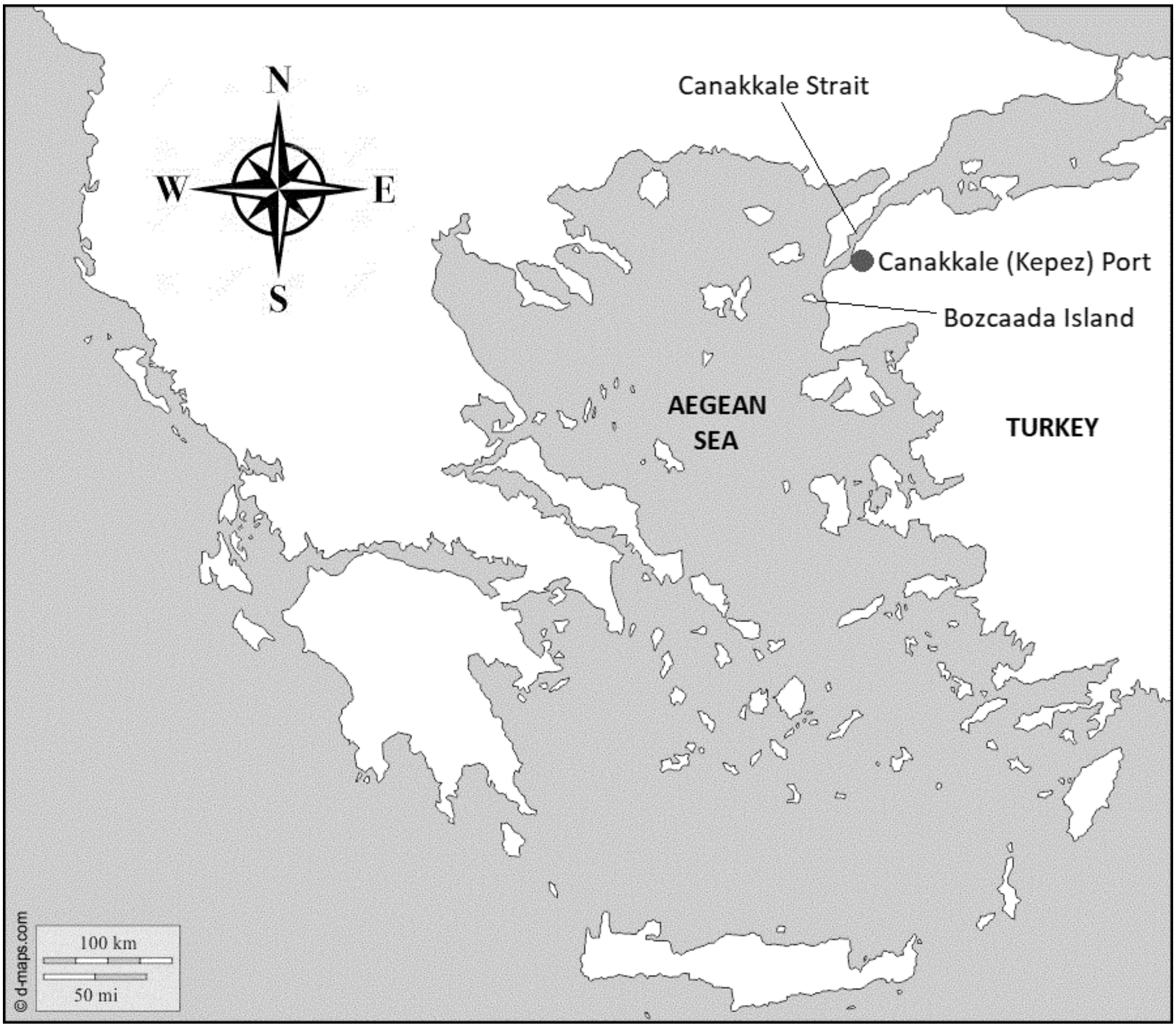

Figure 1. Map of the study area.

Results

As a result, for the total period of the study, it is determined that most of the vessels passed through the Canakkale Strait were transit vessels with a percentage of 58,67% and 21.60% of them being dangerous cargo vessels (Table 1)

It shows that Canakkale (Kepez) Port provided waste reception services 61.76% to transit vessels and 95.24% of total collected waste is slop which are generated as cargo residues by the oil tankers (TTA) and chemical tankers (TCH) (Table 2).

In the period of 2015 to 2017, 54.45% of total quantity of waste collected with an amount of 690,409.30 m^3 had been received from transit vessels. Most of the transit vessels serviced are chemical tankers (TCH) with 18.60% (Table 2).

Table 1. 2015-2017 Statistics about vessel passages through Canakkale Strait

Year	Number of Vessels	Total Gross Tonnage	With Pilot	SP1 Given	Transit Vessels	LOA Over Than 200 m	Tankers			Towaged
							TTA	LPG/ LNG	TCH	
2015	43,230	777,989,382	18,843	42,755	25,220	5,842	6,009	1,036	2,479	122
2016	44,035	772,922,682	19,007	43,543	26,071	5,665	6,041	881	2,559	139
2017	44,615	823,460,636	19,925	43,888	26,087	6,197	6,145	734	2,599	149

Table 2. 2015-2017 Statistics about the vessels which have been serviced for waste reception by Canakkale (Kepez) Port

Year	Number of Transit Vessel	Number of Non-transit Vessel	Type of Transit Vessels Serviced				Ship-generated Waste Collected from Transit Vessels (m³)					Cargo Residues Colected from Transit Vessels (m³)	
			Tankers			Other Types							
			TTA	LPG	TCH		Bilge Water	E/R Sludge	Waste Oil	Sewage	Garbage	Slop	Solid Sludge
2015	564	459	226	4	282	52	1,471.93	1,771.77	75.37	0.00	433.13	116,734.41	78.83
2016	618	351	21	1	22	574	1,327.18	2,141.12	96.57	7.50	488.06	122,586.85	29.57
2017	667	335	23	0	40	604	1,481.97	1,891.02	57.93	0.00	786.37	124,104.91	332.99
Total	**1,849**	**1,145**	**270**	**5**	**344**	**1,230**	**4,281.08**	**5,803.91**	**229.87**	**7.50**	**1,707.56**	**363,426.17**	**441.39**
Grand Total	**2,994**		**Grand Total of Waste Collected from All Vessels (m³)**				9,567.50	10,734.09	446.89	6,430.27	2,972.48	657,541.23	2,716.84
Non-Transit (m³)							**5,286.42**	**4,930.18**	**217.02**	**6,422.77**	**1,264.92**	**294,115.06**	**2,275.45**

Discussion

Since one of the results of the study determines that most of vessels passing through Canakkale Strait are transit vessels, it indicates the importance of establishing the obligated notification system for all vessel passing through the Turkish Straits.

As the other part of the study, approximately 90% of international trade is done via shipping industry (Turkey National Ballast Water Management Strategy, Prime Ministry Undersecretariat for Maritime Affairs, 2010) and it is estimated that 3-5 billion tons of ballast water and 4,000-7,000 different species are carried in the world seas every year. This means that the specified number of species are transported between different ports every day in ballast water tanks.

When the impact of invasive aquatic organisms on the ecosystem is compared with petroleum pollution; It is known that the effect of oil pollution is acute, destructive and observable. However, the effect of oil pollution is decreasing over time and disappearing in longer periods. The first effect is very low when we evaluate an invasion. However, after a certain period of time, the effect of habitat increases irreversibly and the results are destructive. The Turkish coast is one of the most sensitive regions in the world due to the heavy traffic it is exposed to. As a result of the Project "Control and Management of Harmful Aquatic Organisms Transported by Ballast Water" initiated by the Undersecretariat of Maritime Affairs in 2006, 23 million tonnes of ballast water have been discharged between 2002 and 2006 and it has been determined that the majority of this amount comes from the ports in Mediterranean countries. Yet the coasts of Turkey 288 non-native (invasive) species have been identified (Turkey National Ballast Water Management Strategy for Turkey, Prime Ministry Undersecretariat for Maritime Affairs, 2010).

Therefore, this study also indicates the importance of control and the management of ballast water and the sediments coming from the ships pass through the Canakkale Strait, since the most part of them are transit vessels which are trading in international waterways.

Acknowledgements

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References

Akten, Necmettin, 2006. Shipping accidents: a serious threat for marine environment. Journal of Black Sea/Mediterranean Environment, 12: 269-304.

Beceren, Evren, 2015-2017. Statistics for waste reception services by Canakkale (Kepez) Port.

EMSA/OP/02/2016. The Management of Ship-Generated Waste On-board Ships.

Erol, Sercan & Basar, Ersan, 2014. The analysis of ship accident occurred in Turkish search and rescue area by using decision tree. pp. 1-12.

Özsoy, E., Çağatay, M.N., Balkıs, N., Balkıs, N., Öztürk, B. (Eds.), 2016. The Sea of Marmara; Marine Biodiversity, Fisheries, Conservation and Governance. pp. 755-767.

Prime Ministry Undersecretariat for Maritime Affairs, 2010. Control and Management of Harmful Aquatic Organisms Transported by Ballast Water. pp. 1-25.

Microstallite Analysis of Genetic Diversity in the Two Banded Seabream (*Diplodus vulgaris*) in East Meditarranean Coast in Turkey

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The common two banded seabream is a fish that lives in the Meditarranean and the Western Black Sea in Turkish waters. Dispite high commercial value particularly its genetic characterization about this species not found enough information on several internatinal genetic database. The study was specifically aimed to idendification of *D. vulgaris* with microsatellite markers. Microsatellites are repeated DNA sequences which are polymorphe and built up by any permutation of mono-di-tri or tetranucletid motifs. Microsatellites have a wide wariety genetic markers that are finding applications in many studies such as ecology, polymophism, classtification, improvement besides useful for PCR. In this research fish samples was collected from different location a total of 75 *D. vulgaris*; 25 from Mersin Coast, 25 from Antalya Coast and 25 from Iskenderun Gulf in Turkey. Approximately 10 mg was cut up for each samples from dorsal side and into to put eppendorf and was stored (-20 C^0). Genomic DNA extraction was performed by using kits. Then, the usefullness of Polimerase Chain Reaction (PCR) system was searched by using microsatellite marker Dvul33 (363 bp-long), fragment from NCBI that international genetic databases. DNA fagments and PCR products were analysed using agarose gel electrophoresis. As a result of DNA band length DNA fragments show few difference among each location's samples. However for the comrehensive genetic analyze need to study mitochondirial genom markers (Cytochrome C oxidase I etc.) and DNA sequance analysis. In this study begining start from the point of view DNA markers for *D.vulgaris*.

Keywords: *Diplodus vulgaris* , Microsatellites, DNA fagments ,PCR, East Meditarranean Coast

Cosmopolitanism in Copepods Revisited: *Ameira parvula* (Claus, 1866) (Copepoda: Harpacticoida: Ameiridae) Complex Example

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Using of modern microscopy techniques in the copepods systematics and the demonstration of the importance of micro-characters in species identification has led to the idea that the concept of misleading cosmopolitanism, which is not normally true in copepods, is replaced by a relatively limited geographical area of species and endemism at a high level. Ameiridae is the third largest family in the order Harpacticoida with more than 300 species. Many genera of the Ameiridae are not well defined and need almost revision. *Ameira* parvula was identified by Clauss as *Canthocamptus parvulus* in 1866 from Nice, France. Many researchers have given *Ameira parvula*'s record from different geographical regions. As a result of the previous studies based on setation and length of swimming legs, a very wide variation has emerged for the species. When the available materials and literatures are examined, it is supported that *Ameira parvula* (Claus, 1866) represents a species complex. This study is aimed to reveal the real state of *Ameira parvula* to eliminate the confusion in the literature by comparing related literature and the available materials from the international museum and the materials deposited in the Mersin University zoology collection. A comprehensive revisionary study of this species is not available in the literature so far. This study was supported by the Research Fund of Mersin University in Turkey with Project Number 2017-2-TP3-2611.

Keywords: Taxonomy, biodiversity, revision, ameirids, species.

Seasonal $\delta^{13}C$ and $\delta^{15}N$ stable isotope composition of POM in the Dardanelles Strait and influence of environmental variables

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In this study, seasonal changes in the stable isotope ratios of Particulate Organic Matter (POM) $\delta^{13}C$ and $\delta^{15}N$ were examined in two different regions of the Dardanelles between January 2017 and October 2017, and the effects of environmental and biological factors such as temperature, salinity, suspended solids and chlorophyll-*a* on these changes were analyzed. As a result, it has been revealed that the $\delta^{13}C$ values of POM were not affected by the environmental or biological factors as expected and that there are many other organic substances such as bacteria, microzooplankton and detritus rather than phytoplankton to contribute POM. Although $\delta^{15}N$ values were under the influence of environmental and biological factors, enrichment during periods of high terrestrial inflows has shown that POM was predominantly composed of microzooplankton in the higher food chain.

Keywords: Particulate organic matter, Stable isotopes, Environmental variables, Dardanelles

Introduction

Stable isotopes have long been used to determine the food web structure in marine ecosystems (Peterson & Fry, 1987). In the marine ecosystem studies, $\delta^{13}C$ and $\delta^{15}N$ isotopes are generally used and these two elements contain complementary information as they show different fractions along the trophic level (Peterson et al., 1985). The rate of ^{13}C / ^{12}C determines the origins of carbon sources within the $\delta^{13}C$ nutrient-food web network, from the predator to the prey by 1-2 ‰ (De Niro & Epstein, 1978; McCutchan & Lewis, 2002). In addition, a large increase in the ^{15}N / ^{14}N rate (average 3.2 to 3.4 ‰) from predator to prey allows the use of the $\delta^{15}N$ value in determining the trophic level of organisms (Owens, 1987; Sweeting *et al*., 2007; Minagawa & Wada, 1984; Cabana & Rasmussen, 1996; Schmidt *et al*., 2004). POM isotopic values are used in most studies to identify the food webs. POM, a possible food group of primary consumers, does not only represent isotopic values of phytoplanktonic organisms in the system, but also is a heterogeneous material composed of bacteria, microzooplankton, detritus and various organic substances which may affect the isotopic values of the structure (Riera *et al*., 1999; Michener *et al*., 2007). In coastal areas where terrestrial inputs are large, the POM isotopic values are quite different (Harmelin-Vivien *et. al*., 2010).

The aim of the study was to determine POM stable carbon and nitrogen isotope values in the two regions chosen in the Dardanelles Strait, and the relationship between the obtained values and environmental and biological factors to confirm whether there is a linear relationship between POM and chl-*a* as an indication of phytoplankton abundance.

Material and Methods

The study was conducted seasonally between January 2017 and October 2017. POM samples were collected from the surface using a 5 L Nansen bottle from two stations, Kepez Harbour and Dardanelles (Figure 1). Environmental variables, i.e. temperature and salinity were measured in *situ* using an YSI 650 multiple water analysis probe. Water samples for the measurement of chl-*a* and total suspended solids (TSS) were collected using a 5 L water sampler. For chl-*a*, samples were filtered over 47 mm GF/F filters by gentle vacuum and then frozen for laboratory analysis. The chl-*a* concentration was determined spectrophotometrically after extraction by 90% acetone (Apha, 1995). For TSS, previously weighed and dried GF/C filters were used to filter the water samples and then gravimetric analysis was performed according to (Clesceri et al. 1998). The POM samples brought to the laboratory were first filtered with a 50µ plankton net to remove large organisms. The remaining samples were filtered through precombusted (400°C, 3 hours) GF/F filters. Filtered samples were dried in a drying oven at 60°C for 24 hours and measurements were conducted using an Isotope Ratio Mass Spectrometer (Delta V Thermo Finnigan; Thermo, Waltham, USA), in Akdeniz University Food Safety and Agricultural Research Center. The obtained results are expressed by δ using the following equation:

$\delta^{13}C$ or $\delta^{15}N$ (‰) = (Rsample/Rstandard−1) x1000

where carbon and nitrogen stable isotope abundance was expressed as $\delta^{13}C$ or δ15N, $^{13}C/^{12}C$ or $^{15}N/^{14}N$ was represented by R as the reference being V-PDB (Vienna Pee Dee Belemnite) and atmospheric N_2 isotope standards.

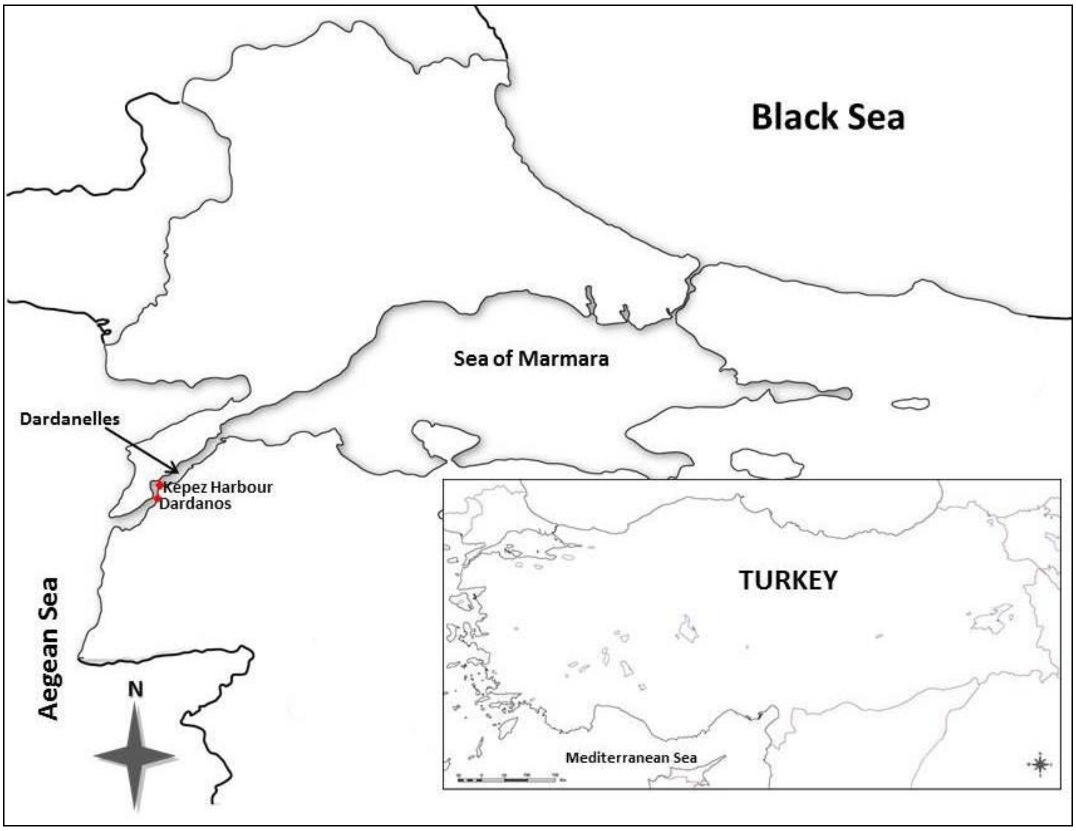

Figure 1. Location of the study area with the sampling stations

Results

The results of the study showed that water temperature and salinity values followed the seasonal progression ranging between 7.10 and 25.25°C, 24.39 and 30.38, respectively. The lowest values of chl-*a* and TSS were observed in autumn (1.405 µg L^{-1}, 1.20 mg L^{-1}, respectively) and reached the maximum values in winter (8.237 µg L^{-1}, 87.65 mg L^{-1}, respectively) in which rainfall and terrestrial inputs were intense (Fig. 2).

The $\delta^{13}C$ values of POM did not show statistically significant changes among seasons, the lowest value was observed in winter (-21.832 ± 1.831‰) and the highest value was observed in autumn (-19.236 ± 1.694‰) (Table 1). On the other hand, statistically significant changes were determined among stations (p=0.032; Table 1) and the $\delta^{13}C$ values in the Dardanos station were lower than those in Kepez Harbour (-19.444±1.332‰ and -21.536±1.947‰, respectively).

$\delta^{15}N$ values showed statistically significant changes seasonally (p=0.001; Table 1). The spring and summer seasonal values showed similar changes (3.537±0,030‰, 3.452 ± 0.615‰, respectively), while winter and autumn (4.460±0.576‰, 2.155±1.035‰, respectively) were separated in terms of group averages. There were not any statistically significant changes in $\delta^{15}N$ among stations.

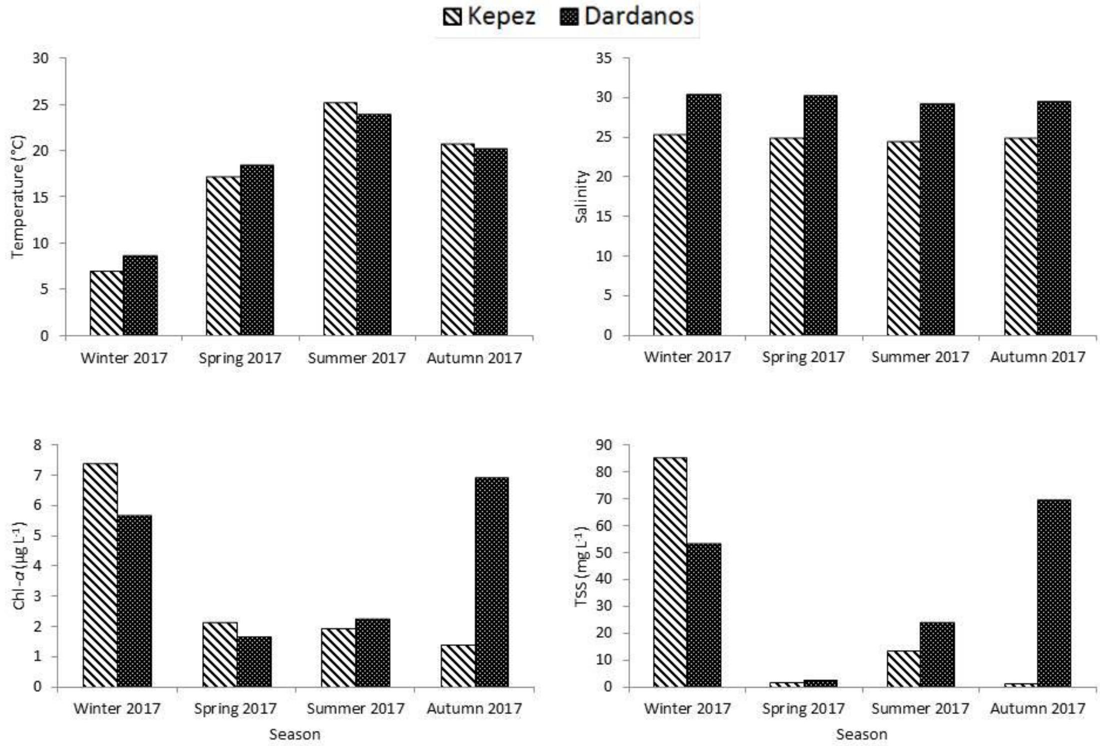

Figure 2. Seasonal and spatial variations of temperature, salinity, Chl-*a* and TSS in the Dardanelles Strait

Table 1. Results of one-way Anova on seasonal and spatial stable isotope ratios (±SD) of POM (n=18, Capital letters shows different groups of seasonal values (p<0.05), lower-case letters show different groups of spatial values (p<0.05)).

Variable	Factor	x+xs			*p* value	Factor	x±xs		*p* value
$\delta^{13}C$ (‰)	Winter 2017	-21.832±1.831	A		0.101	Harbour	-21.536±1.947	b	0.032
	Spring 2017	-21.656±1.306	A			Reference	-19.444±1.332	a	
	Summer 2017	-21.240±2.210	A						
	Autumn 2017	-19.236±1.694	A						
$\delta^{15}N$ (‰)	Winter 2017	4.460±0.576	A		0.001	Harbour	3.075±1.160	a	0.140
	Spring 2017	3.537±0.030	A	B		Reference	3.959±1.091	a	
	Summer 2017	3.452±0.615	A	B					
	Autumn 2017	2.155±1.035		B					

Discussion

The carbon values obtained as a result of the study did not show significant seasonal changes. The $\delta^{13}C$ values at Kepez Harbour, where plankton abundance was high (Buyukates & Inanmaz, 2007, 2010; Türkoğlu, 2010; Buyukates *et al.*, 2017), were lower than in the Dardanos region and this difference was statistically significant (p=0.032; Table 1). In some studies, it was stated that POM represents phytoplankton isotopic values (De Niro & Epstein, 1978; McCutchan & Lewis, 2002).

However, POM in the study area did not show a linear relationship with chl-*a*, which is known as the phytoplankton density indicator, and mostly influenced by organic substances such as bacteria, microzooplankton and detritus (Table 2). Similarly, it has been stated that the POM values obtained in a study conducted in the Mediterranean are not due to phytoplankton (Harmelin-Vivien *et al.*, 2008) and the obtained POM values were similar to those of this study in the Dardanelles Strait. On the other hand, the fact that $\delta^{13}C$ values were not significantly correlated with temperature, salinity, TSS and chl-*α*, values revealed that $\delta^{13}C$ values were not influenced by environmental and biological factors (Table 2).

$\delta^{15}N$, known to be under the influence of terrestrial inputs (Harmelin-Vivien *et al.*, 2008), has shown significant changes among seasons in the study. The highest values were observed during the winter when precipitation was high, indicating that the $\delta^{15}N$ values were under the influence of micro-zooplankton, a significantly higher trophic level, rather than bacteria, detritus, and phytoplankton.

Many of the studies done with POM in the Mediterranean and other oceans were made in river mouths and the effects of terrestrial inputs on the marine ecosystem were emphasized (Soares *et al.*, 2015; Liénart *et al.*, 2017). In this study, seasonal values of POM, which has a large reserve in the energy flow along the trophic level, forming the lowest food structure and the possible food group of plankton in the Dardanelles have been obtained. Therefore, being a first marine stable isotope study in the region it may provide an important reference for future work in the coastal areas of the Mediterranean and the Aegean Sea.

Table 2. Spearman's Correlation results between environmental and biological variables, $\delta^{13}C$ and $\delta^{15}N$ values of POM in study area (n=18; (*): Correlation is significant at the 0.05 level, (**): Correlation is significant at the 0.01 level).

	$\delta^{13}C$	$\delta^{15}N$	Chl-*a*	Salinity	Temperature	TSS
$\delta^{13}C$	1					
p value						
$\delta^{15}N$	-0,346	1				
p value	0,08					
Chl-*a*	-0,143	,428*	1			
p value	0,285	0,038				
Salinity	0,138	,509*	,723**	1		
p value	0,293	0,016	0			
Temperature	0,362	-,673**	-,679**	-,706**	1	
p value	0,07	0,001	0,001	0,001		
TSS	-0,146	,453*	,839**	,623**	-,520*	1
p value	0,282	0,03	0	0,003	0,013	

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References

Apha, A., 1995. Standard methods for the examination of water and waste water. Washington DC: American Public Health Association/American Water Works Association/Water Environment Federation. Washington DC, USA.

Buyukates, Y., Celikkol, B., Yigit, M., DeCew, J., & Bulut, M., 2017. Environmental Monitoring Around an Offshore Fish Farm with Copper Alloy Mesh Pens in the Northern Aegean Sea. American Journal of Environmental Protection, 6(2):50.

Buyukates, Y. & Inanmaz, Ö.E., 2007. Temporal variations in vertical distribution and occurrence of marine cladocerans in an urbanized harbour, Dardanelles, Turkey. Crustaceana, 80(11):1293–1302.

Buyukates, Y. & Inanmaz, Ö. E., 2010. The Annual Mesozooplankton Dynamics and Influence of Environmental Parameters in an Urbanized Harbor (Kepez Harbor-Dardanelles Strait, Turkey). Ekoloji, 68:60–68.

Cabana, G. & Rasmussen, J.B., 1996. Comparison of aquatic food chains using nitrogen isotopes. Proceedings of the National Academy of Sciences, 93:10844–10847.

Clesceri, L.S., Greenberg, A. E. & Eaton, A. D., 1998. Standard methods for the examination of water and wastewater (20th ed.). Washington, DC: American Public Health Association.

De Niro, M.J. & Epstein S., 1978. Influence of diet on the distribution of carbon isotopes in animals. Geochimica et Cosmochimica Acta, 42:495–506.

Harmelin-Vivien, M., Loizeau, V., Mellon, C., Beker, B., Arlhac, D., Bodiguel, X. & Salen-Picard, C., 2008. Comparison of C and N stable isotope ratios between surface particulate organic matter and microphytoplankton in the Gulf of Lions (NW Mediterranean). Continental Shelf Research, 28(15):1911-1919.

Harmelin-Vivien, M., Dierking J., Banaru D., Fontaine M. F. & Arlhac D. 2010. Seasonal variation in stable C and N isotope ratios of the Rhone River inputs to the Mediterranean Sea (2004-2005). Biogeochemistry, 100:139-150.

Liénart, C., Savoye, N., Bozec, Y., Breton, E., Conan, P., David, V., & Lefebvre, S., 2017. Dynamics of particulate organic matter composition in coastal systems: a spatio-temporal study at multi-systems scale. Progress in Oceanography, 156:221-239.

McCutchan, J.H. & Lewis Jr., 2002. Relative importance of carbon sources for macroinvertebrates in a Rocky Mountain stream. Limnology and Oceanography, 47:742–752.

Minagawa, M. & Wada, E., 1984. Stepwise enrichment of ^{15}N along food chains: further evidence and the relation between d15N and animal age. Geochimica et Cosmochimica Acta, 48:1135–1140.

Owens, N.J.P., 1987. Natural variations in 15N in marine environment. Advances in Marine Biology, 24:389–451.

Peterson, B.J., Howarth, R.W. & Garritt, R.H., 1985. Multiple stable isotopes used to trace the flow of organic matter in estuarine food webs. Science, 227:1361–1363.

Peterson, B. J. & Fry, B. 1987. Stable isotopes in ecosystem studies. Annual Reviews Ecological Systems, 18:293–320.

Schmidt, K., McClelland, J.W., Mente, E., Montoya, J.P., Atkinson, A. & Voss, M., 2004. Trophic-level interpretation based on $\delta\ ^{15}$N values: implications of tissuespecific fractionation and amino-acid composition. Marine Ecology Progress Series, 266:43–58.

Soares, M. A., Bhaskar, P. V., Naik, R. K., Dessai, D., George, J., Tiwari, M., & Anilkumar, N., 2015. Latitudinal δ13C and δ15N variations in particulate organic matter (POM) in surface waters from the Indian ocean sector of Southern Ocean and the Tropical Indian Ocean in 2012. Deep Sea Research Part II: Topical Studies in Oceanography, 118:186-196.

Sweeting, C.J., Barry, J., Barnes, C., Polunin, N.V.C. & Jennings, S., 2007. Effects of body size and environment on diet-tissue d15N fractionation in fishes. Journal of Experimental Marine Biology and Ecology, 340:1–10.

Türkoğlu, M., 2010. Temporal variations of surface phytoplankton, nutrients and chlorophyll a in the Dardanelles (Turkish Straits System): a coastal station sample in weekly time intervals. Turkish Journal of Biology, 34(3):319-333.

Investigation of human fecal contamination by detection of Bifidobacterium strains fermenting sorbitol in drinking waters byreal-time PCR method

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Fecal water pollution is one of the major causes of diseases world wide especially in developing countries and it's an important public health problem globally. The digestive system of mammalian species is a complex ecosystem that contains a up to 400 different bacterial species. These species mainly belong to three bacterial group; Firmicutes, Bacteroidetes and Actinobacteria. Some types of these groups can be found in high amounts in stool. Bifidobacterium species are also anaerobic Gram-positive bacteria in belonging to the Actinobacteria group. Sorbitol-fermenting Bifidobacterium strains were obtained only from human stool samples and is not found in other livings. Their detection is a specific indication of the human pollution of water and waste water. So, aim of this study was to detect Sorbitol-fermenting Bifidobacterium strains using with real-time PCR (qPCR) method to check whether there is contamination with human stool in storagewater.

In this study, One hundred (100) drinking water samples taken from water tanks of Gaziantep and Şanlıurfa towns and districts were included. Sorbitol-fermenting Bifidobacterium strains considered as an indicators of human fecal pollution were investigated with qPCR. DNA isolations were made from water samples with the QIAamp DNA stool kit according to manufacturers intructions. After that LightCycler 480 II system was used with specific primers and probes to detect Sorbitol-fermenting Bifidobacterium strains via qPCR.

As a result of ourstudy, 8 (8%)out of 100 water samples were found as a positive for Sorbitol-fermenting Bifidobacteriumstrains. The average amount of Sorbitol-fermenting Bifidobacteriumstrains in these samples was 3.42+E5 copy/mL.

In a conclusion, our study showed that our water in water tanks was found dirty with human stool. If the hygienic conditions around the water tanks are not considered, the water held here may be exposed to human stool contamination and serious public health problems may arise after the use of these dirty waters. Using with qPCR method, detection of Sorbitol-fermenting Bifidobacteriums pp. For specific indication of the human pollution can be detected quickly and reliably and can be monitorized routinely.

Keywords: Bifidobacterium, Sorbitol, Water, Real-Time PCR

Introduction

Water is an important natural resource for our use routinely to drink and other needs in ourlives (1). Fecal pollution in water is a serious public health problem that affects many peoples globally (2,3). Despite efforts to minimize fecal input into the water, the problem still persists. The health risk associated with human exposure to water polluted with human feces is most important, due to spread of the human diseases (4). The digestive system of mammalian species is a complex ecosystem that contains a upto 400 different bacterial species. These species mainly belong to three bacterial group; Firmicutes, Bacteroidetes and Actinobacteria. Some types of these groups can be found in high amounts in stool. Bifidobacterium species are also anaerobic Gram-positive bacteria in belonging to the Actinobacteria group (5). *Bifidobacterium* species are also anaerobic Gram-positive bacteria in belonging to the Actinobacteria group (6). To detect human specific faecal contamination in these species, non-sporing sorbitol-fermenting Bifidobacteria (SFB) are considere among the potential indicators (7). Recent investigation reported fecal source tracking (FST) methods based on molecular techniques are a promising to also identify the host sources of fecal pollution to take effective protection (8). For these reason, the aim of this study was to determine the presence of SFB in strains using with real-time PCR (qPCR) method to check whether there is contamination with human stool in storage water.

Material and Methods

In this study, One hundred (100) drinking water samples taken from watertanks of Gaziantep and Şanlıurfa towns and districts were included. Sorbitol-fermenting Bifidobacterium strains considered as an indicators of human fecal pollution were investigated with qPCR. Table 1 showed the primers and probe used in this study.

Table 1: Primers and probe sequenced used in this study.

Name	Oligonucleotidsequenced (5>3)	Ref.
Bif-F	TTCGGGTTGTAAACCGCTTTT	2
Bif-R	TACGTATTACCGCGGCTGCT	2
HMprobe	FAM-TCGGGGTGAGTGTACCT-BHQ	2

DNA isolations were performed from water samples with the QIAamp DNA stool kit (QiagenGmBH, Hilden, Germany) according to manufacturers intructions. AllDNA's were stored at 20^{o}C until qPCR processes. LightCycler 480 II (Roche Diagnostics gmbH, Mannheim, Germany) real-time PCR system was used to detect Sorbitol-fermenting Bifidobacterium strains. Real-time PCR protocol; denaturation at 95^{o}C for 10 min and then 50 cycle samplification at 95^{o}C for 1 min and 60^{o}C for 1 min were used.

Results and Discussion

As a result of our study, 8 (8%) out of 100 water samples were found as a positive for Sorbitol-fermenting Bifidobacterium (SFB) strains. The average amount of Sorbitol-fermenting Bifidobacterium strains in these samples was 3.42+E5 copy/mL. Table 2 showed quantification amount of all SFB positive waters.

In a conclusion, our study showed that our water in water tankswas found dirty with human stool. If the hygienic conditions around the watertanks are not considered, the water held here may be exposed to human stool contamination and serious public health problems may arise after the use of these dirty waters. Using with qPCR method, detection of Sorbitol-fermenting Bifidobacterium spp. For specific indication of the human pollution can be detected quickly and reliably and can be monitorized routinely.

Nebra and colleagues 2003 have identified two species of Bifidobacterium species in contaminated water with human and animal feces using two 16S rRNA target gene regions. From these probes (BDE), As a target, Bifidobacterium dentium was selected from a region of the 16S rRNA gene. This probe is only specific to a human-derived Bi fi dobacterium species. In this study, a positive DNA-DNA hybridization result with BDE probes was shown in all samples with human faecal contamination. However, in the case of animal fecal pollution, this probe did not work. For this reason, this finding supports the potential use of this probing in the detection and determination of Bifidobacterium in human fecal contamination.

Table 2: Distribution of quantitative amounts of SFB positive water samples

SFB positive watersamples	**copy/ml**	**Log$_{10}$copy/ml**
1	4.25E+05	5.628389
2	3.84E+05	5.584331
3	2.10E+05	5.322219
4	1.90E+05	5.278754
5	3.10E+05	5.491362
6	4.54E+05	5.657056
7	4.10E+05	5.612784
8	3.50E+05	5.544068
Mean	3.42E+05	
Standart Deviation	91.812,22	

Xavier and his colleagues found human fecal pollution at a rate of more than 0.2 in the samples they collected in 2005 as Human Colony Forming Units (CFU) in Human Bifido Sorbitol Agar (HBSA) medium. In this way, fecal pollution at high concentration can be characterized with low cost.

Catherine and her colleagues in 2015 took water from seven different regions of South Africa with persistent fecal contamination. Concentration rates of bifidobacteria (SUB) and total bifidobacteria (TB) using sorbitol should have a certain cut-off value to distinguish sources of animal and human faecal water pollution. SUB concentrations range from 10 to 50000 cells / 100 mL, while TB ranges from 0 to 8000 cells / 100 mL. The monitoring rate was between 0.10 and 6.25. As a result, it has been determined that continuous entry of water or lack of oxygen levels is a major factor in bacterial growth in large water. In our study, Bifidobacteria origins were investigated with qPCR using RealTime PCR method which is low cost.

As a result of ourstudy, 8 (8%)out of 100 water samples were found as a positive for Sorbitol-fermenting Bifidobacteriumstrains. The average amount of Sorbitol-fermenting Bifidobacteriumstrains in these samples was 3.42+E5 copy/mL.

In a conclusion, our study showed that our water in water tanks was found dirty with human stool. If the hygienic conditions around the water tanks are not considered, the water held here may be exposed to human stool contamination and serious public health problems may arise after the use of these dirty waters. Using with qPCR method, detection of Sorbitol-fermenting Bifidobacteriums pp. For specific indication of the human pollution can be detected quickly and reliably and can be monitorized routinely.

References

Bernhard AE, Field KG. Identification of Nonpoint Sources of Fecal Pollution in Coastal Watersby Using Host-Specific 16S Ribosomal DNA Genetic Markers from Fecal Anaerobes. Applied and Environmental Microbiology. 2000; 66 (4): 1587-1594.

Bibi S, Khan RL, Nazir R, et al. Heavy metals in drinking water of Lakki Marwat District, KPK, Pakistan. World applied sciences journal. 2016;34(1):15-19.

Bottacini F, Ventura M, vanSinderen D, O'ConnellMotherway M. Diversity, ecology and intestinal function of bifidobacteria. Microbial Cell Factories. 2014; 13(Suppl 1): S4. doi:10.1186/1475-2859-13-S1-S4.

Catherine D. Luyt, S. M. M. Khamanga, W. J. Muller, Roman Tandlich* Survival of Bifidobacteria and their usefulness in Faecal Source Trackin Liquid Waste Recovery 2015; 1: 1–11.

Gómez-Doñate M, Casanovas-Massana A, Muniesa M, Blanch AR. Development of newhost-specific Bacteroides qPCRs for the identification of fecal contamination sources in water. Microbiology Open. 2016; 5(1): 83-94. doi:10.1002/mbo3.313.

He X, Liu P, Zheng G, et al. Evaluation of five microbial and fourmito chondrial DNA markers for tracking human and pig fecal pollution in freshwater. Scientific Reports. 2016; 6: 35311. doi:10.1038/srep35311.

Mushi D, Byamukama D, Kivaisi AK, Mach RL, Farnleitner AH. Sorbitol-fermenting Bifidobacteriaareindicators of very recent human faecal pollution in streams and ground water habitats in urban tropical lowlands. Journal of waterand health. 2010; 8(3): 466-478. doi:10.2166/wh.2010.116.

Nebra Y, Bonjoch X, Blanch AR. Use of Bifidobacteriumdentium as an Indicator of the Origin of Fecal Water Pollution. Applied and Environmental Microbiology. 2003; 69(5): 2651-2656. doi:10.1128/AEM.69.5.2651-2656.2003.

Thursby E, Juge N. Introduction to the human gut microbiota. Biochemical Journal. 2017; 474(11): 1823-1836. doi:10.1042/BCJ20160510.

Xavier Bonjoch, Elisenda Ballesté, Anicet R.Blanch Enumeration of bifidobacterial populations with selective media to determine the source of waterborne fecal pollution. Water Research Volume 39, Issue 8, April 2005, Pages 1621-1627.

Yolanda Nebra, Xavier Bonjoch, and Anicet R. Blanch Use of Bifidobacterium dentium as an Indicator of the Origin of Fecal Water Pollution APPLIED AND ENVIRONMENTAL MICROBIOLOGY, May 2003, p. 2651–2656 Vol. 69, No. 5

Impact of the water temperature and salinity on the tintinnid ciliates (Ciliophora, Tintinnida) distribution

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The present study was carried out to determine the association between distribution of marine tintinnid ciliates and such abiotic factors as water salinity and temperature. As a result, the 80 tintinnid species were classified into six ecological groups (eurythermal, stenothermal-thermophilic, stenothermal-cold-loving, stenohaline, inhabiting in mixohaline waters, and stenohaline, inhabiting in euhaline waters) based on the own and literary data. The character of marine tintinnid ciliate distribution is substantially regulate by water temperature and salinity but accords with the 'Moderate endemicity model'.

Keywords: Tintinnid ciliates, Distribution, Abiotic factors, Temperature, Salinity, Ecological groups.

Introduction

Two alternative views have been expressed on geographical patterns in unicellular eukaryotes distribution (Azovsky et al., 2016). In the earliest view, the protist distribution has exclusively ecological explanations and fundamental assumption that 'everything is everywhere: but the environment selects'. This statement ('Ubiquitous model') was promulgated by Dutch microbiologist Beijerinck early in the twentieth century (O'Malley, 2008) and developed concerning ciliated protozoans by Fenchel and Finlay (2004).

From other hand, it is believed that the protist (ciliate) biogeography is similar to that of plants and animals, but with an increased proportion of cosmopolites in accordance with Foissner's 'Moderate endemicity model' (Foissner et al., 2008).

The tintinnid ciliates were classified as cosmopolitan, neritic, warmwater, boreal and south polar based mainly on the peculiarities of latitudinal distribution of genera (Pierse and Turner, 1993, Dolan et al, 2012). At this takes place, the water temperature is indicated as the main factor determining the distribution of tintinnids (Dolan et al., 2013).

The aims of our study were to compile the available data for the species distribution of marine tintinnid ciliates to investigate the patterns in this planktonic group distribution and factors responsible for this.

Material and Methods

The present communication based on literary (Dolan et al., 2014, 2017, Hada, 1937, Kofoid and Campbell, 1929, 1939, Kršinić, 2018, Türkoğlu and Kora, 2000 and Wailes, 1943) and our (Gavrilova and Dolan, 2007, Gavrilova and Dovgal, 2016) data on tintinnid ciliates distribution and abundance.

The data on distribution of 617 tintinnid species in the Mediterranean Sea (248 species), Antarctic (207), Arctic seas (89), Atlantic Ocean (340), Indian Ocean (the Arabian Sea, 117 species), Pacific Ocean (291), the Black Sea (50) and the Sea of Azov (17) were reviewed.

The own data on abundance and distribution of 80 tintinnid species from Antarctic, the Arabian Sea, the Black Sea and the Sea of Azov also used.

Species composition of tintinnid ciliates was studied in a 10-m water column in costal and open waters in different seasons during 1997 through 2014.

Water samples were taken with a lockable modification of the small Apstein plankton net (mouth diameter 8.5 cm, mesh size 55 μm). The samples (60-70 mL) were preserved in glutaraldehyde solution to reach the final concentration of 4%. Then the samples were concentrated to 10-20 mL by the sedimentation method.

Abundance and diversity of tintinnid ciliates were investigated using the counting chamber "Nazhotta" (0.8 cm^3) and the light microscope "Nikon Eclipse TS-100" with 100× and 400× magnifications.

The data were processed using software package PAST 3.11 (Hammer et al, 2001).

Results

As illustrated (in Fig. 1) the above listed regions fall into two groups on the tintinnid species compositions by results of cluster analysis conducted using Czekanowsky-Sørensen's similarity index. One group unite the Black Sea, the Sea of Azov and the Arctic seas, whereas the other involve Antarctic, the Mediterranean Sea, Pacific Ocean and the Arabian Sea. The results of Bootstrap analysis showed the high robustness of these clusters (from 75 to 100%).

In the course of the estimation of tintinnid cilates distribution using non-metric multidimensional scaling (n-MDS) the matrix table was transformed by Czekanowsky-Sørensen's index. It should be mentioned that any environmental data were not in use i.e. indirect ordination has been result (Fig. 2).

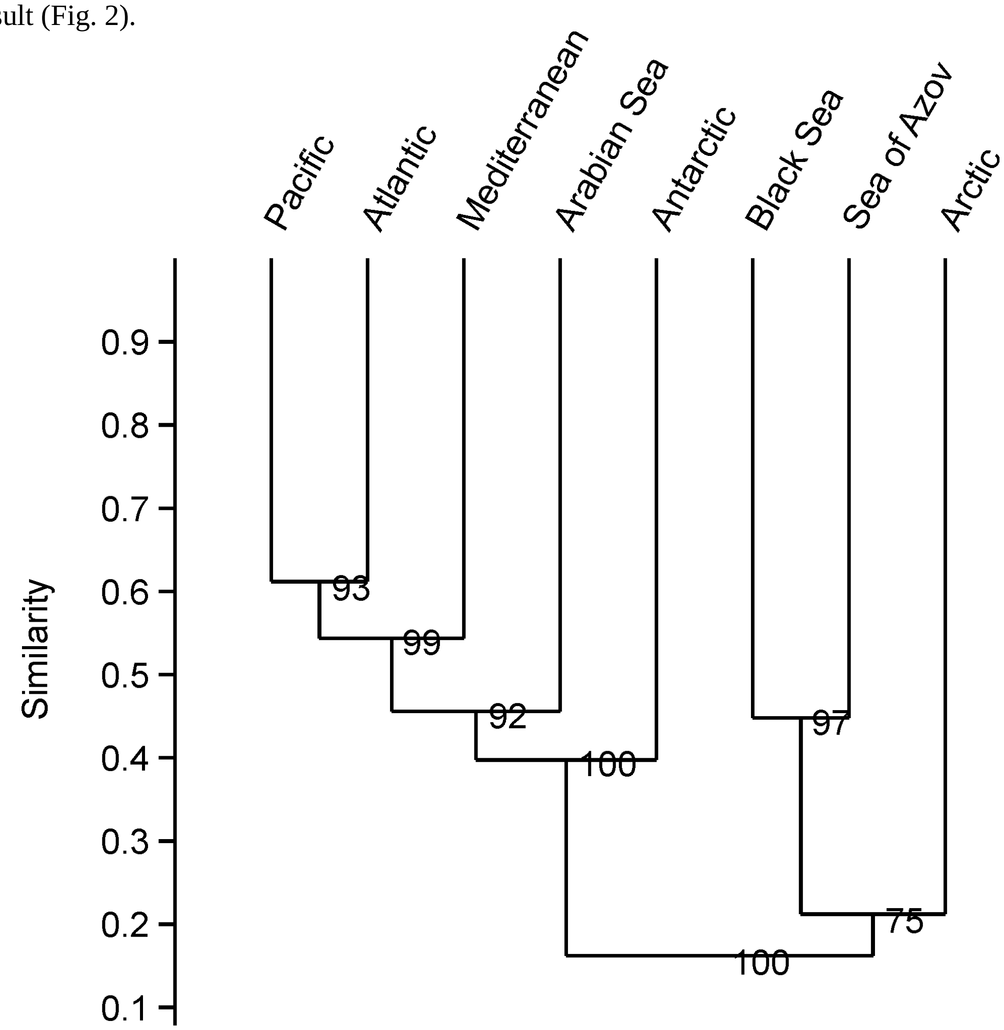

Figure 1. Results of cluster analysis of the species compositions of tintinnid ciliates from different marine regions. In nodes of dendrogam, the results of Bootstrap-analysis are marked.

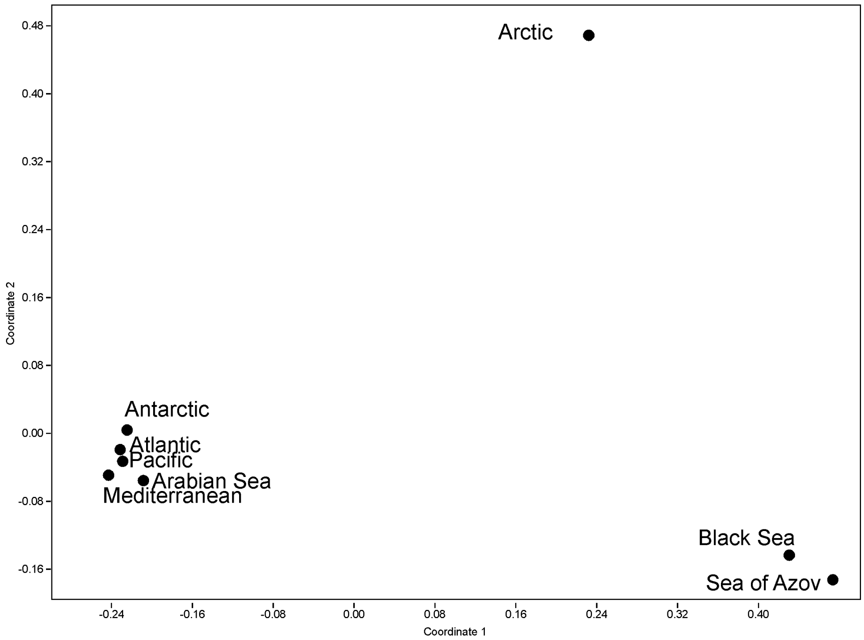

Figure 2. The ordination of different regions based on the tintinnid species compositions (n-MDS results).

As is seen from Fig. 2, the point of ‘Arctic’ stands upright, apart from other regions. At the same time, the Black Sea, the Sea of Azov and Arctic seas remain aloof from other regions in horizontal direction.

Discussion

Of a list of 89 tintinnid species found in Arctic, 21species absent in lists of other marine regions. As a result, the maximal value of the Czekanowsky-Sørensen’s similarity index (between Arctic and the Black Sea) is no greater than 0.27 (Fig. 1). It is our opinion that the isolation of the Arctic seas on Fig. 2 is largely ensured by this circumstance.

From other hand it is felt that the isolation of the Black Sea, the Sea of Azov and Arctic region both on Fig. 1 and Fig. 2 depend on the lower salinity of these regions. According to our data, in the collection sites the salinity varies from 14.1 to 15.2‰ in the Sea of Azov, from 16.0 to 18.0‰ in the Black Sea, whereas was from 36.0 to 38.0‰ in the Arabian Sea and from 33.4 to 34.3‰ in Antarctic. In addition, the Arctic seas are characterized by significant fluctuations with time in water temperature and salinity (Aagaard and Woodgate, 2001).

In accordance with our data the temperature in the collection sites varies from –0.1 to 2.0°C in Antarctic region and from 25.0 to 29.0°C in the Arabian Sea. At the same time, the vertical ordination indicated in the Fig. 2 largely associated with temperature gradation.

It should be noted that any unaccounted factors could affect the tintinnid ciliates distribution. Nevertheless, the determining impact of temperature and salinity on the tintinnid species composition appears rather obvious.

For example, the abundances of two tintinnid species, which are observed only in Antarctic region (registered at a temperature from -0.1 to 2.0 ° C and salinity from 33.4 to 34.3 ‰), and probably endemics, *Laackmaniella naviculaefera* and *Codonellopsis glacialis* negatively correlate with salinity (r= –0.37 in *L. naviculaefera* and r = –0.25 in *C. glacialis*). The positive correlation between abundance of *L. naviculaefera* and temperature (r = 0.50) also recorded.

In turn, the abundance of *Eutintinnus pinguis* inhabiting in warm waters (at temperatures ranges from 26.0 to 29.0^{0}C and salinity from 37.0 to 38.0‰) demonstrates a negative temperature dependence (r = –0.68). On the contrary, the abundance of *Eutintinnus macilentus*, another species found in similar warm conditions (temperature from 25.0 to28.5^0, salinity from 36.0 to 38.0 ‰), demonstrates a positive temperature dependence (r = 0.61).

The presence of tintinnid species with different relation to temperature and salinity allows to classify them among several ecological groups according to tolerance ranges to these factors. 80 tindinnid ciliate species were subdivided into six groups based on our own data.

In relation to the temperature:
Eurythermal, inhabiting at a temperature from –0.03 to 29.0^0: *Tintinnopsis tubulosa, T. lobiancoi, Proplectella columbiana, Dartintinnus alderae, T. campanula, T.minuta, T.beroidea, Salpingella decurtata, Amphorellopsis acuta, T.tocantinensis, T.kofoidi, T.cylindrica, Stenosemella nivalis, T.fimbriata, T. parvula* and *Tintinnidium mucicola.*
Stenothermal, thermophilic, inhabiting at a temperature from 12.0 to 29.0^0: *Tintinnopsis subacuta, Leprotintinnus pelucidus, Metacylis mereschkowskii, T. lacustris, T.compressa, Favella ehrenbergii, Eutintinnus apertus, E. apertus, Rhizodomus tagatzi, T. mortensenii, E.tubulosus, M.jörgensenii, E.lususundae, T. urnula, Dadayiella ganymedes, Craterella aperta, Codonellopsis schabi, C. ostenfeldi, C. biedermanni, C. americana, Climacocylis scalaroides, C. scalaria, Ascampbelliella armilla, Amphorides amphora, Acanthostomella norvegica, A. conicoides, T. nana, T. lata, Steenstrupiella gracilis, Salpingella subconica, Rhabdonella elegans, R. cornucopia, R. striata, Protorhabdonella simplex, P. curta, Proplectella claparedei, Metacylis tropica, M.corbula, Helicostomella longa, F. campanula, F. azorica, E. tenuis, E. stramentus, E. pinguis, E. macilentus, E. fraknoi, E. conicus, Epiplocylis acuta, Dictyocysta lepida, D. elegans var. lepida* and *T. sacculus.*
Stenothermal, cold-loving, inhabiting at a temperature from –0.1 to 12.6^0: *Codonella lagenula, Stenosemella ventricosa, Salpingella laackmanni, Bursaopsis bursa, S. faurei, Laackmaniella naviculaefera, C. labiosa, C. vanhoffeni, C. drygalskii, C. convallaria, Codonellopsis glacialis, C. balechi* and *C. gaussi.*

In relation to the salinity:
Euryhaline, inhabiting at a salinity from 3.5 to 38.0‰: *T. urnula, T. fimbriata, Stenosemella nivalis, T. cylindrica, T.kofoidi* and *T. lobiancoi*
Stenohaline, inhabiting in brackish, mixohaline waters, at a salinity from 5.5 to 37.0‰: *S. ventricosa, Codonella lagenula, T. minuta, T. campanula, Dartintinnus alderae, Proplectella columbiana, T. tubulosa, Tintinnidium mucicola, Tintinnopsis compressa, T. lacustris, Metacylis mereschkowskii, Leprotintinnus pelucidus, T. subacuta, T. tocantinensis, Amphorellopsis acuta, Salpingella decurtata, T.beroidea, Eutintinnus lususundae, Metacylis jörgensenii, E. tubulosus, T. mortensenii, Rhizodomus tagatzi, E. apertus, Favella ehrenbergii* and *T. parvula.*
Stenohaline, inhabiting in brine, euhaline waters, at a salinity from 36.0 to 38.0‰ **:** *Dadayiella ganymedes, Craterella aperta, Codonellopsis schabi, C. ostenfeldi, C. biedermanni, C. americana, Climacocylis scalaroides, C. scalaria, Ascampbelliella armilla, Amphorides amphora, Acanthostomella norvegica, A. conicoides, T. nana, T. lata, Steenstrupiella gracilis, Salpingella subconica, Rhabdonella elegans, R. cornucopia, R. striata, Protorhabdonella simplex, P. curta, Proplectella claparedei, Metacylis tropica, M. corbula, Helicostomella longa, Favella campanula, F. azorica, E. tenuis, E. stramentus, E. pinguis, E. macilentus, E. fraknoi, E. conicus, Epiplocylis acuta, Dictyocysta lepida, D. elegans var. lepida, T. sacculus, S. laackmanni, Bursaopsis bursa, S. faurei, Laackmaniella naviculaefera, Cymatocylis labiosa, C. vanhoffeni, C. drygalskii, C. convallaria, Codonellopsis glacialis, C. balechi* and *C. gaussi.*
It should be mentioned that the tintinnid species complexes of the Arctic and Antarctic cold waters are notably original due to the presence of potential endemics. Hence, the character of marine tintinnid ciliates distribution may accord with the moderate endemicity model.

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References

Aagaard K. &. Woodgate R.A. 2001. Some thoughts on the freezing and melting of sea ice and their effects on the ocean. Ocean Modelling, 3: 127-135.

Azovsky A.I., Tikonenkov D. V & Mazei Yu.A., 2016. An estimation of the global diversity and distribution of the smallest eukaryotes: biogeography of marine benthic heterotrophic flagellates. Protist, 167:411–424.

Dolan J.R., Pierce, R.W., Yang, E.J. & Kim, S.Y., 2012. Southern Ocean biogeography of tintinnid ciliates of the marine plankton. Journal of Eukaryotic Microbiology, 59:511-519.

Dolan J.R. & Pierce R.W., 2013. Diversity and distributions of tintinnid ciliates. *In*: The biology and ecology of tintinnid ciliates: Models for marine plankton. Wiley-Blackwell/Oxford, UK. pp. 214-243.

Dolan J. R., Yang E. J., Kim T. W. and Kang. S.H. 2014. Microzooplankton in a Warming Arctic: A Comparison of Tintinnids and Radiolarians from Summer 2011 and 2012 in the Chukchi Sea. Acta Protozoologica, 53:101–113.

Dolan J. R., Pierce R. W., Yang E. J. 2017. Tintinnid ciliates of the marine microzooplankton in Arctic Seas: a compilation and analysis of species records. Polar Biology, 40(6):1247–1260.

Foissner W., Anne Chao A. & Katz L.A., 2008. Diversity and geographic distribution of ciliates (Protista: Ciliophora). Biodivers. Conserv., 17:345–363.

Fenchel T. & Finlay B.J., 2004. The ubiquity of small species: patterns of local and global diversity. Bioscience, 54:777–784.

Gavrilova N.A. & Dolan J.R., 2007. A note on species lists and ecosystem shifts: Black Sea tintinnids, ciliates of the microzooplankton. Acta Protozoology, 46:279–288.

Gavrilova N.A. & Dovgal I.V., 2016 Tintinnid ciliates (Spirotrichea, Choreotrichia, Tintinnida) of the Black Sea: recent invasions. Protistology, 10(3):91-96.

Hada Y., 1937. The fauna of Akkeshi Bay IV. The pelagic Ciliata. Journal of the Faculty of Science Hokkaido Imperial University, 5:143–216.

Hada Y., 1938. Studies on the Tintinnoinea from the Western Tropical Pacific. Journal of the Faculty of Science Hokkaido Imperial University, 6:87–190.

Hammer Ø, Harper D.A. & Ryan R.D., 2001. PAST: Paleontological statistics software package for education and data analysis. Paleontologia Electronica, 4 (1):1-9.

Kofoid C.A. & Campbell A.S., 1929. A conspectus of the marine and fresh - water Ciliata belonging to the suborder Tintinnoinea, with descriptions of new species principally from the Agassiz Expedition to the Eastern Tropical Pacific 1904–1905. University of California Publications in Zoology, 34:1–403.

Kofoid C.A. & Campbell A.S., 1939. Reports on the scientific results of the expedition to the Eastern Tropical Pacific, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer “Albatross” from October, 1904, to March, 1905, Lieut.-Commander L.M. Garrett, U.S.N. commanding. 37. The Ciliata: The Tintinnoinea. Bulletin of the Museum of Comparative Zoology/Harvard, 84:1–473.

Kršinić F. 2018. Fauna of tintinnids (Tintinnida, Ciliata) during an Arctic-Antarctic cruise, with the S/V “Croatian Tern”. Zootaxa, 4399 (3):301–314.

O’Malley M.A., 2008 ‘Everything is everywhere: but the environment selects’: ubiquitous distribution and ecological determinism in microbial biogeography. Stud. Hist. Phil. Biol. & Biomed. Sci., 39:314–325.

Pierse R.W. & Turner J T., 1993. Global biogeography of marine tintinnids. Marine Ecology Progress Series, 94(1):11-26.

Türkoğlu M. & Koray T. 2000. Ecological and geographical distributions of the planktonic protista in the southern parts of the Black Sea: neritic waters of Sinop peninsula, Turkiye. Su Ürünleri Dergisi, 17**:**161-178.

Wailes, G.H., 1943. Canadian Pacific fauna. 1. Protozoa. 1f. Ciliata. Tintinnoinea. Fish. Res. Bd Canada & Univ. Toronto Press, 13-27.

Taxonomic notes on the subspecies of *Phyllopodopsyllus thiebaudi* Petkovski, 1955 (Tetragonicipitidae: Harpacticoida: Copepoda)

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Genus *Phyllopodopsyllus* T. Scott 1906 of the family Tetragonicipitidae currently accommodates about 60 species/subspecies and nearly cosmopolitan. The genus characterised by its foliaceous female fifth leg that forms a completely sealed brooding chamber with urosomal somites. The genus was first recorded from Turkish marine waters by Karaytuğ and Sak (2006) with *P. briani* Petkovski, 1955, *P. thiebaudi* Petkovski, 1955, and *P. pauli* Crisafi, 1960 from the coasts of Balıkesir. The aim of this study is to redescribe *P. thiebaudi* which was originally described from Bulgaria by Petkovski (1955) with a very brief description and also reveal the variations among the populations of the species which are distributed along the coasts of Turkey. The taxonomic status of the subspecies *P. thiebaudi santacruzensis* Mielke, 1989 is also discussed. For this purpose, *P. thiebaudi* specimens that were collected with previous studies and stored in the collections of Balıkesir and Mersin University Biology departments as well as the newly collected specimens from a Rockpool in Gazipaşa /Antalya (09.07.2017) have been examined and selected specimens were drawn in detail with a DIC attached Olympus BX-51 and BX-53 microscopes with the help of a drawing tube. Also light microscope photographs were taken with Canon EOS 1200 D that was attached to a Olympus BX-53 binocular microscope and focus stacked with Adobe Photoshop CC graphics software.

Keywords: Redescription, taxonomy, biodiversity, fauna.

First record of the genus *Parapseudoleptomesochra* Lang, 1965 (Copepoda, Harpacticoida, Ameiridae) from Turkey with description of a new species

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The genus *Parapseudoleptomesochra* was established by Lang in 1965 to set apart a marine species which was described by Krishnaswamy as *Ameira trisetosa* in 1957. Until now, 28 species and subspecies are reported from subterranean and brackish-waters.

The material was collected from intertidal zone of Kale Cove (Keşan/Edirne/Turkey), during a sampling trip along shore of Saros Bay, in 2013. Seven female and three male specimens which belong to the genus *Parapseudoleptomesochra* were found among collected samples and described as new to science. The new species is morphologically most closely related to *P. incerta* and can be distinguished from its congeners by chaetotaxy of the swimming legs. The genus was reported for the first time from Turkey.

Keywords: Copepoda, Harpacticoida, biodiversity, Edirne, Turkey.

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Heavy metal levels in muscle, livers and digestive tracts of *Cyprinus carpio* L., 1758 from Altınkaya Dam Lake of Samsun Province, Turkey

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In the present study the amounts of five heavy metals in muscle, livers and digestive tract samples of *Cyprinus carpio* from Altınkaya Dam Lake for analysis of Pb, Cd, Hg, Cu and Zn by ICP-MS (Inductively Coupled Plasma – Mass Spectrometer). Big differences in heavy metal amounts were found between muscle, livers and digestive tract samples in *C. carpio*. Zn was the highest in all tissues. The significantly higher levels of Pb was found in digestive tract, while high Cd, Hg, Cu and Zn levels were found in liver of *C. carpio*. The all metal levels in muscle tissues were low compare with the liver and digestive tract samples. The results of the present study showed that estimated weekly and daily intakes of these metals via consumption of *C. carpio* were below the permissible tolerable daily intake and provisional tolerable weekly intake values established by Food and Agriculture Organization/World Health Organization

Keywords: Heavy metals, *Cyprinus carpio*, Altınkaya Dam Lake, Estimated Weekly Intakes, Estimated Daily Intakes, Provisional Tolerable Weekly Intake

Introduction

Carp is one of the most popular fish in freshwaters of our country as it is in all countries. *Cyprinus carpio* have been in all the rivers, reservoirs and natural lakes of Turkey. It inhabits in Kızılırmak naturally. The Kızılırmak Delta is the largest and the most significant delta of Turkey, which is very rich in biological diversity (Bat *et al*., 2015). However, the Kızılırmak Delta receives many pollutants including heavy metals from its basin (Bakan & Büyükgüngör, 2000; Bakan *et al*., 2010). Altınkaya Dam Lake is located in Samsun Province and fishing is very common on Altınkaya Dam Lake (Öztürk *et al*., 1995).

Heavy metals are exist in aquatic ecosystem at low levels and the increase of their levels indicate the environmental pollution. The presence of heavy metals in the aquatic ecosystems depends on anthropogenic activities such influence of industry, domestic wastes and other forms of pollution. It was shown that analysis of heavy metals in biota from aquatic environment were hihger than those in surrounding water (Bat, 2014).

Therefore, the aim of the present study were to determine if Pb, Cd, Hg, Cu and Zn were present in *Cyprinus carpio* L., 1758, from Altınkaya Dam Lake of Samsun Province, describe if the amounts of these heavy metals were significantly different among the obtain muscle, livers and digestive tract samples determine if the concentrations of Pb, Cd, Hg, Cu and Zn were significantly different between tissues, and compare the concentrations of these metals presented in edible tissues with the guidelines of the Turkish Food Codex and Commission Regulation (EC) for the safe consumption limits of fish.

Material and Methods

Common carps (*Cyprinus carpio*) from Altınkaya Dam Lake (Samsun) were caught by professional fishermen during autumn of 2015 and were transported in ice box to the laboratory daily. The samples were dissected in order to obtain muscle, livers and digestive tract samples that were mixed homogeneously and immediately frozen and stored at -21 ºC.

For determination of heavy metal contents in fish samples, digested with Suprapur® HNO_3 (nitric acid) using a microwave digestion system (Milestone Systems, Start D 260) for analysis. At the same time, a blank trial was carried out. After digestion, the concentrations of heavy metals were analyzed by ICP-MS (Agilent Technologies, 7700X). Metal concentrations in fish tissues were determined on wet weight basis as milligram of metal per kilogram. All glassware and plasticware were carefully cleaned and rinsed with HNO3, in order to avoid metal contamination. Standard reference material TORT-3 lobster hepatopancreas for metals was used to determine the reliability of the analysis.

Fish consumption is approximately to 17.1 g/day in Turkey (TUIK, 2016). The EDI of metals was determined using the following equation (Bat, 2017).

EDI = Cmetal ×W / b.w.

Where: Cmetal is the concentration of metals in fish; W represents the daily average consumption of seafood; b.w. is the body weight. EWI values were calculated from EDI values. Intake estimates were expressed as per unit body weight (mg/kg body wt. /weekly and daily).

Results

The significantly highest concentration of Pb was found in digestive tract of *C. carpio*, 0.82±0.07 mg/kg wet wt., while the low concentration of Pb was detected in muscle tissues (0.037±0.002 mg/kg wet wt.). Distribution of Pb was decreased in a following order: digestive tract > liver > muscle (Fig. 1). The higher level of Cd was present in liver of *C. carpio* (0.057±0.003 mg/kg wet wt.) while in digestive tract 0.043±0.002 mg/kg wet wt. was found. Cd was accumulated in low concentration (0.018±0.001 mg/kg wet wt.) in muscles of *C. carpio* (Fig. 2). Similarly distribution of Hg in *C. carpio* was the same in studied tissues. The higher level of Hg in liver was recorded as 0.063±0.004 mg/kg wet wt. followed by digestive tract with 0.055±0.003 mg/kg wet wt. and muscles with 0.033±0.001 mg/kg wet wt. (Fig. 3). Zn was the highest in all tissues. Cu and Zn in muscles of *C. carpio* were 0.90±0.011 and 9.85±0.33 mg/kg wet wt., respectively. The higher Cu and Zn levels in liver were found as 7.6±1.3 and 25±4 mg/kg wet wt., respectively (Figs. 4 and 5).

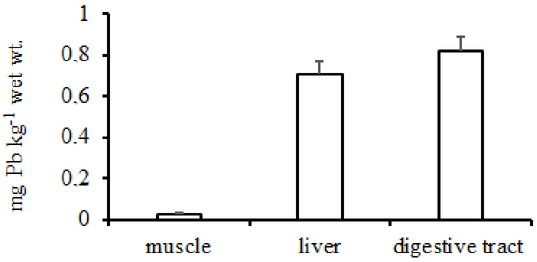

Figure 1. Mean levels and standard deviation of Pb (mg kg^{-1} wet wt.) in muscle, livers and digestive tract samples of *Cyprinus carpio* from Altınkaya Dam Lake in 2015.

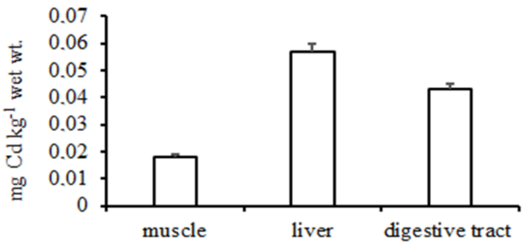

Figure 2. Mean levels and standard deviation of Cd (mg kg^{-1} wet wt.) in muscle, livers and digestive tract samples of *Cyprinus carpio* from Altınkaya Dam Lake in 2015.

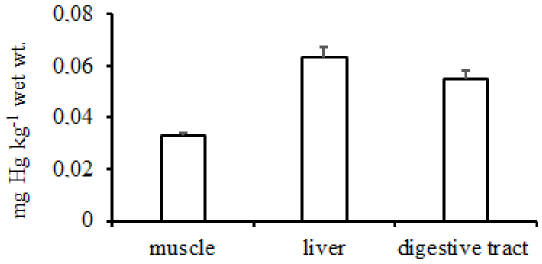

Figure 3. Mean levels and standard deviation of Hg (mg kg^{-1} wet wt.) in muscle, livers and digestive tract samples of *Cyprinus carpio* from Altınkaya Dam Lake in 2015.

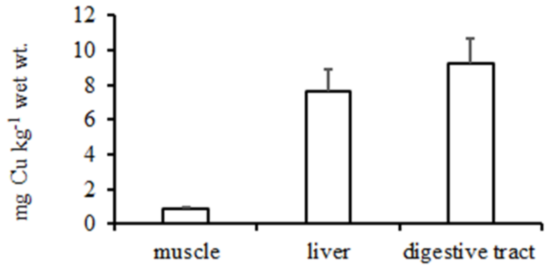

Figure 4. Mean levels and standard deviation of Cu (mg kg^{-1} wet wt.) in muscle, livers and digestive tract samples of *Cyprinus carpio* from Altınkaya Dam Lake in 2015.

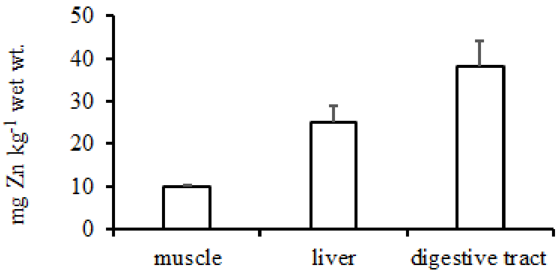

Figure 5. Mean levels and standard deviation of Zn (mg kg-1 wet wt.) in muscle, livers and digestive tract samples of *Cyprinus carpio* from Altınkaya Dam Lake in 2015.

Table 1 shows Estimated Weekly Intakes (EWI) and Estimated Daily Intakes (EDI) of heavy metals in edible muscles of *C. carpio* from Altınkaya Dam Lake, Samsun.

Discussion

Zn was the highest in all tissues followed by Cu. It is normal that they are essential trace elements in the diet and their absence can lead to serious illness (Bat, 2017). However, accumulation of Zn and Cu at high levels in seafood including fish is toxic and not desirable (Bat, 2014; Bat, 2017; Bat & Arıcı, 2018).

The heavy metals amounts were variously distribution in muscle, livers and digestive tract samples of *C. carpio*. The metal levels in muscle samples of *C. carpio* are lower than the other tissues and this result is in agreement with previous researches from Altınkaya Dam Lake (Öztürk *et al.*, 1995) and Balık Lake (Bat *et al.*, 2015) of Samsun Province.

In the present study the significant higher levels of Cd, Hg, Cu and Zn levels were found in liver of *C. carpio*. Liver accumulate heavy metals in higher concentration, while muscles contain lower ones which are in agreement with vital function of these tissues (Ahmed & Bat, 2017). Liver have been considered to be the inner organs for metal accumulation in fish (Bat, 2014). Many studies (Ahmed & Bat, 2015a,b,c; Ahmed *et al.*, 2015; Bat &Arıcı, 2016) argued that liver is the main detoxification destiny. However, the significantly higher levels of Pb were found in digestive tract. *C. carpio* is omnivore fish and feeds on plankton and algae and it may be one of the reasons for higher Pb bioaccumulation.

Table 1. Estimated Weekly Intakes (EWI) and Estimated Daily Intakes (EDI) of heavy metals in edible muscles of *C. carpio* from Altınkaya Dam Lake.

Metals	PTWI[a]	PTWI[b]	PTDI[c]	EWI[d] (EDI)[e]
Pb	25	1750	250	0.003213±0.000119 (0.000459±0.000017)
Cd	7	490	70	0.002142±0.000119 (0.000306±0.000017)
Hg	4	28	40	0.003927±0.000119 (0.000561±0.000017)
Cu	3500	245000	35000	0.1071±0.001309 (0.0153±0.000187)
Zn	7000	490000	70000	1.17215±0.03927 (0.16745±0.00561)

[a]PTWI (Provisional Tolerable Weekly Intake) in µg /week/kg body wt.
[b]PTWI for 70 kg adult person (µg /week/70 kg body wt.)
[c]PTDI (Permissible Tolerable Daily Intake) (µg /day/70 kg body wt.)
[d]EWI (Estimated Weekly Intake) (µg /week/ 70 kg body wt.)
[e]EDI (Estimated Daily Intake) (µg /day/ 70 kg body wt.)

The analysis of Pb, Cd, Hg, Cu and Zn in *C. carpio* from Altınkaya Dam Lake indicates the presence of these metals in the edible tissues, but these amounts are below the recommended values by Turkish (TFC, 2002, 2008 and 2009) and European Community (EC, 2001, 2006 and 2014) Regulations. In subsequent investigation of health risk assessment, concentrations of these metals were also calculated in *C. carpio* from Altınkaya Dam Lake, Samsun.

In terms of health risk, the tolerable weekly intakes were estimated by means of references for only edible tissues (muscle) of *C. carpio* from Altınkaya Dam Lake consumed by people in Samsun Province. The EWI (Estimated Weekly Intake) and EDI (Estimated Daily Intake) values presented in Table 1, were estimated by assuming that a 70-kg person will consume 17.1 g fish per day which is about 120 g fish per week. The tolerable weekly intake of heavy metals as PTWI (Provisional Tolerable Weekly Intake), are set by the Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additives (JECFA). PTWI is the highest amount of a pollutant to which a person can be exposed per week over a lifetime without an unacceptable risk of health effects (National Academy of Science, 1989; FAO/WHO, 2010 and 2011). It can be seen from Table 1 that the estimated EWIs and EDIs of heavy metals in the present study are very low the recommended PTWIs and/or PTDIs and indicated no adverse effects to the consumers.

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References

Ahmed, Q. & Bat, L., 2015a. Heavy metal levels in *Euthynnus affinis* (Cantor, 1849) Kawakawa fish marketed of Karachi fish harbour, Pakistan and potential risk of human health. Journal of the Black Sea/Mediterranean Environment, 21 (1): 35-44.

Ahmed, Q. & Bat, L., 2015b. Potential risk of some heavy metals in *Pampus chinensis* (Euphrasen) Chinese silver pomfret Stromateidae collected from Karachi fish harbour, Pakistan. International Journal of Marine Science, 5 (21): 1-5.

Ahmed, Q. & Bat, L., 2015c. Comparison of Pb and Cd concentration in tissues of fish *Alepes djedaba* (Forsskål, 1775) collected from Karachi fish harbour. International Journal of Fauna and Biological Studies, 2 (4): 93-96.

Ahmed, Q., Bat, L., Yousuf, F., Ali, Q.M. & Nazim, K., 2015. Accumulation of heavy metals (Fe, Mn, Cu, Zn, Ni, Pb, Cd and Cr) in tissues of narrow-barred Spanish mackerel (Family-Scombridae) fish marketed by Karachi Fish Harbor. Open Biological Science Journal, 1: 20-28.

Ahmed, Q. & Bat, L., 2017. Heavy metal levels in different sizes and tissues of *Drepane longimana* (Bloch & Schneider, 1801) from Arabian Sea. Journal of Coastal Life Medicine, 5 (12): 505-509.

Bakan, G. & Büyükgüngör, H., 2000. The Black Sea. Marine Pollution Bulletin, 41(1): 24-43.

Bakan, G., Özkoç, H.B., Tülek. S. & Cüce, H., 2010. Integrated environmental quality assessment of the Kızılırmak River and its coastal environment. Turkish Journal of Fisheries and Aquatic Sciences, 10(4): 453-62.

Bat, L., 2014. Heavy metal pollution in the Black Sea. In: Düzgüneş E, Öztürk B, Zengin M, eds. Turkish Fisheries in the Black Sea. Published by Turkish Marine Research Foundation (TUDAV), Publication number: 40, ISBN: 987-975-8825-32-5 Istanbul, Turkey, pp. 71-107

Bat, L., Arıcı, E., Sezgin, M. & Şahin, F., 2015. Heavy metal levels in the liver and muscle tissues of the four commercial fishes from Lake Balik, Kızılırmak Delta (Samsun, Turkey). Journal of Coastal Life Medicine, 3(12): 950-955.

Bat, L. & Arıcı, E., 2016. Heavy metal levels in tissues of *Merlangius merlangus* (Linnaeus, 1758) from the Black Sea coast of Turkey and potential risks to human health. International Journal of Marine Science, 6 (10): 1-8.

Bat, L., 2017. The contamination status of heavy metals in fish from the Black Sea, Turkey and potential risks to human health. In: Sezgin M, Bat L, Ürkmez D, Arıcı E, Öztürk B, eds. Black Sea Marine Environment: The Turkish Shelf. Turkish Marine Research Foundation (TUDAV), Publication No: 46, ISBN- 978-975-8825-38-7, Istanbul, TURKEY, pp. 322-418

Bat, L. & Arıcı, E., 2018. Chapter 5. Heavy metal levels in fish, molluscs, and crustacea from Turkish seas and potential risk of human health. In: Holban AM, Grumezescu AM, eds. Handbook of Food Bioengineering, Volume 13, Food Quality: Balancing Health and Disease. Elsevier, Academic Press, ISBN: 978-0-12-811442-1, pp. 159-196.

Commission Regulation (EC)., 2001. No 466/2001 of 8 March 2001 setting maximum levels for certain contaminants in foodstuffs.

Commission Regulation (EC)., 2006. Official Journal of the European Union. Setting maximum levels for certain contaminants in food stuffs. Commission Regulation (EC) No 1881/2006, 364: 5-24.

Commission Regulation (EU). 2014. No 488/2014 of 12 May 2014 amending Regulation (EC) No 1881/2006 as regards maximum levels of cadmium in foodstuffs, L 138/75.

FAO/WHO., 2010. Summary report of the seventy-third meeting of JECFA. Joint FAO/WHO Expert Committee on Food Additives. Geneva.

FAO/WHO., 2011. Joint FAO/WHO food standards programme codex committee on contaminants in foods, Fifth Session, working document for information and use in discussions related to contaminants and toxins in the GSCTFF, The Hague, The Netherlands, 90 pages.

National Academy of Science., 1989. Recommended Dietary Allowances, 10th Edition, National Academy Press, Washington, D.C., 298 pages.

Öztürk, M., Bat, L. & Öztürk, M., 1995. The heavy metal levels in different organs and tissues of carp Cyprinus carpio L. 1758, living in Altınkaya Dam Lake, Samsun. II. Ulusal Ekoloji ve Çevre Kongresi, 11-13 Eylül, Ankara, (inTurkish), pp. 650-667.

TFC., 2002. Official Gazette of Republic of Turkey. Notifications about determination of the maximum levels for certain contaminants in foodstuffs of Turkish Food Codex (inTurkish). (Notification No: 2002/63), Issue: 24885.

TFC., 2008. Notification on the maximum limits of contaminants in foodstuffs (in Turkish). (Notification No: 2008/26), Issue: 26879.

TFC., 2009. Official Gazette of Republic of Turkey. Notifications changes to the maximum levels for certain contaminants in foodstuffs (in Turkish). (Notification No: 2009/22), Issue: 27143.

TUIK, Turkish Fishery Statistics.2016. http://www.tuik.gov.tr/ [Accessed December 2016].

Heavy metal levels in crustaceans in Sinop shores of the southern Black Sea coast

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Crustacean species belonging to Isopoda, Amphipoda and Decapoda were collected using a van Veen grab from Sinop coast of the Black Sea, Turkey in 2015. Concentrations of Zn, Cu, Pb, Hg and Cd were determined in the total samples. The mean heavy metal levels followed order: Zn> Cu> Pb> Cd> Hg. . Zn was the highest heavy metal in Isopoda, Amphipoda and Decapoda species, while Hg was lowest. High Hg and Pb levels were found in Amphipoda. On the other hand high Cd and Zn levels were exist in Decapoda. Finally high Cu was in Isopoda. Pb, Cd and Hg levels in Crustacean species from Sinop coasts of the Black Sea were below the tolerable values.

Keywords: Heavy metals, Isopoda, Amphipoda, Decapoda, Black

Introduction

In the last few decades the Black Sea has suffered major changes induced by anthropogenic activities. Pollution and eutrophication process effected irreversible changes in the structure of the benthic species. Indeed human activities are no doubt the greatest driver of change in marine biodiversity at all levels of organization; thus, future trends will depend mostly on human-related impacts (Bat et al., 2018a).

In Turkish coasts the Black Sea shelf is only a narrow intermittent strip. Although the coastal area is free of hydrogen sulphide, concentrations increase rapidly under the thermocline owing to the restricted ventilation of deeper shelf water. Consequently, the number of macro-benthic species decreases rapidly with increasing depth. Communities of macro-benthos especially Crustaceans play an important role in the functioning of littoral and sublittoral zones ecosystem of the Black Sea. They are main food items for fish, the quality and productivity of which determine abundance of fish resources. They possess filtrating qualities, determining the course of the processes of biological purification and its intensity and the participation of the bottom fauna in the destruction and accumulation of organic substances. Heavy metals bind tendency to suspended particles material and bottom sediments of coastal waters (Bat et al., 2016). This have caused to the Black Sea to deteriorate especially benthic communities and sediment and eventually human health, through direct contact of organisms or re-suspension into the overlying water (Bat & Özkan, 2015).

The study area (Sinop Bay) is located at the central part of the southern Black Sea. The Bay is one of the most important natural harbours of the Black Sea and is characterized by high hydrodynamic conditions. Environmental parameters can significantly influence the diversity, density and structure of ecosystems. The significance of the use of bio-indicators to detect contaminants put forwarded by the Marine Strategy Framework Directive. Macro-benthic organisms are used as bio-indicators, because these species are more stable than planktonic organisms and they respond relatively rapidly to anthropogenic stress and contaminants especially heavy metals. Little studies are available on the heavy metal determination in Crustacea from the Black Sea coast of Turkey. In this respect, the heavy metal concentrations have been measured Crustacean species belonging to Isopoda, Amphipoda and Decapoda from Sinop coast of the Black Sea, Turkey in 2015.

Material and Methods

Crustacea species were collected by van Veen grab from Sinop Peninsula in 2015 (Fig. 1). Isopoda, Amphipoda and Decapoda were selected due to the amount of biomass of specimen required for heavy metal analysis was sufficient. The most commonly found species belonging to Isopoda, Amphipoda and Decapoda were used for metal analysis. All species used for metal analysis were identified. These species are identified by Prof. Dr. Murat Sezgin.

The samples were dried in an oven at 100°C in 24 hours and weighted. All samples were stored deep frozen at -21°C until their analysis. Metal analyses were performed using m-AOAC 999.10- ICP/MS method by accredited Environment Industrial Analysis Laboratory Services Trade Company (TÜRKAK Test TS EN ISO IEC 17025 AB-0364-T). The method for determination of heavy metals, used acid, standard reference material, wet digestion was used by European Standard method with number EN 15763. Analytical quality control sample was routinely run through during the period of metal analysis. Standard solutions were prepared from stock solutions (Merck, multi-element standard). Certified Reference Material No: 414 trace elements in plankton (powder) were used for calibration. The results showed good agreement between certified and analytical values. Recovery rates were 97-105% (modified from Bat et al., 2016).

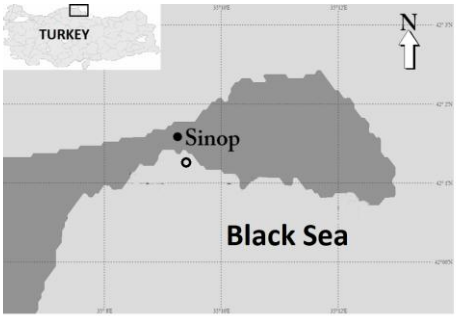

Figure 1. Map of the study area.

Results

The list of Isopoda, Amphipoda and Decapoda species were given in Table 1.

Table 1. List of Isopoda, Amphipoda and Decapoda species during this study.

Species
Isopoda
Idotea balthica (Pallas, 1772)
Sphaeroma serratum (Fabricius, 1787)
Synisoma capito (Rathke, 1837)
Amphipoda
Ampelisca pseudospinimana Bellan-Santini & Kaim-Malka, 1977
Atylus massiliensis Bellan-Santini, 1975
Dexamine spinosa (Montagu, 1813)
Gammarus insensibilis Stock 1966
Microdeutopus algicola Della Valle, 1893
Decapoda
Athanas nitescens (Leach, 1814)
Diogenes pugilator (Roux, 1829)
Upogebia pusilla (Petagna, 1792)

The mean heavy metal concentrations in Crustacean species of the current study are shown in Figs. 2-6. The extent of different heavy metals in Crustacea followed as, Zn> Cu> Pb> Cd> Hg. All metals in the currentt study in detectable amounts, showing some degree of heavy metal pollution in the studied area. Zn was the highest heavy metal in Isopoda, Amphipoda and Decapoda species, while Hg was lowest. High Hg and Pb levels were found in Amphipoda. On the other hand high Cd and Zn levels were exist in Decapoda. Finally high Cu was in Isopoda.

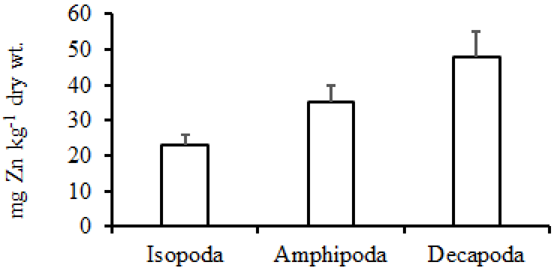

Figure 2. Mean levels and standard deviation of Zn (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

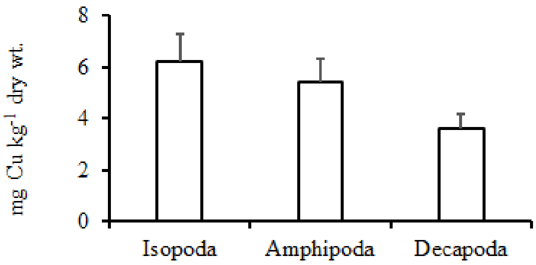

Figure 3. Mean levels and standard deviation of Cu (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

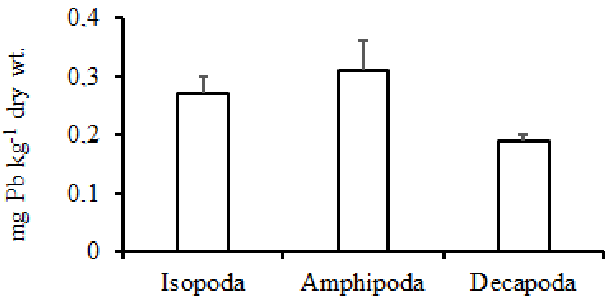

Figure 4. Mean levels and standard deviation of Pb (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

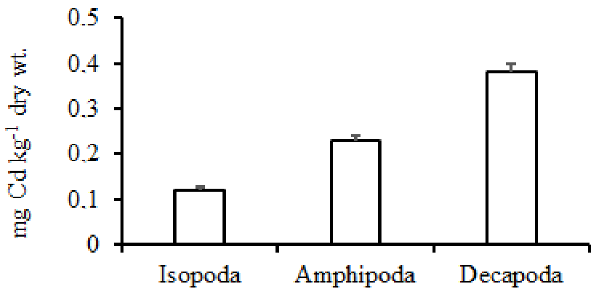

Figure 5. Mean levels and standard deviation of Cd (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

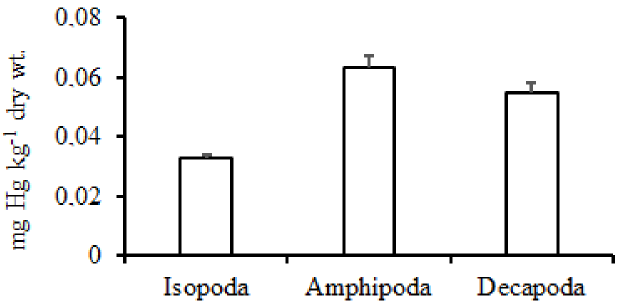

Figure 6. Mean levels and standard deviation of Hg (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

Discussion

Studies on heavy metals in Crustacean species have been performed for many years (Bat 2014; Bat & Arıcı, 2018). Meanwhile there is little information on heavy metal levels in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea are exist (Bat & Öztürk, 1997; Bat et al., 2013; Bat et al., 2018b). Zn was the most common heavy metal in Isopoda, Amphipoda and Decapoda species, Cu was the other heavy metal commonly exists in the samples. Regarding Zn and Cu the reported patterns are in good agreement with the literature obtained in the current study. High accumulation of Zn in Crustacea may be due to co-precipitation of Zn with calcium carbonate (Rejomon et al. 2008). Many Cu ores are processed at the Black Sea coast of Turkey. The Zarbana River bed close to Etibank Küre mine and Zarbana river mouth placed at the Northern Anatolia are highly polluted with respect to heavy metals (Bat et al., 2018a). The tolerable values of Cu and Zn in the crustacea were 20 and 50 mg/kg wet wt., respectively (MAFF, 1995; TFC, 2002). In the current study showed that Cu and Zn levels in Crustecea from Sinop coasts of the Black Sea are acceptable values.

Isopoda, Amphipoda and Decapoda species from Sinop coasts of the Black Sea show non essential metals Pb; Cd and Hg concentrations in detectable levels. Robin et al. (2012) pointed out that salinity had a big role in the depletion of the dissolved Pb in the coastal water. If salinity decreased, the concentrations of dissolved Pb increased. Pb is also known to form colloids in coastal water, and such colloids would have adsorbed onto planktonic debris, which consequently might have resulted in higher concentration of the metals in Crustacea (Rejomon et al. 2008). Moreover, in point of the large surface-to-volume ratio of the organisms, it is accepted that differences in the levels taken up by adsorption-exchange may be greatly responsible for the observed variations of the metals (Martin, 1970). It may be true for the Black Sea (Bat et al., 2016).

The amounts of these heavy metals in organisms from the Black Sea may be due to industrial and domestic effluents into the harbor and its passage to the coastal areas, together with land based sourses from rivers (Altaş and Büyükgüngör, 2007; Bat et al., 2018a). It is indicated that absorption of dissolved Cd by algae and dilution of particulate Cd by high loads of organic matter originating in the process of primary production and resulted in Cd depletion in marine organisms (Pempkowiak et al. 2006). Human activities in Sinop coasts of the Black Sea region were food manufacturing such slaughtering, dairy products, canning of fruits/vegetables/fish, grain mill and bakery products, sugar factories, etc. (Bakan and Büyükgüngör, 2000). It is indicated that Sinop coasts were affected with intensive land-based pollution and organic matter originating from domestic discharge (Bat & Gökkurt Baki, 2014). Although some metal levels were found high in biota of the Black Sea coast, Turkey, the amounts of the heavy metal were not high in Sinop coast and did not present a serious problem (Bat, 2014 and 2017; Bat and Arıcı, 2018).

Moreover the tolerable value of Pb, Cd and Hg in the Crustacea was 0.5 mg/kg wet wt. (EC, 2006; TFC, 2009). In this study Pb, Cd and Hg levels in Isopoda, Amphipoda and Decapoda species from Sinop coasts of the Black Sea are below these values. However recent review (Bat & Arıcı, 2018) showed that potentiality of Crustacean species as bio-indicator is highly recommended.

Acknowledgements

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References

Altaş, L. & Büyükgüngör, H., 2007. Heavy metal pollution in the Black Sea shore and offshore of Turkey. Environmental Geology. 52: 469-476.

Bakan, G. & Büyükgüngör, H., 2000. The Black Sea. Marine Pollution Bulletin, 41(1): 24-43.

Bat, L. & Öztürk, M., 1997. Heavy metal levels in some organisms from Sinop Peninsula of the Black Sea. Tr. J. Engineering and Environ. Sci, 21: 29-33

Bat, L., Şahin, F., Sezgin, M., Üstün, F., Gökkurt Baki, O. & Öztekin, H.C., 2013. Heavy metals in edible tissues of the brown shrimp *Crangon crangon* (Linnaeus, 1758) from the Southern Black Sea (Turkey). J. Black Sea/Mediterranean Environment, 19 (1): 70-81.

Bat, L., 2014. Heavy metal pollution in the Black Sea. In: Düzgüneş E, Öztürk B, Zengin M, eds. Turkish Fisheries in the Black Sea. Published by Turkish Marine Research Foundation (TUDAV), Publication number: 40, ISBN: 987-975-8825-32-5 Istanbul, Turkey, pp. 71-107

Bat, L., Üstün, F. & Öztekin, H.C., 2016. Heavy metal concentrations in zooplankton of Sinop coasts of the Black Sea, Turkey. Marine Biological Journal, 1(1): 5-13

Bat, L., 2017. The contamination status of heavy metals in fish from the Black Sea, Turkey and potential risks to human health. In: Sezgin M, Bat L, Ürkmez D, Arıcı E, Öztürk B, eds. Black Sea Marine Environment: The Turkish Shelf. Turkish Marine Research Foundation (TUDAV), Publication No: 46, ISBN- 978-975-8825-38-7, Istanbul, TURKEY, pp. 322-418

Bat, L., Öztekin, A., Şahin, F., Arıcı, E. & Özsandıkçı U. 2018a. An overview of the Black Sea pollution in Turkey. MedFAR., 1 (2): 67-86.

Bat, L., Sezgin, M. & Sahin, F., 2018b. Heavy metal contamination of aquatic resources from Turkish Black Sea waters. Journal of Environmental Protection and Ecology, 19 (2): 558-563

Bat, L. & Arıcı, E., 2018. Chapter 5. Heavy metal levels in fish, molluscs, and crustacea from Turkish seas and potential risk of human health. In: Holban AM, Grumezescu AM, eds. Handbook of Food Bioengineering, Volume 13, Food Quality: Balancing Health and Disease. Elsevier, Academic Press, ISBN: 978-0-12-811442-1, pp. 159-196.

Commission Regulation (EC)., 2006. Official Journal of the European Union. Setting maximum levels for certain contaminants in food stuffs. Commission Regulation (EC) No 1881/2006, 364: 5-24.

MAFF, 1995. Monitoring and surveillance of non-radioactive contaminants in the aquatic environment and activities regulating the disposal of wastes at sea, 1993, Directorate of Fisheries Research, Lowestoft, Aquatic Environment Monitoring Report, No. 44.

Martin, J.H., 1970. The possible transport of trace metals via moulted Copepod exoskeletons. Limn and Oceanog 15 (5): 756-761.

Pempkowiak, J., Walkusz-Miotk, J., Bełdowski, J. & Walkusz, W., 2006. Heavy metals in zooplankton from the Southern Baltic. Chemosphere 62: 1697–1708.

Rejomon, G., Balachandran, K.K., Nair, M., Joseph, T., Dinesh Kumar, P.K,, Achuthankutty, C.T., Nair, K.K.C. & Pillai, N.G.K., 2008. Trace metal concentrations in zooplankton from the eastern Arabian Sea and western Bay of Bengal. Environ Foren 9: 22-32.

Robin, R.S., Muduli, P.R., Vardhan, K.V., Ganguly, D., Abhilash, K.R. & Balasubramanian, T., 2012. Heavy metal contamination and risk assessment in the marine environment of Arabian Sea, along the southwest coast of India. American J Chem 2(4): 191-208.

TFC., 2002. Official Gazette of Republic of Turkey. Notifications about determination of the maximum levels for certain contaminants in foodstuffs of Turkish Food Codex (inTurkish). (Notification No: 2002/63), Issue: 24885.

TFC., 2009. Official Gazette of Republic of Turkey. Notifications changes to the maximum levels for certain contaminants in foodstuffs (in Turkish). (Notification No: 2009/22), Issue: 27143.

Occupational risk factors of commercial fishing in Turkey

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The present study was carried out to determine the occupational risk factors of fisheries which is a very important but unattended topic of the fishing industry in Turkey and to give the fundamental ways to stand out against these factors. The term risk refers to likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard. Occupational risk factors in fisheries can be classified to five categories as physical, chemical, biological, ergonomic and physicosocial. Altough some risk factors such as vibration is impossible to eliminate, effects of those may still be minimized with suitable controls. Hierarch of controls can easily be adopted to any fishing vessel and fishing technique. PPE's must be used in every step of the fishing practices. Moreover it is obvious that the most important step is to educate the fishermen about hazards and risks of fishing.

Keywords: Fisheries, occupational risk, safety

Introduction

Over 58 million people are engaged in the primary sector of capture fisheries and aquaculture. Of these, approximately 37 percent are engaged full time, 23 percent part time, and the remainder either occasional fishers or of unspecified status. Over 15 million are working full-time on board fishing vessels (ILO, 2018). Fisheries sector has many special circumstances making itself isolated from other sectors. One of these, found throughout the world, is that of not paying fishers a set wage, but instead paying them based on a share of the catch. While this has certain advantages for the fisher, the system may to lead to very long working hours, a tendency to remain at sea during bad weather (which would otherwise motivate fishers to return home) and thus greater risks and more accidents. Accidents and injuries are very often during operations with risky catches or under rough weather conditions (Windle et al., 2008). Therefore fishing is acknowledged to be the most dangerous and risky occupation in many parts of the world. The ILO's Occupational Safety and Health Branch estimates that 24000 fatalities occur worldwide per year in fisheries (FAO, 2001).

OHS has been identified and conducted by the act number 4857 and 6331 in Turkey, covering all employees of all sectors including the field of fisheries. Turkey has been a party to the international convention for the safety of life at sea (SOLAS) since 1980 which is the most important international maritime safety treaty. SOLAS is the most comprehensive study of international maritime organization (IMO) in terms of protecting the safety of life at sea (Ayan and Baykal, 2010). Regulations about health and safety precautions in fishing vessels were published by the Turkish Republic Ministry of Labor and Social Security and became valid in 2013 (Anonymus, 2013). The aim of the regulation is to determine the required precautions for protecting the health and safety of employees working in fishing vessels. Minimum health and safety requirements in fishing vessels, minimum health and safety requirements about lifesaving and survival equipments, minimum health and safety requirements about personal protective equipment (PPE) have been mentioned in the regulation in order to clarify the subjects of fishing vessels, renovation, conversion, equipment and maintenance.

"Occupational risk factor" is defined as a chemical, physical, biological or other agent that may cause harm to an exposed person in the workplace and is potentially modifiable. In addition to these, ergonomic and physicosocial risk factors are also included in the concept of occupational risks. Due to their work environment, fishermen are exposed to all above mentioned risk factors somehow. According to Turkish fishery statistics there have been 14340 commercial fishing vessels and more than 31350 employees in the capture fisheries sector (TÜİK, 2015). Altough there are many studies focusing on fishing safety globally, only a few number of work has been carried out in Turkey (Soykan, 2016; Tantoğlu, 2016; Soykan, 2017 (a,b); Doğanyılmaz Özbilgin and Tok, 2017; Soykan, 2018).

The goal of the present study is to attract attention to fishing safety, particularly on occupational risk factors of fisheries which is a very important but unattended topic of the fishing industry in Turkey and to give the fundamental ways to stand out against these factors.

What are occupational risks in fisheries?

The term risk refers to likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard (ILO, 2018). As mentioned above fisheries occupational risk factors can be classified to five categories as physical, chemical, biological, ergonomic and physicosocial.

Physical risk factors in fisheries

Noise, vibration, lightening, thermal comfort and pressure are the physical risk factors affecting the health and safety of fishermen esspecially during onboard works. Unpredictable and often hostile marine environment, unstable work platforms (Windle et al., 2008) with the vibration and noise effect of the engine are accounted to be the main sources. Lightening is also a very important issue which has negative serious effects to eyes. Regarding the thermal comfort, esspecially winter season fishing is characterized with very low windchill temperature and is done under difficult conditions due to big temperature differences between deck work and cabin rest. Immediate pressure changes brings mortality risk to fishermen who dives for fishing or has to dive for fixing mechanical and/or navigational problems. Altough most of these risk factors are well defined and ways to fight are given in the current legislations, Turkish fishermen are not aware of to those risks they face to and think that this is the nature of their work.

Chemical risk factors in fisheries

Chemical risk factors are the least mentioned issue of occupational health and safety of capture fisheries. Even so, these factors are commonly classified as solid, powder, liquid, gass and vapour. Fishing operations generally don't include chemicals. However liquid matters such as paints, solvents and their vapours, which are very flammable and toxic to health, have been frequently used during maintanence of the vessels which is done by the fishermen themselves. Liquid chemicals are directly absorbed by the dermis. It is also known that during scraping too much powder comes out and must not be taken to respiratory system. The most dangerous size range of the powder is in between 0.5 and 5 micron because they can reach the alveolus and affect their chemical composition. In such studies powder and toxic vapour of the working environment must be measured by reliable methods and suitable precautions according to results of the measurements must be taken. In all steps of working with chemicals personel protective equipments (PPE) such as goggles and gloves must be used.

Biological risk factors in fisheries

The most encountered risk factor of fishermen may be the biological ones due to nature of their job. Small injuries like slash and bleeding wounds frequently happen during on board works which may result in infections. Moreover Poisonous or allergenic species such as *Trachinus* spp., *Myliobatis aquila* and *Scorpaena* spp. create hazards for fishermen (Soykan, 2018). Probably the most important topic for fishermen is the fundamental knowledge of first aid who spend most of their working time very far from professional health care services (Soykan, 2016). Defficient sanitation which was reported to be accepted as a normal condition by trawl fishermen (Soykan, 2016) also leads biologic risk agents (bacteria, virus and etc) to form disases. Biological risk factors are generally excluded in risk assessments due to lack of awareness. Suitable protection methodologies and equipments must be used while working with biological risk factors.

Ergonomic risk factors in fisheries

Specific disorders of the musculoskeletal system may relate to different body regions and occupational work. For example, disorders in the lower back are often correlated to lifting and carrying of loads of to the application of vibration. Upper-limb disorders (at fingers, hands, wrists, arms, elbows, shoulders, neck) may result from repetitive or long-lasting static force exertion or may be intensified by such activities. There are three primary ergonomic risk factors: high task repetative movements, forceful exertions and repetative or sustained awkward postures. The mentioned movement types or activities are very familiar to fishermen during hauling the gears or ropes and carrying fish boxes. Job rotation and engineering controls together or separetly prevent musculoskeletal diseases.

Physicosocial risk factors in fisheries

Fishing is also an occupation with long-standing traditions. One of these, found throughout the world, is that of not paying fishers a set wage, but instead paying them based on a share of the catch. While this has certain advantages for the workers of the fishing vessels, the system may to lead to very long working hours, a tendency to remain at sea during bad weather (which would otherwise motivate fishers to return home) and thus greater risks and more accidents. Uninsured employment was reported to be very common in the Turkish capture fisheries sector (Soykan, 2017) and this situation creates concerns about the future. It was also stated that many fishermen stay far from their families for long periods which making them sensitive and depressive (Ulukan, 2016). Aspiration to family, concerns about the future and ignoble living conditions are the main sources of stress for fishermen.

How to minimize the risk factors?

The first step in fighting against any risk factor is to identify the hazard or hazardous situations and the related risk. As a general rule in occupational safety science hazards should be removed at the source. If it is not possible to remove hazard, then the risk should be minimized with convenient methods. Controlling exposures to occupational hazards is the fundamental method of protecting workers. Traditionally, a hierarchy of controls has been used as a means of determining how to implement feasible and effective control solutions (Figure 1).

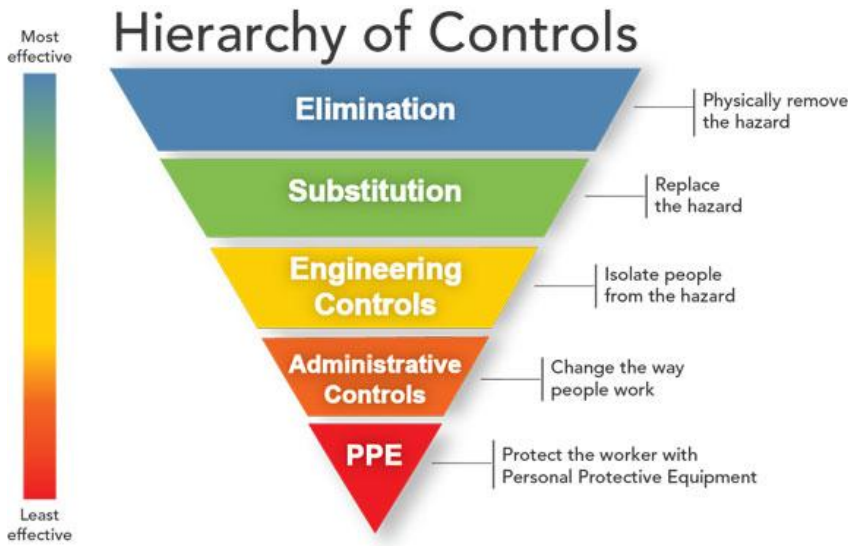

Figure 1. Hierarchy of controls in occupational safety from most effective method to least effective (CDC, 2018).

Altough some risk factors such as vibration is impossible to eliminate, effects of those may still be minimized with suitable controls. Hierarch of controls can easily be adopted to any fishing vessel and fishing technique. PPE's must be used in every step of the fishing practices. Moreover it is obvious that the most important step is to educate the fishermen about hazards and risks of fishing. Commercial fishing provides one of the most important sources of food, in particular animal protein, and is essential to food security (ILO, 2018). Over 38 million people work in capture fisheries, which is considered to be one of the world's most hazardous occupations. Hundreds of millions of dependents and others depend on the sector for their livelihoods (ILO, 2018). Although regulation of occupational health and safety in fishing vessels and some other regulations reported by several ministries aims to improve the occupational conditions of commercial fishing vessels in Turkey, it is known that majority of fishermen community generally do not follow the laws and regulations. In this concept, the most important duty belongs to authorities and non-governmental organizations which is establishing the awareness of occupational risk factors and their cosequences in the capture fisheries sector.

This study focusing on ocupational risk factors in fisheries is one of the limited studies in Turkey. Much more scientific attention is required to improve the fishing safety in Turkey and more detailed research must be performed in order to obtain reliable statistics about the health and safety of Turkish fishermen.

References

Anonymus, 2013b. Balıkçı gemilerinde yapılan çalışmalarda sağlık ve güvenlik Önlemleri hakkında yönetmelik. T.C. Çalışma ve Sosyal Güvenlik Bakanlığı, Ankara, 13 pp.

Ayan, M., Naykal, T., 2010. International maritime organization and the environment: Turkey's in status the organization. Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi 7(13):275- 297

CDC, 2018. https://www.cdc.gov/niosh/topics/hierarchy/default.html [Accessed September 2018].

Doğanyılmaz Özbilgin, Y. & Tok, V., 2017. Investigation of Mersin bay trawl fishermen's safety at sea awareness. Ege Journal of Fisheries and Aquatic Sciences, 34(2):139-144.

FAO, 2001. Safety at sea as an integral part of fisheries management. FAO Fisheries Circular No. 966, 39 pp.

ILO, 2018. Fisheries. Alıntılanma adresi: http://www.ilo.org/global/industriesand-sectors/shipping-ports-fisheries-inland waterways/fisheries/langen/index.htm [Accessed April 2018].

Soykan, O., 2016. A General Evaluation On Occupational Health And Safety in Trawlers Operating in the Aegean Sea, Turkey. 2nd International Congress on Applied Ichthyology & Aquatic Environment. 10 – 12 November 2016. Messolonghi, Greece. 333-337.

Soykan, O., 2017a. Türkiye'deki Büyük Ölçekli Balıkçılıkta Risk Etmenleri Üzerine bir Değerlendirme, *19.* Ulusal Su Ürünleri Sempozyumu 2017 (pp:102) 12-15 Sinop, TÜRKİYE: Bildiriler kitabı.

Soykan, O., 2017b. Türkiye Avcılık Sektöründe İş Sağlığı ve Güvenliği, *19*. Ulusal Su Ürünleri Sempozyumu 2017 (pp:110) 12-15 Sinop, TÜRKİYE: Bildiriler kitabı.

Tantoğlu, G., 2016. Balıkçı gemilerinde yapılan çalışmaların iş sağlığı ve güvenliği yönünden değerlendirilmesi. T.C. Çalışma ve Sosyal Güvenlik Bakanlığı İş Sağlığı ve Güvenliği Genel Müdürlüğü İş sağlığı ve güvenliği uzmanlık tezi, Ankara, 140 pp.

Ulukan, U., 2016. Balıklar, Tekneler ve Tayfalar: Türkiye'de Balıkçılık Sektöründe Çalışma ve Yaşam Koşulları, Çalışma ve Toplum, 1, 115-142.

TÜİK (Turkish Statistical Institute), 2015. Fishery statistics 2015, Ankara.

Windle, M.J.S., Neis, B., Bornstein, S., Binkley, M., Navarro, P., 2008. Fishing occupational health and safety: A comparison of regulatory regimes and safety outcomes in six countries, Marine Policy (32):701–710.

Spatial variability of metal accumulation and metallothionein contents in different tissues of freshwater mussels collected from the Atatürk Dam Lake

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Freshwater ecosystems have been exposed to strong anthropogenic pressures in the last decades. Anthropogenic metal pollution is prevalent throughout much of the world's freshwater ecosystems. Metallothioneins (MTs) have been extensively used as biomarkers of metal pollution. Freshwater mussels are often used to evaluate potential sources of metal contamination because of their ability to accumulate metals in their different tissues. For this reason, it was aimed to determine the effects of metal pollution in the Atatürk dam lake on MT levels of freshwater mussels that were selected as bioindicator organism. Freshwater mussel samples were collected in July-2018 from four different sites that were determined at the dam lake. The metal residues (Cd, Cu, Pb, Zn, and Ni) in the digestive glands and gills were determined by an inductively coupled plasma-mass spectrometer. MT levels were performed using a spectrophotometric method described by Viarengo et al., with some modifications. According to the results, there were significant changes regionally between the metal residues that were determined in the digestive glands and gills, in general ($p<0.05$). The highest MT levels for gills and digestive glands were determined in Kıvırcık and İncebağ, respectively. This difference at the MT levels was also statistically significant ($p<0.05$). In conclusion, although there was a positive correlation between the MT levels and some metal concentrations determined in both tissues, there was no exactly positive correlation between MT levels and metal concentrations. The MT content in both tissues of mussels is not only related to environmental metal concentrations but also could exhibit different variations toward biotic and abiotic factors. As a result, MT is a useful biochemical marker and mussels are appropriate organisms for determining the toxicity of metal.

Keywords: Freshwater mussel, Metallothionein, Metal, Atatürk dam lake, Gill, Digestive gland.

Taxonomic Revision of *Laophonte cornuta* Philippi, 1840 (Copepoda, Harpacticoida, Laophontidae) Species Complex Inhabiting in the Turkey

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Taxonomic revision of *Laophonte cornuta* was made on the basis of the populations collected from various shores along the Mediterranean coast of Turkey. Individuals determined as *L. cornuta* in previous studies were initially dissected and were redefined with the aid of modern light and Scanning Electron Microscope (SEM). Populations represented by the individuals identified as *L. cornuta* were analysed and compared in terms of intra- and interpopulational variations. As a conclusion of the obtained results, it was clearly demonstrated that the hypothesis assumed as "the populations recorded from the Mediterranean Sea under the name of *L. cornuta* represent different species" was true. Hence, previous populations determined as *L. cornuta* from the Turkish coasts were in fact belong to two different morphological species and it was demonstrated for the first time by this study that and one of these species is the true *L. cornuta*, on the other hand some of the other populations were not *L. cornuta* but a new species for science. As a consequence, it was discussed that variations in the present literature for *L. cornuta* may not be in the range of interspecies and the populations reported from the different part of the World for *L. cornuta* may represent different species. This study was supported by the research fund of Mersin University in Turkey with the project number 2017-2-TP2-2612.

Keywords: Mediterranean, Taxonomy, Harpacticoida, Copepoda, *Laophonte cornuta.*

Otolith biometry in *Zosterisessor ophiocephalus* (Pallas, 1814) from the Southern Aegean Sea

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Sagittae are widely used to determine taxon, age and size of the teleost fishes, and are useful tools for studies of prey-predator relationships, population dynamics and ichthyo-archaeology. They can also be used to estimate the size of the prey. We examined the relationships between otolith measurements (length, height and weight) and fish size (total length and weight) for *Zosterisessor ophiocephalus* (Pallas, 1814) (n= 120) from the Güllük Bay (southern Aegean Sea) for the first time. No significant differences were found between left and right otolith sizes. Both linear and exponential functions were applied and we found that, length, height and mass of sagittae were shown to be good indicators for estimating the length and weight of the species. At the same time, we observed that otolith morphology changes as the fish grows.
Keywords: Grass goby, Gobiidae, Güllük Bay, sagittal otolith, body size

Introduction

The grass goby [*Zosterisessor ophiocephalus* (Pallas, 1814)] is a demersal fish species belonging to Family: Gobiidae, distributed in Mediterranean Sea, Black Sea, and Sea of Azov and it's inhabits *Zostera* beds, inshore habitats between other sea meadows and muddy substratums, estuaries and lagoons (Miller, 1986, Akyol *et al.*, 2003). It's maximum reported total length is 29.9 cm (Lanzoni *et al.*, 2016) and distributed up to 100 m. depth (Azouz, 1974).

Several studies were conducted on the age and growth of the species by Akyol *et al.* (2003) in İzmir Bay, by Hajji *et al.* (2013) in the Gulf of Gabes (Central Mediterranean) and by Dulčić & Djodjo (2015) in the Adriatic Sea. Up to date, studies on the morphology of sagittal otoliths or its size relationship with the body size, are very limited on this species within the range of its distribution area: For example, Granzotto *et al.* (2003) were studied on the marginal increment analysis and Sr/Ca ratio in sagittal otoliths of the species from the Venetian Lagoon (Adriatic Sea). Their paper was representing unique data on the otolith biometry for *Z. ophiocephalus*, up to date.

As well known, there's strong correlation between size and mass of the fish and their otoliths. So, it is possible to estimated digested fish's length and weight from the size and mass of its sagittal otolith. For this purpose, the main objective of the present study was to obtain first information on the otolith biometry of this poorly studied species from the Aegean Sea.

Material and Methods

Fish specimens (n= 120) were obtained in 2016 from Güllük Bay by using a fishing rod, at depths between 0.5 and 4 m. Fish total length (TL) was measured to the nearest mm and fish weight (W) was determined to the nearest 0.01 g on a digital balance. Sagittae (Figure 1) were removed with forceps through a cut in the cranium. They were cleaned with 10% NaOH solution, stored dry in glass vials, and the left and right otolith were treated separately. Each sagitta was placed with the sulcus acusticus oriented upwards and otolith length (OL) was measured in mm through an eye-piece micrometer under with a stereo zoom microscope (Nikon SMZ-U). It was defined as the longest dimension between the rostrum and postrostrum axis (nomenclature of Smale *et al.*, 1995,Tuset *et al.*, 2008) through the focus of the otolith (Granzotto *et al.*, 2003). Otolith height (OH) was measured in mm as the longest dimension between the ventral and dorsal surfaces of each sagitta (Granzotto *et al.*, 2003). The image was taken of the internal side (medial or proximal) of the otolith as this side presents the sulcus acusticus (Tuset *et al.*, 2008). Individual sagittal otolith weight (OW) was determined in mg using an electronic balance.

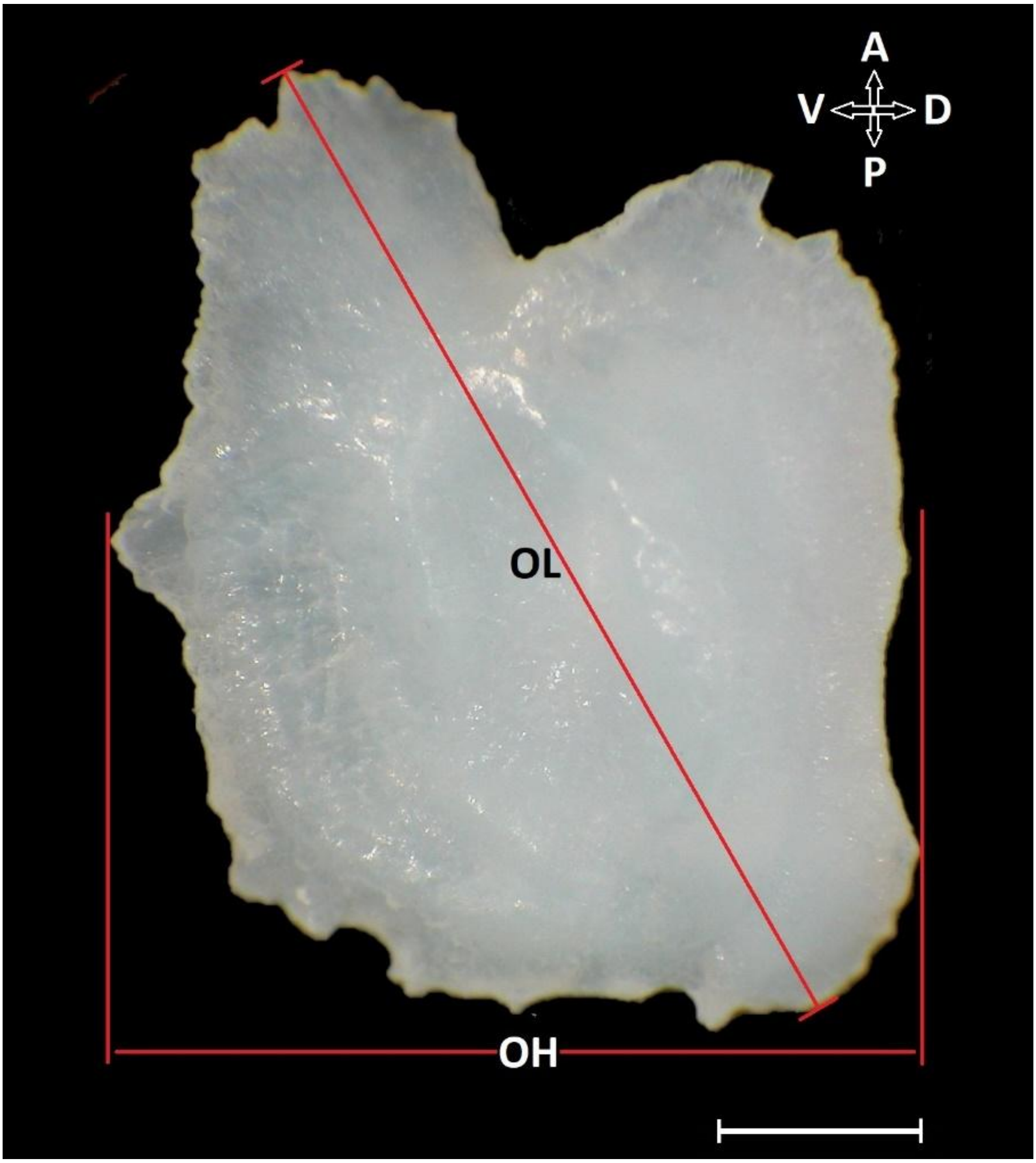

Figure 1. Measurements of right sagittal otolith of *Z. ophiocephalus* from proximal side (OL= Otolith length, OH= Otolith height, A: Anterior, P: Posterior, D: Dorsal, V: Ventral, scale bar: 1 mm).

Following, the paired t-test was used to check any differences between the left and right otolith. As significant differences ($P < 0.05$) were not found, the H_0 hypothesis ($b_{right} = b_{left}$) was accepted and a single regression was used for each parameter (OL, OW, and OH). Both of linear regression equations ($y = ax + b$) and exponential regression equations ($y = ax^b$) were used to determine equations (TL-OL, TL-OH, TL-OW, W-OL, W-OH, W-OW, OW-OL, OH-OL and OW-OH) for described the relationships between otolith and TL and W. Smallest, mid and largest sagittae were photographed for the possible changes in the morphology of the otoliths (Figure 2).

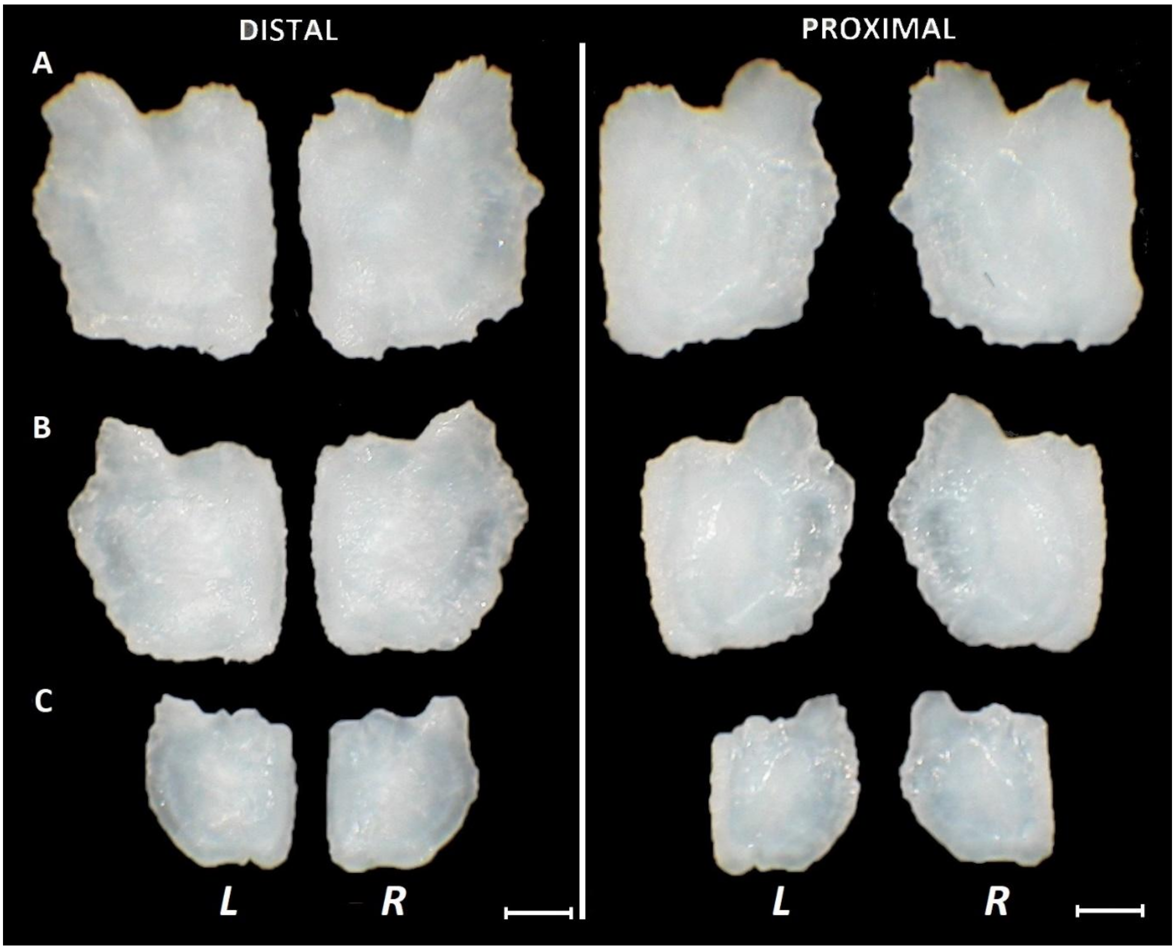

Figure 2. Sagittae of *Z. ophiocephalus* from distal and proximal sides (Belonging to fish specimens, A= 92 mm in TL, B= 126 mm in TL and C= 158 mm in TL) ((scale bar: 1 mm, L: Left, R: Right).

Results

The sagittal otoliths from 120 *Z. ophiocephalus* specimens were examined. Table 1 shows the descriptive statistics regarding TL, W and its sagittal otolith measurements (with otolith height). No significant differences (Student's *t-test* for paired comparisons, $P > 0.05$) were found between left and right otolith length, weight and height data. Therefore, the average of the left and right sagittae measurements were used for the calculation of equations.

Table 1. Descriptive statistics of *Z. ophiocephalus* and their otoliths obtained from the southern Aegean Sea.

Parameter	Value	
	Mean ± SD	Range
Total length [mm]	118.93 ± 16.7476	92 – 158
Total weight [g]	16.56 ± 6.6374	7.04 – 32.62
Otolith length [mm]	4.02 ± 0.3567	3.17 – 4.92
Otolith height [mm]	2.91 ± 0.2464	2.31 – 3.63
Otolith weight [g]	0.0110 ±0.0029	0.0053 – 0.0198

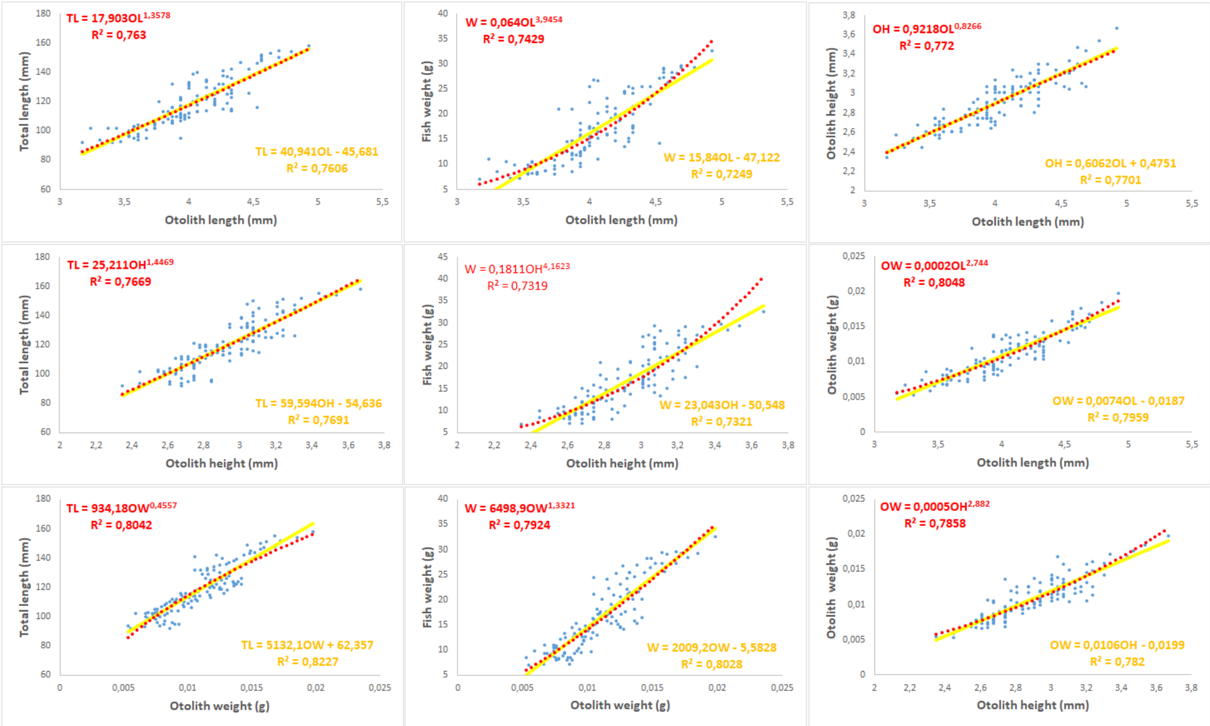

Figure 3. Relationships (and coefficients of determination R^2) between otolith morphometric parameters and fish total length or weight for *Z. ophiocephalus* (OL= otolith length, OH= otolith height, OW= otolith weight, TL= fish total length, W= fish weight, Red: linear regression model, Yellow: exponential regression model).

Relationships between fish and otolith measurements were shown in Figure 3. All regressions displayed a high coefficient of determination (from 0.7249 to 0.8227; Figure 3). Both linear and exponential regression models were used to determine the relationships between the fish length/weight and otolith sizes/mass for the species

Discussion

Granzotto *et al.* (2003) were describe the grass goby sagittae, first time, as, z-shaped with the dorsal side more rounded and thinner than the ventral side; if viewed sulcus-side down, rostrum lay anteroventrally and was less pronounced than prorostrum, which projected from the dorsal side. According to their results, otolith perimeter (Otolith length) and maximum diameter (Otolith height) were moderately and positively correlated with fish length (TL), suggesting a good relationship between sagittae and fish growth, but they did not give any equations between fish and otolith measurements. Even though they were measured maximum height and length of the left sagittae ranged, respectively, between 3.73 and 6.24 mm, 10.50 and 18.62 mm; fish length ranged between 10.1 and 23.0 cm (TL), in the present study, otolith length and height were measured as 3.66 and 2.61 mm belonging to fish specimen which has total length at 10.1 cm. In *Z. ophiocephalus*, they also stated that, sexual dimorphism in body size present in the species was reflected in sagittae size, the male's sagittae being significantly larger.

In the present study, as the fish grows, the otoliths grow and the morphology changes (according to Figure 2 and 3). Otolith weight (R^2= 0.8277) is the best indicator of the prediction of the fish length by examining the regression coefficients for *Z. ophiocephalus* in Güllük Bay (Figure 3). According to Patzner *et al.*, (2011), some seabirds, for example, cormorants (*Phalacrocorax* spp.) are natural predators of *Z. ophiocephalus* specimens. Possibly, the grass goby is also among the prey items of the piscivor fishes or other marine-related vertebrates, but there is no any scientific findings on this case. We hope that, with the data and equations presented for the first time in this study, it is possible to examine the otolith and fish size relation of *Z. ophiocephalus* in the southern Aegean Sea in order to provide a reliable tool for researchers studying food habits of top predators to determine the size and weight of prey fish from the length or weight of the otoliths recovered.

References

Akyol, O., 2003. Age, growth and reproduction period of grass goby (*Zosterisessor ophiocephalus* Pallas 1811) in the Bay of Izmir (Aegean Sea). Archive of Fishery and Marine Research, 50(2):220-224.

Azouz, A., 1974. Les fonds chalutables de la région nord de la Tunisie. 2. Potentialité de la pêche, écologie et répartition bathymétrique des poissons (Funds chalutableses of the north region of Tunisia. 2. Potentiality of the fishing, ecology and distribution bathymétrique of fishes). Bulletin de l'Institut National Scientifique et Technique d'Oceanographie et de Peche Salammbo, 3: 29-94.

Dulčić, J. & Djodjo, Ž., 2015. Age, growth and mortality of the grass goby *Zosterisessor ophiocephalus* (Pallas, 1814), in the Novigrad Sea (Eastern Adriatic) . *In*: Tsagarakis K., Başusta N., Başusta A., Biandolino F., Bostancı D., Buz K., Djodjo Z., Dulčić J., Gökoğlu M., Gücü A.C., Machias A., Maravelias C.D., Özvarol Y., Polat N., Prato E., Vasilakopoulos P. & Yedier S., 2015. New Fisheries-related data from the Mediterranean Sea (October, 2015). Mediterranean Marine Science, 16(3): 703-713.

Granzotto, A., Franceschini, G., Malavasi, S., Molin, G., Pranovi, F. & Torricelli, P., 2003. Marginal increment analysis and Sr/Ca ratio in otoliths of the grass goby, *Zosterisessor ophiocephalus*, Italian Journal of Zoology, 70:1, 5-11.

Hajji, F., Ouannes-Ghorbel, A., Ghorbel, M. & Jarboui, O., 2013. Age and growth of the Grass goby *Zosterisessor ophiocephalus* Pallas, 1811 in the Gulf of Gabes (Tunisia, Central Mediterranean). Acta Adriatica, 54(1): 27-40.

Lanzoni, M., Gavioli, A., Aschonitis, V., Merighi, M., Fano, E.A. & Castaldelli, G., 2016. Length-weight relationships of three estuarine species in the Comacchio Lagoon, Po River delta, Italy. Journal of Applied Ichthyology, 32:1284-1285.

Miller, P.J., 1986. Gobiidae. *In*: Whitehead, P. J. P. *et al.* eds. Fishes of the North-eastern Atlantic and the Mediterranean. Volume III, UNESCO, Paris. pp. 1019-1085.

Patzner, R.A., Van Tassell, J.L., Kovacic, M. & Kapoor, B.G., 2011. The biology of gobies. Enfield, NH. Science Publishers, CRC Press, Boca Raton, 685 p.

Smale, M.J., Watson, G. & Hetch, T., 1995. Otolith atlas of southern African marine fishes. Ichthyological Monographs No. 1. J.L.B. Smith Institute of Ichthyology, Rhodes University, Grahamstown, South Africa, 418 p.

Tuset, V.M., Lombarte, A. & Assis, C.A., 2008. Otolith atlas for the western Mediterranean, north and central eastern Atlantic. Scientia Marina, 72(S1), 7–198.

Contribution to the knowledge of Polyclads (Platyhelminthes, Polycladida) from Sinop Peninsula (western Black Sea, Turkey)

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The information about diversity and distribution of free-living flatworm in the coast of Turkey, especially the coast of the Black Sea, is very limited. The present work was carried out in order to contribute to the knowledge of the free-living flatworm fauna of the Turkish Black Sea. The material was obtained among mussel beds from five stations between October 2013 and July 2014. The mussel beds were collected as three replicates at each station in 4-5 m depth by scraping off an area of 400 cm^{-2} using a spatula. The morphological and histological analysis of flatworms yielded the presence of three polyclad species belonging to the two sub-orders Acotylea and Cotylea. Among them, *Echinoplana celerrima* Haswell, 1907 is firstly reported from the Black Sea and all Turkish coasts. *Leptoplana tremellaris* (Müller OF, 1773) and *Prosthiostomum siphunculus* Delle Chiaje (1822) are also new records for the coast of the Black Sea of Turkey. The morphological and histological characteristics of these species together with their ecological and distributional aspects are provided.

Key words: Polyclads, new records, benthos, diversity, ecology, Black Sea

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Effect of particle size on the bioavailable iron (Fe) solubility of volcanic ash in seawater

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Deposition of volcanic ash is an important source of bioavailable iron (Fe) for the ocean. Fe-input in the volcanic ash fallout regions can stimulate marine primary production (MPP) and higher trophic levels including the zooplankton and the fish populations in the oceans and the neighboring rivers and lakes. Previous voltammetry studies showed that various volcanic ash samples release 200±50 nmol Fe/g ash. The effect of ash particle size on iron dissolution in seawater is an important factor that still remains unanswered. In this study, grain size distribution of ten volcanic ash samples from different volcanoes located world-wide were performed. Particle size measurements showed that most of the finer ash samples with high clay content released higher amounts of Fe into the seawater compared to the coarse ash samples with lower clay content. In addition to grain size analyses, three volcanic ash samples, Hekla 2000, Merapi 1996 and Sakura-Jima 2007, were sieved into five different size fractions were sub-divided into size fractions of >1mm, 1mm-500µm, 500-250µm, 250-100µm and <100µm. Our results showed that, although finer ash samples released more Fe compared to the coarser ash samples, Fe-release within different the size fractions of the same sample were only slightly larger than the internal precision of the experiments. We suggest that size distribution of the ash samples affects iron-mobilization of volcanic ash in seawater, which points out the importance of not only magmatic but also aeolian processes that alters the size distribution and chemistry of the volcanic ash.

Keywords: Volcanic ash, iron mobilization, particle size effect, surface ocean

Lake phytoplankton production and nutrient limitation in King George Island, Antarctica

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Phytoplankton production in lake environments is closely related to the carbon cycle (CO_2, CH_4) and hence the climate. Although, lakes are one the most biogeochemically active regions on Earth, knowledge on the lake environments in Antarctic is limited. Here we present limnological, biological and sedimentological results from the 10 lakes in Fildes Peninsula (Kitiesh, Lake1-Lake8, Pond1) and one lake from Ardley Island (Pond 2) that are located in the King the George Island (62°S) in Antarctic Peninsula. Field studies were performed between 17 February-7 March 2017 and Chilean Escudero Station was used during the field activities. We investigated alkalinity, pH, dissolved oxygen, chl-a concentrations, phytoplankton species recognition and cell count, nutrients and other element concentrations in lake waters. In addition, we analysed the total organic carbon (TOC) and element contents of lake sediments. Our results showed that, lakes investigated in this study are fresh water lakes with alkalinities ranging 16.5-34.5 mg/l HCO_3^-, pH 7.4- 9.2 and 88.7 -100% dissolved oxygen. Diatoms are dominating phytoplankton type in the lakes. The most common diatom species encountered are *Licomorhpo antarctico*, *Raphosis sp*., *Palgiotropis gausi*. In addition to diatoms, *Dissodinium sp.*which is a dinoflagellate species were also found in Kitiesh Lake. Generally low chl-a values and low phytoplankton cell counts showed that trophic status in King George lakes is ranging from ultra-oligotrophic (Fildes Peninsula: 0.31-1.35 µg/l chl-a; 14.8 cells/ml) and to oligotrophic (Ardley Island: 6.92 µg/l chl-a; 206.4 cells/ml). Dissolved nutrient concentrations are <0.001-1.086 mg/l NH_4^+, <0.001 mg/l NO_2^-, <0.001-3.124 mg/l NO_3^-, <0.001 mg/l PO_4^{3-} and 5.05-17.08 mg/l Si. Phytoplankton production, is closely related to the concentrations of dissolved NH_4^+, NO_3^- and Si. Although PO_4^{3-} concentrations are very low in all lakes below the detection limits, the differences in the trophic status can be explained by the variations in the nitrogen species and silica. TOC contents of the lake bottom sediments from ultra-oligotrophic lakes in Fildes Peninsula ranged from 1.85% to 3.16% and showed a correlation between lake water chl-a (R^2=0.77). However, in oligotrophic Pond2 in Ardley Island, the bottom sediment TOC content was lower than expected (3.07%) which points out the higher bacterial activity in the lake. Higher chl-a

concentrations in the studied lakes are also in agreement with higher concentrations of the lake water Cl, Br, Na, Ca, Mg, Mn, Fe, Co and Ni. We did not observe any direct relation between the proximity to scientific research bases (or human impact) with the variable chl-a concentrations in lakes. Therefore, the biogeochemical differences in lakes in the King George Island are more likely to be derived to from the differences in lake sediment geochemistry and the chemical alteration process involved during the evolution of the lakes. We suggest that, phytoplankton in the studied lakes are to be adopted to low levels of phosphate and primary productivity is highly controlled by the presence of the lake nitrogen and silica in the King George Island in Antarctica.

Keywords: Antarctic, lake phytoplankton, nutrients, organic carbon

Free-living marine nematodes community structural changes within a post-dredging site at the Romanian shelf

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The paper presents the results of assessment of nematodes community diversity and quantitative structure within an area heavily affected by dredging activities performed in the summer 2016 in a perimeter of 2.7 km^2, at depths between 23 – 27 m within the circalittoral habitats of the Romanian shelf. The nematodes composition changes after almost three years since the dredging cessation were investigated within the direct impacted area where the physical disturbance of sediments is still clearly detectible and in a reference site. Our results show that the recolonization process of the impacted area is still ongoing, a lower diversity being noted in the centre than at the fringes of the investigated perimeters. In terms of abundance, the community distribution did not exhibit a clear pattern, a trending biased by substrate type and macrofauna influence being assumed. The attempt of evaluating the ecological quality using Bongers' Maturity Index (MI) based on changes underwent by nematodes community reflected the physical disturbance of habitats in general, allowing us to assess the meiobenthic population resilience after such events. In addition, the MI showed a good evidence on the organic pollution and contamination.

Keywords: Romanian Black Sea shelf, free-living marine nematodes, structural changes, post - dredging impact, physical disturbance, ecological indicators

Introduction

Several authors pointed out to the meiobenthos and especially to nematodes as potential indicators of physical disturbance in marine ecosystems (e.g. Boyd *et al.*, 2000; Vanaverbeke *et al.*, 2007; Schratzberger *et al.*, 2000). A comparative study showed that nematode and macrofauna should be used together in monitoring surveys due to their complementary responses regarding environmental status, which may be explained by different response-to stress times of each benthic community (Alves *et al*., 2013). Nematodes are generally considered to be more resilient to physical disturbance than the larger macrofauna (Whomersley *et al.*, 2009), being able to better reflect the short to medium term changes, as result of their enhanced turnover rates and of their capacity to recolonize adjacent disturbed patches by actively dispersing vertically and horizontally through the sediments (Gallucci *et al.*, 2008). However, the evidences on meiobenthic communities response to physical disturbance are not consistent, data available to date indicate either a minor (Schratzberger *et al.*, 2002), negative (Hinz *et al.*, 2011) or even a positive effect (Liu *et al.*, 2011) of trawling on nematodes. Nematode abundance, production, species richness and diversity decreasing were among the negative effects observed, while a possitive effect was seen in abundance of some species. At the Black Sea level, Ürkmez *et al.*,2014 found a good relation of functional diversity of nematodes with the quality status at a Turkish coastal site influenced by anthropogenic pollution.

In the period 2015 – 2016, large scale sand extraction (2.7 km^2 area) has been carried out at the Romanian littoral within the framework of the project "Protection and rehabilitation of the Southern part of the Romanian littoral in front of Mamaia, Constanta and Eforie Nord", aiming to protect the front beaches against accelerated erosion by artificial nourishment with sand extracted from the sea. After almost three years since dredging cessation, the physical disturbance of substrate is still visible, deep traces left by dredge operation being identified by means of geophysical investigation. The aim of the current study was to identify the magnitude and level of response of nematodes to the impact produced by dredging (strong siltation of sandy sediments, displacement of sediments, organic enrichment) by employing a comprehensive analysis of their community in terms of composition and life strategies.

Material and method

The meiobenthic samples were collected in July 2018 on board of the R/V “Mare Nigrum” from six stations (Fig.1) selected from within and around the dredging area, which is located at depths between 23 – 27 m within the circalittoral habitats of the Romanian shelf, on a transversal profile to Constanta town. The sampling was performed by cutting off the sedimentary material from the surface of Van Veen by helping of a cylinder of 5 cm^2 area. Immediately after collecting, the samples were preserved in 4 - 5 % formaldehyde seawater buffered and stored in plastic recipients until laboratory analysis. About 200 nematodes (or all individuals if less than 200 were present) were picked at random transferred to glycerine and mounted on slides. For identification there was used the pictorial keys of Platt & Warwick (1983, 1988), NeMys online (http://nemys.ugent.be/) (Steyaert *et al.*, 2005). The number of nematodes was given at 5 cm^2. Taking into account the low number of harpacticoids found in the samples, these were not quantitative estimated but qualitatively. The statistical analysis was carried out by helping of available free software PAST v. 3 (Hammer *et al.*, 2001). The Maturity Index (MI, Bongers *et al.*, 1991) was calculated to measure the impact of disturbances and to monitor changes in the structure and functioning of nematodes assemblages. Based on their specific characteristics, all nematode genera were distributed along a colonizer-persister (c-p) scale. The MI was calculated as the weighted mean of the individual taxon scores. 36 bathymetric profiles using the Elak Nautik SeaBeam Multibeam Echo Sounder Systems 1050D at 50 KHz frequency were performed in the dredging area (Fig. 1) in order to reveal the marks left. The bathymetry transverse profile through the dredged area displayed at the bottom of the bathymetry map shows the furrows left (0.5 to 3 m deep).

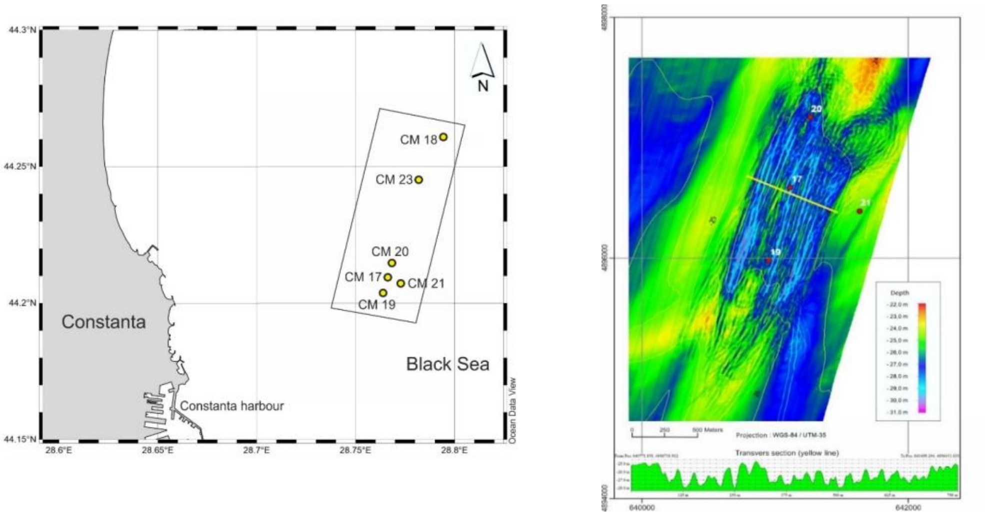

Figure 1. Sampling sites (right), the bathymetry map and transvers profile through the dredging site (yellow line) (left)

Results

The nematodes within the analysed perimeter was characterised by a relatively low diversity with an average of 15 nematodes taxa (min. 9 – max. 21) belonging to 19 families. The abundances varied between 832 and 128,512 ind.5 cm^{-2} (Table 2). The first ranked species after indices of ecological significance (W) and their total abundance (Ab), frequency (F%), average density (D_{avg}) and dominance after abundance (D%) are displayed in the Table 1.

The nematodes distribution showed an ongoing recolonization and recovery process of populations within the impacted site, much slower within the inner mixed (mud and sand) habitats (middle of the area) (station CM 17) than in the sandy mud ones situated at its extremities (stations CM 19 and CM 20). Thus, as low as 9 taxa and 3072 ind.5 cm^{-2} were found in the station 17, where *Microlaimus* sp. with 1344 ind.5 cm^{-2} and *Axonolaimus ponticus* with 736 ind.5 cm^{-2} dominated. Comparatively, a higher diversity was recorded within CM 19 and CM 20, with 15 and 21 taxa, respectively. In both stations, *Microlaimus* sp. made up to 25 – 35% as abundance, being present also in the entire study area, reaching a maximum in the reference station 18 (muddy sediments), located in the north eastern part of the perimeter.

Table 1. The first eight ranked species after indices of ecological significance (W).

Species	Ab	F%	Davg	D%	W
*Mesacanthion conicum (*Filipjev, 1918) Filipjev, 1927	1792	83.33	358.40	0.98	9.05
Sabatieria abyssalis (Filipjev, 1918)	47360	100.00	7893.33	25.96	50.95
Terschellingia longicaudata de Man, 1907	24560	100.00	4093.33	13.46	36.69
Axonolaimus ponticus Filipjev, 1918	32928	100.00	5488.00	18.05	42.48
Paracanthonchus sp. Micoletzky, 1924	1776	83.33	355.20	0.97	9.01
Sphaerocephalum crassicauda Filipjev, 1918	2528	100.00	421.33	1.39	11.77
Sabatieria pulchra (Schneider, 1906)	3424	100.00	570.67	1.88	13.70
Microlaimus sp.	57008	100.00	9501.33	31.24	55.90

After *S. abyssalis*, the second ranked species after abundance (26%), *A. ponticus* attained almost 20% of total abundance, both species showing a higher preference for the muddy sand sediments. Distribution of the latter seems to be related to the changes underwent within the dredging area, very low densities being assessed in stations CM 19 (96 ind.5 cm^{-2}) and CM 17 (736 ind.5 cm^{-2}) comparative with the one of the station CM 18 (20480 ind.5 cm^{-2}). On contrary, the higher diversity (21 taxa) within the station CM 20 points out to a rapid occupation from the nearby not impacted area of the new habitat niches, consisting of a mix of mud and sand. Should be remarked the presence only in this station of the araeolaimid species *Campylaimus ponticus* and of the enoplid *Leptosomatum sabangense,* though in low number. In the same station, the highest abundance (960 ind.5 cm^{-2}) of the enoplid *M. conicum* has been noted, although pretty numerous populations within the muddy sand habitats were recorded in the station CM 23 as well (480 ind.5cm^{-2}), situated at some distance away from the impacted area. Similarly, *Dichromadora* was predominantly found in the above mentioned stations. In two of the impacted stations (CM 19 and CM 20), there were found harpacticoids belonging to the genus *Enhydrosoma* and *Amphiascus,* known for their tolerance to disturbance and organic enriched sediments. The poorest community was estimated in the station CM 21, situated eastward of the impacted site, consisting of 832 ind.5 cm^{-2}. Nevertheless, 18 taxa were identified here, among which *M. conicum* reached up to 31% of the total abundance. Instead, there was evinced the weak presence of *Microlaimus* and *A. ponticus*, probably as result of higher fraction of shells.

The non-parametric Kruskal – Wallis test ($p<0.05$) followed by a Mann – Whitney pairwise test with Bonferroni corrected p-values (after a Shapiro- Wilk normality test was applied to samples distribution) performed revealed spatial significant differences of density ($p<0.05$) between the samples CM 17, CM 19 and CM 21 and the samples CM 20, CM 23. The differences mainly reflect the spatial gradient of disturbance level, higher in the middle than at the fringes of the dredged area.

The estimation of magnitude of impact of dredging activities based on the Bongers' Maturity Index (Table 2) revealed a good ecological status within the stations CM 21and CM 23, a moderate status in the stations CM 19 and CM 20, while the worst situation was found in the station CM 17 and

CM 18. In general, a quite clear differentiation of the status between the reference and the dredging impacted sites was shown, excepting the station CM18 due to overwhelming abundance of c-p 2 colonizers (the Comesomatidae, Axonolaimidae and Microlaimidae representatives) as opposite to the station CM 21, where these were encountered in low amount. In general, the c-p 4 and 5 persisters were scarce, only five species belonging to the families Oxystominidae, Leptosomatidae, Enoplidae, Desmoscolecidae and Pandolaimidae being recorded. The thresholds between the ecological statuses were set at 2.00 between bad and moderate and at 2.20 between moderate and good, respectively.

Table 2. The species richness, total abundance (ind.5cm^{-2}) and calculated MI for each station

Stations	CM19	CM20	CM17	CM23	CM21	CM18
Species richness	15	21	9	20	18	11
Abundance (ind.5cm^{-2})	1,840	27,520	3,072	20,688	832	128,512
MI=$\sum$(c-p value*f_i)	2.09	2.12	1.57	2.43	2.45	1.77

Where MI – the Maturity index (calculated as the weighted mean of the individual taxon scores), *vi* = colonizer-persister (c-p) value assigned to genus, *fi* - frequency of genus *i* in sample

Discussion

Based on six samples collected within an impacted (3 stations) by dredging and within a reference site (3 stations), our study revealed the response of nematodes community in terms of changes of qualitative, quantitative and functional composition. After almost three years since dredging cessation, the physical disturbance of habitats was still clearly detected by the geophysical investigation. The initial sandy habitat has underwent almost a complete topographic and granulometric restructuration. Both siltation and the roughness of the landscape increased. This strong perturbation affected profoundly the macrofauna, but also the nematodes, as shown in this paper. Nematodes species richness varied from 9 in the CM 17, located in the middle of the dredged perimeter to 20 and 21 species, respectively at the fringe of it, but still inside the dredging area (CM 20) and within the reference site, in the station situated at 3.6 km northward (CM 23). The abundances were also affected, these being among the lowest in the stations CM 19 and CM 17. However, the spatial distribution of dominant r-strategist taxa (*Microlaimus* sp., *A. ponticus, S. abysallis, T. longicaudata*), and their abundances witnessess for a slightly reconolization process or recovery of former populations. For comparisation, k-strategist enoplids (*M. conicum, E. littoralis)* were accidentally found in these stations comparing to CM 23. The colonizers (c-p 2) presented in general, a larger proportion of eggs carrying (pregnant) females (e.g. *A. ponticus, S. abyssalis*), males and juveniles, while most of the females of *Paracanthoncus* (present in all samples, excepting CM 17) carried offspring. The Maturity Index showed a quite clear differentiation of the ecological status between the reference and the dredging impacted sites, excepting the CM18, which is due to overwhelming abundance of c-p 2 colonizers (the Comesomatidae, Axonolaimidae and Microlaimidae representatives) as opposite to the station CM 21. The diversity and abundance proved also potentially effective in detecting changes in the post-dredging trawling site. Nevertheless, it is recognized that further knowledge of the functional roles of nematode will be the key to improve the sensitivity and interpretation of biological traits analyses of benthic communities (Alves *et al.*,2014). Our study is consistent with the results provided by other similar publications in terms of effects observed, in spite of inferred different natural frame and operational conditions (e.g., Schratzberger & Jenning, 2002; Miljutin *et al.*, 2011). Lately, the studies dedicated to meiobenthic populations, in general, and the nematodes, in special, have paid more attention to their role as effective indicators of pollution and physical disturbance of habitats (Balsamo et., 2012), boosting the research and application in environmental status assessment according to the The Marine Strategy Framework Directive, especially for the pressure descriptors (6 and 8).

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References

Alves, A. S. & Adão, H. & Ferrero & T. J., Marques, J. C., Costa & M.. J., Patrício, J., 2013. Benthic meiofauna as indicator of ecological changes in estuarine ecosystems: The use of nematodes in ecological quality assessment. Ecological Indicators 24, 462-475. doi: 10.1016/j.ecolind.2012.07.013

Alves, A.S., Veríssimo, H., Costa, M.J., Marques, J.C., 2014. Taxonomic resolution and Biological Traits Analysis (BTA) approaches in estuarine free-living nematodes. Estuarine, Coastal and Shelf Science 138, 69-78. doi: 10.1016/j.ecss.2013.12.014

Balsamo, M.. & Semprucci, F. & Frontalini, F. & Coccioni, R., 2012. Meiofauna as a tool for marine ecosystem biomonitoring. InTech Publisher.

Bongers, A.M.T. & Alkemade R.. & Yeates G. W., 1991. Interpretation of disturbance-induced maturity decrease in marine nematode assemblages by means of the Maturity Index. Marine Ecology Progress Series 76(2). DOI: 10.3354/meps076135

Boyd, S. E. & Rees, H. L. & Richardson, C., 2000. Nematodes as Sensitive Indicators of Change at Dredged Material Disposal Sites. Estuarine, Coastal and Shelf Science. 51. 805-819. 10.1006/ecss.2000.0722.

Gallucci, F. & Moens, T. & Vanreusel, A. & Fonseca, G., 2008. Active colonization of disturbed sediments by deep-sea nematodes: evidence for the patch mosaic model. Mar. Ecol. Prog. Ser. 367.173 – 183.

Hammer, Ø. & Harper, D.A.T. & Paul D. R., 2001. Past: Paleontological Statistics Software Package for Education and Data Analysis. Palaeontologia Electronica, vol. 4, issue 1, art. 4: 9pp., 178kb. http://palaeo-electronica.org/2001_1/past/issue1_01.htm.

Hinz, H. & Hiddink, J. & Forde, J. & Kaiser, M., 2011. Large-scale responses of nematode communities to chronic otter-trawl disturbance. Canadian Journal of Fisheries and Aquatic Sciences. 65. 723-732. 10.1139/f08-002.

Liu, X.S. & Xu, W.Z. & Cheung, S.G. & Shin, P.K.S., 2011. Response of meiofaunal community with special reference to nematodes upon deployment of artificial reefs and cessation of bottom trawling in subtropical waters, Hong Kong. Marine Pollution Bulletin 63(5–12), 376–384. 10.1016/j.marpolbul.2010.11.019.

Miljutin, D. M. & Miljutina, M. A. & Arbizua, P. M. & Galéron, J., 2011. Deep-sea nematode assemblage has not recovered 26 years after experimental mining of polymetallic nodules (Clarion-Clipperton Fracture Zone, Tropical Eastern Pacific). Volume 58: 8, 885-897 http://dx.doi.org/10.1016/j.dsr.2011.06.003

Platt, H.M. & Warwick, R.M., 1983. Freeliving marine nematodes. Pt.1. British Enoplids. Pictorial key to world genera and notes for the identification of British species. Cambridge University Press, Cambridge, 307pp.

Platt, H. M. & Warwick, R. M., 1988. Freeliving marine nematodes. Pt. 2. British Chromadorids. Pictorial key to world genera and notes for the identification of British species. Brill/Backhuys, Leiden, 302pp.

Schratzberger, M. & Jennings, S., 2002. Impacts of chronic trawling disturbance on meiofaunal communities. Marine Biology. 141. 991-1000. 10.1007/s00227-002-0895-5.

Schratzberger, M. & Dinmore, T.A. & Jennings, S., 2002. Impacts of trawling on the diversity, biomass and structure of meiofauna assemblages. Marine Biology 140: 83–93. 10.1007/s002270100688

Schratzberger, M. & Rees, H. L. & Boyd, S. E., 2000. Effects of the simulated deposition of dredged material on the structure of nematode assemblages—the role of burial. Marine Biology, Vol. 136, pp. 519–530

Ürkmez, D. & Sezgin, M. & Bat, L., 2014. Use of nematode maturity index for the determination of ecological quality status: a case study from the Black Sea. J. Black Sea/Mediterranean Environment Vol. 20, No. 2: 96-107

Steyaert, M. & Deprez, T. & Raes, M. & Bezerra, T. & Demesel, I. & Derycke, S. & Desmet, G., Fonseca, G. & de Assuncao F., M.. & Gheskiere, T. & Hoste, E. & Ingels, J. & Moens, T. & Vanaverbeke, J. & VanGaever, S. & Vanhove, S.& Vanreusel, A. & Verschelde D. & Vincx, M., 2005. Electronic Key to the free-living marine Nematodes, http://nemys.ugent.be

Vanaverbeke, J. & Deprez, T. & Vincx, M., 2007. Changes in nematode communities at the long-term sand extraction site of the Kwintebank (southern bight of the North Sea). Mar Pollut Bull. 54(9):1351-1360.

Whomersley, P. & Huxham, M. & Schratzberger & M., Bolam, S., 2009. Differential response of meio- and macrofauna to in situ burial. J. of the Mar. Biol. Ass. of the U.K. 89 (6): 1091-1098 https://doi.org/10.1017/S0025315409000344

Reproductive Biology of Common Octopus, *Octopus vulgaris* Cuvier, 1797 (Octopoda: Cephalopoda) from the eastern Mediterranean Sea

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Octopus vulgaris has a wide range distribution in tropical and subtropical seas all around the world from 0 to 250 m depths. It is an important cephalopod species in global fishery. An annual catch of *O. vulgaris* was estimated as 215 tonnes in Turkey. In this study, there were 95 specimens (42 females and 53 males) collected in Bodrum (eastern Mediterranean Sea) from local fishermen between 2016 and 2017. Their mantle lengths varied between 8 – 30 cm (mean: 16.6 ± 4.7) and the total weights ranged from 1000 to 8300 g (mean: 2535.8 ± 1879.5). Potential fecundities of 42 investigated females were between 225 and 982 eggs (mean: 589 ± 196), and the oocyte diameters varied between 0.025 and 3.5 mm (mean: 1.06 ± 0.8). Numbers of spermatophores of males ranged between 12 and 557 (mean: 140 ± 127), and their lengths varied from 1.2 to 10.7 cm (mean: 4.66 ± 1.33). The potential fecundities of females were significantly correlated with mantle lengths (r = 0.717). Mean spermatophore lengths and spermatophore numbers were correlated with mantle lengths of males (r = 0.797 and r = 0.529 respectively). Males got mature at smaller sizes than females. The gonadosomatic indices had a peak in March for females, therefore one might expect that the reproductive season of *O. vulgaris* was in late winter and early spring.

Keywords: Reproductive biology, Octopus, Fecundity, Spawning, Cephalopod fishery.

An overview of diversity of freshwater molluscs in the Russian Arctic

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The research represents an analysis of original and literary data on freshwater mollusks of the Arctic Region of Russia. The main question is how many freshwater mollusk species live there? Currently, approximately 80 species of freshwater mollusks are known from the Arctic, mainly of the families Sphaeriidae, Lymnaeidae, and Planorbidae; the families Physidae, Valvatidae, and Unionidae are presented as well (Vinarski, 2018). The Arctic freshwater mollusk fauna represents only 1.5% of the global diversity in this group (Vinarski, 2018), however, this estimate may change in the future. An increasingly growing body of integrative taxonomic research (Bespalaya et al., 2015, 2018, Bolotov et al., 2017; Nekhaev, Palatov, 2016; Vinarski et al., 2013; 2015; 2016a, 2016b, 2017) shows that our knowledge of the Arctic malacofauna is very far from being complete, and the species richness may be underestimated. For example, a molecular study has revealed three species of sphaeriid clams in the waterbodies of the Novaya Zemlya Archipelago (Bespalaya et al., 2017a, 2017b), where only one species was hitherto known (Odhner, 1923). New non-indigenous species of mollusks have recently been discovered in the Arctic, i.e. *Physella acuta* (Nekhaev, Palatov, 2016; Vinarski, 2017 and our unpublished data) and *Corbicula fluminea* (Bespalaya et al., 2018). The close relationships between Nearctic and Palearctic mollusk faunas were established (Bespalaya et al., 2015). Our results highlight that intense research and increased sampling efforts are urgently needed to uncover the patterns of mollusk diversity in high latitude areas. A large-scale taxonomic revision of Arctic mollusk fauna is necessary to ensure the further development of ecological research, climate change studies, and conservation efforts. This study was supported by the FASO (no. 0409-2016-0022), the UB RAS (18-4-4-8), Russian Ministry of Education and Science (no. 6.2343.2017/4.6), by grants from the President of Russia (MD-2394.2017.4) and by the RFBR (16-05-00854_a, 17-44-290016_r_a; 17-44-290436_r_a).
Keywords: Arctic, freshwater mollusks, biodiversity, integrative taxonomy, evolutionary biogeography, invasions

Redescription of *Echinolaophonte hystrix* (Brian, 1928) (Copepoda, Harpacticoida, Laophontidae) with remarks on the synonymy with *E. armiger* f. *typica* Lang, 1965

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The taxonomic history of *E. hystrix* has been so complicated since it was described from the Tyrrhenian Sea by Brian (1928) as *Laophonte hystrix*. One of the main problem causing such taxonomic confusion is the lack of a modern detailed description of *E. hystrix*. The type material is lost and therefore in order to resolve the taxonomic problem of *E. hystrix*, the number of specimens identified as *E. hystrix* from the Aegean and Mediterranean Sea of Turkish coasts which were deposited in the collection of the biology departments of Mersin and Balıkesir Universities were examined and both sexes of *E. hystrix* were redescribed with the aid of modern light and electron microscopes. The results revealed additional important characteristics which were overlooked in previous studies. On the other hand, the detailed examination of the previous literature has been revealed for the first time that *Laophonte hystrix* Brian, 1928 and *E. armiger* f. *typica* Lang, 1965 were defined, interestingly, on the basis of the same material and therefore the two taxa are conspecific. This study was supported by the research fund of Mersin University in Turkey with the project number 2017-2-TP3-2610.

Keywords: Harpacticoida, intertidal, Echinolaophonte, taxonomy, meiofauna

Has Rainbow Trout Established Natural Populations in Turkey?

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The rainbow trout *Oncorhynchus mykiss,* one of the most popular species for aquaculture, has been introduced worldwide for commercial and recreational purposes. Owing to its flexible ecological characteristics, it has successfully adapted to a wide variety of new habitats. Self-sustaining non-native populations of *O. mykiss* are known from Northern Europe, yet no has been recorded so far from Turkey, although it has been introduced in many natural environments, too.

In this study, we reported wild-caught juvenile specimens of *O.mykiss* from a natural habitat in Western Black Sea region in Turkey. Four fish were caught in July 2017 and February 2018 from Çakmaklı Creek (Kocaali-Sakarya) by electrofishing during an ecological survey. The total length of the specimens ranged between 8.2 and 13.4 cm. The samples were immature according to the microscopic examination of their gonads and their sexes could be determined only by microscopic examination. According to information obtained from the authorities responsible for fish introduction, no authorized introduction of rainbow trout has been implemented in the area. We determined that market-size rainbow trouts larger than 30 cm are found in small pools of fish restaurants near the creek. Since there is no hatchery near the sampling area, the occurrence of juveniles can be regarded as a sign of naturally reproducing population if the juvenile fish were not illegally released into the creek. And this case may be a sign of reproduction of *O. mykiss* in natural environments in Turkey.

The impacts of *Oncorhynchus mykiss* is suggested to include disease transmission, predation and competition with native species, especially with Salmonids. Moreover, their ability to hybridize with native salmonids threatens the genetic integrity of native species. More research including regular monitoring surveys of Çakmaklı Creek is needed to better understand the case, and to take due precautions, if necessary.

Key Words: *Oncorhynchus mykiss,* Aquaculture, non-native species, hybridization

Habitat Preferences of Cryptobenthic Fishes around the Gökçeada Island (North Aegean Sea)

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In the last 30 years, several studies have been conducted on the fish fauna of the Gökçeada Island located in the North Aegean, yet none of these studies addressed to the cryptobenthic fish assemblage of the island. The aim of this study, carried out on the hard substrates of the island between the depths of 0-15 m, is to investigate the spatial distribution of cryptobenthic fish assemblages and to determine their ecological preferences around the island. Furthermore, we aimed to assess the effects of some macroscale habitat characteristics on the distribution pattern of cryptobenthic fishes. Anesthethic census method was applied with SCUBA during the samplings. 1x1 m quadrats were used in order to standardize the data and the calculations were based on the unit area.

Overall, 48 benthic and pelagic species, belonging to 14 families were observed. Among them, 25 species from 4 families were considered as cryptobenthic. In order to assess the ecological preferences of these species, four most common factors in the relevant literature were taken into account. These factors were the type of substrate, depth, inclination and presence/absence of biocover. According to the results, the main drivers of the habitat preferences of these cryptobenthic species were substrate type and depth.

As reported by the frequency and dominance index, *Gobius bucchichi* and *Tripterygion delaisi* were the most abundant (dominant) species. Species richness (S), diversity (H'), evenness (J) and Simpson's Dominance Index (D) were calculated for each factor. The habitat type with the highest diversity is the block rocks and rocky substrate with a gentle inclination (<20°) between the depths of 0-1 m. The presence of biocover had no specific influence on the habitat preferences of the species, but both the abundance and diversity of the obtained species were higher in the absence of biocover.

Keywords: Cryptobenthic fishes, Habitat preference, Gökçeada Island, North Aegean

Phytal Harpacticoid Copepods Inhabiting Subtidal Zone of Biga Peninsula Coasts (Çanakkale)

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Harpacticoida is one of the ten orders of the Copepoda subclass. The tremendous majority are marine and freshwater living creatures. In recent studies, it has been revealed that more than 6000 species belonging to 645 genera in 59 families are found in Harpacticoida. Harpacticoids which are generally as free-living organisms, mainly located within sediments and macroalgae, a small section of the species live as planktonic and a small proportion can be found as external parasites.

The study area is the sea coasts of the Biga Peninsula in the west of Turkey. A total of 7 stations were sampled. Macroalgae were collected by bare hand from the subtidal zone of the reachable rocky areas in the coastline. Collected macroalgae entrenched in 200 ml sealed containers and fixed in 4% formaldehyde solution. Extraction and preparation process of the fixed samples were carried with an Olympus SZX-16 stereo microscope. When the preparation process was completed, the specimen identifications were made with a DIC attached Olympus BX-51 microscope.

As a result of examining the collected samples, 8 species/subspecies belonging to 7 genera in 4 families were determined. All of the identified species were reported for the first time from the study area. In terms of the number of species, Laophontidae was the first family with 4 species, Miraciidae has 2 species, Harpacticidae and Dactylopusiidae have 1 species for this sampling.

Keywords: Harpacticoida, Copepoda, Biodiversity

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Bioeconomic Modelling of the Black Sea Anchovy Fisheries: An Age-Structured Model under Climate Uncertainty

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Black Sea anchovy, *Engraulis encrasicolus*, is the key species for Black Sea pelagic purse-seine fisheries. Especially, the species has great importance for the Turkish fleet because every two-species caught by the Turkish fleet is anchovy. During last decades, the Black Sea anchovy has faced many human-induced threats such as overfishing, eutrophication, invasive species (e.g., *Mnemiopsis leidyi*) and climate change. In literature, there are limited number of studies that uses age-structured models for pelagic species by assessing the management reference points under climate change. We used deterministic and stochastic age-structured bioeconomic models that focused on the optimal management of Black Sea anchovy fishery under climate uncertainty. The novel contribution of this bio-economic model further gave insights on the biological and economic reference points including fishing mortalities including fishing mortalities, maximum economic and sustainable yields under different temperature scenarios. The results were contrasted each other for varying climate scenarios and also compared with similar previous studies in the literature. Furthermore, different discount rate sensitivity of the operated models was tested. The output of this study were supposed to add value in decision making process of the Black Sea anchovy fishery management in the region.

Keywords: Black Sea Anchovy, age-structured, optimal management, reference points, climate uncertainty

Recreational Fishing along the Middle and Eastern Black Sea Turkish coasts: Biological, Social and Economic Aspects

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This study assessed biological, social and mainly economic dimensions of recreational fishing (RF) in 8 coastal provinces in the Middle and Eastern Black Sea Region of Turkey. In all provinces, a total number of 874 shore-based recreational fishers were interviewed via on-site face-to-face interviews during the fishing activity or at access points. The regular monthly surveys were conducted between January and December in 2015. Market value approaches were used to calculate economic gains and losses from RF. Statistically positive relationships were observed for the variables, education level, fishing expense and market value in the Middle Black Sea provinces; Kastamonu, Samsun, Sinop and Ordu. In all provinces, the harvesting costs were far below the average market values of the target species. However, RF index values calculated for each province were found to be positive. No statistically significant difference was observed between the species catch composition in the Western and the Eastern provinces. Furthermore, even if the habitat type along the Black Sea continental shelf of Turkey does not show great variations, some certain species including *T. trachurus, S. sarda, B. belone, P. saltatrix, M. cephalus* were caught in higher amounts in the Western provinces. To summarize, RF along the Black Sea coasts of Turkey is an economy generating activity with high economic returns by expenditures, jobs, catch value as well as high indirect economic impact in services sector.

Keywords: Recreational fishing, social, economics, biological, Black Sea, Turkey.

Seasonal diel vertical migration of some zooplankton species in a deep lake (Turkey)

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In the present study, Diel Vertical Migration (DVM) of dominant zooplankton species was seasonally studied in a deep meso-eutrophic Lake. Zooplankton species dominancy were differed seasonally and DVM behaviour showed alteration among species. Big-sized cladoceran *Daphnia cucullata* Sars, 1862 and medium-sized cladoceran *Diaphanosoma brachyurum* (Liévin, 1848) showed obvious DVM in the water column in spring and autumn respectively, moreover ciliates exhibited reverse diel vertical migration in autumn. Other dominant species did not migrate between the layers. According to the observations and data analysis, each species affected by different limnological variables. Dominant zooplankton species in Lake İznik correlated negatively with high nutrient concentrations, conversely they may tolerate changing physicochemical variables (SPM, DO, pH) and chlorophyll *a* along the water column. High pH and electrical conductivity (EC) values were not limiting factor for microzooplankton (rotifers and ciliates) presence, however crustaceans may not tolerate high EC values. Also, Secchi disc depth (transparency) was the determinant factor on DVM of *D.cucullata* for avoidance from planktivorous fish, *Atherina boyeri* Risso, 1810, which is the main fish species in Lake İznik.

Keywords: zooplankton, diel vertical migration, physicochemical variables, deep lake

The Evaluation of Physico-Chemical and Microbiological Water Quality of Iztuzu Beach (*Caretta caretta* Beach)

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Water is one of the most essential factors for survival. All living organisms have the right to access quality water. But quality water is a limited resource. Aquatic environments are dynamic spaces that are vulnerable to physical, chemical and biological pollutions. For this reason, it is important to monitor water parameters and observe water quality on regular basis. The aim of current study is to reveal quality of water sampled from both delta and seaside in Iztuzu Dalyan Special Environmental Protection Area which is under heavy pressure of tourists and visitors specifically during high tourism season. According to the results of sampling efforts carried out every two months for a year from specified six stations, physico-chemical parameters of water (pH, temperature, oxygen amount, total dissolved solids, salinity and conductivity) were measured; the amounts of suspended solids (SS) nitrogen compounds (nitrite, nitrate and ammonium) and total phosphate (PO_4) were determined. Also, coliform bacteria levels were also revealed through microbiological analyses. In this study, mean measured temperature, pH, salinity, dissolved oxygen and electrical conductivity values of samples from delta were found as 18,7-19,18 °C, 9,02-9,33, ‰ 17,92-25,21, 7,70-7,94 mg L^{-1} and 29.282-39.550 µS cm^{-1} respectively. The values of same parameters from seaside were determined as 21,32-21,60 °C, 8,32-8,96, ‰ 34,11-36,29, 6,90-7,02 mg L^{-1} and 52.158-55588 µS cm^{-1} respectively. The highest mean TDS concentration was found as 35,68 g L^{-1} at seaside. While the mean suspended solid amount was 0,01 g L^{-1} at delta, determined amount of SS at seaside was 0,02 g L^{-1}. The amounts of nitrite, nitrate, phosphate and ammonium specified at seaside were between the levels of 0,001-0,004 mg L^{-1}, 0,02-0,01 mg $L^{-1,}$ 0,075-0,077 mg L^{-1} and 0,03-0,08 mg L^{-1} respectively. The amounts of same nutrients specified at delta were between the levels of 0,007-0,008 mg L^{-1}, 0,04-0,05 mg L^{-1}, 0,003-0,008 mg L^{-1} and 0,06-0,08 mg L^{-1} respectively. Mean amounts of organic and inorganic matters sampled from delta were measured as between the levels of 0,0036-0091 mg L^{-1} and 0,0031-0,0062 mg L^{-1} respectively; the values of those matters sampled from seaside were measured as between the levels of 0,0072-0,0144 mg L^{-1} and 0,0018-0,0025 mg L^{-1} respectively. Lastly, coliform bacteria amounts were also determined and as a result of obtained data, it was deduced that there was not any problem in the usage of delta and seaside of Iztuzu Beach for recreational purposes.

Key words: Iztuzu, water quality, *Caretta caretta*, monitoring, water pollution

Introduction

Köyceğiz-Dalyan Special Environmental Protection Area (SEPA) covers a region 461 km^2 wide within the borders of Köyceğiz and Ortaca districts in Mugla province. There are 19 settlements within this protected area; 1 city center, 2 towns (Beyobası and Toparlar) and 12 villages (Çandır, Döğüşbelen, Hamitköy, Kavakarası, Köyceğiz, Ekincik, Sultaniye, Yangı, Yeşilköy, Pınarköy, Zaferler and Zeytinalanı) in Köyceğiz and 1 town (Dalyan) and 3 villages (Eskiköy, Gökbel and Tepearası) in Ortaca district. Located within the transition area between Mediterranean and Aegean regions, the eastern part of SEPA, which is situated in Köyceğiz Lake and Dalyan Channel, gets into Mediterranean Region and the western part gets into Aegean Region. Situated in the western part of the region and formed as a crooked mountain chain, Datça (Reşadiye) Peninsula constitutes a barrier between Mediterranean and Aegean Regions. The height around the western part of the Dalyan River can be as much as 937 meters. Köyceğiz-Dalyan SEPA is one of the most valuable wetlands of Turkey and covers a very rich flora. Also, Caretta carettas, which are among the endangered species, use Iztuzu beach as a reproduction area. This special region hosts a freshwater lake and islands in it; a delta system whose waters are half salty; Iztuzu beach with a width of 4.5 km; woods comprised of incense trees, coniferous trees and macquis groves and many other special habitat types. The most significant freshwater source in the region is Yuvarlak Stream and the other freshwater sources feeding the area are Asar Spring, Marmarlı Spring, Büyükmaar Spring, Ada Spring, Karagöl Spring, Değirmendere Spring, İçmece Spring and Rızaçavuş Spring. The aim of current study is to reveal quality of water sampled from both delta and seaside in Iztuzu Dalyan Special Environmental Protection Area which is under heavy pressure of tourists and visitors specifically during high tourism season.

Material and Methods

For the water samplings of this study, six different stations were determined (See Fig. 1.) and the analyses of temperature, dissolved oxygen and pH were conducted in-situ on the samples. In order to determine the physic-chemical qualities (dissolved oxygen, conductivity, total dissolved solid matters and temperature) of water samples in-situ, multiple measurement device with YSI brand Professional Plus model were used. The specification of nutrients such as nitrite nitrogen, nitrate nitrogen, ammonium nitrogen and phosphate phosphorus was conducted via Hach Lange brand DR3900 model spectrophotometer. Nitrogen compounds in water samples (NH_3-N, NO_2-N and NH_4^+-N) and total phosphate amount (PO_4) were determined by using appropriate ready-to-use kits and the results were calculated as mg L^{-1}. Suspended solids (SS) in the water samples were analyzed with the methods of filtering-weighing and burning-weighing and the results were calculated as g L^{-1}. Measuring ranges of test kits are 0-0,50 mg L^{-1} for ammoniac nitrogen; 0,23-13,50 mg L^{-1} for nitrate nitrogen; 0,0015-0,03 mg L^{-1} for nitrite nitrogen and between 0,15-4,50 mg L^{-1} for total phosphate.

Figure 1. The stations on the sampling area

For the determination of microbial load in water samples, seawater samples taken from 0-30 cm surface into sterile bottles were carried to the laboratory via cold chain and analyzed on the same day. The samples were analyzed three times repeatedly. For the determination of total coliform and fecal coliform, membrane filtration technique was used. In order to specify coliform bacteria in water samples, samples were filtered under vacuum through sterile membrane filters with an aperture size of 0.45 μm and in this way microorganisms were to be attached on the filters which were placed on the broth mediums of m- Endo-NKS, m- FC-NKS in a way that there was not any bubble. The samples cultured in m- Endo-NKS broth medium were incubated at 37 °C and the samples cultured in m- FC-NKS were incubated at 44 °C for 24 hours and after that, quantitative descriptions of grown colonies were conducted by the average of three repetitions (KOB/100 ml: unit forming colony at 100 ml). Hydrophobic lines on the filters that cut each other vertically prevent formed colonies from scattering and make calculation easier. Yellow-green metallic bright and pink-red colonies grown in m- Endo-NKS broth medium are qualified as coliform bacteria and blue colonies grown in m- FC-NKS broth medium are qualified as fecal coliform bacteria (APHA, 1998).

Results

Table 1 presents microbiological analysis results of surface water samples. As a result of statistical analyses, when stations on the seaside (stations 2,3 and 4) and 5th and 6th stations located at the middle and end of the beach at Dalyan freshwater area were compared, it was determined that total coliform amount was much higher and there was a statistically significant difference ($p<0.05$). On the other hand, as a result of statistical analyses, in terms of fecal coliform amount, there was not found any statistically significant difference between stations ($p>0,05$).

Table 1. Coliform bacteria amounts in the stations

Parameter		Stations					
		1	2	3	4	5	6
Total Coliform (KOB/100ml)	Min	820,00	70,00	31,50	26,00	6500,00	6250,00
	Max	4700,00	88,00	660,00	60,70	10000,00	6600,00
	Mean	2760,00 ± 2743,57	79,00 ± 12,72	345,75 ± 444,41	43,35 ± 24,54	8250,00 ± 2474,87	6425,00 ± 247,50
Fecal Coliform (KOB/100ml)	Min	2,00	0,00	0,00	0,00	1,50	2,60
	Max	8,00	3,75	1,00	5,60	10,40	10,30
	Mean	5,00 ± 4,24	1,88 ± 2,65	0,50 ± 0,71	2,80 ± 3,96	5,95 ± 6,29	6,45 ± 5,44

Station no: 1, 5 and 6 Dalyan freshwater area
Station no: 2, 3 and 4 Dalyan sea side

Table 2 presents measurement results of physico-chemical parameters of surface water samples obtained from samplings conducted bimonthly for a year from six different stations. The results of statistical analyses showed that there was not any difference between stations in terms of the concentrations of temperature, pH, DO, OS, TDS, SS, organic and inorganic matter amounts. However, there was a statistically significant difference between 3rd station (sea side, middle of the beach) and 5th and 6th station (Dalyan freshwater side, at the end of the beach and the middle of the beach respectively) in terms of salinity. Also, there was a statistically significant difference between 4th station (sea side and at the end of the beach) and 5th station (Dalyan side, at the end of the beach) ($p<0.05$). In terms of total dissolved solids (TDS), when the stations at the sea side (stations 2,3 and 4) and the stations 5th and 6th (Dalyan side at the end and middle of the beach) were compared separately, statistically significant differences were determined ($p<0.05$). Maximum nitrite, nitrate, phosphate and ammonium amounts measured in water samples obtained from the stations at the Dalyan freshwater side were 0,020 mg L^{-1}, 0,09 mg L^{-1}, 0,092 mg L^{-1} and 0,33 mg L^{-1} respectively while minimum values were 0,00 mg L^{-1}, 0,01 mg L^{-1}, 0,073 mg L^{-1} and 0,00 mg L^{-1} respectively. Measured maximum values of nitrite, nitrate, phosphate and ammonium at the Dalyan sea side were 0,013 mg L^{-1}, 0,06 mg L^{-1}, 0,085 mg L^{-1} and 0,23 mg L^{-1} respectively; minimum levels were determined as 0,001 mg L^{-1}, 0,00 mg L^{-1}, 0,073 mg L^{-1} and 0,00 mg L^{-1}. As a result of statistical analyses, there was not found any statistically significant difference in terms of nitrite, nitrate, ammonium nitrogen and total phosphate ($p>0,05$).

Table 2. Measured physico-chemical parameter results

Parameters		Stations 1	2	3	4	5	6
Temperature (°C)	Min	10,20	15,10	15,50	15,70	11,00	10,50
	Max	29,70	30,40	30,70	30,40	30,00	30,10
	Mean	18,77 ± 7,25	20,75 ± 5,81	10,83 ± 5,79	20,80 ± 5,69	19,65 ± 7,24	19,58 ± 7,50
Salinity (‰)	Min	5,78	22,45	35,23	26,10	5,75	5,74
	Max	38,00	38,97	39,61	39,51	38,60	38,90
	Mean	25,21 ± 14	34,11 ± 5,86	36,29 ± 1,65	35,24 ± 4,79	17,92 ± 12,25	18,94 ± 12,79
pH	Min	8,09	7,53	8,15	8,28	8,29	8,18
	Max	11,50	8,62	11,23	11,07	12,60	12,50
	Mean	9,02 ± 1,24	8,32 ± 0,42	8,95 ± 1,13	8,96 ± 1,04	9,33 ± 1,62	9,28 ± 1,59
DO (mg L^{-1})	Min	5,88	5,99	6,67	5,93	5,83	5,71
	Max	9,87	7,60	7,40	7,53	10,74	9,83
	Mean	7,72 ± 1,68	6,90 ± 0,59	7,01 ± 0,29	7,02 ± 0,62	7,94 ± 2,02	7,70 ± 1,74
OS (%)	Min	80,70	85,00	86,70	87,70	77,80	77,30
	Max	98,80	93,70	92,40	100,00	109,30	100,00
	Mean	90,72 ± 6,17	90,25 ± 3,41	90,23 ± 2,10	92,10 ± 4,53	91,45 ± 12,44	87,15 ± 8,85
Conductivity (µS cm^{-1})	Min	10138,00	33787,00	53365,00	49884,00	10125,00	10133,00
	Max	62800,00	60200,00	59900,00	64200,00	64000,00	64200,00
	Mean	39550,33 ± 21426,98	52158,00 ± 9361,82	55587,50 ± 2721,30	55574,33 ± 4860,70	29282,17 ± 19862,35	30719,17 ± 20365,56
TDS (g L^{-1})	Min	6,63	22,45	34,68	32,10	6,59	6,58
	Max	35.33	37.96	38.48	38.35	23.71	26.78
	Mean	22,89 ± 13,27	33,14 ± 6,11	35,68 ± 1,58	35,15 ± 2,22	14,65 ± 7,59	15,75 ± 9,00
SS (g L^{-1})	Min	0,0042	0,0069	0,0159	0,0117	0,0037	0,0035
	Max	0,0210	0,0328	0,0365	0,0369	0,0569	0,0188
	Mean	0,0119 ± 0,0063	0,0145 ± 0,0095	0,0241 ± 0,0087	0,0218 ± 0,0096	0,0163 ± 0,0202	0,0092 ± 0,0056
Inorganic matter (g L^{-1})	Min	0,000	0,0023	0,0067	0,0063	0,000	0,000
	Max	0,0134	0,0221	0,0257	0,0270	0,0383	0,0065
	Mean	0,0062 ± 0,0031	0,0080 ± 0,0072	0,0143 ± 0,0082	0,0137 ± 0,0086	0,0091 ± 0,0144	0,0036 ± 0,0024
Organic matter (g L^{-1})	Min	0,0017	0,0036	0,0068	0,0053	0,0030	0,0023
	Max	0,0096	0,0107	0,0115	0,0104	0,0186	0,0138
	Mean	0,0057 ± 0,0031	0,0067 ± 0,0025	0,0096 ± 0,0018	0,0081 ± 0,0023	0,0071 ± 0,0062	0,005 ± 0,0042

Discussion

Mean temperature levels are found between 18,7-19,18 °C at Dalyan side and between 21,32-21,60 °C at sea side in this study. Dalyan side has lower temperature rates than sea side because Dalyan is connected with Köyceğiz Lake through Namnam Creek, Yuvarlak Stream and Kargıcak River. Water temperatures change seasonally at both Dalyan and sea side. Iztuzu Beach is located at the point where Mediterranean and Aegean Sea unite and is a South Aegean beach. According to official statistics of General Directorate of Meteorology, water temperature of Aegean Sea between 1970 and 2016 changed dramatically from 18,2°C (1970-1979) to 19°C (2008-2016). Considering this official data, the effect of global warming has been felt. Salinity can be described as total melted salt amount in water and is one of the important parameters affecting distribution of some aquatic organisms. In this study, mean salinity values are ‰ 17,92-25,21 at Dalyan side and ‰ 34,11-36,29 at sea side. The opposite of the logarithm of concentrations of hydrogen ions in the water is defined as pH and scaled between 0-14. The waters with pH level between 0-7 can be assessed as acidic and level between 7-14 as alkali waters (Göksu, 2015). pH level in aquatic environments can change seasonally and daily depending biological incidents and the temperature in the environment. Also, pH level of the waters, which are carbon dioxide-poor, is generally high (Kocataş, 1993). In current study, the mean pH level is determined as 9,02-9,33 at Dalyan side and as 8,32-8,96 at the sea side. The most important dissolved gas is oxygen in waters as well as in earth (Geldiay and Kocataş, 1998). EPA (1979) admits that for the maintenance of life with oxygen, required oxygen amount should be present in the water. Mean dissolved oxygen amount of Aegean Sea is about 7 mg L^{-1} (Aydın and Sunlu, 2004). In our study, mean dissolved oxygen concentrations are measured as 7,70-7,94 mg L^{-1} at Dalyan side and as

6,90-7,02 mg L^{-1} at sea side. Critical dissolved oxygen amount for living organisms is 5,0 mg L^{-1} (Dirican, 2005). In this study, the result of the measurement was not under the critical level at both sea side and Dalyan side. The more the salinity of the water, the more the conductivity of it (Göksu, 2015). According to this, the obtained electrical conductivity values are parallel to salinity values and they are found as 29.282-39.550 µS cm^{-1} at Dalyan side and as 52.158-55588 µS cm^{-1} at sea side. Total dissolved solid matters (TDS) refer to dissolved minerals, salts, metals, cations and anions in the water. The amount of TDS is higher in marine environments than fresh waters generally. The concentration of TDS in natural resources varies by geological structure of a region (WHO, 1996). The highest TDS concentration determined in this study is 35,68 g L^{-1} and is assessed as a low level. Measured suspended solids (SS) amount in all the stations are found lower than standard value of 30 mg L^{-1} specified in Water Pollution Control Regulations. The mean SS value is determined as 0,01 g L^{-1} at Dalyan side and as 0,02 g L^{-1} at sea side. Inorganic matter amount in SS is higher than organic matter.

According to Surface Water Quality Management Regulations (official journal no: 28483), the waters with nitrite value between 0,002-0,01 mg L^{-1} are classified as less-polluted water (II. Class). In the current study, the determined nitrite concentrations show that the area is included in II. Class less-polluted waters, which mean usable waters for recreational aims including activities, like swimming. The determined nitrate concentrations show that the area is included in I. Class according to Surface Water Quality Management Regulations (<5 mg L^{-1} NO_3-N), which means that all the stations are very clean in terms of nitrate nitrogen. According to same regulations, the area of the stations can be classified as I. Class with regard to ammonium nitrogen (<0,2 mg L^{-1}). In this study, the mean phosphate amount is determined as 0,08 mg L^{-1} which qualifies the area as II. Class according to the aforementioned regulations (0,03-0,16 mg L^{-1} total phosphorus) (Anonymous, 2004).

According to 76/160/EC microbiological quality requirements for bathing water declared by the European Union, reference value for total coliform is 500 KOB/100 ml and for fecal coliform is 100 kob/100 ml. The obligatory value for total coliform is 10000 KOB/100 ml. Hereunder in this study the mean fecal coliform amounts are much lower than the reference value (100 KOB/100 ml). In terms of total coliform, the amount determined in surface water at the sea side is below the reference value too. The amount at Dalyan side (Station 6) is below reference value and the amount at Stations 1 and 5 is lower than obligatory limit value.

As a conclusion, it is revealed that there is not any problem in using Iztuzu Beach (Dalyan and sea sides) for recreational activities. On the other hand, monitoring and controlling pollutants in specifically Dalyan side is of prime importance for the health of ecosystem in the region. The authorities or researchers may give educational seminars for increasing environmental consciousness and environmental awareness of the employees of tourism facilities and boat owners.

References

Anonymous, (2004). Su Kirliliği Kontrolü Yönetmeliği. 25687 Sayılı Resmi Gazete, 31.12.2004.

APHA. (1998). Standard methods for the examination of water and wastewater. American Public Health Association, Washington, DC, 1268.

Aydın, A. ve Sunlu, U., (2004), Güney Ege Denizi sedimentlerindeki karbon ve yanabilen madde düzeylerinin araştırılması, E.Ü., Su Ürünleri Dergisi, 21(3-4): 229-234.

Dirican, S. (2005), Salih Adası (Bodrum-Muğla) civarında su ürünleri yetiştiriciliğinin dip canlıları üzerine etkisinin araştırılması, doktora tezi, E.Ü., Fen Bilimleri Enstitüsü, Su Ürünleri Temel Bilimler Anabilim Dalı, 78s.

EPA, US. (1979). A review of the EPA red book, quality criteria for water, American Fisheries Society Water Quality Section, Maryland.

Geldiay, R. Ve Kocataş, A. (1998), Deniz biyolojisine giriş, Ege Üniversitesi Fen Fakültesi Kitaplar Serisi No: 31, 562 s., Bornova.

Göksu, M.Z.L. (2015) Su Kirliliği, Akademisyen Kitapevi, Ankara, 200s.

Kocataş, A. (1993). Oseanoloji - Deniz Bilimlerine Giriş, Ege Üniversitesi Su Ürünleri Fakültesi Kitaplar Serisi No: 60, İzmir, 358s.

WHO, (1996). Guidelines for drinking-water quality, 2nd ed. Vol. 2. Health criteria and other supporting information. World Health Organization, Geneva.

Marine benthic habitats within a physical disturbed site from the Romanian coast of the Black Sea

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The present study was carried out in the NW Romanian shelf in an area highly affected by dredging and trawling activities performed in scope of sand extraction and *Rapana* whelk harvesting. The aim was to assess the magnitude of impact and the post-dredging evolution of the circalittoral benthic habitats and their populations. On this purpose, 23 samples of macrobenthos were collected during the survey conducted in 2018. The results were compared with data colected in 2016, three months after dredging events. The physical disturbance of habitats was revealed by side scan sonar and multibeam bathymetry scanning. The sand extracting area and the trawled one extend on 2.7 km^2 (2500 m lenght and 700 m width) and 33.6 km^2 of seabottom, respectively, totalizing more than 70% of the study area. Moreover, a changing in benthic community in terms of diversity and abundance as well as of functional groups dominance was detected.
Keywords: Romanian Black Sea shelf, dredging and trawling activities, environmental impact, circalittoral benthic habitats, physical disturbance, macrobenthic ecological response

Introduction

Beam trawling is regarded as one of the most disturbing activities becoming a regularly activity in the last years at the Romanian littoral. In adittion, dredging and related activities such as dredge material placement ocassionally performed may affect the fragile marine ecosystem through released sediments into the water column, physical disturbance of habitats, species replacement or dissapering, enrichment of sediments with organic matter, pollutants recycling. Large scale sand extraction has been carried out for the first time within the framework of the project "Protection and rehabilitation of the Southern part of the Black Sea Romanian littoral in front of Constanta and Eforie Nord", aiming among others to protect the front beaches from Mamaia, Constanta and Eforie against accelerated errossion by artificial nourishment. Since 2016, permissions for using beam trawling were issued by the national authority for fishing and aquaculture, anual quota for harvesting being set at the national level.

Gutperlet (Gutperlet *et al.*, 2015) used benthic organisms as efficient indicators of physical disturbance such as dredging, which affects the sediment structure and composition (Taupp & Wetzel, 2013). Recurring dredging activities often lead to substantial reduction in benthic standing crop and species diversity (Desprez, 2000; Guerra Garcia *et al.*, 2003). Studies on the impact of dredging activities on the benthic fauna is widely researched worldwide (Van Dolah *et al.*, 1984) being mostly focused on its distribution and diversity but the impact of dredging have not been addressed comprehensively till date. The impact of of drag-nets (beam and bottom trawl) for rapa catch, mainly (82%) on the benthic habitat operating for a long period (since 1980s) has been assessed along the southern Black Sea. The by catch species was estimated at 29.7%, represented by Mollusca (25.7% - of the total catch), Crustaceans (3.5%), fishes (mostly juveniles) (0.2%) and Tunicates (0.3%) (Nielsen *et al.*, 2014).

In this context, the present study will evaluate whether and how the dredging/trawiling activities carried out affected some of the major circalittoral habitats from the Romanian littoral, bringing new data about the structure and distribution of macrozoobenthos.

Material and Methods

The study area was located in front of Constanta town. In July 2018, 23 stations were sampled onboard the R/V “Mare Nigrum” (Fig. 1). Macrozoobenthos samples were collected with a Van Veen grab of 0.135 m^2 area and then washed through a 0.5 mm mesh sieve according to the methodology agreed at the Black Sea level (Todorova, Konsulova, 2007). The density and biomass per sample are given at square meter. Bivalves were weighed with shells. The free software AZTI Marine Biotic Index, M-AMBI was used to determine the state of soft-bottom macroinvertebrate communities.

For the spatial distribution of species the freeware program OceanDataView was used. Benthic broad habitat types are classified according to the Commission Decision (EU) 2017/848, using the classification system of the European nature information system (EUNIS). The nomenclature of species was checked following the World Register of Marine Species (www.marinespecies.org).

For the bathymetric study, the Elak Nautik SeaBeam Multibeam Echo Sounder Systems 1050D at 50 KHz frequency was used. For the acoustic measurements the Klein L3900 Side Scan sonar was used at a frequency of 455 KHz. 39 profiles with lateral sonar and 78 profiles with the multibeam system were performed in the study perimeter.

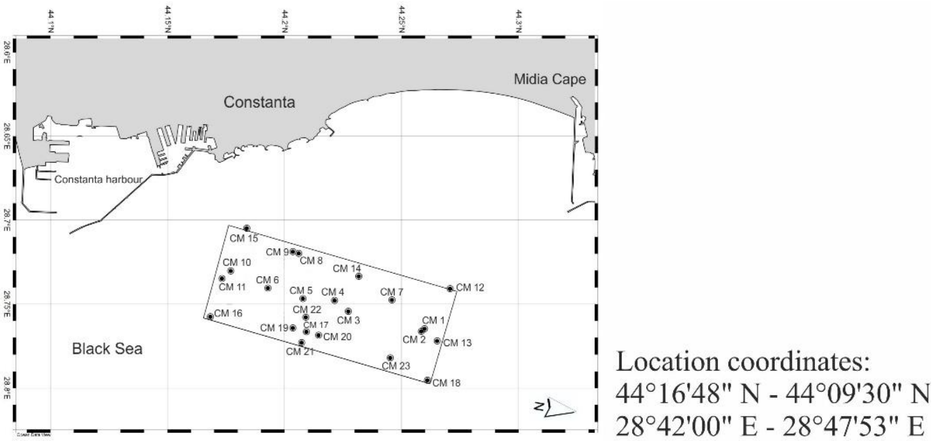


Figure 1. Map of the study area, with locations of sampling stations.

Results

There were 62 macrozoobenthic taxa identified in the area. The highest diversity was shown by the groups - Annelida, Crustacea and Mollusca. Species number per station varied between 10 to 31, with the lowest one in the station CM 05 and the highest in the station CM 23, while the average abundances and biomass reached almost 3,304.86 indv.m^{-2} and 121.3 g.m^{-2}, respectively (Fig. 2).

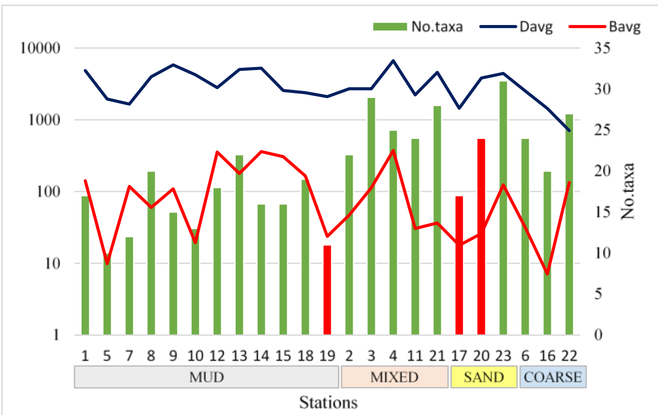


Figure. 2. Distribution of species richness, density and biomass of macrobenthic populations in the study area (impacted stations by sand dredging displayed with red column).

Four major habitats have been identified within the study area (51.433 km^2: 11.2 km length, 4.5 km width) belonging to circalittoral floor: circalittoral mud (33.42 km^2), circalittoral mixed sediments (12.784 km^2), circalittoral sand: 3.08 km^2 (present also within the dredged polygon), circalittoral coarse (shell debris) sediments: 3.43 km^2 (Fig. 3). The trawling activity performed regularly (during the summer season) for *Rapana venosa* harvesting affected more than 65% of the entire area, being mostly carried out within the circalittoral mud with communities of *Spisula*, *Abra*, *Pitar* and *Acanthocardia*. In the period 2012 – 2015, the whelck captures increased three times from about 1,500 tonnes to almost 4,000 tonnes. The dredging activity carried out in the winter – spring of 2016 impacted 5% (2.582 km^2) of the area, causing a partial distruction of the habitat of *Upogebia pusilla*, a protected species at the regional level (according to data from 2016 collected short time aftter dredging activity). The depth within the study area varied between 22m and 27m (Fig. 3)

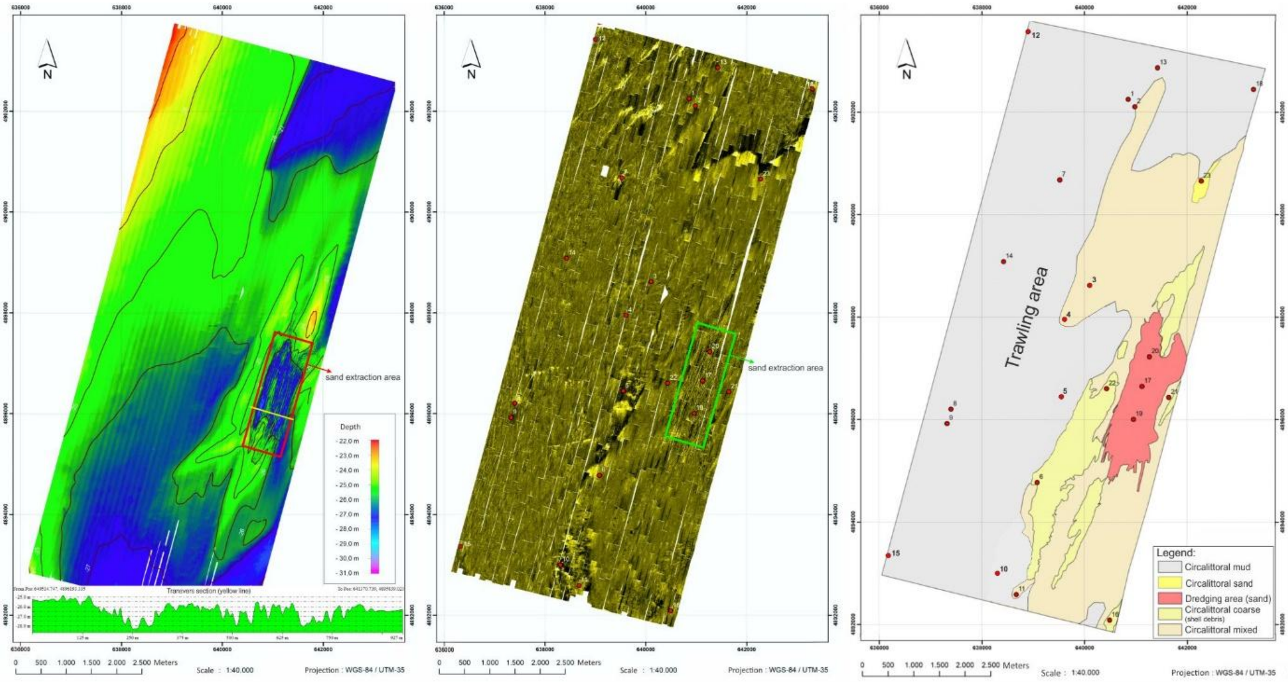


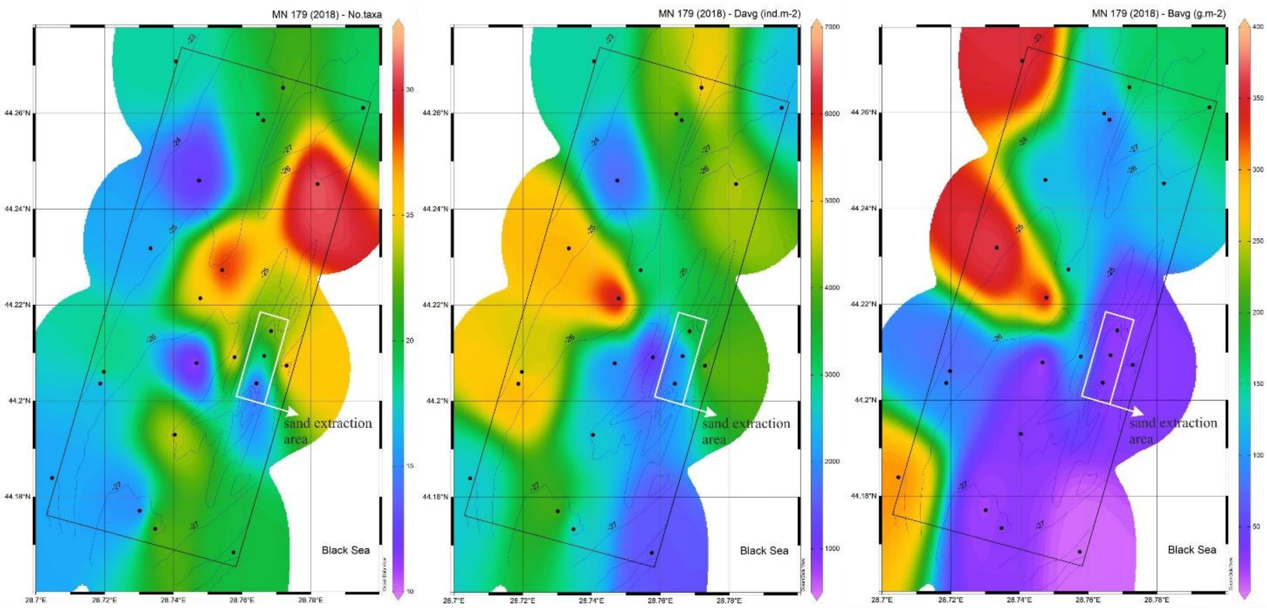
Figure 3. Bathymetric, side scan and habitats map of the study perimeter.

Circalittoral mud habitat was characterized by a species richness of 46 taxa, among which, besides opportunistic oligochaets and polychaets species (68% of total density; 4% of total biomass): *Melinna palmata*, *Nephtys hombergii*, *Heteromastus filiformis*, typical molluscs association of this habitat dominated: *Abra nitida* (6231 indv.m^{-2}), *Spisula truncata* (991.6 indv.m^{-2}) and *Acanthocardia paucicostata* (481 indv.m^{-2}). The molluscs' wet biomass represented 92% of the total. Pretty numerous but with limited distribution within this habitat were found the crustacean *Ampelisca sarsi* (414.4 indv.m^{-2}) and the phoronid *Phoronis euxinicola* (873.2 indv.m^{-2}), forming with *M. palmata* a distinct community/enclave present in the stations CM 1 and 13 (Fig. 4).

Circalittoral mixed habitat accounted for a diversity of 45 taxa, distinguished from the mud habitat through the dominance of small deposit feeders spionid polychaetes *Prionospio multibranchiata* (2,568 indv.m^{-2}) and *Pygospio elegans* (1,354 indv.m^{-2}) though almost overwhelmed in abundance by *M. palmata* (1,420 indv.m^{-2}), the predators *Nephtys hombergi* (725 indv.m^{-2}) and *Micronephthys stammeri* (1,495 indv.m^{-2}). *A. nitida*, *S. subtruncata* and *Pitar rudis* constituted the greatest bulk of the mollusks' association, being predominantely found in the station CM 4 located at about 1.5 km off the impacted dredging area. In terms of biomass, mollusks made up 76% of the total.

Circalittorral sand with only 3.08 km^2 summed up to 35 taxa, a distinct differentiation being seen in their distribution within and outside the impacted area by dredging. Hence, whereas a richness of 31 taxa was noted in the station 23, only 17 and 24 taxa, respectively were found within the stations 17 and 20 (Fig. 4). As two to threefold increase of abundance and two to six fold of biomass as distance increases from the station 17 to 23 was recorded. A shift in species dominance was also found. Hence, from an almost exclusively domination of *M. palmata* (58%) in the station 17 to a more equitable community structure constituted of a mixture of spionids (4 species), nepthyiids (2 species), capitelids (1 species), nemerteans (2 species), phoronids (1 species) in the station 20 and to a community where molluscs (6 species; 7% after density; 77% as biomass) and crustaceans (5 species; 4% after density) mainly featured the habitat structure in the station 23 give a full prove on the changes occurred over time in this habitat due to dredging activities.

Figure 4. Distribution of number of species, average density and biomass of the macrobenthic populations.



Circalittoral coarse sediments represent the ancient littoral bars accumulated at this level after sea transgression. It is seen on the sidescan sonar image (Fig. 3) as an alternace of dunes of about 0.5 m in height. The habitats is particular, the faunistic composition being diverse (41 taxa) but poor (1,559 indv.m^{-2} in average). *Microphthalmus sczelkowii* is rarely found elswhere, inhabiting almost exclusively coarse sediments found here. *Prionospio multibranchiata* (454 indv.m^{-2}; 1.81 g.m^{-2}) was dominant, while *Polydora cornuta* (451.4 indv.m^{-2}; 0.24 g.m^{-2}), *Alitta succinea*, mostly as juveniles and subadults (222 indv.m^{-2}; 0.38 g.m^{-2}), were subdominant in the same association. Overall, the density was the lowest (710.4 indv.m^{-2}) in the station 22, located in the very vicinity of the impacted area.

The Bray – Curtis dendrogram based on biomass highlighted the differentiation of coarse habitat, on one hand, and a high similarity between mixed and sand habitats, on the other hand (Fig. 5). 14 species most contributed at similarity between habitats (Fig. 5)

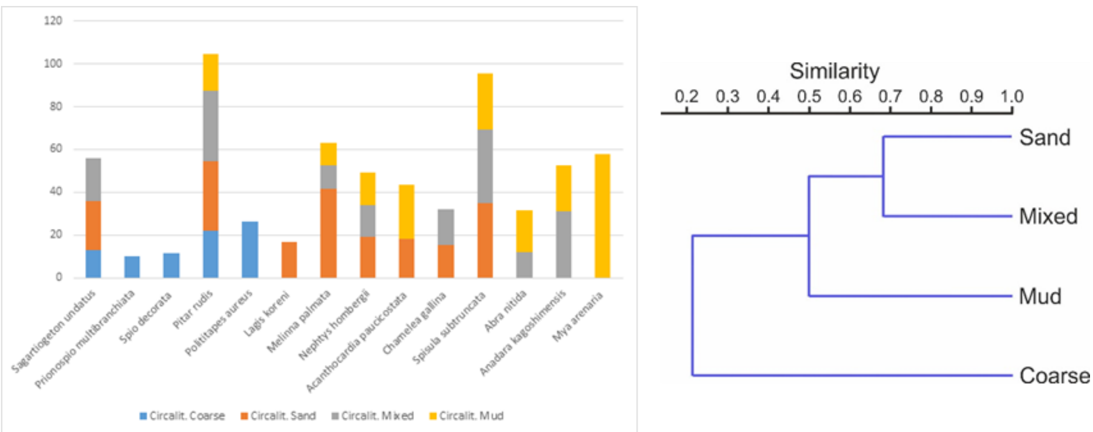


Figure. 5. Proportion of ecological significant species and Bray – Curtis similarity between habitats based on not-transformed biomass data.

The assessment of ecological quality status of the area by using M-AMBI indices showed that most part of the mud habitat is in poor state, the second opportunistic species representing more than 50% of the taxa number, while the mixed, sand and coarse habitats are in good and high state, disturbance – tolerant species being predominantely met in stations within these habitats.

Discussion

We studied medium-term changes in macrozoobenthos structure and diversity as well as the physical disturbance of habitats within the impacted sites by dredging and by beam trawling. Yet, three years after the cessation of sand extraction, macrozoobenthic community is not completely recovered. Comparing the results of observations made in 2016 at three months (unpublished data) after extraction in the very close stations in sandy habitats and the fauna present in 2018 in the same stations, it is noted that characteristic species that used to inhabit the sandy substrate in the area is still absent. A rapid recovery of opportunistic species followed the dredging period. Thus, *M. palmata* and *N. hombergii* replaced in most of the area *P. multibranchiata*, while the number and diversity of nemerteans species drastically reduced (*Carinina heterosoma*, *Cephalothrix sp.).* We assume that the process of siltation contributed the most at the changes observed. *M. palmata* and *N. hombergii* are highly tolerant species to organic enrichment comparative with the other polichaetes species or nemerteans. Several sediment characteristics also changed significantly in that time interval. The sidescan sonar and bathymetry images taken in 2016 show clearly the deep marks (of about 2 m) left by the dredge, which still could be seen in the present. In time, these suffered a slightly process of steepness attenuation. Based on the current observations, we foresee a very slow recovery of the former habitat. The entire studied area, as also revealed by geophysical investigations, is crossed by beam trawl traces. Our assessment showed an increased number of small detritivore species. Taken into consideration that the mud habitat covers 65% of the area, we believe that the strong siltation produced by the trawl operation affected mainly the epibenthic organisms, the molluscs community such as *S. subtruncata*, and the crustaceans (e.g., *Iphinoe elisae*, *Paramysis pontica*, *Diogenes pugilator*). Still, the poor status of the benthos in trawled area does not permit the detection of significant effects on macrofaunal community structure. We recommend continuing monitoring to investigate long-term impacts.

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References

Desprez, M., 2000. Physical and biological impact of marine aggregate extraction along the French coast of the Eastern English Channel: short- and long-term post-dredging restoration. ICES Journal of Marine Science, 57, 1428-1438.

Guerra-Garcia, J.M., Corzo, J. & Garcia-Gomez, J.C., 2003. Short-term benthic re-colonisation after dredging in the harbour of Ceuta, North Africa. P.S.Z.N.: Marine Ecology, 24(3), 217-229.

Gutperlet, R., Capperucci, R..M., Bartholomä, A., Kröncke, I., 2015. Benthic biodiversity changes in response to dredging activities during the construction of a deep-water port. Marine Biodiversity. DOI 10.1007/s12526-014-0298-0

Nielsen, R., *et al.*, 2014. Report on assessing trawling impact in regional seas. Benthic Ecosystem Fisheries Impact Study (BENTHIS project). 183pp.

Schlitzer, R., Ocean Data View, https://odv.awi.de, 2018.

Taupp, T., Wetzel, M. A., 2013. Relocation of dredged material in estuaries under the aspect of the Water Framework Directive-A comparison of benthic quality indicators at dumping areas in the Elbe estuary. Ecological Indicators 34:323–331. DOI: 10.1016/j.ecolind.2013.05.008

Todorova,V., Konsulova, Ts., 2005. Manual for quantitative sampling and sample treatment of marine soft-bottom macrozoobenthos. IO-BAS Fund, www.blacksea-commission.org. 38pp.

Van Dolah, R. F., Wendt, P. H., Nicholson, N., 1987. Effects of a research trawl on a hard-bottom assemblage of sponges and corals. Fisheries Research, Volume 5, Issue 1: 39-54.

Effects of environmental variables on distribution of Potamogetonaceae species in Turkey

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We collected 14 Potamogetonaceae species from 96 different wetlands (both lentic and lotic) throughout whole Turkey and measured 11 water chemistry parameters for 193 sampling. We examined the relationship between distribution of species and hydrochemistry using canonical correspondence analysis. Additionally, we investigated the distribution and abundance patterns of species along an altitudinal gradient. We have found that the most important environmental variables affecting the distribution of species are electrical conductivity (EC), dissolved oxygen (DO), water temperature, and pH. These four variables explained 62.9% of the total variance. Rare lowland species *Potamogeton coloratus* has the lowest optima for water temperature and the narrowest tolerance for DO. It is positively correlated with EC and negatively with pH. *Potamogeton gramineus* is positively correlated with pH and has the highest optima for water temperature and the lowest optima and the narrowest tolerance for EC. *Potamogeton pusillus* has the highest optima and tolerance for EC. Alpine species *Stuckenia amblyphylla* is positively correlated with DO and occurs in waters with low EC and low salinity. *Potamogeton natans* sampled mainly from highlands has the lowest optima and a narrow tolerance for DO and the second lowest optima for EC. *Stuckenia pectinata* has the highest tolerance and high optima for EC. It can grow in estuarine waters and closed basin lakes and also in freshwaters. *Potamogeton coloratus, S. amblyphylla* and *P. gramineus* and the first two are the most vulnerable species to be affected by increased water temperatures. The remaining species are widespread with broad altitudinal distributions and have average values for the measured environmental parameters.

Keywords: Canonical correspondence analysis (CCA); altitude; optimum tolerance; pondweed; ecology; aquatic plants

Consumer Behaviour of Fish Consumption in Kilis City

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This study was conducted to determine the fish consumption behaviour and preferences of people living in the city of Kilis. It was determined that fish prices were found to be expensive; and sea bream, sea bass, sand smelt, catfish and carp were the most frequently preferred fish in the city. It was also determined that the preferences of the consumers in the city were close to each other as marine fish (52%) and freshwater fish (48%). The consumers stated that they consumed mostly red meat and chicken, and only 12% of them stated that they consumed fisheries. The annual fishery consumption rate was determined to be 4 kg per capita. The most frequently consumed fishery was the sea bream. The first factor in fish preference was determined to be freshness and taste, and fisheries were mostly consumed as fried. It was also determined that over fishing, pollution and prohibited fishing were the most important factors in the decrease in the fish stocks.

Keywords: Fish Consumption Behavior, Kilis

Introduction

In the last quarter of the present century, a change was observed in the eating habits of consumers with the spread of awareness on healthy eating habits in many regions of the world and with the change from red meat consumption, which has high cholesterol, to white meat consumption, depending on the demands of consumers. Habits in eating fish are important in consumption of fishery products. Although fish is an animal protein, the fact that unwanted features (i.e. cholesterol, vascular stiffness etc.) in some animal meats being not observed in fish, and on the contrary, the benefits of fishery products for human health increase the demands of consumers for fish meat (Özcan *et al.*, 2003).

Low levels of aquaculture production in Turkey causes that the level of consumption is also low in direct proportion with the production. While the average fishery consumption in the world is between 16-19 kg per capita and the average in European and EU countries is around 22 kg; the annual consumption of fishery products in Turkey is around 7 kg per capita (TUIK, 2017). These numbers are 90 kg in Iceland, 80 kg in Japan, 18 kg in the USA, 19 kg in Greece, 7 kg in Bulgaria, 16 kg in Germany and 3 kg in Iraq.

There are studies conducted on the consumption of fishery products in the world, and the studies conducted in our country are mostly on fish consumption (Verbeke *et al.*, 2007; Pieniak *et al.*, 2008; Pieniak *et al.*, 2010; Elbek & Emiroğlu, 1999; Özcan *et al.*, 2003; Şen *et al.*, 2008; Hikmet & Yüksel, 2010; Aydın & Karadurmuş, 2013, Saygı *et al.*, 2015).

With the present study, despite its importance for public health, it was aimed to investigate how the information on income level, education level, fish species, reliability (having no health risks) method of cooking and the price of fish, which is consumed in a limited amount due to economic conditions and consumer habits in Turkey, affect the fish consumption and purchasing behaviors of individuals.

Material and Methods

In the present study, Kilis city center and Musabeyli, Polateli and Elbeyli districts were chosen as the study area. According to the census of 2017, the population of Kilis was determined as 136.319; this amount is the population of three districts together with all the villages. The population of the central district of Kilis was 112.553, Musabeyli was 13251, Elbeyli was 5325, and Polateli was 5190 (Anonymous, 2018). When the sampling volume was computed, it was accepted as 500; and it was determined that 410 sampling should be taken from Kilis city center, 50 from Musabeyli, 25 from Elbeyli and 25 from Polateli districts. Since the present study was conducted only in the centers, the total sampling volume for other settlement units was accepted to be 500. A total of 500 consumers were selected randomly for each dimension, and face-to-face interview technique was employed. The data that were obtained with the Questioning Method were analyzed with the EXCEL package program in computer medium; and it was questioned whether there were significant differences between the determined characteristics (Anonymous, 1993). In addition, the relation between education and income level and the amount of consumed meat was also determined.

Results

The age, profession and income levels of the 510 consumers, who were included in the present study, were determined. A total of 39% of the individuals living in Kilis were below 21 years of age, 25% were between the ages of 21-30, 16% are between the ages of 31-40, 10% are between the ages of 41-50, 6% were between 51-60, and 3% were between the ages of 61 and over (Fig 1).

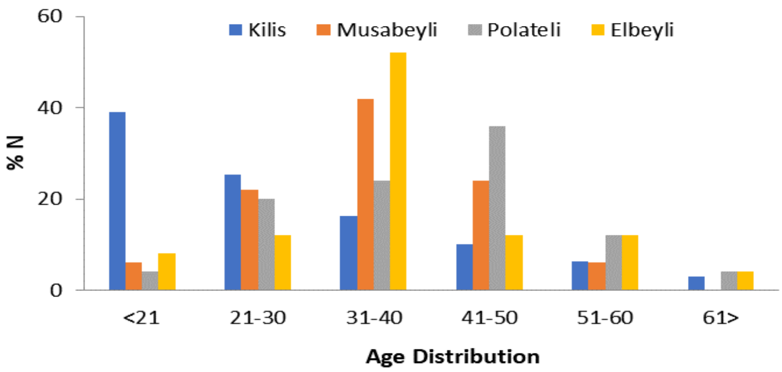

Figure 1. Age distribution of the consumers according to sex.

It was determined that 16%, 40%, 16%, 32% of the consumers were at primary education; 24%, 32%, 24%, 32% were at high school; 34%, 8%, 8%, 8% were at foundation degree level, and 18% and 8% were at undergraduate level in Kilis, Musabeyli, Polateli and Elbeyli, respectively (no undergraduate level students were interviewed in Musabeyli and Polateli). A total of 4% of the participants stated that they were studying at post-graduate level (no post-graduate students were interviewed in Musabeyli, Polateli and Elbeyli); and 4%, 20%, 52% and 20% of the consumers stated that they were illiterate.

The consumers were determined to be self-employed in Kilis, Musabeyli, Polateli and Elbeyli regions at a rate of 15%, 22% and 4%, respectively (no self-employed groups were interviewed in Polateli); 12%, 2%, and 4% were civil servants (no civil servant groups were interviewed in Polateli); 13%, 47%, 36% and 56% were employees; 9%, 6%, 32% and 16% were retired, 41%, 8%, 4%, 8% were students and 10%, 16%, 28% and 12% were housewives. As a result of the questionnaires, it was determined that the income levels of the regions where employees and retirees lived were distributed between 1001-3001. The consumers in Kilis, Musabeyli, Polateli and Elbeyli stated that the fish prices were cheap at a rate of 10%, 8%, 8% and 8%, respectively; 28%, 34%, 52% and 12% stated that fish prices were normal; 38%, 50%, 32% and 76% stated that the prices were expensive; and 24%, 8%, 8% and 4% said that they did not know the price of the fish. It was also determined that the majority of the consumers consumed fish as fried and few people consumed fish as grilled. The consumers interviewed in Kilis, Musabeyli, Polateli and Elbeyli consumed fish as fried at a rate of 41%, 72% 60%, 68%; a total of 20%, 4%, 16% of them stated that they grilled the fish; 27%, 14%, 12%, 20% of them stated that they consumed the fish by baking in the oven; and 12%, 10%, 12% and 12% preferred to consume the fish with other methods (Fig 2).

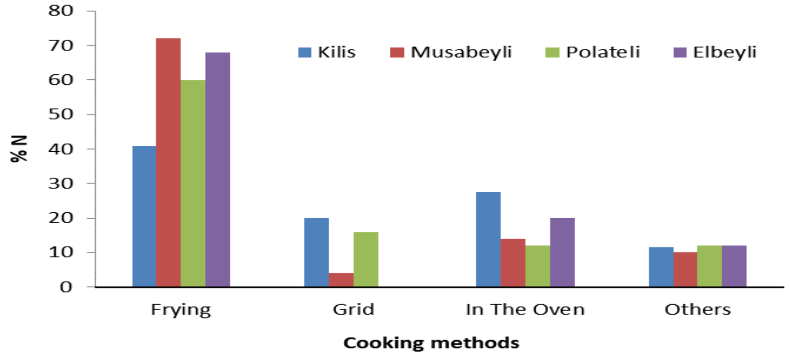

Figure 2. Cooking methods of the consumers for Fish

Most of consumption forms of the consumers for fish were in the form of fresh and fried. Consumers, who were of the opinion that fish stocks were decreasing, stated that the reasons for this were over fishing, pollution and prohibited hunting. The majority of the consumers said that they did not hunt fish in an amateur manner. It was determined in Kilis, Musabeyli, Polateli and Elbeyli regions that only a total of 46% and 28% of the consumers, respectively, fished in an amateur manner (no people who dealt with amateur fishing were interviewed in Polateli and Elbeyli). A total of 25%, 22% and 4% of the fishers who dealt with amateur fishing used fishing rods (no people, who went fishing with fishing rod, were interviewed in Polateli); 12%, 4% of the fishermen used casting net (no people, who used casting net for fishing, were interviewed in Polateli and Elbeyli); 20% and 2% of the consumers used net for fishing (no people, who used net for fishing, were interviewed in Polateli and Elbeyli); 12% used harpoon and 31%, 72%, 100%, 96% used other fishing tools.

The meat preferences of the consumers in Kilis, Musabeyli, Polateli and Elbeyli were 18%, 12%, 8% fish (no people who preferred fish were interviewed in Polateli); 55%, 20%, 56%, 8% preferred red meat, and 24%, 68%, 44%, 84% preferred white meat. The least preferred meat was determined as crustacea with3%, and interviews were made with those who preferred these meats only in Kilis.

Consumers in the region preferred fish at rates that were close to each other. A total of 52% of the consumers preferred sea fish and 48% preferred freshwater fish. Consumers preferred Red Mullet in the districts of Kilis, in Musabeyli, Polateli and Elbeyli with 6%, 16%, 8% (none were detected in Polateli), and 18%, 40%, 16%, 12% preferred Sea bream; 26%, 8% 28%, 4% preferred Sea bass; 6%, 2%, 12% preferred Gray Mullet (none were detected in Elbeyli); 9%, 2%, 8%, 12% preferred carp; 7%, 2%, 8%, 8% preferred Trout; 3%, 14% and 12% preferred catfish (none were detected in Elbeyli); 8%, 12%, 16%, 48% preferred Sand smelt; and 16%, 4%, 8% preferred other fish types (none in Polateli) (Fig. 3). When choosing fish, the criteria were as follows; 17%, 60%, 4%, 4% mentioned Economic criteria; 26%, 20%, 52%, 52% mentioned Less bony fish; 41%, 18%, 40%, 40% mentioned taste and freshness; 9%, 2%, 4%, 4% did not share their opinions; and 7% preferred other criteria (no criteria were mentioned in Musabeyli, Polateli and Elbeyli).

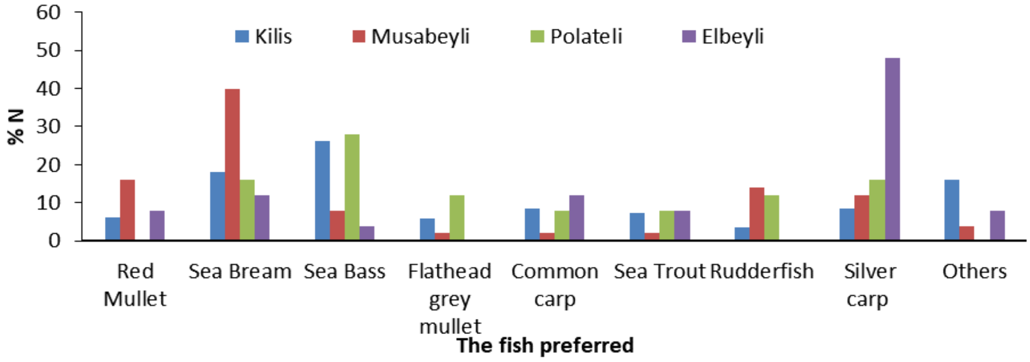

Figure 3. The fish preferred.

A total of 7% of the consumers stated that they only bought fish in Kilis every day; and stated that they did not buy fish in other regions. The consumers in the area stated that they bought fish once a month in general. In addition, an important deal of the consumers also stated that the fish were provided to them for free by amateur fishermen who were their friends. The reasons why they preferred freshwater fish were due to their taste in Kilis, Musabeyli, Polateli and Elbeyli at rates of 41%, 12%, 56%, 68%, respectively. The consumers stated that they mostly preferred trout in Kilis, Musabeyli, Polateli and Elbeyli, respectively at rates of 29%, 20%, 12%, 28%; and Carp fish at rates of 20%, 16%, 44%, 40%, respectively. It was determined that a significant part of the consumers consumed between 1-5 kg of fish on a monthly scale.

Discussion

In the results of a study conducted in 1996 on direct fish consumption in Turkey in February and May in Izmir, it was reported that the consumption of fish was not as much as the red meat yet and poultry meat; and an important part of the people living in such a city with high education and income level did not consume fish (Elbek *et al.*, 1999). Later, in a questionnaire that was conducted to determine the current situation of fish consumption in the city of Elazığ (2008), it was reported that fish was consumed at the highest level and poultry meat was consumed at the lowest rate. 6A total of 0% of the consumers consider that fish prices are high. Approximately 80% of fish-consuming families complained that the fish market was not clean; and the fish were not always fresh. Sea fish was more preferred. A total of 62% of the consumed fish were consumed as fried and cooked (Şen *et al.*, 2008).

In the questionnaire study that was conducted in Burdur in 2010, it was reported that 89% of the consumers consumed fish; and 11% of them did not consume any fish at all. It was reported that the consumption of the fish was the most important nutrient because it is a healthy food (70%). Many of the consumers stated that they consumed fish once a week (41%) or once every two weeks (40%). It was determined that those who stated that they consumed sea fish consumed anchovies at a high rate (77%) and those who stated that they consumed freshwater fish consumed trout (67%). The common cooking method of the fish was determined frying (46%) (Hikmet and Yüksel, 2010). Again, according to a questionnaire that was conducted in 2013 to determine fish consumption behavior and preferences of consumers living in Giresun and Trabzon, the consumers preferred fisheries (41%). Chicken meat was ranked the second (33%) and red meat the third (26%). While 7.5% of the consumers did not consume fisheries, 92.5% stated that they consumed fisheries. It was reported that the average annual fishery consumption per capita was 29.52 kg. The most frequently consumed fishery product was anchovy with 17.75%. It was also determined that 95.14% of the consumers consumed fish freshly; and they preferred frying (52.97%) or grilling (29.73%) (Aydın and Karadurmuş, 2013). In addition, in another questionnaire that was conducted in Ankara and Izmir in 2015, 81% of the consumers living in Ankara, and 83% of them who lived in Izmir preferred chicken meat at the highest level. While the preferences of the consumers were anchovy (59%) in Ankara at a high level, those in Izmir stated that they preferred sea bream (38%) and sea bass (36%). It was determined that the consumers preferred to consume fish freshly, and the cooking method was frying at a rate of 55%. A total of 48% of the consumers stated that they preferred fish for its taste and 36% for its being healthy (Saygı *et al.*, 2015).

This study was conducted to investigate the fish consumption habits in the city of Kilis and its districts. In our present day when people consider balanced and healthy nutrition important, fish has become an important food element. In Kilis, which has fish consumption rates below the consumption rates of Turkey as a whole, the most commonly consumed fish species, the fish consumption frequency, and the consumption form and many other issues related to fish consumption were investigated; and the present study is an important effort because it is the first study on the consumption of fish.

An important part of the consumers, who were included in the present study, were in the employee group. It was determined that the consumers were distributed mostly in the income class between 1001-3001 income class. The consumers in the study area stated that the fish prices were expensive. Most of the consumers cooked fish by frying; however, only a few of the consumers preferred other fish cooking methods like grilling, baking, steaming, and boiling, etc.

Most of the consumers, who were included in the present study, stated that they consumed fish in the form of fresh and fried. They also stated that in general, fish stocks were decreasing due to over fishing, pollution and prohibited hunting. The consumers mostly preferred red meat. In the second place, they preferred white meat and then fish. The consumers in the area preferred sea fish (52%) and freshwater fish (48%), which had close values to each other; and the consumers in the region consumed mostly sea bream, sea bass, Sand smelt, catfishand carp. Especially the economic dimension of the fish was mentioned in the first place, and its being less bony and having taste were important for consumers. More than half of the consumers stated that they were interested in fish hunting, and the majority of those who were interested in amateur fish hunting fished with other fishing tools.

Only 7% of the consumers stated that they bought fish in Kilis every day; however, none of the consumers stated that they bought fish every day in other regions. The consumers stated that they usually consumed fish once a month, and that a significant part of them provided fish free of charge from amateur fishermen who were their friends. A significant part of the consumers stated that they consumed between 1-5 kg of fish per month. The above-mentioned findings on fish consumption of the consumers are similar to those of reported by Sayili *et al.*, 1999 & Anonymous, 2008.

As a result, in this study, the rates of those who consumed fish were found to be very low when compared to white and red meat consumption. A significant part of the consumers (75.88%) was determined to consume 1 to 5 kg of fish in average on a monthly basis, which is below the average of Turkey.

References

Anonim, 2018. Adrese Dayalı Nüfus Kayıt Sistemi Sonuçları.

Anonim, 1993. SPSS for Windoes Advanced Statistics Release 6.0., 578 s.

Aydın, M. & Karadurmuş, U., 2013. Trabzon ve Giresun Bölgelerindeki Su Ürünleri Tüketim Alışkanlıkları, *Karadeniz Fen Bilimleri Dergisi/The Black Sea Journal of Sciences*, 3(9):57 71.

Elbek, D. Emiroğlu & H. Saygı., 1999. İzmir İlinde Su ürünleri Tüketimi, E.Ü. Su Ürün. Fak. Yayınları No:57, E.Ü. Basımevi, Bornova/İzmir.

Hikmet, O. & Yüksel, O., 2010. Burdur İli Su ürünleri Tüketimi Anket Uygulaması. *Süleyman Demirel Üniversitesi Ziraat Fakültesi Dergisi*, 5(1):1-7.

Özcan, G., Özcan, T., Akyurt, İ. & Türkmen, M., 2003. İskenderun Körfezi'nin Çevresinde Bulunan Yerleşim Bölgelerindeki Balık Tüketiminde Tutum ve Davranışların Değerlendirilmesi. XII. Ulusal Su Ürünleri Sempozyumu 2-5 Eylül 2003 Elazığ, Sayfa 480-485.

Pieniak, Z., Verbeke, W., Perez-Cueto, F., Brunso, K. & DeHenauw, S. 2008. Fish consumption and its motives in households with versus without self-reported medical history of CVD: A consumer survey from five European countries. *BMC Public Health*, 8(1):306.

Pieniak, Z., Verbeke, W. & Scholderer, J. 2010. Health related beliefs and consumer knowledge as determinants of fish consumption. *Journal of Human Nutrition and Dietetics*, 23(5):480 488.

Saygı, H., Bayhan, B., & Hekimoğlu, M. A., 2015. Türkiye'nin İzmir ve Ankara İllerinde Su Ürünleri Tüketimi. *Türk Tarım – Gıda Bilim ve Teknoloji Dergisi*, 3(5):248-254.

Sayılı, M., Esengün, K., Kayım, M. & Akça, H. 1999. Tokat-Merkez ilçede Balık Tüketimini Etkileyen Faktörlerin Ekonometrik Analizi, X. Ulusal Su Ürünleri Sempozyumu, Bildiriler Kitabı, Cilt: 1, 33 -42, Adana.

Şen, B., Canpolat, Ö., Sevim, A.F. & Sönmez, F., 2008. Elâzığ İlinde Balık Eti Tüketimi. *Fırat Üniversitesi, Fen ve Mühendislik Bilimleri Dergisi*, 20(3):433-437.

TÜİK, 2017. http://www.tuik.gov.tr/PreHaberBultenleri.do?id=27669.

Verbeke, W., Vanhonacker, F., Sioen, I., Van Camp, J. & DeHenauw, S. 2007. Perceived importance of sustainability and ethics related to fish: A consumer behavior perspective. *AMBIO: A Journal of the Human Environment,* 36(7):580-585.

Short-term research on the growth of the *Mytilus galloprovincialis* within nets in Gökceada

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In the mussel culture system established in Gökceada Kaleköy at the coordinates of 40.231550-25.893957, 120 number mussels which have average of 19,58 ± 0,29 mm length and 0,98 ± 0,07 g weight were transferred to the nets. Then growth amounts were determined between November 2017 and August 2018. The experiment was carried out in three replicates. Temperature, salinity, pH, chlorophyll-a and particulate organic matter amounts were measured monthly. The highest amount of chlorophyll-a was measured as 0.56 µg/L in August 2018 and the lowest value was measured as 0.12 µg/L in December 2017. The highest water temperature was 26.7 °C in August and the lowest water temperature was 11.8°C in February. There is no significant difference has been observed between the particulate organic matter and chlorophyll-a because of the nets are at the same depth. When three nets were released to the water in November 2017, the length average was 19,58 ± 0,29 mm, after 10 months later it was 41,56 ± 1,13 mm in August 2018. In the growth measures made between the months, the maximum growth was measured in winter months as January-February and summer months as July-August. In the analysis of length-weight correlation between the months, it was determined that there is a high positive correlation between length and weight. (r=0.86)

Keywords: *Mytilus galloprovincialis*, Gökceada, Cultivation, Spesific Growth Rate

Introduction

17.1 tonnes of crustacean culture and 1.1 tonnes of Mytilidae culture are all part of a total 110.2 million tonnes aquaculture production in the world (FAO, 2018). In our country, aquaculture production is 276.502 tonnes in 2017 and mussel culture are a part 489 tonnes of this total production (TÜİK, 2018). *Mytilus galloprovincialis* is a species fed by filtering water soluble materials, phytoplankton, organic detritus and bacteria as nutritional source (Karayücel et al, 2003). Growth rates in the mussels depends on how much they are exposed to the waves, population density, salinity, especially temperature and the amount of nutrients in the water (Sukhotin & Maximovich, 1994). In study conducted by Stirling & Okumuş (1994), it was determined that the two most important factors affecting growth in the mussels are water temperature and chlorophyll-a. However, they found that organic material suspended in sea water was very effective also. In this study, although the productivity of black mussel growing has been determined previously in the Marmara Sea, Black Sea and Dardanelles Strait, the growth potential of black mussel in Gökceada has not been determined before. For this reason, this study was carried out with the aim of having information about the potential of mussel culture in Gökceada.

Material and Methods

The mussel culture is established in the Kaleköy region of Gökceada with the coordinates of 40.231550 - 25.893957. The 120 number mussels collected from the nature were added to the nettings which have 4 mm mesh width so as to be 40 in each net. They were added to the system as a suspend.

Figure 1. Map of study area, Gökceada, Kaleköy

The water temperature, salinity and pH of the region where the system is established were measured monthly by multiparameter (HQ40d) device of Gökceada Marine Research Unit. Three replicates of water samples were taken each month from study area and chlorophyll-a and total particulate matter analyzes were carried out. In the chlorophyll-a analyzes, 1L seawater sample was primarily filtered through a GF / C filter paper by means of a vacuum pump. After filtration, the filter paper is folded in half with sterile pens and wrapped with aluminum foil paper to protection from light. After the filtration processes were finished, the samples were cut into small pieces and transferred to 10 ml glass test tubes. Then, 90% of acetone was added and kept in the refrigerator overnight in the dark (APHA, 2000). The next day, after centrifugation at 3000 rpm for 20 min, the supernatant layer was taken with a pipette. After the acetone was introduced in the spectrophotometer as a blank, the supernatant in the quartz tube was measured at wave lengths of 630, 647, 664 and 750 nm and the results were recorded (APHA, 2000). In the analysis of total particulate matter, filter papers were first wrapped in aluminum foil and burned in an ash furnace for 6 hours at 450˚C. After the burning process, the filter papers were cooled in a desiccator, weighed on the precision scales and the preliminary weights were determined. Then, seawater filtration process was performed on filter papers, they were dried at 60 °C for 38 hours and weights was taken again. As final step, final weights were taken after the ash furnace for 6 hours at 450˚C and calculations were made according to the formula of total particulate matter= (mg / L^{-1}) = W2-W1 + X / V (Strickland & Parsons, 1972).
Taken nets from the system were dried with drying papers. Then measured to lengths using by the Bts digital calipers and measured to weights using by the precision scales. The calculations are based on the formula K = (InL2-InL1) / (t2-t1) (Malouf & Bricelj, 1989). L2 and L1 were the final size and the first size, t2-t1 difference was 30 days (Chatterji et al, 1984).

Results

According to the ten months results from November 2017 until August 2018, The average of water temperature was recorded 18.06 ± 5.44 °C, with the highest water temperature at 26.7 °C in August and the lowest at 11.8 °C in February. The average of salinity was measured as 34.37 ± 2.53 °C, the highest value of salinity was measured ‰31.1 in January and minimum value was measured ‰38.6 in February. The salinity average is the close each other during the transition periods from January to February and from July to August but January to February has most growth than the other months. There is not much fluctuation in the pH values, the mean value is measured as 8,12 ± 0,04 (Min:8,1 ve Max:8,2).

According to chlorophyll-a measurements, the mean was calculated as 0.23 ± 0.12µg / L. The highest value was found as 0,56 µg / L in August and the lowest value was found as 0,12 µg / L in December. Monthly chlorophyll-a values are shown in Figure 2 below.

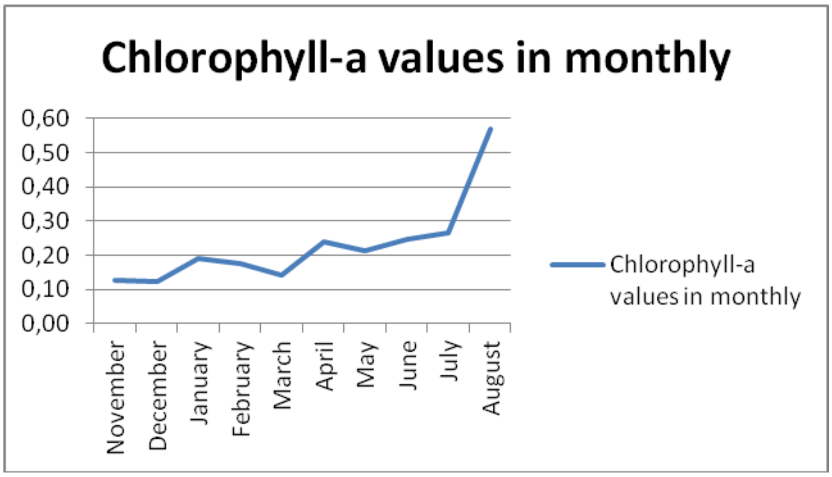

Figure 2. Chlorophyll-a values in monthly

According to the results obtained from the analysis of total particulate matter (seston), the average was obtained as 19.36 ± 11.85mg L^{-1}. Significant differences were found in monthly measured values. The highest value of seston was obtained in February with 35.90 mg L^{-1} and the lowest value was obtained in May with 4,23 mg L^{-1}.

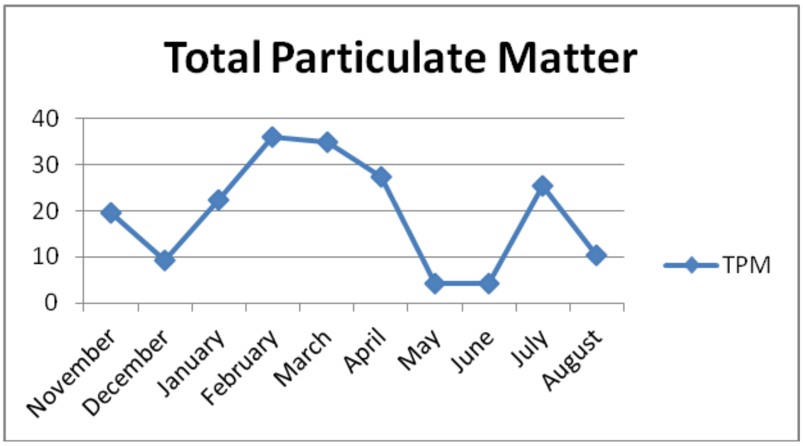

Figure 3. Total particulate matter values in monthly

In the correlation analysis between the monthly growth amounts of the mussels and the sea water parameters, it was determined that the growth was strongly related to chlorophyll-a and sea water temperature.

	Growth	*Chlorophyll-a*	*Salinity*	*Temperature*
Growth	1			
Chlorophyll-a	0,671126	1		
Salinity	-0,09374	-0,179766335	1	
Temperature	0,611403	0,745817004	-0,46414	1

Figure 4. Correlation analysis between growth and water parameters in mussels

According to the results of the correlation analysis between lengths and weights of mussels in ten months, it was found that there is a high positive correlation between length and weight. (r=0.86)

	Length	*Weight*
Length	1	
Weight	0,869191345	1

Figure 5. Correlation analysis between length and weight in mussels

The average of lengths were measured 32,49 ± 7,09 mm and average of weights were measured 4 ± 2,59 gr. Specific growth rate calculations were made with length growth. According to this; the highest growth was observed in January-February in the winter months and July-August in summer months. The study began in November 2017 showed a steady increase in the spring and summer periods following the sudden increase between January and February. The extreme increase in the January-February period was associated with the rapid growth of mussel when they are small and the high amount of chlorophyll-a with the amount of seston in the sea water during the given months.

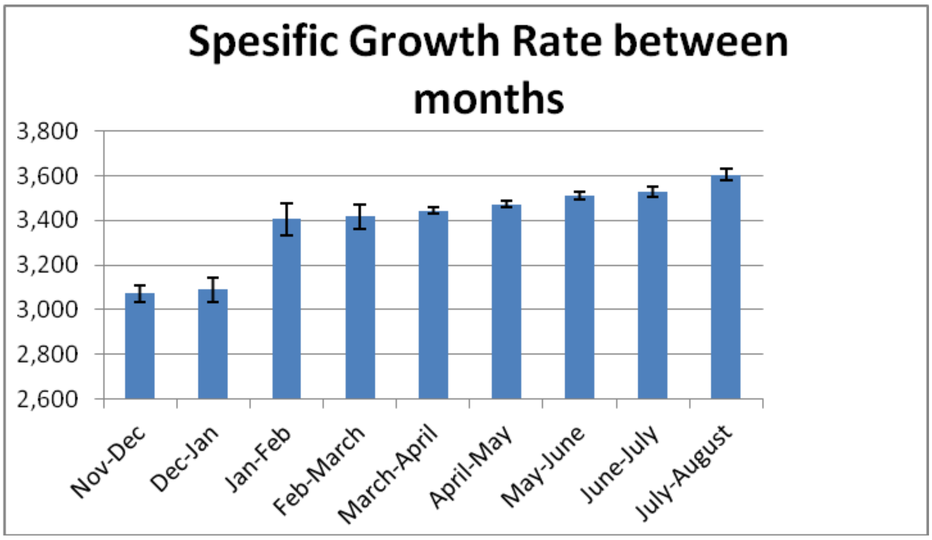

Figure 6. Spesific Growth Rate between months

There is no significant difference between November-December and December-January but the other months are significantly different when compared to these two growth periods. Especially the last month, July-August period, there is a big difference in growth compared to other months.

Discussion

Yıldız and Lök (2005) were made a study on the growth and survival performances of mussels in different length groups in two different systems both are ropes and nets in Poyraz Bay in Canakkale Strait. The growth rate of the small size mussels groups was the greatest, when size was increase growth rate was began decrease. In Gökceada, Kaleköy, we have also observed that the growth rate was the highest in the small size mussels who were collected from the nature stocks and added to the nets, the growth rates decreased when the mussels size were increased to the month to month.

Yıldırım (1997) was studied the mussel culture in the nets in two different stations in his master thesis. In most studies, the salinity that mussels needed in optimum growth conditions was ‰20 ± 5, the average values measured in Dalyan and Urla in this study were over ‰ 30 in all seasons and the mussels growth changes at different stations in May, June and August were measured between 1,78 mm-10,48mm and the mussels was not affected by high salinity. Chlorophyll-a values are lowest in winter and highest in spring and summer. In our study in Gökceada-Kaleköy, salinity was over ‰30 in all months when mussels grew. The amount of growth between May, June and August was 5,28 mm. At the same time, the chlorophyll-a values obtained in this study reached the lowest in winter and the peak in spring and summer seasons.

Lök (2001) was separated to six different size groups the mussels of different size groups collected from the Quarantine Island in Urla-Iskele and put them in nets. According to the findings, average of the sea water temperature is 18.5 ± 1.38 °C, minimum temperature is 13.5 °C in December and maximum temperature is 24.5 °C in June and July. Salinity was measured as an average of ‰ 36.59 ± 0.23. The annual growth amounts in six different groups ranged from 9.75 to 18.38 mm. In our study, the average of sea water temperature was found as 18.06 ± 5.44 °C, while the minimum temperature was found as 11.8 °C in February and maximum temperature was found as 26.7 °C in August. Sea water salinity was found as ‰ 34,37 ± 2,53 and similarities with the above-mentioned study were observed. The increase in the end of the ten months of study was found as 21.98 mm.

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I would like to thanks Assist. Prof. Dr.Onur GÖNÜLAL and staffs in the Gökceada Marine Research Unit of Istanbul University for help during the study period. This work was supported by the master thesis project number 25357 of the Executive Secretary of the Istanbul University Scientific Research Projects.

References

APHA, A. 2000. Standard methods for the examination of water and wastewater, American Public Health Association. Inc., Washington. DC.

Chatterji, A., Ansari, Z. A., Ingole, B. S., & Parulekar, A. H. 1984. Growth of the green mussel, *Perna viridis* L., in a sea water circulating system. Aquaculture, 40(1), 47-55.

FAO, 2018. http://www.fao.org/3/I9540EN/i9540en.pdf [Accessed September 2018]

Karayücel, S., Karayücel, I., Erdem, M., Saygun, S., & Uyan, O. 2003. Growth and production in long-line cultivated Mediterranean mussel (*Mytilus galloprovincialis*) in Sinop, Black Sea.

Lök, A. 2001. İskele-Urla'da (İzmir Körfezi) Kültüre Alınan Farklı Boy Gruplarındaki Midyelerin (*Mytilus galloprovincialis* Lamarck, 1819) Büyüme Oranları. Su Ürünleri Dergisi, 18(1-2), 141-147. In Turkish.

Malouf, R. E. & V. M. Bricelj. 1989. Comparative biology of clams: environmental tolerances, feeding and growth. In: Manzi, J. J. & M. Castagna, editors. Clam mariculture in North America. Amsterdam, The Netherlands: Elsevier. pp. 23–73.

Stirling, H. P., & Okumuş, İ. 1994. Growth, mortality and shell morphology of cultivated mussel (*Mytilus edulis*) stocks cross-planted between two Scottish sea lochs. Marine Biology, 119(1), 115-123.

Strickland, J.D.H., Parsons, T.R., 1972. A practical handbook of seawater analysis. Fish. Res. Brd. Canada Bull. 310.

Sukhotin, A. A., & Maximovich, N. V. 1994. Variability of growth rate in Mytilus edulis L. from the Chupa Inlet (the White Sea). Journal of Experimental Marine Biology and Ecology, 176(1), 15-26.

TUIK, 2018. http://www.tuik.gov.tr/PreTablo.do?alt_id=1005 [Accessed September 2018]

Yıldırım, Ş.,1997. Mussel (*Mytilus galloprovincialis*, Lamarck 1819) Culture In Floating Cages In Two Different Stations, (in Turkish). E.Ü. Fen Bilimleri Enstitüsü, Su Ürünleri Yetiştiriciliği Anabilim Dalı, Yüksek Lisans Tezi, S:70. Bornova, İzmir.

Yıldız, H., & Lök, A. 2005. Çanakkale Boğazında Farklı Boy Gruplarındaki Midyelerin (*Mytilus galloprovincialis* Lamarck, 1819) İki Değişik Sistemde Büyüme ve Yaşama Performansları. Ege Üniversitesi Su Ürünleri Dergisi, 22(1-2), 69-74. In Turkish.

Reproductive Features and Microhabitat Preferences of Mosquitofish (*Gambusia holbrooki)* in Freshwaters of Turkey

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In this study, it was aimed to investigate habitat preferences and reproductive features of mosquitofish (*Gambusia holbrooki* Girard, 1859), which are considered as a threat especially for endemic species' persistence. A total of 130 localities were investigated in Turkey in 2016 and 2017. *G. holbrooki* specimens were found in total of 67 stations, including 28 lotic and 39 lentic stations. The samples were collected by seine net and hand net. Permutational multivariate analysis of variance (PERMANOVA) was used to determine the relationship between the physico-chemical parameters and the presence of species. As a result of the microhabitat analysis, it was determined that the species preferred shady and shallow habitats with abundant vegetation. Pregnant individuals were found in many sampling locations. Minimum and maximum number of egg and embryo were determined as 2 and 182.

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Keywords: *Gambusia holbrooki*, mosquitofish, reproduction, microhabitat preference, invasive species.

"Green tides" and metal pollution in the eastern Gulf of Finland (Baltic Sea): accumulation of biomass and it effect on the coastal zone. A case study.

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Presented long-term study had been carried out at the coastal zone of the eastern Gulf of Finland, Baltic Sea, which is suffered by mass development of green opportunistic macroalgae *Cladophora glomerata* (L.) Kutz. and Ulva, which morphologically was identified as *U. intestinalis* L. We analyzed the long-term data on the biomass dynamics of opportunistic macroalgae. The factors regulating the biomass accumulation as well as its consequences were defined. Analysis of sediment contamination by heavy metals allowed to propose the hypothesis that mass development and accumulation of green macroalgae may contribute to accumulation of organic matter, nutrients and associated metals.

Key words: Green tides, Eastern Gulf of Finland, Metal pollution, Ulva, Cladophora

Introduction

Eastern Gulf of Finland, which includes Neva estuary, is a most eastern part of the Baltic Sea. According to landscape features and hydrological conditions it can be divided on an upper part (Neva Bay) and a lower part (inner and outer estuary). Inner estuary can be regarded as an transition zone where condition changes from freshwater to brackish water. Outer estuary includes shallow brackish-water area and eastern deep-water area (Ostov, 1971). City of Saint Petersburg which is located on the shore of the eastern Gulf of Finland, as well as intense shipping, construction of new ports and engineering works have caused high anthropogenic pressure on the estuary. According to the results of BASE Project, annual nutrient loading coming to the eastern Gulf of Finland with water of the Neva River is 2,700 t for total phosphorus and 63,000 t for total nitrogen (Korzun et al. 2014). High anthropogenic impact causes intense eutrophication and pollution of the area (Rybalko and Fedorova, 2008; Telesh et al., 2008; Golubkov et al., 2017). Results of our previous surveys in this area allowed to propose the hypothesis that mass development and accumulation of green macroalgae may contribute to accumulation of organic matter, nutrients and associated metals.

Material and methods

Our study has been carried out in 2014, 2016 and 2017 at permanent monitoring sites along northern and southern shorelines of the Gulf of Finland between the latitudes 59°49' and 60°00′

N and the longitudes 28°36' and 30°08′ E. (Fig.1). We have chosen the sampling sites in both upper and lower parts of the Neva estuary.

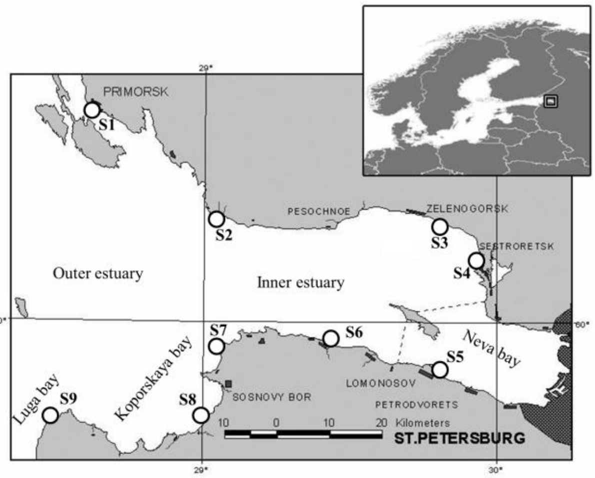

Figure 1. Location of the sampling sites (white circles) in the eastern Gulf of Finland.

Samples of both surface sediments and macroalgae were taken at a depth of 0.5 m in July 2014, 2016 and 2017. In 2016 and 2017 on the sites with regular accumulation of decomposing algal biomass (S7 and S8) we have taken two sets of the samples - under algal layer and in “clean” areas which were free of algae. Sediments for chemical analysis were collected with a plastic cylinder and placed in polyethylene bags. Attached filamentous algae on hard substrata were sampled in triplicate, using a cylindrical metal frame with area of $0.03m^2$, according to the previously proposed approach (Berezina et al., 2005). In 2017 we took the samples of algae *Cladophora glomerata* (L.) Kutz (sites S6, S7, S9), *Ulva intestinalis* L. (S7) and *Fucus vesiculosus* L. (S9) on the analysis of the metal content in the biomass. All these samples were transported on ice to the laboratory for further analysis. For metal analysis all the samples were oven dried at 60 °C, and a 1 mm fraction was separated with a sieve. The passing fraction was powdered with an agate mortar, and digested using a combination of ultrapure acids $HCl/HF/HNO_3$ (1:1:1) in a microwave oven Mars 5 (CEM, USA). Products of digestion were transferred to polypropylene vials, diluted to 50 ml with deionized water (grade 1 according to ISO 3696), and stored at −20 °C until analysis. Samples were analyzed for Cu, Zn, Pb, Cd, Fe and Mn by using inductively coupled plasma mass spectrometry (ICP-MS) with a mass spectrometer Agilent 7700x (Agilent technologies, Japan) (Karandashev et al., 2008). Accuracy was controlled by the use of certified standard (CRM 5365-90) and provided suitable recoveries (<5%).

Results and Discussion

Studied area is suffered by massive macroalgal blooms during the last two decades (Bäck et al., 2002; Gubelit, 2015). We analyzed the long-term data on the biomass dynamics of opportunistic macroalgae. The factors regulating the biomass accumulation as well as its consequences were defined. Our study has shown that in 2014-2015 the biomass dispersion and its maximum had increased at site S1 (Primorsk), however ANOVA didn’t show significant difference. Nevertheless in 2014-2015 the macroalgal biomass exceeded 1200 $gDWm^{-2}$, when in previous years (2004-2011) it was not higher than 500 $gDWm^{-2}$. On the other sites of the southern shore sharp rise of the biomass was registered in 2016. In Koporskaya bay biomass on the depht 0.5 m varied from 1129±522 (S8; Sisto-Palkino) up to 4630±1506 gDWm-2 (S7; Grafskaya bay) when in previous years the biomass on these two sites did not exceed 718±405 and 500±180 $gDWm^{-2}$ respectively. Traces of hypoxic conditions had a presence in Primorsk under thick layer (until 20 cm) of alive macroalgae. In Koporskaya bay conditions of hypoxia varied from strong, caused by mass of decaying algae near the shore, to the traces under the scattered and unconsolidated alive algal biomass with areas of clean bottom. At the second monitoring site in Koporskaya Bay (Grafskaya Bay) we had observed conditions of strong hypoxia with thick (30cm) continuous layer of decaying macroalgae that had created some difficulties for quantitative assessment of the algal biomass at this site. Since statistical analysis shown significant correlations between algal biomass and climatic factors (wind speed, air temperature, NAO – index) we have proposed that, besides of anthropogenic impact, the rise of macroalgal biomass at all these studied sites may be caused by climatic factors. This assumption requires confirmation by further observations. Long-term observations together with investigation of concentrations of metals in surface sediments, macroalgal biomass and water in the coastal zone, allowed to define negative consequences of macroalgal blooms. As a rule, in the published literature about "green tides" the main recorded consequences are substitution of perennial algal species, hypoxia, mass mortality and migration of benthic animals, accumulation enterobacteria in algal biomass (Valiela et al. 1997; Berger et al. 2003, etc.). All these consequences were also confirmed for the eastern Gulf of Finland (Gubelit & Vainschtein, 2011). Our recent study also confirmed a high degree of metal bioaccumulation in macroalgal biomass (Table 1).

Table 1. Metal content (mg kg^{-1}) in biomass of various algal species from the eastern Gulf of Finland in 2017

Species	***C. glomerata***			***U. intestinalis***	***F. vesiculosus***
Site	**S6**	**S7**	**S9**	**S7**	**S9**
Cu	9.56±0.56*	13.21±1.98*	3.37±0.67*	5.43±0.54*	4.61±0.54
Zn	41.7±2.45	53.23±10.64	7.64±1.61*	17.51±2.62*	90.81±7.26*
Cd	0.21±0.09	0.21±0.05	0.09±0.05	0.12±0.03	3.46±0.96*
Pb	17.27±1.74	19.30±3.09	1.36±0.21*	3.14±0.63*	1.12±0.13

Note: * - significant difference at p <0.05

Since the coastal eutrophication is significant problem for the eastern Gulf of Finland, the mass development of these algae in the coastal area may contribute to accumulation of organic matter, nutrients and associated metals. On the other hand decomposition of this biomass may promote anoxic conditions and contribute to remobilization of adsorbed metals. In our study the highest metal concentrations in sediments were found at sites with dense and continuous layer of fresh or decaying macroalgal biomass accompanied by hypoxic conditions (Table 1). Highest metal concentrations under algal mats were registered in 2016, when algal biomass had been extremely high.

Table 1. Metal content (mg kg^{-1}) in surface sediments under algal mats (1) and sediments, which are free of algal cover (2).

Metal		Cu		Zn		Cd		Pb	
Site	Year	1	2	1	2	1	2	1	2
S7	2017	5.23±0.89	4.22±0.09	32.3±3.45	25.4±0.44	0.08±0.02	0.037±0.004	17.71±2.08	13.8±0.4
S8	2016	14.5±0.97	12.97±0.25	**61.8±5.45***	16.33±0.45	**0.11±0.01***	0.057±0.005	**11.46±0.8***	6.22±0.34
	2017	3.01±0.3	2.34±0.04	**11.44±1.02***	8.13±0.08	**0.096±0.009***	0.047±0.004	8.05±0.57	9.47±0.25

Note: * - significant difference at p <0.05

As can be seen from the Table 2, in the most cases the metal concentrations under sediments covered by algae had been higher than in "clean" sediments. Also we found out significant difference in Zn, Cd and Pb concentrations in these two types of sediments. Thus, our data are in agreement with the hypothesis about influence of algal mats on contamination of sediments.

In recent years so-called "green tides" has become a widespread phenomenon, reaching a great scale. Thick layer of opportunistic macroalgae may cover hectares of the coastal area of seas and lakes (Smetachek and Zingone, 2013). In view of this large-scale problem there is a need in further and more detailed studies of the effect of accumulated algal biomass on biogeochemistry and health of the coastal ecosystems.

References

Bäck S., Lehvo A. & Blomster J. 2000. Mass occurrence of the unattached Enteromorpha interstinalis on the Finnish Baltic coast. Annales Botanici Fennici 37: 155-161.

Berger R., Henriksson E., Kautsky L. & Malm T. (2003) Effects of filamentous algae and deposited matter on the survival of Fucus vesiculosus L. germlings in the Baltic Sea. Aquatic Ecology 37: 1–11

Golubkov S.M., Berezina N. A., Gubelit Yu. I., Demchuk A. S., Golubkov M.S. &Tiunov A. V. 2018. A relative contribution of carbon from green tide algae Cladophora glomerata and Ulva intestinalis in the coastal food webs in the Neva Estuary (Baltic Sea). Marine Pollution Bulletin 126: 43–50.

Gubelit Yu. I. & Vainshtein M.B. 2011. Growth of Enterobacteria on Algal Mats in the Eastern Part of the Gulf of Finland. Inland Water Biology. 4(2):132–136.

Karandashev, V.K., Turanov, A.N., Orlova, T.A., Lezhnev, A.E., Nosenko, S.V., Zolotareva, N.I., & Moskvitina, I.R. 2008. Use of the inductively coupled plasma mass spectrometry for element analysis of environmental objects. Inorg. Mater. 44 (14): 1491–1500.

Korzun A, Nagornova N, Oblomkova N, Saukkoriipi J & Salminen E. 2014. HELCOM 2014, BASE project 2012-2014: Assessment and quantification of nutrient loads to the Baltic Sea from Leningrad Oblast and transboundary rivers, and the evaluation of their sources. Baltic Marine Environment Protection Commission HELCOM. 126 pp.

Ostov, I. M., 1971. Characteristic Peculiarities of the Hydrological and Hydrochemical Regime as the Basis of its Exploitation by the Fish Industry. Biological and Fish Industry Resources of the Gulf of Finland, Leningrad:18–45 (in Russian).

Rybalko, A.E. & Fedorova, N.K., 2008. Bottom sediments of the Neva estuary and its contamination under influence of anthropogenic processes. In: Alimov, A.F., Golubkov, S.M. (Eds.), Ecosystem of the Neva Estuary: Biological Diversity and Ecological Problems. KMK, St. Petersburg—Moscow, pp. 39–58 (in Russian).

Smetacek V. & Zingone A. 2013. Green and golden seaweed tides on the rise. Nature 504: 84-88.

Telesh, I.V., Golubkov, S.M. & Alimov A.F., 2008. The Neva Estuary ecosystem. In: Schiewer, U. (Ed.), Ecology of Baltic Coastal Waters. 197. Springer-Verlag, Berlin, Heidelberg, pp. 259–284 Ecological Studies.

Valiela I., McClelland J., Hauxwell J., Behr P.J., Hersh D. & Foreman K. 1997. Macroalgal blooms in shallow estuaries: Controls and ecophysiological and ecosystem consequences. Limnology and Oceanography 42: 1105-1118.

ORAL PRESENTATION

Bowed Down In a Sea of Troubles: The Role of Recreational Boats in the Spread of Alien Species in the Mediterranean Sea

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Despite the Mediterranean being both a hotspot for recreational boating and for non-indigenous species (NIS), no data currently exists on the recreational boating sector's contribution to the spread of NIS in the Mediterranean. To provide recommendations to reduce further introductions and spreading, a wide-scale sampling study on the biofouling communities of recreational vessels and recreational marinas was undertaken surveying over 600 boat owners and sampling their boat hulls for NIS in 25 marinas across the Mediterranean, from France to Turkey, to determine which factors (i.e., boat characteristics, travelling behaviour, home marina) drive higher NIS richness on boat-hulls.
The data revealed that Mediterranean recreational vessels travel considerably, averaging 67 travel days and 7.5 visited marinas per annum, resulting in a high potential for spreading NIS, especially as 71% of sampled vessels host at least one (and up to even 11) NIS. Boats with high NIS richness strongly correlated to marinas with high NIS richness. The presence of biofouling in niche areas of the hull (i.e., in the cavities and metallic parts) was the strongest predictor for NIS richness on the hulls along with longer elapsed times since their last cleaning and antifouling applications. Interestingly, colonization of NIS was shown to rapidly occur on boats which recently had their hulls professionally cleaned. We hereby warn that boats moored particularly in the Eastern Mediterranean region pose a higher risk of spreading NIS due to hosting more NIS in general and more cases of new NIS either on boats or in the marinas. To inhibit further introductions and spreading of NIS within the basin, routine marina monitoring for new NIS and pontoon cleaning is recommended for marinas, and a preliminary screening is recommended for incoming vessels. In addition, a visible fouling estimate of niche areas either by camera or snorkelling would help to determine if they require either a power washing/quarantine solution to ensure they are free of NIS.

Keywords: NIS, niche areas, non-indigenous species, Mediterranean, recreational boating, vector, Suez Canal

Quantity and types of microplastics in the the tissues of the spiny oysters *Spondylus spinosus* Schreibers, 1793 (Mollusca, Bivalvia) in the Yumurtalık Bight (Iskenderun Bay, The northeastern coast of Levatine Sea)

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In this study, microplastics in spiny oysters (*S. spinosus*) in the Yumurtalık Bight (Iskenderun Bay, The northeastern coast of Levatine Sea) were investigated. As a result, microplastics were detected in all oyster samples. The number of microplastics were found between from 1.8 to 2.6 items per individual and 1.8 to 2.1 particles per gr. Three types of microplastics, including fiber, fragment and film, were detected in the soft tissues. Size of microplastics ranged between 0.01 to 5.2 mm.

Keywords: Plastic pollution, Public Awareness, Plastic Consumption, *Spondylus spinosus*

Introduction

Microplastic pollution has become an important problem in the world oceans and seas in the past years (Andrady, 2011). Mostly, microplastics, defined as plastic materials or fragments <5 mm. It was estimated more than 5 trillion plastic pieces in the world's oceans (Eriksen et al., 2014). The quantities of microplastics will inevitably increase due to the degradation of large, single plastic items, ultimately breaking down into millions of microplastic pieces and or originate from cosmetics and synthetic fabrics (Andrady, 2011; Cole et al., 2011; Cozar et al., 2014). These microplastics have been frequently detected in seawater, sediments, biota, and even in polar ice (Auta et al., 2017, Gundogdu and Çevik, 2017). A wide range of marine organisms from invertebrates to fish could ingest the small and ubiquitous plastic particles, microplastics (Wright et al., 2013). Especially those bivalves that filter large volume of water for food are likely to be affected by microplastic pollution.

In this study, we conducted an investigation of microplastic pollution in the tissues of the spiny oysters (*S. spinosus*) in the Yumurtalık Bight (Iskenderun Bay, The northeastern coast of Levatine Sea).

Material and Methods

Study Area and Collection of Samples

Samples of *S. spinosus* were collected at November 2018 (except February) from Yumurtalik Bight (Fig. 1). Specimens were collected with a scuba diving activity at 0-20m depths. During the collection of samples, the number of individuals was limited to 30 because of the high impact of habitat destruction.

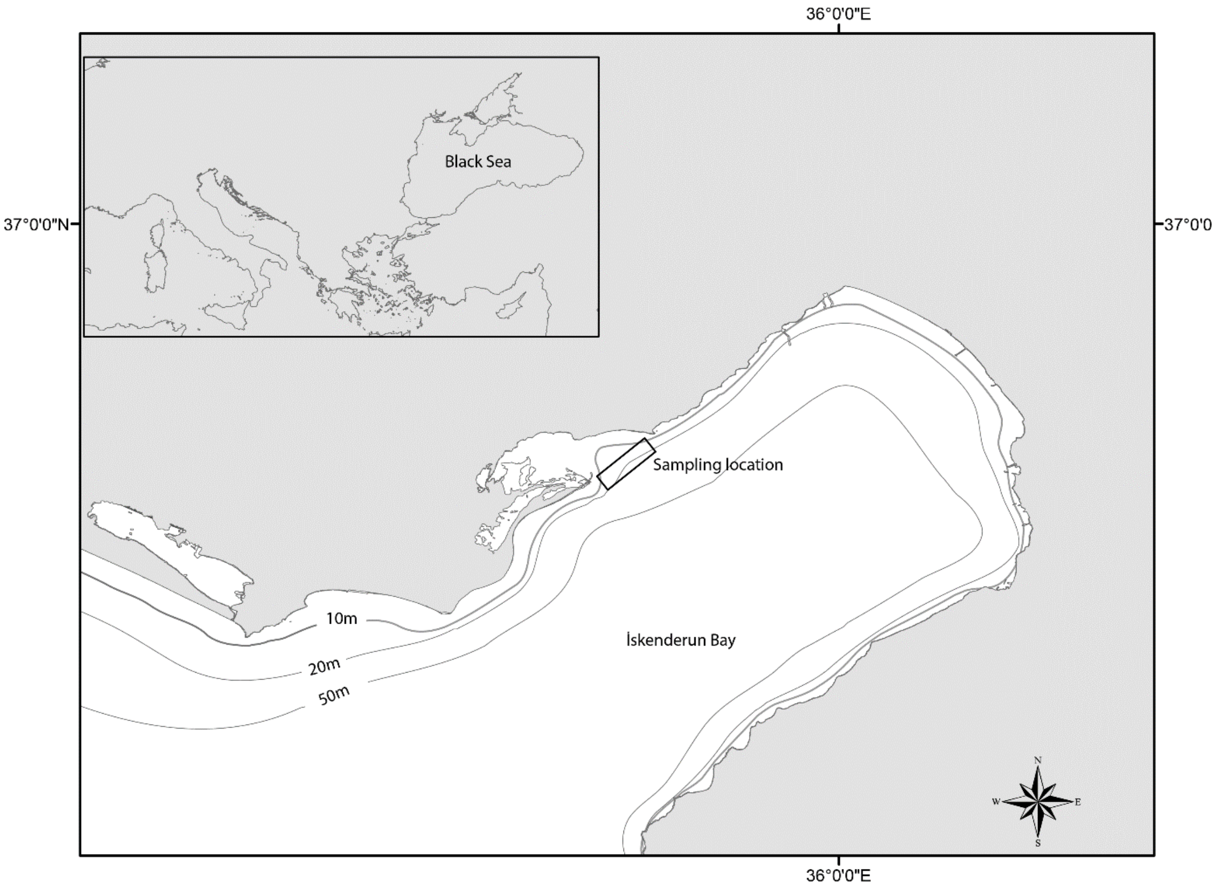

Fig. 1. Study Area

Analyzing of Samples

Shell width and shell length of individuals was measured using a vernier caliper. The soft tissue was removed from the shell and weighted (wet weight) with a microbalance. Each of ten individuals were combined as a replicate and three replicates were prepared. The digestion, separation and collection of microplastics from oysters were conducted by an amended protocol (Enders et al. 2017). In brief, the soft tissues were treated with a diluted version (30%) of the 1:1 KOH:NaClO mixture. After complete digestion, approximately 800ml of Nal (1.8 gr/ml) solution was added to each bottle to float the microplastics. After 24 h of floatation at room temperature, the overlying water was vacuum filtered through a 20 mm pore size, 47mm diameter filter. Each filter was placed into a clean glass petri dish with a cover for observation under a stereoscopic microscope with a digital camera (Olympus, SZX16). The numbers, sizes and shapes of microplastics on filters were identified and recorded.

Results

Microplastics were detected in all oyster samples collected from the Yumurtalık Bight (Fig. 2). The abundance of microplastics ranged from 1.8 to 2.6 items per individual. Three types of microplastic shape, including fiber, fragment and film, were detected in the soft tissues of examined oysters (Table 1; Fig. 3). Size of microplastics ranged from 0.01 to 5.2 mm.

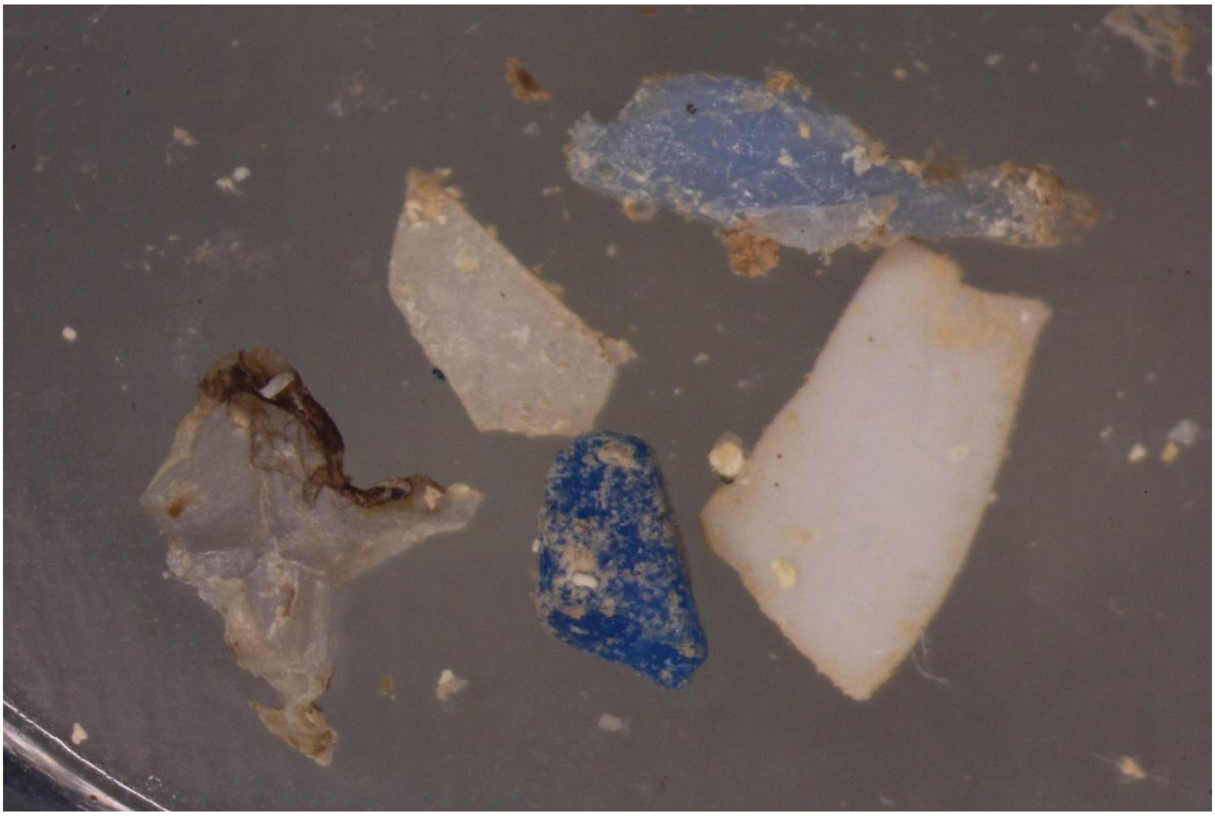

Fig. 2. Extracted Microplastics from soft tissue of *S.spinosus*

Table 1. Type of microplastics and their size.

		Size			
		Mean	**Standard Error of Mean**	**Minimum**	**Maximum**
Type	**Fibril**	2.1	0.3	0.1	5.2
	Film	2.0	0.3	0.01	3.8
	Fragment	1.8	0.3	0.1	4.3

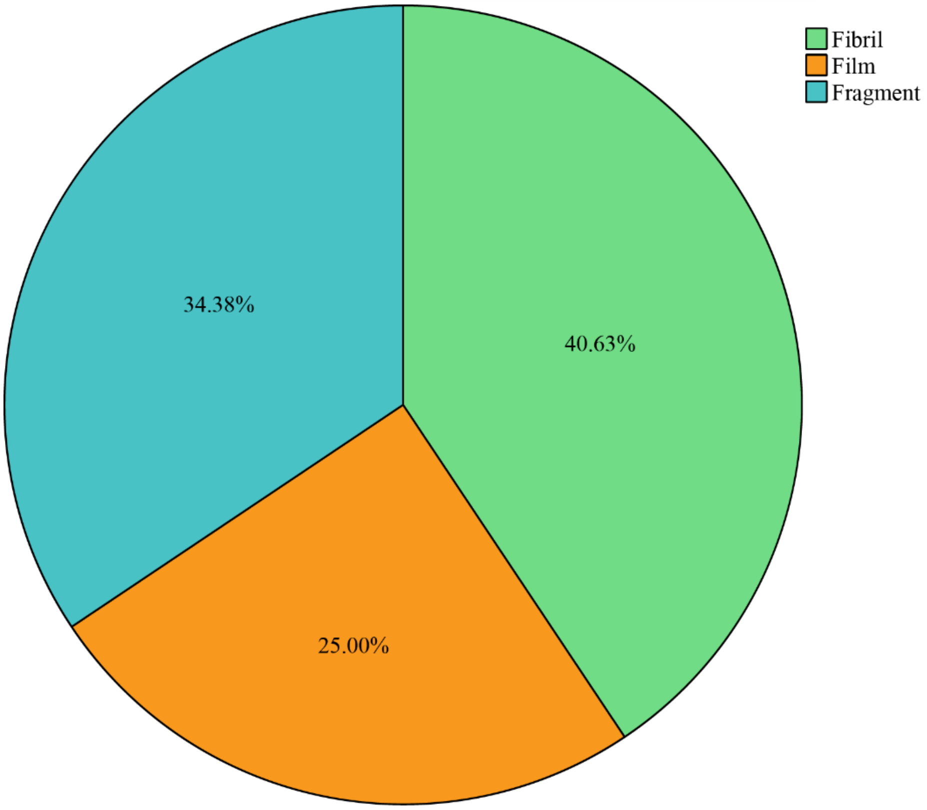

Fig. 3. Proportion of types of detected microplastics

Discussion

This is the first study conducted in the Turkish coasts on microplastics pollution in spiny oyster (*S. spinosus*). As a result, microplastisc were found in all samples.

As it can be seen Table 2, the amount of microplastics in *S. spinosus* in this study is different than those other studies conducted on diffeens species of Bivalvia.

Table 2. A comparison of the results found in this study and other studies regarding the microplastic pollution in different species of Bivalvia in different location

Location	Species	Mean microplastics (item/individual)	References
China	*Saccostrea cucullata*	1.4-7.0 items/individual,	Li et al., 2018
China	Bivalves (Nine species)	4.3-57.2 items/ individual,	Li et al., 2015
Canada	*Mytilus edulis*	34-178 items/ individual (~100 items per control)	Mathalon and Hill, 2014
China	*Mytilus edulis*	1.5-7.6 items/ individual,	Li et al., 2016

Compared to other studies performed on microplastics in other species of oysters and mussels, it can be said that the reason for the low amount of microplastics in our study may be due to the amount of microplastic in water. Microplastics in oysters were strongly related to the levels of microplastics in water they live.

Spiny oyster is not yet a commercial specias in Turkey. However, it is collected and eat locally. So in the future this situation can pose serious risks for human health. Since microplastics have the potential to absorb persistent organic pollutants, they can transfer these pollutants into the food chain and pose a serious risk to human health. (Avio et al., 2005; Engler, 2012).

References

Andrady, A. L., 2011. Microplastics in the marine environment. Marine pollution bulletin, 62(8), 1596-1605.

Auta, H. S., Emenike, C. U., & Fauziah, S. H., 2017. Distribution and importance of microplastics in the marine environment: a review of the sources, fate, effects, and potential solutions. Environment international, 102, 165-176.

Avio, C.G., Gorbi, S., Milan, M., Benedetti, M., Fattorini, D., D'Errico, G., Pauletto, M.,Bargelloni, L., Regoli, F., 2015. Pollutants bioavailability and toxicological risk from microplastics to marine mussels. Environ. Pollut. 198, 211-222.

Cole, M., Lindeque, P., Halsband, C., Galloway, T.S., 2011. Microplastics as contaminants in the marine environment: a review. Mar. Pollut. Bull. 62, 2588e2597.

Cózar, A., Echevarría, F., González-Gordillo, J. I., Irigoien, X., Úbeda, B., Hernández-León, S., ... & Fernández-de-Puelles, M. L., 2014. Plastic debris in the open ocean. Proceedings of the National Academy of Sciences, 111(28), 10239-10244.

Engler, R.E., 2012. The complex interaction between marine debris and toxic chemicals in the ocean. Environ. Sci. Technol. 46, 12302-12315.

Eriksen, M., Lebreton, L. C., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., ... & Reisser, J. 2014. Plastic pollution in the world's oceans: more than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. PloS one, 9(12), 111913.

Li, J., Yang, D., Li, L., Jabeen, K., Shi, H., 2015. Microplastics in commercial bivalves from China. Environ. Pollut. 207, 190-195.

Li, J., Qu, X., Su, L., Zhang, W., Yang, D., Kolandhasamy, P., Li, D., Shi, H., 2016. Microplastics in mussels along the coastal waters of China. Environ. Pollut. 214, 177-184.

Li, H. X., Ma, L. S., Lin, L., Ni, Z. X., Xu, X. R., Shi, H. H., & Rittschof, D., 2018. Microplastics in oysters Saccostrea cucullata along the Pearl River Estuary, China. Environmental Pollution, 236, 619-625.Mathalon, A., & Hill, P., 2014. Microplastic fibers in the intertidal ecosystem surrounding Halifax Harbor, Nova Scotia. Marine pollution bulletin, 81(1), 69-79.

Wright, S. L., Thompson, R. C., & Galloway, T. S., 2013. The physical impacts of microplastics on marine organisms: a review. Environmental pollution, 178, 483-492.

Consumer Behaviour of Cephalopod Consumption in Kilis City

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This study was conducted to determine the cephalopod consumption behaviour and preferences of the people living in the city of Kilis. In addition to that people do not know the prices of cephalopods, most of the consumers stated that they consumed other cephalopod species; and the consumption of squid, cuttle fish and octopus were close to each other. The consumers in the area stated that they consumed other species than octopus, squid and cuttlefish. The reason for this is that other species are perceived as fish in the area, and therefore, the “Other” category was determined at the highest level. Most of the consumers (91.7%) stated that they did not consume cuttlefish, although the most consumed fish product was determined to be cuttlefish. They stated that they consumed cephalopods mostly with “Other” cooking methods, and it was determined that they consumed them as boiled at the lowest level. The consumption of cephalopod stocks was decreasing due to pollution, forbidden and excessive fishing.

Keywords: Cephalopod Consumption Habit, Octopus, Squid, Kilis region

Introduction

Present day, in many areas of the world, healthy nutrition has become common; and food choices of consumers are changing from red meat consumption, which has high cholesterol, to white meat consumption in terms of meat preferences. It is important to have the habit of eating other living things except fish in the consumption of fisheries.

Cephalopods are regarded as a highly-evolved class of the invertebrates living in seas. In addition, members of this family are separated from other invertebrate with their sensory organs and large brains. Cephalopods show fairly complex protection, nutrition, reproduction, communication and behavioral characteristics (Roper et al., 1984).

A total of 57 invertebrate species have commercial importance in the waters of Turkey (Doğan et al, 2007). This number increased to 63 with the new exotic species that entered the Mediterranean ecosystem. Aquatic invertebrates are consumed as nutrients all over the world; and 10 species of them, which have commercial value, are fishing in our country (Doğan et al., 2007). Cephalopods have more than 700 species including squid and octopus. All these species are marine, sexually separate and carnivorous. Cephalopods have extremely important commercial values in aquaculture sector. The fauna of the cephalopods is represented with 61 species in the Mediterranean Sea. A great part of this number consists of the species of Atlantic-origin. When the distribution of these species is considered, it is seen that 59 species are in Western Mediterranean, 38 species in the Adriatic, and 50 species in Eastern Mediterranean (Öztürk et al., 2014). They are catched because they constitute an important nutrient element and have high commercial value. Approximately 25 of the species in the Mediterranean find purchasers in the market. Some of these species are *O. vulgaris*, *L. vulgaris* and *S. officinalis* are catched intensely (Erdem et al., 2010). Studies conducted on the consumption of cephalopods are very few in Turkey, and most of them are conducted on fish consumption.

With the present study, despite its importance for public health, it was aimed to investigate how the information on income level, education level, fish species, reliability (having no health risks) method of cooking and the price of cephalopods, which are consumed in a limited amount due to economic conditions and consumer habits in Turkey, affect the cephalopod consumption and purchasing behaviors of individuals.

Material and Methods

In the present study, Kilis city center and Musabeyli, Polateli and Elbeyli districts were chosen as the study area. According to the census of 2017, the population of Kilis was determined as 136.319; this amount is the population of three districts together with all the villages. The population of the central district of Kilis was 112.553, Musabeyli was 13251, Elbeyli was 5325, Polateli was 5190 (Anonymous, 2018). When the sampling volume was computed, it was accepted as 510; and 410 sampling should be taken from Kilis city center, 50 from Musabeyli, 25 from Elbeyli and 25 from Polateli districts. Since the present study was conducted only in the centers, the total sampling volume for other settlement units was accepted to be 510. A total of 510 consumers were selected randomly for each dimension, and face-to-face interview technique was employed. The data that were obtained with the Questioning Method were analyzed with the EXCEL package program in computer medium; and it was questioned whether there were significant differences between the determined characteristics (Anonymous, 1993). In addition, the relation between education and income level and the amount of consumed meat was also determined.

Results

The age, profession and income levels of the 510 consumers, who were included in the present study, were determined. A total of 39% of the individuals living in Kilis were below 21 years of age, 25% were between the ages of 21-30, 16% are between the ages of 31-40, 10% are between the ages of 41-50, 6% were between 51-60, and 3% were between the ages of 61 and over (Fig 1).

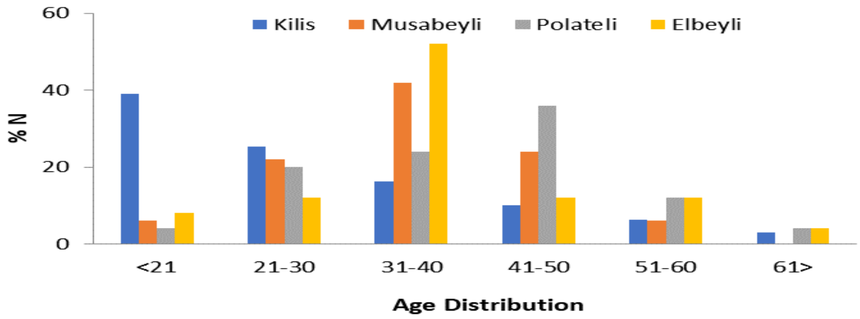

Figure 1. Age distribution of the consumers.

It was determined that 16%, 40%, 16%, 32% of the participants were at primary education; 24%, 32%, 24%, 32% were at high school; 34%, 8%, 8%, 8% were at foundation degree level, and 18% and 8% were at undergraduate level in Kilis, Musabeyli, Polateli and Elbeyli, respectively (no undergraduate level participants were interviewed in Musabeyli and Polateli). A total of 4% of the participants stated that they were studying at post-graduate level (no post-graduate participants were interviewed in Musabeyli, Polateli and Elbeyli); and 4%, 20%, 52% and 20% of the participants stated that they were illiterate (Fig 2).

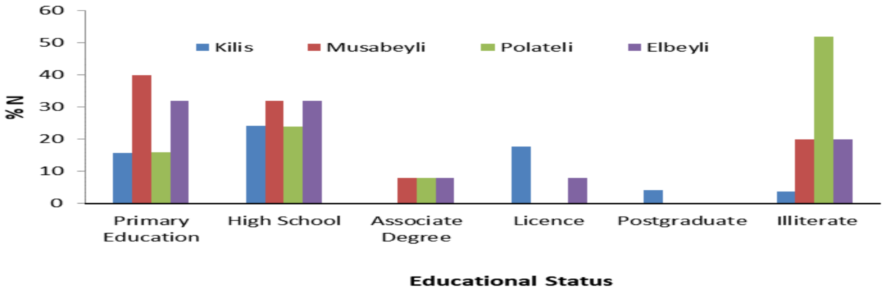

Figure 2. Educational Status of the consumers.

The consumers were determined to be self-employed in Kilis, Musabeyli, Polateli and Elbeyli regions at a rate of 15%, 22% and 4%, respectively (no self-employed groups were interviewed in Polateli); 12%, 2%, and 4% were civil servants (no civil servant groups were interviewed in Polateli); 13%, 47%, 36% and 56% were employees; 9%, 6%, 32% and 16% were retired, 41%, 8%, 4%, 8% were students and 10%, 16%, 28% and 12% were housewives. As a result of the questionnaires, it was determined that the income levels of the regions where employees and retirees lived were distributed between 1001-3001. The consumers stated that the prices of the cephalopods were cheap only in Kilis at a rate of 11.4% (no interviews were made with relevant people in Musabeyli, Polateli and Elbeyli), 20.09% stated that the prices were normal (no interviews were made with relevant people in Musabeyli, Polateli and Elbeyli); 15.38% and 4% in Kilis and Musabeyli stated that the prices were expensive (no interviews were made with relevant people in Polateli and Elbeyli) and 53.10%, 96%, 100% and 100% in Kilis, Musabeyli, Polateli and Elbeyli, respectively, stated that they did not know the prices of the cephalopods. It was determined that most of consumers consumed cephalopods with “Other” cooking methods, and very few consumed them by boiling. A total of 27.8%, 4% and 4% of the consumers, respectively, interviewed in Kilis, Musabeyli, Polateli and Elbeyli stated that they fried the cephalopods (no groups that preferred to fry the cephalopod were interviewed in Elbeyli), 7.6% of the consumers stated that they consumed the cephalopods as grilled (no groups that preferred to grill the cephalopod were interviewed in Musabeyli, Polateli and Elbeyli), 17.6% and 2% of them consumed the cephalopod by baking in oven, (no groups that preferred to bake the cephalopod in oven were interviewed in Polateli and Elbeyli), 42.09%, 94%, 96% and 100% of the consumers stated that the consumed the cephalopod by cooking with “Other” methods, and 4.84% preferred to consume the cephalopod by boiling (no groups that preferred to boil the cephalopod were interviewed in Musabeyli, Polateli and Elbeyli) (Fig 3).

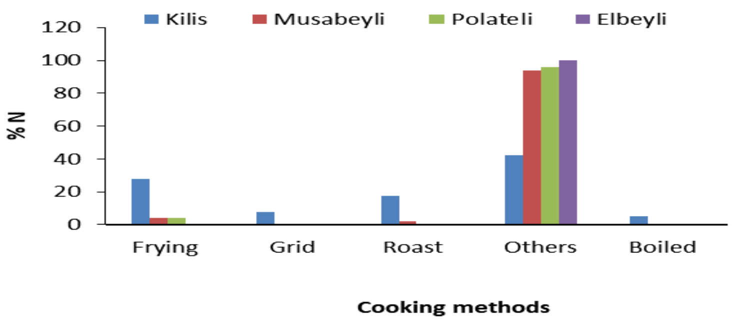

Figure 3. Consumers’s cooking methods for Cephalopods.

Most of consumption styles of the cephalopods by the consumers (87.73%) were as “Other” cooking methods. The consumers share a common opinion that cephalopod stocks were decreasing due to pollution, prohibited and excessive fishing.

The meat preferences of the consumers living in Kilis, Musabeyli, Polateli and Elbeyli were as fish at a rate of 18%, 12%, 8% (no participants who preferred fish were interviewed in Polateli), 55%, 20%, 56%, 8% preferred red meat, 24%, 68%, 44%, 84% preferred white meat. As the result of the questionnaire, the least preferred was determined to be crustacea at a rate of 3%, and only those who preferred crustacea were interviewed in Kilis.

It was determined in the region that the preferences of the consumers for cephalopods were close to each other. The consumers preferred octopus at a rate of 15.97% and 2%, respectively, in Kilis, Musabeyli, Polateli and Elbeyli (none in Elbeyli); cuttlefish with 22%, 4% and 8% (none in Elbeyli); squid with 19.32%, 4% and 4% (none in Elbeyli); and other cephalopod species with 42.5%, 90%, 88% and 100% (Fig. 4). A total of 20% and 2% in Kilis and Musabeyli respectively, of the consumers stated that their reason of preference for cephalopods were taste and freshness (none in Polateli and Elbeyli); 14.28% stated "economical concern" was the reason (none in Musabeyli, Polateli and Elbeyli), 18.54%, 8% and 8% stated that "difference" was the reason (none in Elbeyli); 35.58%, 86%, 84%, 76% of them did not share their viewpoints; and 11.52%, 4%, 8%, 24% preferred the "Other" criteria.

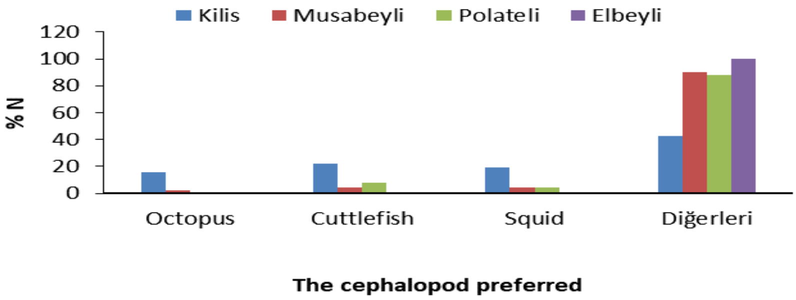

Figure 4. The cephalopod preferred.

A total of 8.52% of the consumers stated that they purchased cephalopods daily only in Kilis, and no consumers stated that they purchased cephalopods in other regions. Most of the consumers (91.7%) stated that they provided cephalopods free of charge from amateur fishermen, who were their friends; 20.20%, 2%, 4% of them stated that they preferred cuttlefish for being delicious in Kilis, Musabeyli and Polateli and Elbeyli (none in Elbeyli); 14.83% for being fresh (none in Musabeyli, Polateli and Elbeyli); 9.71% and 4% for being cheap (none in Musabeyli and Elbeyli); and 39.64%, 96%, 92%, 100% did not state any viewpoints (Fig 5).

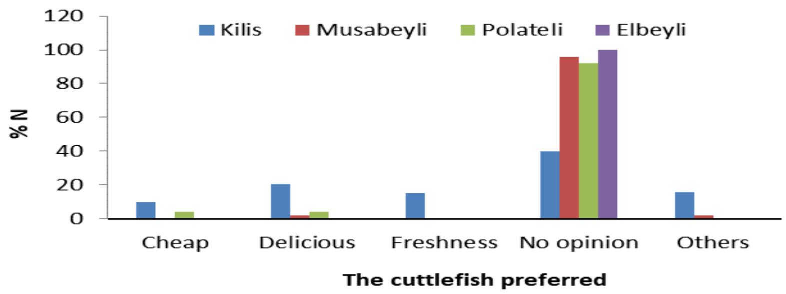

Figure 5. Preferred reasons of the cuttlefish.

Discussion

There are no direct studies in Turkey conducted on the consumption of cephalopods. The present study was conducted to examine the consumption habits in the city of Kilis and its districts. In present day, people care much for balanced and healthy nutrition, and cephalopods are luxurious and quality food. In the city of Kilis where even the fish consumption rates are blow the average rates of Turkey, it was understood that very few amounts of cephalopods were consumed; and the present study is important in that it is the first study conducted on cephalopod consumption. An important part of the consumers who were interviewed was in the employee group. It was determined that the consumers were mostly distributed in the income class between 1001-3001 Turkish Liras. In the study area, it was determined that the consumers stated that the prices of fish were expensive. In the light of these data, it should be considered normal that fisheries are consumed in limited amounts because they are economically more expensive. These data that were obtained in the present study provide us with important results in terms of comparing the habits of consumers living between coastal cities and rural cities. The present study provides pioneering data for the purpose of raising public awareness and diversity on healthy food habits parallel with the present study.

References

Anonim, 1993. SPSS for Windoes Advanced Statistics Release 6.0., 578 s.

Anonim, 2018. Adrese Dayalı Nüfus Kayıt Sistemi Sonuçları.

Doğan, A., Dağlı, E., Özcan, T., Bakır, K., Ergen, Z., Önen, M. & T. Katağan 2007. Commercially important invertebrates inhabiting the Turkish seas. Türk Sucul Yaşam Dergisi 3-5(5-8): 36 44 (in Turkish).

Erdem, Ü., Başusta, N., Türeli, C. & Duysak, Ö. 2010. Su Omurgasızları. Ankara Nobel Yayın Dağıtım. 3. Baskı. s.273.

Öztürk, B., Doğan, A., Bakır, B. B. & Salman, A. 2014. Marine Molluscs of The Turkish coasts: an updated checklist. Turkish Journal of Zoology, 38(6), 832-879.

Roper, C, F, E., Sweeney, M, J. & Nauen, C. 1984. Cephalopods of the world, An annotated and illustrated catalogue of species of interest to fisheries. *FAO Fish. Synop,* 4 (3) 125-277.

Evaluating for Turkey Fisheries and Aquaculture Import and Export

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Turkey is a very rich country in terms of fisheries and aquaculture industry has been growing every passing day comes to further stages. As a result, exports were 14533 tons and $ 46 million in the year 2000 and reached 156681 tons and $ 854 million in 2017, respectively. In addition, while the imports of 44230 tons and $ 36 million in 2000 years, and reached 100444 tons and $ 230 million in 2017, respectively. In other words, an increase in both is observed. In this study; It is aimed to estimate the quantity and value of the Import and Export for the year 2030 with the help of the least squares method in time series analysis. For this purpose 18 year TUIK utilizing the Turkey's fisheries import and export statistical modeling was performed. According to the export model results obtained by using the time series, a linear and exponential model was obtained according to the years in the quantity and value of exports, and the percentage of explanations according to the obtained models is 93.5% and 97.7% respectively. According to the result of the analysis, it is expected that the export value will be about 148 million USD while the export amount is 825 thousand tons in 2030. A exponential and quadratic model was obtained for the amount and value of Import, and the percentiles were 94.1% and 77.1%, respectively. Besides, it is expected that the amount of import is about $ 31 million while it is 148 thousand tons. Imports of products made in Turkey are proposed to be brought to levels that can be met.

Anahtar Kelimeler: Turkey, Fisheries, Aquaculture, Export, Import

Introduction

Population approaching 80 million, fisheries for Turkey in the field of agriculture and animal husbandry is a success story of recent years.

In particular, aquaculture farms around Mugla and Izmir clustered is the production base of manufacturers and exporters in Turkey.

Sea bream and sea bass produced in these farms and trout produced in fresh water sources in the inner parts are exported to different countries of the world, especially to Europe. Countries in which Turkey's export of aquatic products are as shown in Figure 1.

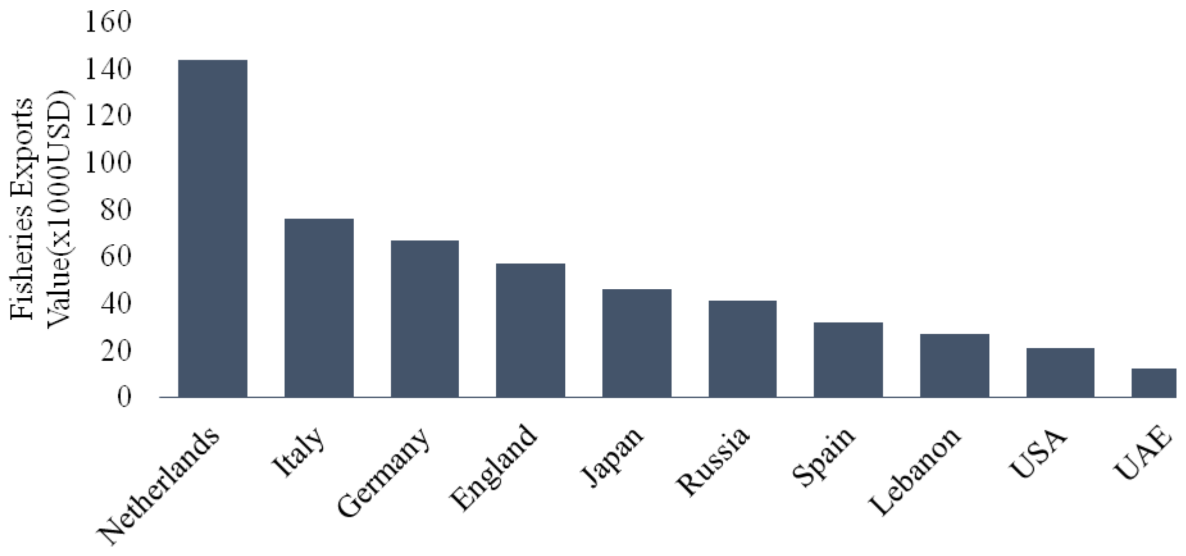

Figure 1. Countries Exported (2015)

Turkey's fisheries shows an increase in imports. In Figure 2, in Turkey in 2015, it is located the countries which have been imported in fisheries and aquaculture.

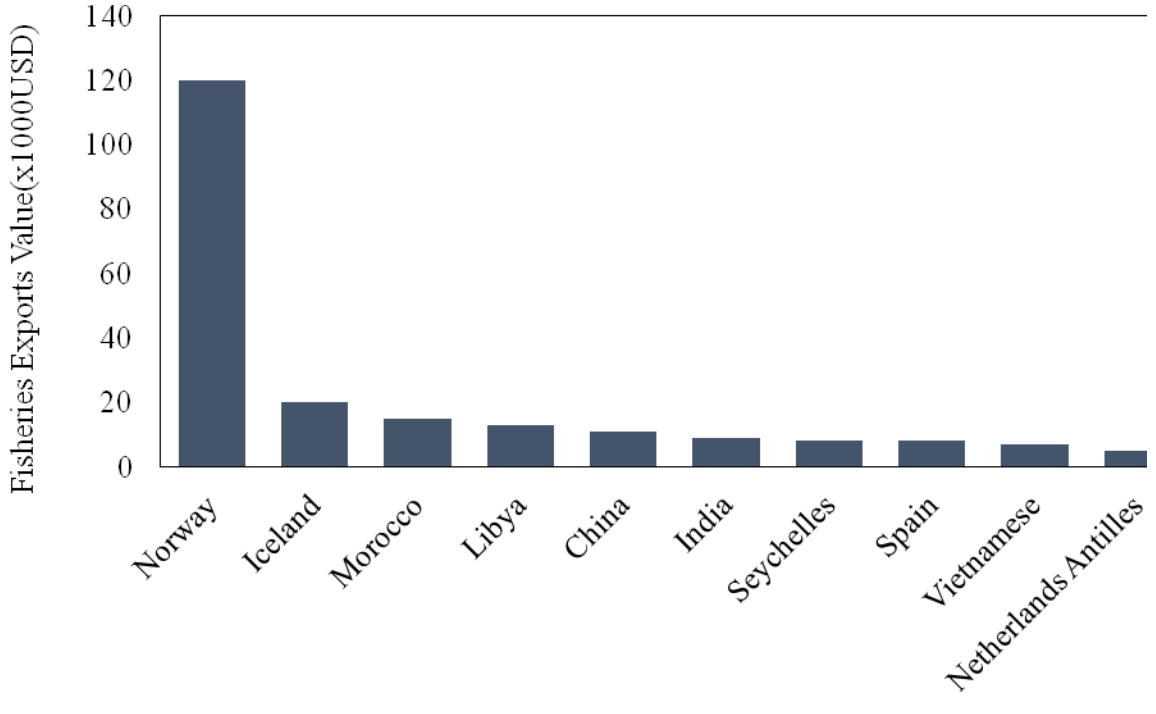

Figure 2. Countries Imported (2015)

In this study, in 2030, Turkey's fisheries were estimated value and quantity of exports and imports. Regression analysis was used for this purpose. Regression analysis is one of the widely used econometric tools in econometric data analysis. In regression models, We need certain estimate realizations. A time series is a set of sorted measurement of related values in time intervals (Maddala and Kim, 2002; Saygı et al., 2011; Saygı and Bayhan, 2011; Saygı and Emiroğlu, 2014). The purpose of time series analysis is to understand the facts represented by the observation set and accurately forecast the future variable values. Turkey is the 30th in total fishery production with a rank the 27th in capture fisheries and 21st in aquaculture production in the world (FAO, 2018). Turkey's fisheries has an important place in the world. Turkey's fisheries export tends to increase continuously (Saygı and Bayhan, 2011).

Material and Methods

Researchers collect, classify and interpret the data to make reliable and realistic decisions in terms of situation assesment and planning. The purpose of this study is to estimate the future of fishery exports and import value. For this, we resorted to the data between 2000 and 2017 taken from Turkish Statistical Institute. Regression analysis was used to create a time series analysis method. IBM SPSS SPSS Statistics version 20 was used for assessment.

Results and Conclusion

We analyzed Turkey's fisheries and aquaculture of the last 18 years with respect to fisheries import and export using regression analysis method. Fort his purpose, we made a regression analysis on time series related to the data of 2000-2017.

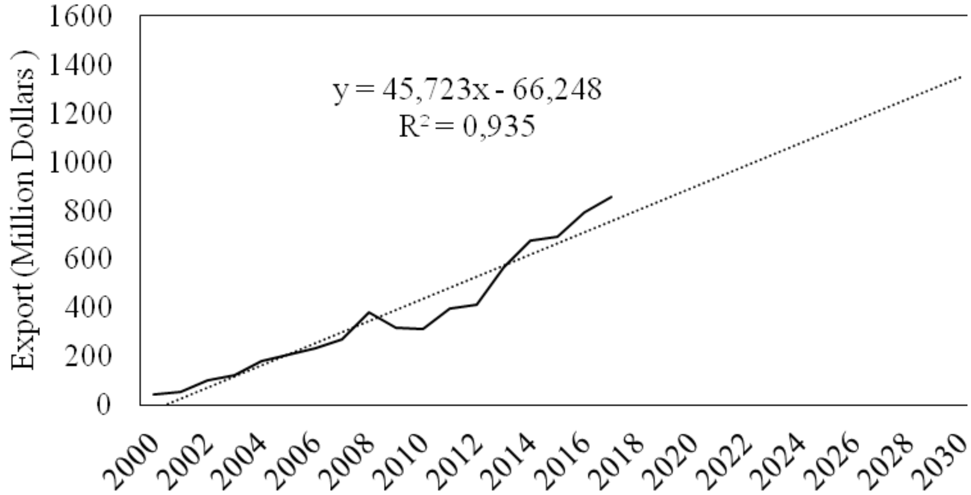

Figure 3. Export Value Forecast (2000-2030)

The model was linear (F=48.473; p<0.05), thus we can say that model is acceptable. Although 93.5 % of the model can be explained with these independent variables, the remaining 6.5% should be explained by other methods. As a result, we can conclude that increase in exports have a great impact of the years in Turkey (Figure 3). Export quantity model was exponential (F=23,542; p<0.05), thus we can say that model is acceptable. Although 97.7% of the model can be explained with these independent variables, the remaining 2.3% should be explained by other methods. As a result, we can conclude that increase in exports have a great impact of the years in Turkey.

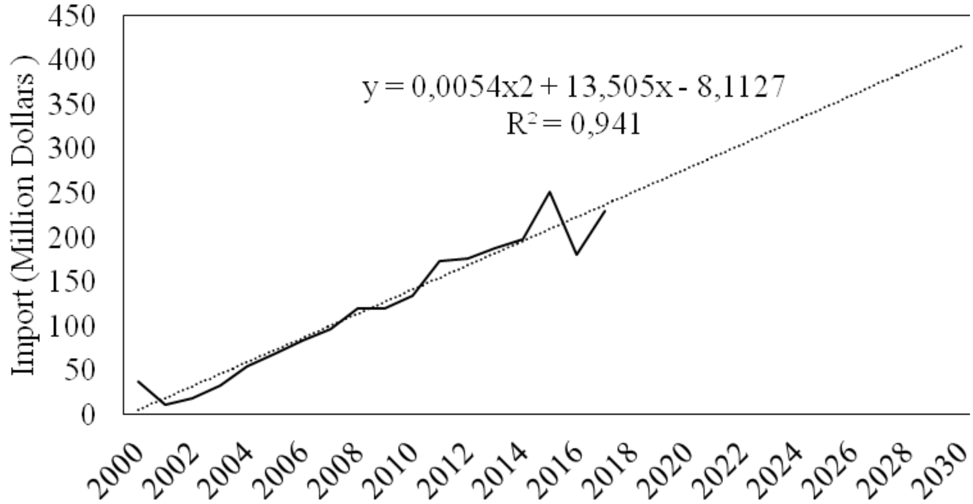

Figure 4. Import Value Forecast (2000-2030)

The model was quadratic (F=72.563; $p<0.05$), thus we can say that model is acceptable. Although 94.1 % of the model can be explained with these independent variables, the remaining 5.9 % should be explained by other methods. As a result, we can conclude that increase in exports have a great impact of the years in Turkey (Figure 4). Export quantity model was exponential (F=54.231; $p<0.05$), thus we can say that model is acceptable. Although 77.1% of the model can be explained with these independent variables, the remaining 22.9% should be explained by other methods. As a result, we can conclude that increase in exports have a great impact of the years in Turkey.

According to results; Turkey exports of fishery products in 2017 was 85 million dollars, according to results made in 2030 estimated to be $ 148 million, is expected at 93.5% reliability. In addition, the export amount is expected to increase from 157 thousand tons to 825 thousand tons respectively. Thus, exported quantity and their value should be increased.

Turkey import of fishery products in 2017 was 23 million dollars, according to results made in 2030 estimated to be $ 31 million, is expected at 94.1% reliability. In addition, the import amount is expected to increase from 100 thousand tons to 148 thousand tons respectively. Thus, imported quantity and their value should be decreased.

References

FAO, 2018, The state of world fisheries and aquaculture. Rome, FAO.15.07.2018.

Maddala GS, Kim Inn-Moo, 2002, Unit Roots, Cointegration and Structural Changes. U.K, Cambridge University Press. 189.

Saygı H, Bayhan B, 2011, Analysisof Turkey’s import demand of fishery products, African Journal of Agricultural Research 6, 1853-1856.

Saygı H, İşgören Emiroğlu D, 2014, Explanation of the Turkish inflation rate with fisheries export and import, Journal of Academic Documents for Fisheries and Aquaculture, 2:63-68.

Saygı H, Kop, A, Bayhan B, 2011, The forecast of the future production amounts of the some fish species being cultivated in Turkey, Kafkas Üniversitesi Veterinerlik Fakültesi Dergisi, 7,13-20.

Types, Ratios and Sizes of Nematocysts in *Phyllorhiza punctata* (von Lendenfeld, 1884)

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Nematocyst types and ratios and their relationships with bell diameters of *Phyllorhiza punctata* were investigated in this study. Totaly fifty one *P. punctata* individuals were sampled by direct observation on the boat and taken by hand net from Sülüngür Lake which is located in Köyceğiz-Dalyan Lagoon System, Muğla, Turkey in September, 2017. Oral arms and margins were seperated from the samples and freezed at -18°. Before counting, samples were thawed, homogenized and centrifuged at +4 for separating nematocysts from tissues. Each nematocyst types were identified, counted and photographed. Length and width ratios of undischarged nematocysts were measured with micrometric ocular. Relationship between number of each nematocyst types and bell diameters were determined by using correlation coefficient. Six nematocyst types which are a-isorhiza, A-isorhiza, O-isorhiza, eurytele, birhopaloid and polyspiras were identified both in margin and oral arms. It was determined that total nematocyst numbers in oral arms were greater than in margins.

Keywords: *Phyllorhiza punctata*, isorhizas, eurytele, birhopaloid, polyspiras, bell diameter, correlation.

Introduction

Cnidocyst is a cellular organelle which secreted by Golgi apparatus (Slautterback and Fawcett, 1959, Slautterback, 1963, Carre, 1972, Carre, 1974, Carre and Carre, 1973, Skaer, 1973, Engel *et al*., 2001, Holstein, 1981). Cnidocysts are divided into two main categories: nematocyst and spirocyst (Weill, 1934). Spirocysts are only found in Anthozoa. There are over thirty types of nematocysts which are used for cupturing prey and defense against predators (Carlgren, 1940,1945; Cutress, 1955; Werner, 1965; Mariscal,1974; Bauillon et al., 1986; Östman, 1983,1997; Rifkin, 1996; Östman and Hymon, 1997; Wiebring *et al.*, 2010).

Nematocyst consists of a protein capsule, a thread and stinging venom (Marino et al., 2007). Nematocysts are found intensely in tentacles, oral arms and margins. It was determined that, nematocyst types have different morphology and different venom contents. Also, different venoms have different effects on organisms such as paralytic, neurotoxic, cytotoxic, dermotoxic (Mariottini and Pane, 2010; Helmholz *et al*., 2011; Endean and Rifkin, 1975; Burnett *et al.*, 1986).

Sutton and Burnett (1969) distinguished at least ten nematocyst types in *Chrysaora hysoscella*. Furthermore, the studies on nematocyst types of *Aurelia aurita* (Calder, 1971; 1977), *Cyanea capillata* (Östman, 1991), *Cyanea lamarckii* (Östman and Hydman, 1997, Östman, 1991), *Pelagia noctiluca* (Avian *et al*.,1991; Marino *et al*., 2007; Marino *et al*., 2008, Mariottini *et al.*, 2008), *Rhopilema nomadica* (Avian *et al*., 1995), *Catostylus mosaicus* ve *Phyllohiza punctata* (Peach and Pitt, 2005) were done. In Turkey, there are two studies of scyphozoa species which are *Cassiopea andromeda* and *Chrysaora hysoscella* (Gülşahin, 2016a; 2016b).

Phyllorhiza punctata is a lessepsien jellyfish was found for the first time in İskenderun Bay in Turkey seas (Çevik *et al.*, 2011). And then, this species was observed in Sülüngür Bay, Köyceğiz-Dalyan lagoon system, Muğla in 2011 (Gülşahin and Tarkan, 2012). It is aimed that nematocyst types and ratios and their relationships with bell diameters of *P. punctata* in this study.

Material and Methods

This study was performed in Sülüngür Lake which is located in Köyceğiz-Dalyan Lagoon System, Muğla, Turkey in September, 2017 (Figure 1). *P. punctata* individuals were sampled by direct observation on the boat and taken by hand net from the lake. Samples were put into conteiners and carried to the Marine Biology Laboratory in Faculty of Fisheries. Bell diameters of the samples were measured by measuring board and wet weights were determined with scales. Oral arms and margins were seperated from the samples and freezed at -18°C. Samples taken from deepfreeze thawed at +4°C before counting and were keeped in the refrigerator for one more day and shaken at one hour intervals. Then, samples were disintegrated in the homogenizer for seperating nematocysts from tissues. Samples taken from homogenizer were santrifuged at +4°C, 5000 rpm for five minutes. Supernatant was removed and residue was observed under the light microscope. One mililiter subsamples were taken from each residue and counted at three repetition. Each nematocyst types were identified, counted and photographed. Nematocyst types identification was done according to Calder (1974) and Östman (2000). Also, length and width ratios of undischarged nematocysts were measured with micrometric ocular. Relationship between number of each nematocyst types and bell diameters were determined by using correlation coefficient.

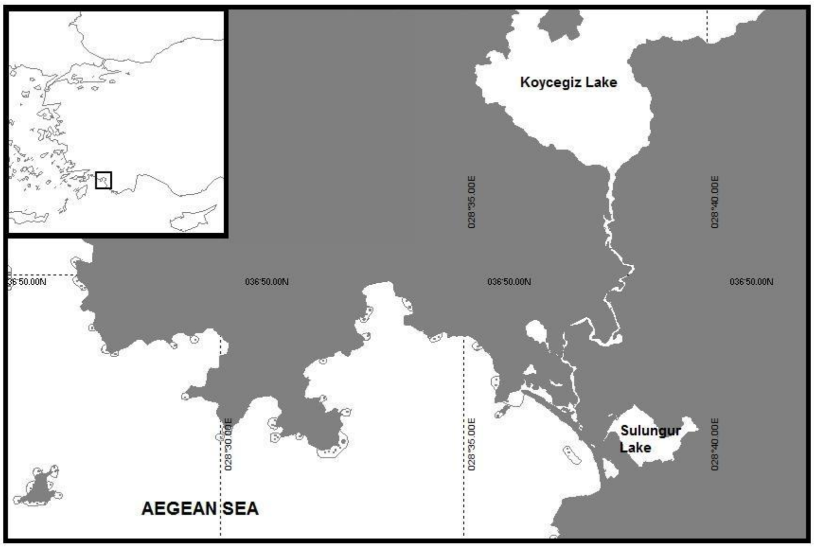

Figure 1. Sampling area (Sülüngür Lake) and Köyceğiz-Dalyan Lagoon System.

Results

Totaly fifty one *P. punctata* specimens were sampled in Sülüngür Lake which is inside of Köyceğiz-Dalyan Lagoon System. Six nematocyst types were identified both in margin and oral arms. These are a-isorhiza, A-isorhiza, O-isorhiza, eurytele, birhopaloid and polyspiras. It was determined that total nematocyst numbers in oral arms were greater than in margins. But, total numbers a-isorhizas, A-isorhizas and polyspiras were more in margin than in oral arms (Figure 2).

In margins of the specimens, eurytele was the most abundant nematocyst type up to 22 cm diameter group. High amount of a-isorhizas were found in 22-25 cm and O-isorhizas were found in 31-34 cm diameter group. Polyspiras and birhopaloids were determined in a few specimens with low numbers. According to corelations between bell diameters and nematocyst numbers of the samples, only correlation was found between O-isorhizas and bell diameters (r=0,53).

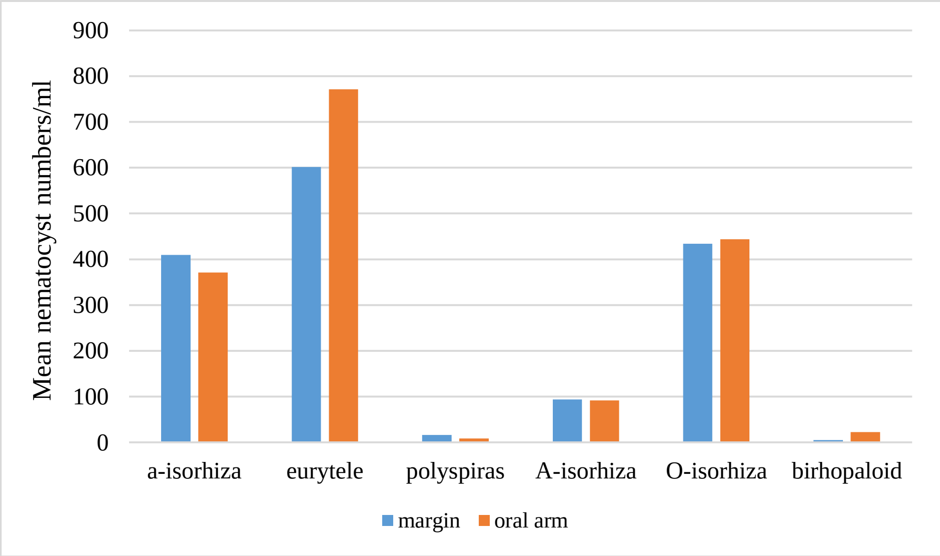

Figure 2. Mean numbers of nematocyst types per mililiter both in margins and oral arms of *P. punctata* samples.

In the oral arms, O-isorhizas were found densely in 31-34 cm diameter group. In other groups, euryteles were the most abundant nematocyst type. Numbers of the birhopaloids in oral arms were higher than that of margins. Polyspiras were seen in a few specimens with low numbers. It was determined that, a-isorhiza and O-isorhiza nematocysts numbers were positively correlated with bell diameters (r=0,74 and r=0,56 respectively).

Length (L) and width (W) ratios of a-isorhizas and A-isorhizas have not changed with increasing bell diameters. Euryteles were observed in three sizes which are small (L≤7, W≤5), medium (L≤11, W≤7) and large (L≤20, W≤15). While maximum length of birhopaloids was 18 µ in margins, it increased up to 20 µ in the oral arms.

Discussion

Six nematocyst types were found in the *P. punctata* samples but all types of nematocyst were not present in all specimens. For example, A-isorhizas and birhopaloids were not exist in 31-34 cm bell diameter group both in margin and oral arms.

Peach and Pitt (2005) sampled six *P. punctata* in Australia in 2003. It was determined four or five nematocyst types in the samples. Large euryteles and birhopaloids were very rare of all nematocyst in both margin and oral arms as it is in our study.

It was recorded that, mean length and mean width of eurytele nematocysts in *P. punctata* were 6,60 µm and 4,60 µm, respectively (Nicholas and Yong, 2012). In our study, euryteles were separated into three length size groups which were small (5-7 µm), medium (8-11 µm) and large (12-20 µm). Mean length and mean width of small euryteles were 6,7 µm and 5 µm, respectively.

Birhopaloid and a-isorhiza nematocyst types were found in *C. andromeda* in Güllük Bay. It was seen that nematocyst sizes increased with increasing the bell diameters of the individuals (Gülşahin, 2016a). In *P. punctata*, only birhopaloids increased related with increasing bell diameters. Four types of nematocysts which are O-isorhiza, a-isorhiza, A-isorhiza and eurytele were identified in *C. hysoscella*. a-isorhizas and O-izorhizas were the most frequently seen in the samples, while euryteles were rarely found. Lengths of O-isorhizas in this species were found up to 18 µm (Gülşahin 2016b). In this study, euryteles, O-isorhizas and a-isorhizas were commonly seen in *P. punctata*. Also, lengths of O-isorhizas were up to 7 µm.

Nematocyst types and ratios in *P. punctata* were investigated in this study. Studies on nematocyst types and also venoms of other Scyphozoa species must be planned in Turkey.

Acknowledgements

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References

Avian, M., Del Negro, P., & Sandrini, L. R., 1991. A comparative analysis of nematocysts in *Pelagia noctiluca* and *Rhizostoma pulmo* from the North Adriatic Sea. In Hydrobiologia (Vol. 216, No. 1, pp. 615-621). Kluwer Academic Publishers.

Avian, M., Spanier, E., & Galil, B., 1995. Nematocysts of *Rhopilema nomadica* (Scyphozoa: Rhizostomeae), an immigrant jellyfish in the Eastern Mediterranean. Journal of Morphology, 224(2), 221-231.

Bouillon, J., Claereboudt, M., & Seghers, G., 1986. Hydroméduses de la baie de Hansa (Mer de Bismarck; Papouasie; Nouvelle-Guinée). Répartition, conditions climatiques et hydrologiques. Indo-Malayan Zoology, 3(2), 105-152.

Burnett, J. W., Ordonez, J. V., & Calton, G. J., 1986. Differential toxicity of *Physalia physalis* (Portuguese man-o'war) nematocysts separated by flow cytometry. Toxicon, 24(5), 514-518.

Calder, D. R., 1971. Nematocysts of polyps of *Aurelia*, *Chrysaora*, and *Cyanea*, and their utility in identification. Transactions of the American Microscopical Society, 269-274.

Calder, D. R., 1974. Nematocysts of the coronate scyphomedusa, *Linuche unguiculata*, with a brief reexamination of scyphozoan nematocyst classification. Chesapeake Science, 15(3), 170-173.

Calder, D. R., 1977. Nematocysts of the ephyra stages of *Aurelia*, *Chrysaora*, *Cyanea*, and *Rhopilema* (Cnidaria, Scyphozoa). Transactions of the American Microscopical Society, 13-19.

Carlgren, O.H., 1945. Further contributions to the knowledge of the Cnidom in the Anthozoa, especially in the Actiniaria. GWK Gleerup.

Carlgren, O. H., 1940. A Contribution to the Knowledge of the Structure and Distribution of the Cnidae in the Anthozoa,. CWK Gleerup.

Carre, C. & Carre, D., 1973. Etude du cnidome et de la cnidogenese chez *Apolemia uvaria* (Lesueur, 1811) (siphonophore physonecte) Exp. Cell Res., 81 (1973), pp. 237-249.

Carre, D., 1972. Étude du developpement des cnidocystes dans le gastrozoide de Muggiaea kochi (Will, 1844) (siphonophore calycophore) C.R. Hebd. Sianc. Acad. Set., Paris, 275 (1972), pp. 1263-1266.

Carre, D., 1974. Formation, migration et maturation des nematoblastes et des nematocystes chez les siphonophores. l – Mise en evidence et formation des clones de nematocystes Annales Embryol., 7 (1974), pp. 205-218.

Cutress, C.E., 1955. An interpretation of the structure and distribution of cnidae in Anthozoa. Systematic Zoology, 4(3), 120-137.

Çevik, C., Derici, O. B., & Cevik, F., 2011. First record of Phyllorhiza punctata von Lendenfeld, 1884 (Scyphozoa: Rhizostomeae: Mastigiidae) from Turkey.

Endean, R. & Rifkin, J., 1975. Isolation of different types of nematocysts from the Cubomedusan Chironex fleckeri. Toxicon 13, 375–376.

Engel, U., Pertz, O., Fauser, C., Engel, J., David, C.N., & Holstein, T.W., 2001. A switch in disulfide linkage during minicollagen assembly in Hydra nematocysts. The EMBO journal, 20(12), 3063-3073.

Gülşahin, N., 2016a. Preliminary study on nematocyst types and venom isolation of *Cassiopea andromeda* Forskål, 1775 (Scyphozoa, Cnidaria) from Turkey. Cent. Nerv. Syst. Agents Med. Chem, 16, 208-212.

Gülşahin, N., 2016b. Nematocyst types of *Chrysaora hysoscella* (Linnaeus, 1766) from Turkey. 5th International Jellyfish Bloom Symposium, May 30- June 3, 2016, Barcelona, Spain, p.166.

Gülşahin, N., & Tarkan, A. N., 2012. The first record of *Phyllorhiza punctata* von Lendenfeld, 1884 from the southern Aegean Coast of Turkey. Bio. Inv. Rec, 1, 41-44.

Helmholz, H., Wiebring, A., Lassen, S., Ruhnau, C., Schuett, C., & Prange, A., 2011. Cnidom analysis combined with an in vitro evaluation of the lytic, cyto-and neurotoxic potential of *Cyanea capillata* (Cnidaria: Scyphozoa). Scientia Marina, 76(2), 339-348.

Holstein, T., 1981. The morphogenesis of nematocytes in Hydra and Forskalia: an ultrastructural study J. Ultrastruct. Res., 75 (1981), pp. 276-290.

Marino, A., Crupi, R., Rizzo, G., Morabito, R., Musci, G., & La Spada, G., 2007. The unusual toxicity and stability properties of crude venom from isolated nematocysts of *Pelagia noctiluca* (Cnidaria, Scyphozoa). Cell. Mol. Biol, 53, 994-1002.

Mariottini, G.L. & Pane, L., 2010. Mediterranean jellyfish venoms: a review on scyphomedusae. Marine Drugs, 8(4), 1122-1152.

Mariscal, R.N., 1974. Nematocysts. Coelenterate biology, 129-178.

Nicholas, Y.W.L., & Yong, O. J., 2012. A survey of jellyfish (Cnidaria) around St John's Island in the Singapore Straits. Contributions to Marine Science, 2012, 57-74.

Östman, C., 1983. Taxonomy of Scandinavian hydroids (Cnidaria, Campanulariidae): a study based on nematocyst morphology and isoenzymes (Doctoral dissertation, Acta Universitatis Upsaliensis).

Östman, C., 1991. Scanning electron microscopic observations on Scandinavian scyphozoans with special reference to their nematocysts. In UNEP: Jellyfish blooms in the Mediterranean. Proceedings of the II Workshop on Jellyfish in the Mediterranean Sea. MAP Tech. Rep. Ser (No. 47, pp. 283-292).

Östman, C., 1997. Abundance, feding behaviour and nematocysts of scyphopolyps (Cnidaria) and nematocysts in their predator; the nudibranch *Coryphella verrucosa* (Mollusca). In: A.D. Naumov, H. Hummel, A.A. Sukhotin & R. Ryland (eds.) Interactions and Adoption Strategies of Marine Organisms. Hydrobiologia, 355: 21-28.

Östman, C., 2000. A guideline to nematocyst nomenclature and classification, and some notes on the systematic value of nematocysts. Scientia Marina, 64(S1), 31-46.

Östman, C., & Hydman, J., 1997. Nematocyst analysis of *Cyanea capillata* and *Cyanea lamarckii* (Scyphozoa, Cnidaria). Scientia Marina, 61(3), 313-344.

Peach, M.B., & Pitt, K.A., 2005. Morphology of the nematocysts of the medusae of two scyphozoans, *Catostylus mosaicus* and *Phyllorhiza punctata* (Rhizostomeae): implications for capture of prey. Invertebrate Biology, 124(2), 98-108.

Rifkin, J., 1996. Cnida structure and fimction. In: Williamson JA, Fenner PJ, Burnett JW, lifkin JF (eds) Venomous and poisonous structures in marme animak. Univ New South Wales Press, Sidney 2502, Australia, pp 156–158

Skaer, R.J., 1973. The secretion and development of nematocysts in a siphonophore. J. Cell Sci., 13 (1973), pp. 371-393.

Slautterback, D.B., 1963. Cytoplasmic microtubules. I. Hydra. J. Cell Biol., 18 (1963), pp. 367-388

Slautterback, D.B. & Fawcett, D.W., 1959. The development of the cnidoblasts of *Hydra*; an electron microscope study of cell differentiation. J. Biophys. Biochem. Cytol., 25 (1959), pp. 441-452.

Sutton, J. S., & Burnett, J. W. (1969). A light and electron microscopic study of nernatocytes of *Chrysaora quinquecirrha*. Journal of ultrastructure research, 28(3-4), 214-234.

Weill R., 1934. Contributions a l'étude de cnidaires et de leurs nématocystes. Trav. Stn. Zool. Wimereux 10, 1–347; 11, 347–701.

Werner, B., 1965. Die Nesselkapseln der Cnidaria, mit besonderer Berücksichtigung der Hydroida. I. Klassifikation und Bedeutung für die Systematik und Evolution. Helgoländer Wiss Meeresunters 12(1/2):1–39.

Wiebring, A., Helmholz, H., Lassen, S., Prange, A., & Jarms, G., 2010. Separation and analysis of different types of nematocysts from *Cyanea capillata* (L.) medusae. In Jellyfish Blooms: New Problems and Solutions (pp. 203-212). Springer, Dordrecht.

Two new records and updated distribution of Caucasian Parsley Frog, *Pelodytes caucasicus* Boulenger, 1896, in Turkey

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The Caucasian parsley frog, *Pelodytes caucasicus*, is a little-known species due to fragmented distribution and endemic in mountain forests of the Caucasus. Here, we report two new localities for Caucasian parsley frog from Giresun (Cımbırtlık, Dereli and Gelevera River) based on fieldwork conducted in 2017. These new localities have filled in the gap in the species' distribution range in Blacksea Region, Turkey. Besides, we updated the distribution of *P. caucasicus* for future conservation and management studies.

Key words: Amphibia, Caucasian Parsley Frog, distribution, Pelodytidae.

Introduction

The Caucasus Ecoregion covers a total area of 580,000 km^2, extending over all of Armenia, Azerbaijan and Georgia, North Caucasian part of Russian Federation, north-eastern Turkey, and part of northwestern Iran. There are 14 amphibian species in the region and four of them are endemic. The Caucasian parsley frog (*Pelodytes caucasicus*) inhabit mountain forests of the Caucasian Isthmus (ECP 2012, CEPF 2017). The species distributes in the mountainous parts of Azerbaijan, Georgia, Russian Federation, Turkey and possibly Armenia upto sea level to 2,300 m a.s.l. It is listed as near threatened category in the IUCN Red List due to population declines resulting from the introduction of *Procyon lotor* (introduced in 1970-1980) which has recently become considerably more abundant (Kaya *et al.*, 2009).

The Caucasian parsley frog lives in broad-leaved, mixed coniferous-deciduous, rarely coniferous mountain forests and the subalpine belt (Kaya et al. 2009, AmphibiaWeb 2018). It occurs on the shores and banks of ponds and streams with clear and cold semi-flowing and flowing water (Terentjev & Chernov, 1949; Başoğlu *et al*., 1994; Tarkhnishvili & Gokhelashvili 1999, AmphibiaWeb 2018). The species is generally preferring shaded and cool conditions, sheltering under stones and other cover during the day (Tarkhnishvili & Gokhelashvili 1999, Kaya et al. 2009, AmphibiaWeb 2018).

The southern range margin of species extends from the Blacksea region of Turkey (Rize Vilayet) (Başoğlu *et al*., 1994; AmphibiaWeb 2018). However, we have a limited data on Turkish part of its distribution. Here, we report two new localities for Caucasian parsley frog from province of Giresun (Cımbırtlık, Dereli and Gelevera Rivers) and present updated distribution with new records.

Material and Methods

In our project fieldwork about conservation plan of Caucasian salamander, we found two new localities from province of Giresun: Cımbırtlık, Dereli, Giresun (Lat.: 40.587819°, Long.: 38.455281°, 1297 m a.s.l.) on June 16, 2017 and Gelevera stream (Lat.: 40.691496°, Long.: 38.88075°, 1343 m a.s.l.) on August 26, 2017. We recorded the geographical coordinates of the new localities via the GPS device (Garmin GPSMAP 62s) and photographed observed individuals and its habitats. The the frogs relased their habitats when they capture. We also observed potential threats and interviewed with locals. These localities were shown on the map in Figure 2.

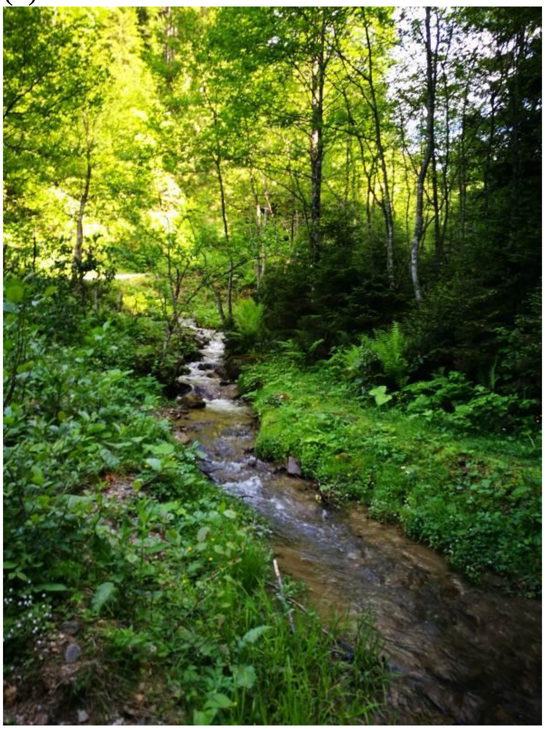
Results

During our fieldwork, we detected two new localities from province of Giresun on June and August 2017 (Figure 1a, b). These results represent range extension 90 km air distance from Hıdırnebi yayla, Trabzon to the West direction. Dorsum skin of both individuals has tubercles, regular in arrangement. The dorsum of male is gray-brownish with dark spots. The dorsum of female is light brown with dark brownish-black spots. Both has gray belly. Both habitats is slow moving stream in mixed coniferous-deciduous mountain forests (Figure 1c,d). The species share its habitat with five amphibians: *Mertensiella caucasica*, *Ommatotriton ophryticus*, *Bufo verrucosissimus*, *Bufotes variabilis*, and *Rana macrocnemis*. We also prepared the detailed distribution map of the species with new records for future conservation and management studies (Figure 2).

(a)

(b)

(c)



(d)

Figure 1. The adult male (a) and female (b) from Giresun with general view of its biotope from Gelevera stream (c) and Cımbırtlık, Dereli (d).

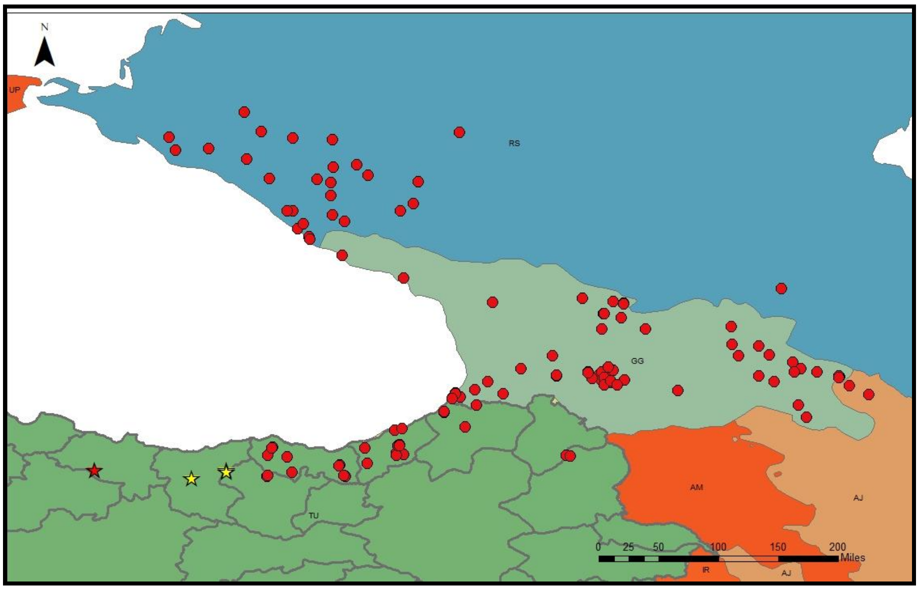


Figure 2. Distribution of *P. caucasicus.* Yellow Star: new localities, red star: Tarkhnishvili's personal record from Ordu; red circle: known localities from literatures (Steiner, 1968; Golubev, 1980; Franzen, 1999; Tarkhnishvili & Gokhelasvili, 1999; Tarkhnishvili *et al*., 2002; Tosunoğlu & Taşkavak, 2004; İğci *et al*. 2013).

(a) (b)

Figure 3. Dead *P. caucasicus* individuals in Hıdırnebi, Trabzon and "dozer tracks" in breeding ponds.

Discussion

The Caucasian parsley frog (*Pelodytes caucasicus*) distributes mountain forests of the Caucasian Isthmus and found in Blacksea Region, Turkey. Our record extend its distribution 90 km air distance from Hıdırnebi yayla, Trabzon (İğci *et al*., 2013) to the West direction. According to previous published literature, *P. caucasicus* has known from 16 different localities in Blacksea Region (Başoğlu et al. 1994, Franzen 1999, 2012, Afsar et al. 2012, İğci *et al*., 2013). Prof. David Tarkhnishvili stated that he had observed and photographed a juvenile P. caucasicus in Turnalık, Korgan, Ordu (Tarkhnishvili, Georgia, pers. comm. 2013 in İğci *et al*., 2013). Our records is strengthen the presence possibility in Ordu. The situation should be clarify with delailed fieldwork in Ordu as mentioned (İğci *et al*., 2013).

The species is threatened due to habitat loss and destruction (urbanization, constrcution), pollution ((pesticides, mineral fertilizers, and cattles), predation from the introduced North America Raccoon (*Procyon lotor*) (Kaya et al. 2009) within its range. In Turkey, its suffering from urbanization, constrution, ecoturism and recreational activities. For example, one of the well-known habitat in Lake Uzungol (Trabzon) is destroyed from pollution, ecoturism and recreational activities. The species is seriously threatened by loss of suitable vegetation through drainage of areas surrounding the lake as part of tourism development. Other Turkish populations within the country are patchily distributed (Kaya et al. 2009). As we noticed during th fieldwork, yayla and urbanization activities in the highlands cause the main threat for the species. This imply the species is urgently need to consrvation activities such as deteriming detailed distribution, planning long term monitoring study, education and public awareness.

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References

Afsar, M., Ayaz, D., Afsar, B., Çiçek, K. & Tok, C.V. 2012. Camili Biyosfer Rezerv Alanı'nın (Borçka, Artvin, Türkiye) Herpetofaunası [Herpetofauna of the Camili Biosphere Rezerve Area (Borçka, Artvin, Turkey)]. Anadolu Üniversitesi Bilim ve Teknoloji Dergisi 2: 41-49.

Arikan, H., Atatür, M. K. & Tosunoğlu, M. 2003. A study on the blood cells of the Caucasus Frog, *Pelodytes caucasicus*. Zoology in the Middle East 30: 43-47.

Arıkan, H., Tosunoğlu, M., Atatür, M.K., Göçmen, B. 2007. Some Comments of the Breeding Biology of *Pelodytes caucasicus* Boulenger, 1896 (Anura: Pelodytidae) from Uzungöl, Northeast Anatolia. Turkish Journal of Zoology 31: 53-64.

Başoğlu, M., Özeti, N. & Yılmaz, İ. 1994. Türkiye Amfibileri [The Amphibians of Turkey]. Ege Üniversitesi Fen Fakültesi Kitaplar Serisi No: 151, İzmir (In Turkish).

Franzen, M. 1999. Verbreitung und Ökologie von *Pelodytes caucasicus* Boulenger, 1896 in der Türkei (Distribution and Ecology of Pelodytes caucasicus Boulenger, 1896 in Turkey). Salamandra. 35: 1-18.

Dinets, V. 2015. Trogloxeny in the Caucasian parsley frog (Pelodytes caucasicus). Herpetological Bulletin, 133, 31.

Erişmiş, U.C., Arıkan, H., Konuk, M. & Guarino, F.M. 2009. Age Structure and Growth in Caucasian Parsley Frog *Pelodytes caucasicus* (Boulenger, 1896) from Turkey. Russian Journal of Herpetology 16: 19-26.

Golubev, N. S. 1980. On the area of distribution of *Pelodytes caucasicus* (Amphibia, Pelobatidae). Vestnik Zoologii 1980:52-55.

Gül, S. 2014. Habitat preferences of endemic Caucasian parsley frog (*Pelodytes caucasicus*) Boulenger, 1896 and Caucasian salamander (*Mertensiella caucasica*) (Waga, 1876) based on bioclimatic data of Fırtına Valley (Rize, Northeastern Anatolia). Anadolu Doğa Bilimleri Dergisi (Journal of Anatolian Natural Sciences) 5: 24–29.

Iğci , N., Akman, B., Göçmen, B., Adakul, A. & Oğuz, M.A. 2013. A new locality record of Caucasian parsley frog, *Pelodytes caucasicus* Boulenger, 1896 (Amphibia: Anura: Pelodytidae) in the eastern Black Sea region of Anatolia. Biharean Biologist, 7: 54–56.

Kaya, U., Tuniyev, B., Tuniyev, S., Kuzmin, S., Tarkhnishvili, D., Tuniyev, B., Papaenfuss, T., Sparreboom, M., Ugurtas, I., Anderson, S., Eken, G., Kılıç, T. & Gem, E. 2009. *Pelodytes caucasicus*. The IUCN Red List of Threatened Species 2009: e.T39422A10236383. http://dx.doi.org/10.2305/IUCN.UK.2009.RLTS.T39422A10236383.en. Downloaded on 18 September 2018Tarkhnishvili, D. N. 1996. The distribution and ecology of the amphibians of Georgia and the Caucasus: a biogeographical analysis. Zeitschrift für Feldherpetologie 3:167-196.

Steiner, H.M. 1968. *Pelodytes caucasicus* Boulenger, 1896 (Pelobatidae: Amphibia) in der Türkei. Annalen des Naturhistorischen Museums in Wien 72: 291-298.

Tarkhnishvili, D. & Gokhelashvili, R.K. 1999. The Amphibians of the Caucasus. Pensoft, Sofia, Moscow.

Tarkhnishvili, D.N, A. Kandaurov and A. Bukhnikashvili. 2002. Declines of amphibians and reptiles in Georgia during the 20th century: virtual vs. actual problems. Zeitschrift fuer Feldherpetologie 9: 89-108.

Terentjev, P.V. & Chernov, S.A. 1949. Key to Amphibians and Reptiles. Israel Program for Scientific Translations. Jerusalem, 1965.

Tosunoğlu, M. & Taşkavak, E. 2004. A Preliminary Study on Morphology and Serology of *Pelodytes caucasicus* Boulenger 1896 Populations From North- Eastern Turkey. Pakistan Journal of Biological Sciences 7: 1186-1190.

Veith, M., Fromhage, L., Kosuch, J. & Vences, M. 2006. Historical biogeography of Western Palaearctic pelobatid and pelodytid frogs: a molecular phylogenetic perspective. Contributions to Zoology, 75, 109-120.

Yıldırımhan, H.S., Bursey, C.R. & Goldberg, S.R. 2009. Helminth Parasites of the Caucasian Parsley Frog, *Pelodytes caucasicus*, from Turkey. Comparative Parasitology 76(2): 247-257.

AmphibiaWeb. 2018. <http://amphibiaweb.org> University of California, Berkeley, CA, USA. Accessed 17 Sep 2018.

Conservation strategies for Caucasian salamander, *Mertensiella caucasica* (Waga, 1876), in Turkey

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The endemic Caucasian salamander, *Mertensiella caucasica* (Waga, 1876), is a stream-dwelling amphibian in the west Lesser Caucasus and faced serious threats within distribution range. Here, we evaluated the main threats of Caucasian salamander from East Black Sea Region, Turkey by 135-days intensive fieldwork and interviews with locals. We found that (1) logging along with brooks and use of brooks bed for the transportation, (2) HEP, stream reclamation and road construction, (3) urbanization/infrasutructure, (4) intensive ecotourism activities, (5) the liquid / solid wastes into streams from yayla activities, (6) uncontrolled recreational and overgrazing activities, (7) intentionally or accidentally killing, (8) illegal pet trade, (9) misapplied chemicals and artificial fertilizing in agriculture, (10) invasive / alien fish species, and (11) global climate change are main factors threatening of Caucasian salamander.

We prepared 5-year Action Plan for Turkish General Directorate of Nature Conservation and National Parks and planned the road map for sustainability of the species with participation of regional administration, NGOs, and locals. The main conservation measures include: (1) reducing habitat loss/destruction of the salamander habitats, (2) creating a monitoring program to determine population trends, and (3) educational and awareness-raising activities.

Keywords: Caucasian salamander, conservation, distribution, species action plan, Turkey.

Introduction

The Caucasus ecoregion is one of the earth's 36 recognized biodiversity hotspots and covers more than 500,000 km^2 including Armenia, Azerbaijan, and Georgia, as well as the North Caucasian portion of the Russian Federation, the northeastern part of Turkey, and a part of northwestern Iran. The ecoregion host nearly 14 amphibian species and 4 of which are endemic in the ecoregion and many of them occupy entire ranges of only a few thousand square kilometers (ECP 2012, CEPF 2017).

The Caucasian salamander, *Mertensiella caucasica* (Waga, 1876), is restricted to north-east Anatolia (the cities of Ordu, Giresun, Rize, Trabzon, Artvin, Ardahan, Bayburt, and Gümüşhane), Turkey (Başoğlu *et al.*, 1994; Baran *et al.*, 2012), and the western spurs of the Trialeti Mountain Ridge, Meskhetian and Lazistanian ridges, Georgia (Kaya *et al.*, 2009) up to about 2400 m above sea level (Tarkhnishvili & Gokhelashvili, 1999). The species is listed as vulnerable category in the IUCN Red List due to its area of occupancy is less than 2,000 km2 and severely fragmented distribution (Kaya *et al.*, 2009).

Our main objective of the study was to determine the population status and major threats of *M. caucasica* in Eastern Blacksea Region, Turkey. We done a rapid assessment of the fieldwork observations, interview with the locals, literature knowledge and developed five-year (2018-2022) species conservation action plan with contribution of regional administrations, NGOs, and the locals for General Directorate of Nature Protection and Natural Parks (GDNPNP).

Material and Methods

We conducted 135-day intensive fieldwork in most of the species disrtibution area (five cities: Giresun, Rize, Trabzon, Artvin, and Gümüşhane) between April - December 2017 with two or three people. We utilized visual encounter survey (Guyer & Donnelly, 2012) and visited at least three times study area. The macrohabitats of each grid was visited at least three times to detection on presence of Caucasian salamander. Prior to starting field studies, we created preliminary ecological niche modelling with maximum entropy approach to organizing our fieldwork determining new localities for Caucasian salamander.

During our fieldwork, we interviewed with locals and ask some questions about to find out their thoughts on species. We asked (1) whether they know the species or not by showing them the pictures of it, -if the answer is positive- (2a) where (locality) or (2b) when (season, time) do you observe the salamander?, (3) which other amphibians lives in the region. In addition to that (4) their positive/negative thoughts about the species were asked.

During field observations, interviews with locals at field studies and related literature scanning; threats to Caucasian salamander, we determined potential threats on Caucasian salamander. We discussed short term and long term targets with the stakeholders (locals, NGOs, local administrations, GDNPNP) in various workshops on December 2017. We prepated the Action Plan for the 5-year period between 2018 and 2022.

Results

We determined distribution of the salamander with scanned existing literature records (Atatür & Budak, 1982; Yılmaz, 1987; Franzen, 1985, 1999; Başoğlu *et al*., 1994; Tarkhnishvili *et al*,. 2009; Terrestrial and inland water ecosystems biological diversity inventory and monitoring project records) and our intensive fieldworks. We created a detailed distribution map for using conservation/management actions (Figure 1).

The main threats are (1) logging along with brooks and use of brooks bed for the transportation of timber, (2) HEP, stream reclamation and road construction, (3) urbanization / infrastructure, (4) unconscious ecotourism activities, (5) mixing of the liquid / solid wastes into streams from yayla activities, (6) uncontrolled recreational and overgrazing activities, (7) intentionally or accidentally killing, (8) illegal pet trade, (9) misapplied chemicals and artificial fertilizing in agriculture, (10) invasive / alien fish species [introduced species, *Oncorhynchus mykiss* Walbaum, 1792], and (11) global climate change.

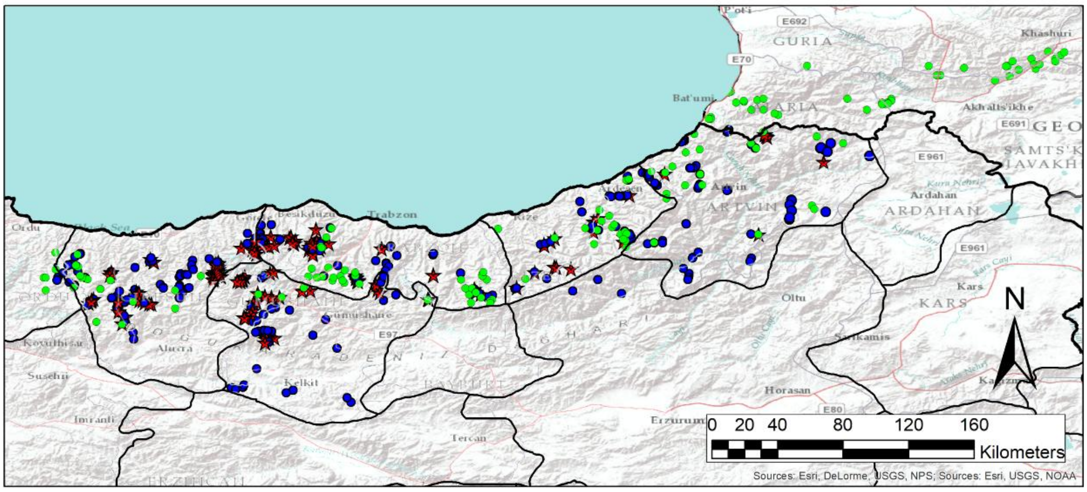

Figure 1. The distribution of Caucasian salamander. Green circle: literature records, red stars: new records, blue circle: possible record to interviewed with locals.

Discussion

The Caucasian salamander lives a range of habitats, including mixed, broadleaved, and subalpine forests, and shrubs/grasslands above the timberline (Tarkhnishvili & Kaya, 2009). Its distribution depends on depending on rainfall, temperature and slope (Tarkhnishvili *et al.*, 2009). The species live along small mountain streams with an uneven flow, usually with stony beds and shelters formed by stones or/and fallen logs. But it avoids anthropologically altered landscapes (Tarkhnishvili & Kaya, 2009).

According to our data, the species is mainly suffering from habitat loss and degradation of salamander's terrestrial habitats due to degradation of stream beds and river banks, construction and urbanization activities. The logging near streambed and pulling trees along the streambeds cause degradation of riparian vegetation, vegetation - in particular ostrich fern (*Matteuccia struthiopteris*) - decrease in humidity of microhabitats, increase in water temperature as a result of increased illumination, direct damage to stream beds and shelters of larvae and adults (Tarkhnishvili & Kaya, 2009).

We recommended to General Directorate of Forestry that they should be completely banned logging within at least 50 m of a streambed and pulling trees along the streambeds (Tarkhnishvili & Kaya, 2009). Research and monitoring is urgently need for Anatolian part of species's distribution. Because we have a limited data on ecology, phenology and population trend of Caucasian salamander. The rangers should be trained to identify new salamander locations and record on larvae/breeding sites (Tarkhnishvili & Kaya, 2009). Therefore, the detailed distribution map will be shaped and updated. Besides, the long term monitoring program should be started for determining population trends. Education and awareness-raising activities are important stage for sustainablity of the salamander. The increased public awareness on the importance of the species as a part of unique regional biodiversity; a public campaign for several endemic Tertiary relict species (Tarkhnishvili & Kaya, 2009). These measures should be maintained riparian habitats/corridors and benefit to can survive not only Caucasian salamanders but also other endemic species of fauna and flora.

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The data obtained in this study were reached within the scope of a project entitled "The species action plan of Caucasian salmander, *Mertensiella caucasica*, in Artvin, Giresun, Gümüşhane, Rize and Trabzon provinces”, funded by the Directorate of Trabzon Branch of the 12th Regional Directorate of the Department of Nature Protection and National Parks of the Republic of Turkey, Ministry of Forestry and Water Affairs. We would like to thank the establishment concerned and AnaDOKU for the support to the study.

References

Atatür, M. K., & Budak, A. 1982. The Present Status of Mertensiella caucasica (WAGA, 1876)(Urodela: Salamandridae) in Northeastern Anatolia. Amphibia-Reptilia, 3: 295-301.

Baran İ., Ilgaz Ç., Avcı A., Kumlutaş Y. & Olgun K. 2012. Türkiye Amfibi ve Sürüngenleri. TÜBİTAK Popüler Bilim Kitapları, Ankara. 204 pp.

Başoğlu, M., Özeti, N. & Yılmaz, İ. 1994. Türkiye Amfibileri [The Amphibians of Turkey]. Ege Üniversitesi Fen Fakültesi Kitaplar Serisi No: 151, İzmir (In Turkish).

Franzen, M. 1985. *Mertensiella caucasica* (WAGA, 1876)(Caudata: Salamandridae) in Meereshöhe. Salamandra, 21(1), 98-99.

Franzen, M. 1999. Verbreitung und Ökologie von *Pelodytes caucasicus* Boulenger, 1896 in der Türkei (Distribution and Ecology of Pelodytes caucasicus Boulenger, 1896 in Turkey). Salamandra. 35: 1-18.

Guyer, C. & Donnelly, M. A. 2012. Visual encounter surveys. Reptile Biodiversity Standard Methods for Inventorying and Monitoring, 218-220.

Kaya, U., Tuniyev, B., Tuniyev, S., Kuzmin, S., Tarkhnishvili, D., Tuniyev, B., Papaenfuss, T., Sparreboom, M., Ugurtas, I., Anderson, S., Eken, G., Kılıç, T. & Gem, E. 2009. Pelodytes caucasicus. The IUCN Red List of Threatened Species 2009: e.T39422A10236383.http://dx.doi.org/10.2305/IUCN.UK.2009.RLTS.T39422A10236383.en. Downloaded on 18 September 2018Tarkhnishvili, D. N. 1996. The distribution and ecology of the amphibians of Georgia and the Caucasus: a biogeographical analysis. Zeitschrift für Feldherpetologie 3:167-196.

Tarkhnishvili, D., Kaya, U., Gavashelishvili, A. & Serbinova, I. 2009. Ecological divergence between two evolutionary lineages of the Caucasian Salamander: Evidence from the GIS analysis. Herpetological Journal, 18: 155-163.

Tarkhnishvili, D. & Gokhelashvili, R. 1999. The amphibians of the Caucasus. Sofia: Pensoft Publications. Tarkhnishvili, D.N. and Serbinova, I.A. 1993. The ecology of the Caucasian salamander (*Mertensiella caucasica* Waga) in a local population. Asiatic Herpetological Research 5: 147-165.

Tarkhnishvili, D. & Kaya, U. 2009. Status and Conservation of the Caucasian Salamander (*Mertensiella caucasica*). *In:* Zazanashvuli, N. and Mallon, D. Eds. Status and Protection of Globally Threatened Species in the Caucasus. Tbilisi: CEPF, WWF. Contour Ltd. Pp. 157-164.

Yılmaz, İ., 1987. Kuzey Anadolu amfibilerinin taksonomisi. TÜBTAK Proje Kesin Raporu.

Freshwater Fish Fauna of Bakırçay River in Turkey

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Bakırçay River is emptying into the Aegean Sea in the Çandarlı Gulf (north of Izmir). This river is a transition region between the Marmara Sea and the Aegean region, so it is special in terms of the species it hosts. In addition, mining activities are carried out in the drainage canals of this river. Balık et al. (1999) conducted the first study related to Bakırçay River's fish fauna. Kuru (2001) also reported the fishes of the Bakırçay River. Since then, no ichthyofaunal studies have been carried out in the stream. The present study, therefore aimed to determine the current fish fauna of Bakırçay River. To this end, sampling was carried out in 15 stations including 11 lotic and 4 lentic water bodies in 2017 and 2018, seasonally. The samples were collected seasonally using an electro shocker (Samus 725 G) in the lotic habitats and multi mesh gillnets (TS EN 14757) in the lentic habitats. The fishes were euthanized with phenoxyethanol (1 ml/L) and fixed with 4% formaldehyde. In the laboratory, the samples were diagnosed at the species level. In total, 16 taxa belonging to Anguillidae, Atherinidae, Cyprinidae, Cobitidae, Nemacheilidae and Poecilidae families were identified. Cyprinidae family represented the highest diversity within 11 taxa in the Bakırçay River. Anguillidae, Atherinidae, Cobitidae, Nemacheilidae and Poecilidae families were represented by only one species. To date, 12 taxa from 5 families were reported in the Bakırçay River. In the present study, 16 species belonging to 6 families were detected. Non-native species, *Carassius gibelio*, *Cyprinus carpio*, *Gambusia holbrooki*, *Pseudorasbora parva*, translocated species *Atherina boyeri* and native species *Oxynemacheilus teophilia* were found in this study for the first time for Bakırçay River.

Acknowledgement: We would like to thank the Ege University Scientific Research Project Commission for supporting this study (BAP-2016/SÜF/038).

Keywords: West Anatolia, North Aegean, ichthyofauna, distribution, alien species.

Distribution of the Economically Important Echinoderm Species along the Turkish Seas

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Information about the commercially important echinoderm species distributing along the Turkish seas was provided. Five holothurian species are known from the Turkish seas as commercially important echinoderms all of which are distributing in the Aegean coasts of Turkey while *Holothuria tubulosa* is known from the all part of the Turkish seas. Remaining echinoderm classes have less number of economically important species. Of these, Echinoidea which is being used in ecotoxicological studies represented with 20 species from the Turkish Seas. Only *Paracentrotus lividus* has commercial importance in Turkish Seas from the classis Echinodermata as it is being consumed as human food. *Echinus melo*, *Sphaerechinus granularis*, *Arbacia lixula*, *Pssammechinus microtüberculorus*, *Ophiotrix fragilis*, *Astropecten bispinosus* and *Echinaster sepositus* are the main echinoderm species are being utilized in the Mediterranean but not in Turkey.

Keywords: Echinodermata, Turkish Seas, bio-ecological features, commercial species, distribution.

Introduction

About 15500 invertebrate species are known from the Mediterranean Sea, 4272 of these has been reported from the Turkish seas up to date (Author database). Among these, 78 species have commercial importance. Aegean coast of Turkey is represented with the maximum number (66 species) of commercially important species followed by Levantine (64 species), Marmara Sea and the Straits (50 species) and the Black Sea coast (24 species) (Author database). Six of these 78 economically important species belong to the phylum Echinodermata, 5 of these species have been recorded from the Aegean coast of Turkey followed by Lavantine coast (3 species), Marmara Sea and the Straits (2 species) and the Black Sea coast (one species) of Turkey (Öztoprak et al., 2014).

The phylum Echinodermata which is also called as spiny skinned animals is the most advanced group within the invertebrates has five classes named as Crinoidea, Asteroidea, Ophiuroidea, Echinoidea and Holothuroidea. The class Holothuraidea has the maximum number of economically important species within the phylum Echinodermata. Five species of the class Holothuroidea [(*Holothuria* (*Holothuria*) *tubulosa* Gmelin, 1791; *Holothuria* (*Holothuria*) *mammata* Grube, 1840; *Holothuria* (*Rowethuria*) *poli* Delle Chiaje, 1824; *Holothuria* (*Platyperona*) *sanctori* Delle Chiaje, 1823 and *Parastichopus regalis* (Cuvier, 1817)] are commercially being hunted in Turkey. The class

Echinoidea is another group having commercially important species in the Mediterranean Sea. *Paracentrotus lividus* (Lamarck, 1816) is the unique echinoid species having commercial importance which is also being used in the ecotoxicological studies in Turkey. *Echinus melo*, *Sphaerechinus granularis*, *Arbacia lixula*, *Pssammechinus microtübercularus*, *Ophiotrix fragilis*, *Astropecten bispinosus* and *Echinaster sepositus* are the main echinoderm species distributing along the Turkish Seas are being utilised as ornaments in the aquariums or being consumed as human food.

Distribution, bio-ecological features, the way of utilisation and the amounts of the production of the commercially important species and the alternative echinoderm species to be utilised distributing along the Turkish seas is emphasizes in this study.

Material and Method

Related literature was examined in order to determine, distribution, bio-ecological features, the way of utilisation and the amounts of the production of the commercially important species as well as the alternative echinoderm species to be utilised distributing along the Turkish seas. Besides, people who hunt and import some commercially important echinoderms which are being sold and not take part in the fisheries statistics were interviewed in order to get information within the frame of the present study.

Results

Six commercially important echinoderm species distributing along the Turkish seas were determined according to the studies were conducted up to date.

General information about species

***Holothuria* (*Holothuria*) *tubulosa* Gmelin, 1791**

Description: Cylindrical body with terminal mouth opening, dorsal feet usually converted to papillae, ventral side with many podias, spicules represented by corpuscles in the form of towers, very small, with thorns all around their base and at the top, and by irregular oval plates bearing at least 2 pairs of pores, brownish-violet to brown-red, ventral side more clear, usually with dots and brown spots, cuvier hose is missing.

Ecology: Common benthic species, lives in the littoral zone up to 100 m depth, on the bedrock covered algae, meadows of *Posidonia* and other phanerogams, sandy, muddy gravelly and stony habitats.

Distribution: Biscay Bay, Northern Atlantic, Red Sea and Mediterranean Sea (Buharalı, 2018). Turkish coasts: Aegean coasts (Aslan Cihangir, 2012), Levantine coasts (Özgür et al., 2008), Black Sea coasts (Özgür et al., 2008), Marmara Sea (Tortonese & Demir, 1960).

***Holothuria* (*Rowethuria*) *poli* Delle Chiaje, 1824**

Description: Species with velvety black skin, the underside also bright brown, feet and tips of the dorsal papillae bright white, cuvier hose is missing.

Ecology: Mostly prefers soft muddy substrats and *Zostera* meadows (Aydın 2016).

Distribution: Northern Atlantic, Red Sea and Mediterranean Sea and Biscay Bay (Buharalı, 2018). Turkish coasts: Common in the Turkish coasts of Aegean Sea (Aydın, 2016).

***Holothuria* (*Holothuria*) *mammata* Grube, 1840**

Description: The body is smooth, somewhat cylindrical, reddish-brown above gray, covered with a number of small, and with about 5 longitudinal rows of large protrusions, cuverian tubules are few in number.

Ecology: From the shallow waters up to 200 m depth. Mostly prefers stony and rocky substrates occasionally sandy bottoms (Özgür Özbek, 2013).
Distribution: Mediterranean Sea (Şahin, 2008); Turkish coasts: Aegean Sea (Özgür Özbek, 2013).

***Holothuria* (*Platyperona*) *sanctori* Delle Chiaje**
Description: Body cylindrical, colour was uniformly dark brown or nearly black, ventral part with lighter colour mostly yellowish, large dorsal and lateral papillae, scattered over the surface, mostly with whitish or beige rings at the base. Dense ventral tube feet.
Ecology: Mostly prefers darker places between rocks, caves and hollows (Aydın, 2016). From shallow waters up to 50 m (Buharalı, 2018)
Distribution: Canary Islands, Cape Verde, Boka Kotorska Bay, Algerian coast, Sea of Marmara and Aegean Sea, Continental shelf of the Montenegrin coast, Northern Aegean Sea, Biscay Gulf, Portugal, Azores, Madeira, Savage Islands, Saint Helena, Croatia, France, Italy, and Mexico (Moussa & Wiravati, 2018). Turkish coasts: Aegean and the Levantine coasts (Aydın, 2016).

***Parastichopus regalis* (Cuvier, 1817)**
Description: Subterminal mouth opening, two gonadal tufts, dorsoventrally flattened, skin rough, dorsal surface with tubercles more or less aligned in longitudinal series and ending with conical papillae, ventral side shaped sole with 3 more or less distinct strips of podias, cuvier organs absent.
Ecology: Prefers muddy, sandy-muddy and gravelly substrates, between 5-800 m depths (Aydın, 2016).
Distribution: Biscay Bay, northern Atlantic, Mexico Bay and the Mediterranean Sea (Buharalı, 2018). Turkish coasts: Marmara Sea (Tortonese & Demir, 1960), Aegean Sea (Özaydın et al., 1995), Levantine coasts (Özaydın et al., 1995).
***Paracentrotus lividus* (Lamarck, 1816)**
Description: Body slightly depressed, spines strong and pointed, dark violet to dark olive, rarely brownish, primary tubercles very regular, 5-pair ambulacral plates pores, exceptionally 4 or 6, jaws of the globular pedicellars with lateral teeth and one gland, pedicellaria have long, narrow jaws with crenulated margins.
Ecology: Prefers, coralligenous or rocky hard substrates, also soft substrates with sand or *Zostera* (Buharalı, 2018).
Distribution: Biscay Bay, northern Atlantic, Kelt Sea and the Mediterranean Sea (Buharalı, 2018). Turkish coasts: Aegean Sea (Aslan Cihangir, 2012), Marmara Sea (Tortonese & Demir, 1960) Levantine coasts (Gözcelioğlu, 2011).

The phylum Echinodermata which is the most advanced group within the invertebrates with five classes, has 7291 living species on Earth, 154 and 91 of which is known from the Mediterranean and the Turkish seas respectively (Pawson, 2007; Coll et al., 2010; Öztoprak et al., 2014). Among these five classes Holothuroidea is represent with the maximum number (60 species) of commercially important species in worldwide. Five holothurian species is being hunted and exported.

Holothurian species which are being hunted in Aegean Sea, processed in İzmir and Bandırma and exported mainly China, India, pacific islands and USA (pers. comm). As the cucumber production has importance for the national economy and for also people who live for the sea cucumber, hunting of the sea cucumbers should be under controlled and their hunting should be banned in their spawning period.

Sea urchins are another group of echinoderms which are being commercially caught worldwide as the sea cucumbers. These group of animals is consumed in many countries as human food. Especially, gonads of *Echinus melo*, *Sphaerechinus granularis Arbacia lixula*, *Psammechinus* *microtuberculatus* and *Paracentratus lividus* are consumed as food (Ünsal, 1973; Özgür Özbek, 2013). *Arbacia lixula* and *Paracentratus lividus* are commonly used in ecotoxicological studies in Turkey. Of these species *P. lividus* is consumed as human food especially in the western part of Turkey.

There are six commercially important echinoderm species distributing along the Turkish seas. *Echinus melo, Brissopsis lyrifera, Sphaerechinus granularis, Astropecten bispinosus, Astropecten aranciacus, Astropecten spinulosus*, *Echinaster sepositus* and *Hacelia attenuate* are commercially important echinoderms are utilised in the world seas. These are alternative species distributing along the Turkish seas for utilising and making contribution to the national economy.

As a result, the echinoderms which have great importance in food, medicine and cosmetic industry are making important contribution to the national economy and the families as means of living. Sustainability of these process could be provided by utilising the stocks properly and efficiently. In order to succeed this, it is thought that biological properties of commercially important species should be well known, hunting should be done properly and paying attention to the aquaculture researches.

References

Aslan Cihangir, H., 2012. The echinoderm fauna of Gökçeada Island (NE Aegean Sea), Journal of Animal Veterinary Advances, 11: 26-29.

Aydın, M., 2016. Sea cucumber (Holothuria) species of Turkey. Denizcilik ve Deniz Bilimleri Dergisi, Cilt: 2 Sayı: 1 (2016) 49-58.

Buharalı, B., 2018. Marmara Denizi ve Türk Boğazlar Sistemi'nde dağılım gösteren echinodermata türlerinin biyoekolojik özellikleri. Ege Üniversitesi Fen Bilimleri Enstitüsü Yüksek Lisans Tezi, İzmir.

Coll, M., Piroddi, C., Steenbeek, J., Kaschner K., Lasram, F. B. R., Aguzzi, J., Ballesteros, E., Bianchi, C. N., *et al.*, 2010. The biodiversity of the Mediterranean Sea: estimates patterns, and threats. Plos One, 5(8): e11842.

Gözcelioğlu, B., 2011. Denizlerimizin Sakinleri. 1. Baskı, Gökçe Ofset Basım Yayın Ankara.

Moussa, R.M. & Wiravati, I., 2018. Observations on some biological characteristics of Holothuria polii and Holothuria sanctori from Mediterranean Egypt. International Journal of Fisheries and Aquatic Studies, 6(3): 351-357.

Özaydın, O., Katağan, T. & Ünsal, S., 1995. The Echinoderms of the Turkish Seas. Israel Journal of Zoology, 41(1):57-68.

Özgür, E., Öztürk, B. & Karakulak, S., 2008. The Echinoderm Fauna of Turkey with new records from the Levantine coast of Turkey. The 2nd Scientific Conference of Animal Wealth Research in the Middle East & North Africa. Cairo International Concention Center, Egypt, pp. 571 - 581.

Özgür Özbek, E., 2013. Antalya Körfezi littoralindeki makrobentik derisi dikenliler (echinodermata) faunası ve mevsimsel dağılılmlarını etkileyen bazı ekolojik faktörler. Akdeniz Üniversitesi Fen Bilimleri Enstitüsü Doktora Tezi, Antalya.

Öztoprak, B., Doğan, A. & Dağlı, E., 2014. Checklist of Echinodermata from the coasts of Turkey. Turkish Journal of Zoology, 38: 892-900.

Pawson, D., 2007. Phylum Echinodermata. Zootaxa, 1668:749–764.

Şahin, Ö., 2008. Antalya Körfezi Doğu Kıyıları'nda (Antalya-Gazipaşa) Echinodermata Faunası'nın Belirlenmesi. Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü, Isparta.

Tortonese, E. & Demir, M., 1960. The Echinoderm fauna of the Sea of Marmara and the Bosphorus. İstanbul Üniversitesi Fen Fakültesi Hidrobiyologi Araştırma Enstitüsü Yayınları, Serie B, Fas 1,2: 1-16 pp.

Ünsal, S., 1973. Ege Denizi'nin Türkiye karasularında yaşamakta olan derisi dikenliler (Echinodermata) üzerine bio-ekolojik araştırmalar. Ege Üniversitesi Doktora Tezi, İzmir.

ORAL PRESENTATION

Determination of Water Quality Level of Gökçedoğan Pond (Kargı, Çorum) using statical methods

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The objectives of this study, which was carried out in Gökçedağ Pond located in Çorum city, were to observe the seasonal, monthly and annual changes in water samples through physico-chemical methods. The monitoring study was performed in four sampling points between March 2017 and February 2018. The dissolved oxygen, water temperature, electrical conductivity, salinity, biological oxygen demand, chemical oxygen demand, total hardness, total alkalinity, phosphate, nitrite, nitrate, ammonium nitrogen, sulfite, sulfate chloride, sodium, potassium, calcium, magnesium, ferrous, lead, zinc, copper, nickel, cadmium was measured and determined during the study and the suitability level in terms of aquatic life and also to classify the quality of water in accordance with the Surface Water Quality Management Regulation (SWQMR) criteria at this Pond, was defined as high quality and polluted respectively. The phosphorus level of this pond was poorly contaminated (Class II) but the pH level was determined in the pollution water (Class III). In Gökçedağ Pond is under pollution pressure, it should be regularly monitored periodically.

Keywords: Freshwater, water pollution, heavy metal, hierarchical cluster analysis (HCA), Pearson's correlation.

The Relationship between Zooplankton and Abiotic Factors Using Statistical Analysis in the Boğacık Creek (Giresun/Turkey)

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The zooplankton groups and physico-chemical structure in Boğacık Creek were determined monthly, from June 2014 to May 2015 in four determined stations. The relationships between the zooplankton groups and the physico-chemical parameters of the water have been demonstrated by using Pearson's Correlation and Principal Components Analysis (PCA).

In this study, seven zooplankton groups have been identified Ephemeroptera Hyatt & Arms,1891 (%52), Ephemeroptera Hyatt & Arms,1891(larvae) (%17), Odonata Fabricius,1793 (%2), Odonata Fabricius, 1793 (larvae) (%8), Copepoda H. Milne-Edwards, 1840 (%15), Cladocera Latreille, 1829 (%5), Rotifera Cuvier, 1798 (%0.7) Acaridae Latreille,1802 (%0.14), Diptera, Linnaeus,1758 (%0.07).

The most abundant group in Zooplankton sampling is the Ephemeroptera. The group concluded that there was a positive, but weak relationship with temperature, Chl a, pH and nitrite. The temperature has a positive and strong relationship with EC, DO, BOI_5 and Chl a, but also positively correlated with Cladocera and Acaridae groups, but it appears to be negatively correlated with the Copepoda, Rotifera and Diptera groups.

Keywords: Zooplankton, physico-chemical parameters, Principal components analysis, Pearson correlation analysis,

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A Case Study: Integrated Aquaculture System, Fish Feed – Polychaeta Model

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This is a case study on fish feed and polychaete integrated model. The meaning of integration is to combine two or more things in order to become more efficient. According to this sense, scientists are trying to produce many useful models by using living sources. Bioremediation plays a role in getting lots of new ideas on ecology and living resources. Aquaculture is one of the easiest and ideal methods for human consumption. It is known that every industrial production has some side effects like pollution. Aquaculture is a such industry with uneaten fish feeds and feces etc. The biological benefit is very important for living sources. Some pollutants are an opportunity for some creatures. For instance, organic wastes of the fish farm are one of those. In this study, we tried to find some fingerprints of the useful conversion between fish feed and polychaete by using fatty acid profiles, which were carried out in earthen marine fish ponds. According to our results SAFA, MUFA, PUFA, and HUFA were analyzed and results were as follows; for polychaete: PUFA>MUFA>SAFA>HUFA and fish feed: PUFA>MUFA>SAFA>HUFA.

Keywords: European Sea Bass, Fatty Acid profiles, *Nereis* sp.,

Introduction:

Aquaculture is a good way for healthy nutrition for all living things. Day by day this industry improves and expands. Water is the most valuable thing on Earth for life that’s why human being has to be careful with using it. Aquaculture is one the of industries with related by fresh and marine water. Industries which uses water has knife-back relations with nature. Aquaculture effluents were mostly organics which nature has a capability of eliminating these wastes by using biological and chemical processes.

Aquaculture in Turkey has an acceleration in recent years. Marine and freshwater fish production is over 276000 tonnes/year in Turkey(BSGM,2018). Earthen ponds aquaculture is one of the ways that farmer’s choice for marine aquaculture in Muğla region. Over 10.000 tonnes/year, sea bass and sea bream breeding in this area. According to Köymenoğlu and Ercan (2013) study shows that nearly over 1,2 times of the fish production farmers use fish feeds in this area. And the authors calculate the most of the organic phosphorus and nitrogen elements in drainage waters of the systems were cleaned in this earthen ponds by chemical and biological processes.

As a biological process polychaete is one of the potential and economically valuable product in the ecosystem. Ragworm has used as a bait fish for sea angling. The economic value of this ragworm is nearly 30$/kg (Fidalgo et al., 2003). Ragworm is a highly preferred fish bait in our country. And this bait is an imported from Greece and etc. Over 1million active sea anglers in the UK, make substantial demands on the natural environment(Olive and Cowin, 1994). Since 1986, English farmers saw this potential and they culture this bait. All Nereids have jawed eversible pharynges and in feeding experiments, these species with few exceptions were found to be omnivorous (Reish, 1954; Goerke, 1971). This feeding feature and economical value highlight the use of this species in integrated aquaculture systems.

In this study, it has been tried to determine the potential of fish feed used in fish ponds in Earthen ponds to be transformed into a useful product(fatty acids) by evaluating the transition of the natural stock polychaete (*Nereis* sp.) co-culture with sea bass.

Material and Methods:

Polychaete:

Nereis sp. is naturally found in seabass Earthen Ponds in Milas, Muğla. This species has a natural distribution area in Güllük Lagoon (Egemen et al., 1999) which has openings with drainage canals in Earthen pond aquaculture plants. The samples (200g) were collected from earthen pond area.

Fish Feed:

The fish feed used in the experiment is a commercial feed used for sea bass. The nutritional content of this feed as follows; Protein: 45%, Lipid: 20%, Ash: 10% etc.

Fatty Acids Methyl Esters (FAME) Analyses:

Lipid extraction was done according to the Bligh and Dyer method (1959). Methyl esters were prepared by transmethylation using 2 M KOH in methanol and isooctane according to the method described by Ichihara et al., (1996) with minor modification; 25 mg of extracted oil was dissolved in 2 ml isooctane, followed by 4 ml of 2 M methanolic KOH. Then, the tube was vortexed for 2 min at room temperature. After centrifugation at 4000 rpm for 10 min, the isooctane layer was taken for GC analyses.

Gas Chromatography (GC) Conditions:

FAME was analyzed on an Agilent gas chromatograph (GC) model 7820 equipped with a flame ionization detector (FID) and fitted with an HP-88 capillary column (60 m x 0.25 mm i.d. x 0.25 μm thickness). Helium was used as the carrier gas at a constant pressure of 16 psi. Injection port was maintained at 220°C, and the sample was injected in split mode with a split ratio of 50:1. Detector temperature was 280°C. The column temperature was started at 140°C, and then programmed at 4°C/min to 200°C, ramped at 1°C/min to 220°C, and held for 10 min. The total running time was 25 minutes. Helium was used as the makeup gas at a constant flow of 30 mL/min, and hydrogen and dry air were used as detector gases (EN ISO 5508, 1990). Identification of fatty acids was carried out by comparing sample FAME peak relative retention times with those obtained for Supelco standards (Supelco 37 Compounds FAME mix 10 mg/ml in CH_2Cl_2 – 47885 U, Supelco 1819-1 Ampule FAME mix C4-C24).

Results of each fatty acids were expressed as FID response area relative percentages of the total fatty acids determined (EN ISO 5508, 1990).

Results and Discussion

In this study, Fatty Acid(FA) analyses were done by GC and, Saturated FA(SAFA), Monosaturated FA(MUFA), Polysaturated FA(PUFA), Highly Unsaturated FA(HUFA) were calculated by percentage. Comparison of the results, fish feed lipid has a low percentage than the ragworm in SAFA and HUFA but on the other hand MUFA, PUFA levels were higher than ragworm.

Table 1: Fatty Acid Profiles of Fish Feed and Ragworm(*Nereis* sp.)

FA	Fish Feed	Ragworm
SAFA	15,999 (±1,78)	27,87043(±2,40)
MUFA	39,18192(±0,93)	32,91025(±0,89)
PUFA	39,86425(±0,83)	39,21933 (±1,51)
HUFA in PUFA	11,61 (±0,061)	12,9042 (±0,36)
n3:n6	0,624038	1,162791
DHA/EPA	0,80	0,48

In the light of the results, ragworm FA analyses show a high correlation with fish feed in FA profile. This levels will be changed the availability of fish feed in the sediment which was conducted by seasonal differences(Alonso et al., 2008) and fish density in the Earthen Ponds. The findings on fish feed and ragworm FA profiles also have the same correlation with Pajand et al., 2016. EPA and DHA were the major components of fish oil and these FA were over %10 of FA components of Ragworms.

All these results demonstrate that *Nereis* sp. has a good potential candidate for fish feed and reduction the organic matters from the sediment of the Earthen Pond systems. But it has to know that co-culture has disadvantages which some group of fish(Sparidae) likes to eat these worms.

References

Bligh,E.G. and Dyer,W.J. 1959. A rapid method for total lipid extraction and purification. Can.J.Biochem.Physiol. 37: 911-917

BSGM, 2018, Balıkçılık ve Su Ürünleri Genel Müdürlüğü Türkiye'de su ürünleri üretimi, 2017 yılı verileri https://www.tarimorman.gov.tr/sgb/Belgeler/SagMenuVeriler/BSGM.pdf

Egemen, Ö., Önen, M., Büyükışık, B., Hoşsucu, B., Sunlu, U., Gökpınar, Ş., Cirik, S., 1999. Güllük Lagünü Ekosistemi, Tr.J.of Agriculture and Forestry 23 (1999). Ek sayı 3, s.927-947 TÜBITAK.

Fidalgo e Costa, P., Passos, A.M., and Fonseca L. Cancela da, 2003, Polychaetes and their potential use in aquaculture, World Aquaculture vol:43 pp:41-43

Goerke H. 1971. Die Ernahrangwise der Nereis-arten (Polychaeta: Nereidae) Der Duetschen Kusten. Verof Institute Meeresforch, Bremeth 13:1-50

Köymenoğlu A.,Ercan E., 2013. Muğla İli Milas İlçesinde Toprak Havuzlarda Balık Yetiştiriciliği Yapan İşletmelerde Su Kalitesinin Üretim Kapasitelerine Etkisi. 17. Ulusal Su Ürünleri Sempozyumu, İstanbul

Olive, P.J.W. and Cowin P.B.D.. 1994. The management of natural stocks and the commercial culture of Polychaeta as solutions to the problems of "bait-digging" and worm supply for sea angling in the UK. Polychaete Res., 16: 23-27

Reish, D. J. 1954. The life history and ecology of the polychaetous annelid *Nereis grubei* (Kinberg). Occ. Pap. Allan Hancock Found. 14: 1-75.

The determination of the binding capacity of heavy metal ions of *Nannochloropsis oculata*

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Nannochloropsis oculata is widely used as a live microalgae in many marine fish hatcheries (rotifer production and larval tanks) due to its rich nutritional value. Zinc chloride (ZnCl2), copper chloride ($CuCl_2$), cobalt chloride (CoCl2.H2O), manganese chloride (MnCl2) were used for metal bonding studies. The initial culture density was applied in 5 different doses of Zn, $^{+2}$, Mn, Co, Cu metals for biomass amounts at 82.4 days -1, *in vivo* ch la, and each dose was administered in three replicates. In the study, heavy metals were prepared such that 0.1, 0.2, 0.3, 0.4, 0.5 atomic weights were moles. . The whole concentration of zinc, cobalt and copper on *Nannochloropsis oculata* adversely affected the growth and inhibited the growth of the species. In the case of manganese copper, the zinc structure of 0.4 and 0.5 mol was effective in inhibiting growth. Manganese treatments were found to have no negative effect on the growth of *Nannochloropsis oculata*.

Keywords: Absorption, Adsorption, Heavy metal, *Nannochloropsis oculata*

Introduction

Owing to their high toxicity, heavy metals pose a serious threat to biota (Areco and Afonso, 2007) and the environment. As a result, it is necessary to treat or alleviate heavy metal burden of wastewaters properly before discharge (Volesky, 2001). For years, researchers have looked for alternative methods to remediate the problem on heavy metal-contaminated waters and thus reducing growing public health risk. Several conventional physicochemical methods for stripping toxic metals from heavy waters are neither efficient nor cost effective (Eccley,1999). They are only practical when applied to high strength wastes with heavy metal ion concentrations greater than 100 ppm, but generally, treatment for low strength heavy metal content in wastewaters is not successful with such methods (Madacha et. al., 2006).

The organism was selected because it is unicellular, generally does not clump or attach to surfaces, divides uniformly, has a broad nutrient response, is an obligate autotroph, and is generally found in oligotrophic water. The growth kinetics and nutrient response of organism have been widely stuied. *Nannochloropsis oculata* has rich nutritional value is widely used as live microalgae for larvae breeding (both of rotifer production and of larval tanks) in many marine fish hatcheries. The aim of this study is to determine levels of intake from the environment by *N. oculata* a microalga of zinc, copper, manganese and cobalt elements found at high levels in the wastewater. Another goal is to increase the quality of water by eliminating of heavy metals that increase environmental pollution and disrupt ecological balance, in addition, to investigate the effect of heavy metals on the growth rate of *N. oculata*.

Material and Methods

Zinc chloride ($ZnCl_2$), copper chloride ($CuCl_2$), cobalt chloride ($CoCl_2$), manganese chloride ($MnCl_2$) components were used for metal binding studies. The *in vivo* chlorophyll a value for initial culture density was 82.4 days^{-1}. Zinc (Zn), manganese (Mn), cobalt (Co) and copper (Cu) metals were used in five different doses (0.1, 0.2, 0.3, 0.4, 0.5 g mol^{-1}) with each dose three times for biomass quantities.

Results

All concentrations of Zn, Co and Cu adversely affected the growth of *N. oculata* and inhibited its growth (Fig 1,2). The percentage of inhibition was the highest (75 %) in concentrations both of 0.2 g mol^{-1} of zinc and of 0.3 g mol^{-1} of cupper, by followed 0.2 g mol^{-1} of cobalt (74 %). Manganese did not have a negative effect on the growth of *N. oculata* (Fig 2).

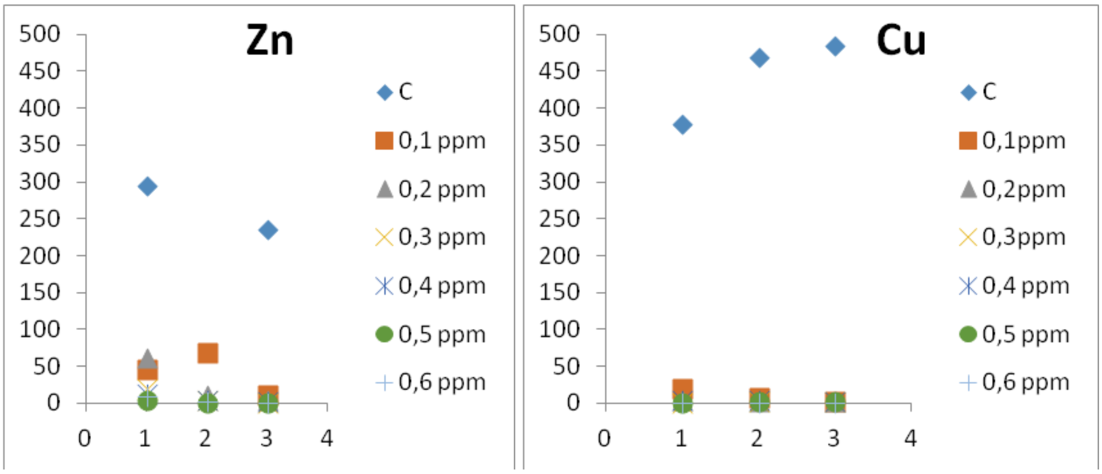

Figure 1. ***Nannochloropsis oculat*****a time dependent toxicity values exposed to zinc, copper (control; 0,2; 1; 5,10; 25; 50 ppm)**

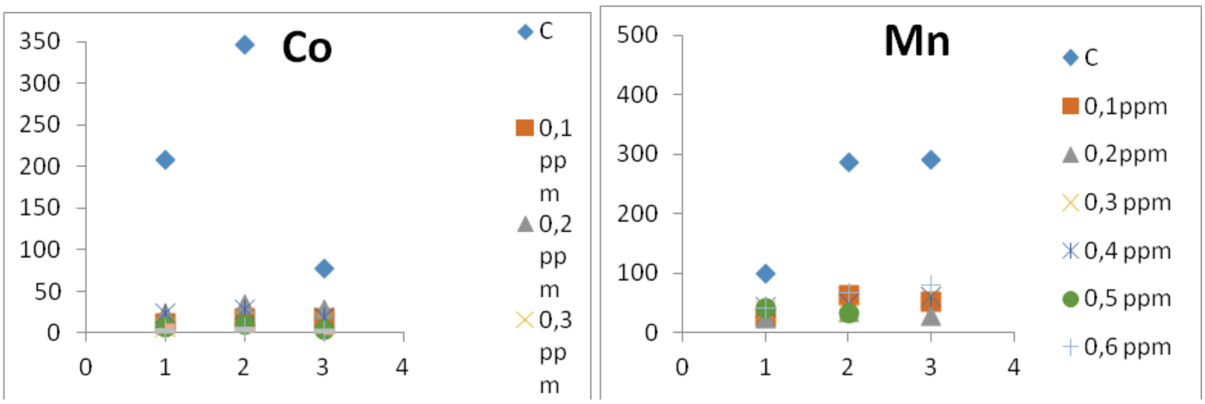

Figure 2. ***Nannochloropsis oculat*****a time dependent toxicity values exposed to Co, Mn (control; 0,2; 1; 5,10; 25; 50 ppm)**

Conclusion

It revealed by this research that the amount of Mn added to the culture medium did not have a negative effect of on *N. oculata* alga growth. Due to the effect on Mn precipitation, N. *oculata* may be suggested to use this metal for removal from water.

References

Areco, M. M., & Afonso, M. D. S. 2007. Zinc biosorption by seaweed illustrated by the zincon colorimetric method and the Langmuir isotherm. Journal of chemical education, 84(2), 302-305.

Eccles, H. 1999. Treatment of metal-contaminated wastes: why select a biological process?. Trends in biotechnology, 17(12), 462-465.

Madacha, V., Apiratikul, R., & Pavasant, P. 2006. Heavy metals uptake by dried Caulerpa lentillifera. In The 2nd Joint international conference on "Sustainable Energy and Environment (SEE 2006)" E043 (P)(pp. 21-23).

Volesky, B. 2001. Detoxification of metal-bearing effluents: biosorption for the next century. Hydrometallurgy, 59(2), 203-216.

Otolith Dimensions-Fish Length Relationships of Mediterranean slimehead (*Hoplostethus mediterraneus*) Caught From Northeastern Mediterranean, Turkey

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This study provides the first information on the otolith dimensions-fish length relationships of *Hoplostethus mediterraneus* in the Northeastern Mediterranean Sea. Fish samples were caught by commercial bottom trawler at a depth of 200 to 380 m off the Iskenderun Bay (Hatay, Turkey). A total of 432 fish specimens were examined. Minimum-maximum length and weight of captured fishes were determined as 6.4-17.6 cm and 3.40-77.92 g for females and 6.5-16.8 cm and 3.40-66.88 g for males respectively. The relationships of total length of fish with otolith length and total length with otolith breadth were possitive and strong levels(R^2=0.8615; (R^2=0.8233). There is no significant differences were found on the values of right otoliths and left otoliths ($P > 0.05$).

Keywords: Otolith morphometry, *Hoplostethus mediterraneus*, Mediterranean slimehead, northeastern Mediterranean

Introduction

Mediterranean slimehead, *Hoplostethus mediterraneus* is one of the cosmopolitan bathypelagic fish species inhabiting mainly near the bottom at depths 300-1000 m (Anastasopoulou, 2017; Başusta *et al.*,2016). Distribution includes the Atlantic ocean from the British Isles to South Africa, Indian Ocean and New Zealand (Golani *et al.*, 2006). It has minor commercial importance and considered as target species for fishery in other areas (Golani *et al.*, 2006).

There is only a study on the otolith morphometry of *H. Mediterraneus* by Anastasopoulou (2017). Therefore, this study provides the first knowledge on the otolith dimensions-fish length relationships of *H. mediterraneus* in the North-eastern Mediterranean Sea.

Material and Methods

Fish samples were caught by commercial bottom trawler at a depth of 200 to 380 m off the Iskenderun Bay (Hatay, Turkey) between May 2015 and July 2015 (36° 13' 650"N- 035° 23' 032"E; 36° 16' 622"N- 035° 18' 509"E) (Fig. 1). Both right and left sagittal otoliths were extracted from each fish, kept in 10% KOH solution for nearly 5 min and stored dry in plastic bag for further observation. Otolith length (OL), breadth (OB) weight (OW) were measured from each specimen nearest 0.001 mm and 0.0001g respectively and scale under a binocular stereoscopic microscope (Leica S8APO) combined to a computer. The otolith dimensions-total length relationships were examined by using the following equation: $y= a+bx$.

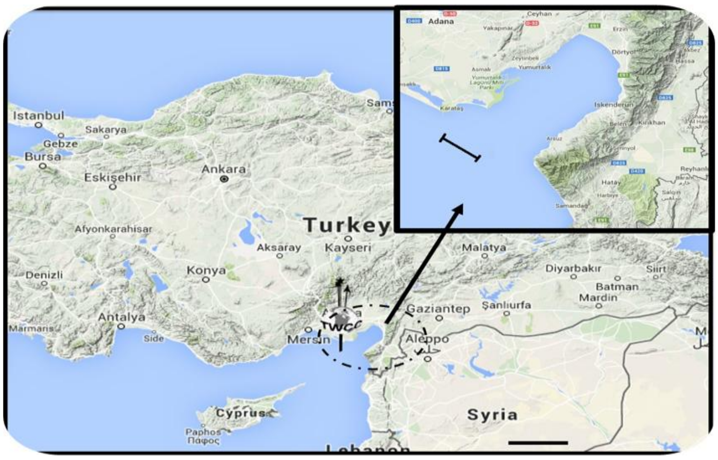

Figure 1. Map of the study area, off Iskenderun Bay.

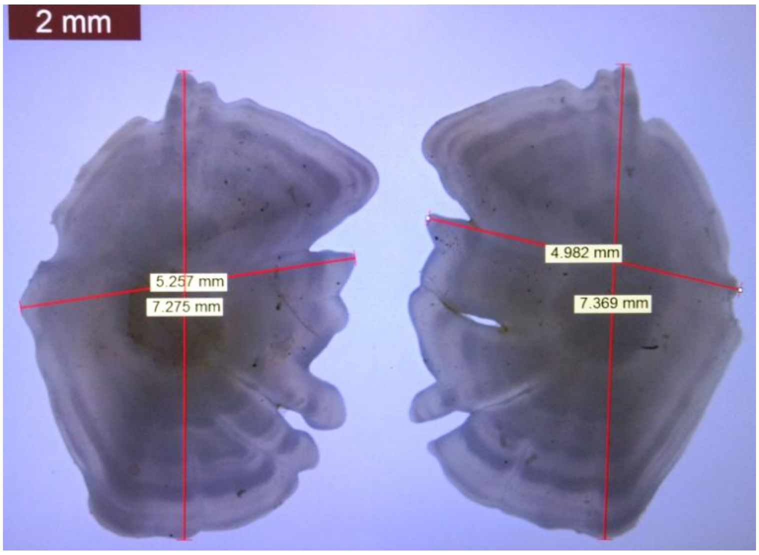

Figure 2. Lengths and breadths measurements of right and left otoliths.

Results

The right and left otolith measurements are given in Table 1. and 2. The relationships of total length of fish with otolith length and total length with otolith breadth are shown in (Fig. 3 and Fig. 4). Both relationships were linear with equations: y=0.5817x0.5833 (R^2=0.8615) and y=0.4097x+0.5541(R^2=0.8233), respectively. According to the determination coefficients (R^2), it can be said that both relationships are possitive and strong level. The relationships of total length with otolith weight and fish weight with otolith weight are shown in Fig. 5 and Fig. 6. Both relationships were linear with equations: y=0.007x-0.0373 (R^2=0.9049) and y=0.0015x+0.0158 (R^2=0.8153), respectively.

Table 1. Right and left otolith measurements.

	Otolith length (mm)		Otolith breadth (mm)		Otolith weight (g)	
	Min-Max	**Average±S.E**	**Min-Max**	**Average ±S.E**	**Min-Max**	**Average ±S.E**
Right Otolith	4.124-10.838	5.829±0.05	2.908-7.757	4.248±0.04	0.0124-0.0998	0.031±0.0007
Left Otolith	4.100-10.596	5.731±0.05	2.908-7.265	4.161±0.03	0.0119-0.0990	0.031±0.0007

Table 2. According to sexes otolith measurements.

	Otolith length (mm)		Otolith breadth (mm)		Otolith weight (g)	
	Min-Max	**Average±S.E**	**Min-Max**	**Average ±S.E**	**Min-Max**	**Average ±S.E**
Right Otolith	4.124-10.838	5.829±0.05	2.908-7.757	4.248±0.04	0.0124-0.0998	0.031±0.0007
Left Otolith	4.100-10.596	5.731±0.05	2.908-7.265	4.161±0.03	0.0119-0.0990	0.031±0.0007

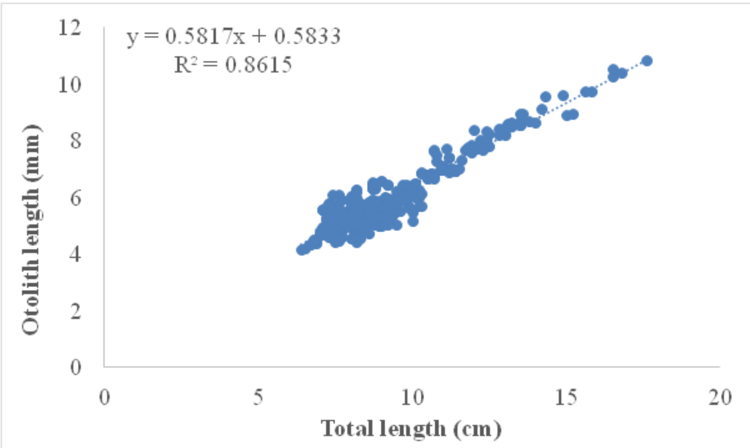

Figure 3. The relationship between total length and otolith length.

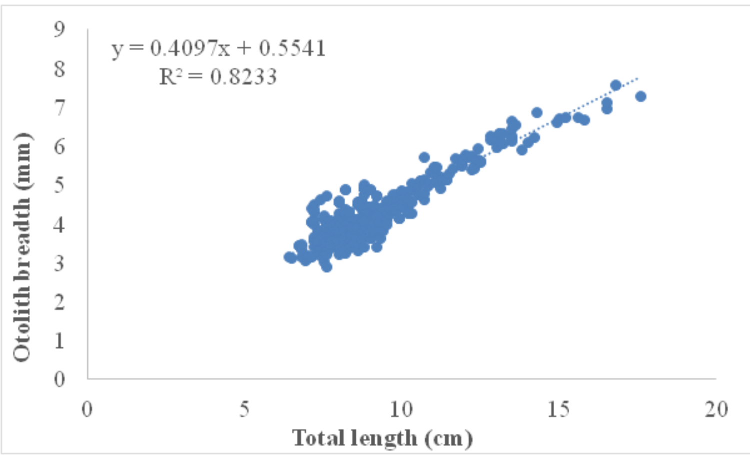

Figure 4. The relationship between total length and otolith breadth.

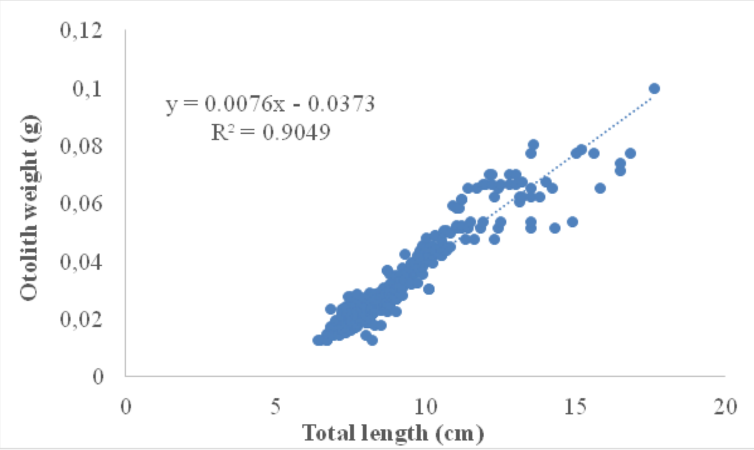

Figure 5. The relationship between total length and otolith weight.

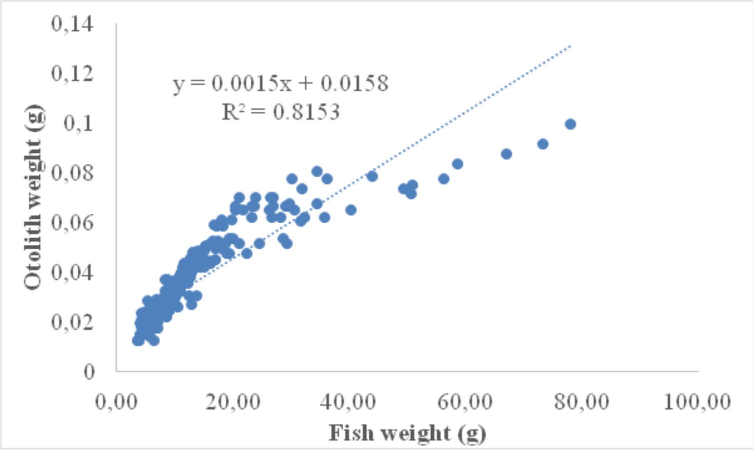

Figure 6. The relationship between fish weight and otolith weight.

Discussion

There is no significant differences were found on the values of right otoliths and left otoliths ($P > 0.05$). So, only right or left otolith can be used instead of both of them in future studies on this species. It is possible to say that 90% increase in otolith weight was due to total length increase for this species. Harkönen (1986), reported that there is a high correlation between fish length and otolith length and that is generally a linear relationship. Brander (1974) asserted that otolith mass has a direct relationship to the fish age. This is the first study on the otolith dimensions-fish length relationships of *H. mediterraneus* in the Northeastern Mediterranean Sea.

References

Anastasopoulou A., Vassilopoulou V., Katsanevakis S., and Karachle P.K., (2017) Mediterranean slimehead, *Hoplostethus mediterraneus* in the Ionian Sea, Greece: otolith morphometry, age and growth. Pp. 1-11 In Pauly D., Hood L., and Stergiou K.I. (eds.) Belated contributions on the biology of fish, fisheries and features of their ecosystems. Fisheries Centre Research Reports 25(1). Institute for the Oceans and Fisheries, University of British Columbia.

Başusta, A., Başusta, N., Buz, K., Girgin, H. & Dağ, N., (2016). Length-weight relationship of Mediterranean slimehead (*Hoplostethus mediterraneus*) obtained from northeast Mediterranean (in Turkish with English abstract).Ege Journal of Fisheries and Aquatic Sciences, 33(1): 63-65.doi:10.12714/egejfas.2016.33.1.09

Brander, K. 1974. The effects of age-reading errors on the statistical reliability of marine fishery modelling. In: The Ageing of Fish (ed. T.B. Begenal). Unwin Bros., Surrey.

Golani D., Öztürk B. and Başusta N., 2006. Fishes of The Eastern Mediterranean. Turkish Marine Research Foundation, Istanbul, Turkey. Pub. Number: 24, pp. 259.

Härkönen, T. 1986. Guide to the otoliths of the bony fishes of the Northeast Atlantic. Danbiu ApS. Biological Consultants, Denmark, 251 pp

Length- Weight Relationship and Condition Factor of Hollowsnout grenadier (*Coelorinchus caelorhincus*, (Rinso, 1810)) From Iskenderun Bay, northeastern Mediterranean, Turkey

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This study was carried out to determine the length-weight relationship of *Coelorinchus caelorhincus* obtained from northeastern Mediterranean. A total of 545 fish samples (263 females and 282 males) were collected. Female/male ratio of this species was 1.07/1. The length-weight relationships of *Coelorinchus caelorhincus* were estimated as $W=0.0024*L^{3.136}$, $R^2=0.94$, for all individuals, $W=0.0020*L^{3.202}$, $R^2=0.95$ for females and $W=0.0033*L^{3.021}$, $R^2=0.91$ for males. According to b values, the growth type of this species was isometric for males and sexes combined (b = 3) positive allometric growth for females (b>3), (t-test: $p < 0.05$). Condition factor ranged from 0.2434 to 0.4811 for females and from 0.2212 to 0.5956 for males

Keywords: Length-weight relationship, Hollowsnout grenadier, Growth, *Coelorinchus caelorhincus*, Condition factor.

Introduction

Hollowsnout grenadier (*Coelorinchus caelorhincus*), inhabits on muddy substrate at depths of 100-800 m (usually150-400m). *C. caelorhincus* is Atlanto-Mediterranean and distributed from Norway to Angola on the eastern Atlantic and from Canada to Brazil on the western Atlantic (Golani *et al.*, 2006).

Hollowsnout grenadier in the other areas of the Mediterranenan were studied satisfactorily on the lenght-weight relationships (LWR), age, growth and feeding habits by some researchers during recent years (Morey et al. (2003); Borges et al. (2003); Filiz and Bilge (2004); Filiz et al. (2006); Isajlovic et al. (2009).

Biological studies on the deep sea fish fauna are limited. Therefore, this paper provides the first information on the length-weight relationships and condition factor of *C. caelorhincus* in the Northeastern Mediterranean coast of Turkey.

Material and Methods

Coelorinchus caelorhincus specimens were caught by commercial bottom trawler at a depth of 300 to 400 m off the Iskenderun Bay (36°07´148 N-035°17´978 E, 36°13´720 N-035°22´998 E). The trawler was equipped with 44 mm stretched mesh size nets at the cod-end. Trawling lasted 4 hours and the trawling speed was 2.5 knots (Fig. 1). Fish specimens transported to the laboratory, Fisheries Faculty, Firat University on ice.

Each fish was measured for total length to the nearest 0.1 cm, weight (W) was measured to the nearest 0.1 g and the sex was determined by macroscopic observation of the gonads.

Total lengths and weights were fitted to the length-weight equation: $W=aL^b$, by using least square methods with Statistica software (Ricker, 1975).

The *b* value for this species was tested by a *t*-test at the 0.01 significance level to verify if it was significantly different from 3 (Zar, 1999).

Figure 1. Map of the study area, off Iskenderun Bay (Northeastern Mediterranean).

Results

A total of 545 *C. caelorhincus* (263 females and 282 males) were collected. Minimum-maximum length and weight of captured fishes were determined as 10-29.3 cm and 2.93-93.36 g for females and 9.4-25.6 cm and 2.71-62.89 g for males, respectively. Female/male ratio of captured fishes was 1.07/1.

Length-weight relationships of *C. caelorhincus* were estimated as $W=0.0024*L^{3.136}$, $R^2=0.94$, Standart Error (SE) of b=0.0024 and 95 % confidence intervals of b=2.969-3.339, t-test P<0.05 for sexes combined (Fig. 2), $W=0.0033*L^{3.021}$, $R^2=0.91$ SE of b=0.0037 and 95 % confidence intervals of b=2.848-3.221, t-test P<0.05 for males and $W=0.0020*L^{3.202}$, $R^2=0.95$, SE of b=0.0029 and 95 % confidence intervals of b=3.077-3.318, t-test P<0.05 for females. According to these values, the growth type of this species was isometric for males and all sexes (b = 3) positive allometric growth for females, (t-test: $p < 0.05$).

Regression analysis is shown that fish length has significant correlation with weight (R = 0.97, $R^2 = 0.94$,) and it is possible to say that 94% increase in weight was due to length increase for sexes combined.

In addition, when the t-test results were examined for the significance of regression coefficients (P <0.01 for all sexes), it was found that fish-length data could be used in high precision to predict fish weight.

Condition factor ranged from 0.2434 to 0.4811 for females and from 0.2212 to 0.5956 for males.

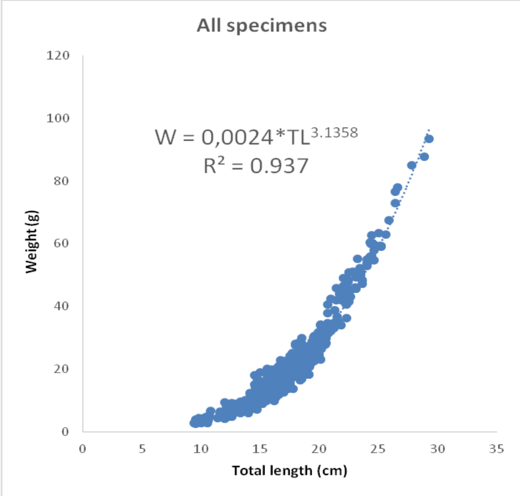

Figure 2. Length-weight relationships of *C. caelorhincus*

Discussion

According to *b* values, all individuals and males showed isometric growth (t-test: $p < 0.05$) while females showed positive allometric growth. According to regions calculated b values for this species were found 3.008 for sexes combined, 3.17 for males and 2.969 for females in Sigacik Bay (Aegean Sea) by Filiz et al. (2006), 3.1417 for westhern Mediterranean by Morey et al. (2003), 3.106 for south coast of Portugal by Borges et al. (2003), 3.110 for Lebanese marine waters by Lelli et al. (2017), These values are very close in our study. Reported some b values, 2.74 for North Aegean Sea by Filiz and Bilge (2004), 2.6501 for sexes combined, 2.6668 for males and 2.6173 dor females in Adriatic Sea by Isajlovic et al. (2009) are different from our b values. These differences may be caused by the lower sample size, sampling season, different regions or used fishing techniques. In this study, the data did not represent a total year, thus, these calculated parameters should be considered to represent only for 2015 summer season.

References

Borges, T.C., Olim, S., Erzini, K., 2003. Weight-length relationships for fish species discarded in the commercal fisheries of the Algarve (southern Portugal). J. Appl. Ichthyol. 19: 394-396.

Golani D., Öztürk B. and Başusta N., 2006. Fishes of The Eastern Mediterranean. Turkish Marine Research Foundation, Istanbul, Turkey. Pub. Number: 24, pp. 259.

Filiz, H., Bilge, G., 2004. Length–weight relationship of 24 fish species from the North Aegean Sea, Turkey. J Appl Ichthyol 20: 431-432.

Filiz, H., Bilge, G., Irmak, E., Toğulga, M., Akalın, S. 2006. Age and growth of hollowsnout grenadier, Coelorinchus caelorinchus (Risso,1810) in the Aegean Sea. J. Appl. Ichthyol.,22: 285-287.

Isajlovic, I., Vrgoc, N., Zorica, B., Peharda, M., Sifner, S.K., Piccinetti, C., 2009. Age, growth and length-weight relationship of Coelorinchus caelorinchus (Risso,1810) in the Adriatic Sea. Acta Adriat. 50 (1): 23-30.

Lelli, S., Lteif, M., Jemaa, S., Khalaf, G., Verdoit-Jarraya, M., 2017. Weight–length relationships of 3 fish species from Lebanese marine waters, eastern Mediterranean. J Appl Ichthyol 34: 153–156.

Morey, G., Moranta, J., Massuti, E., Grau, A.,Linde, M., Riera, F., Morales Nin, B., 2003. Weight-length relationships of littoral to lower slope fishes from the western Mediterranean. Fish. Res. 62: 89-96.

Ricker, W.E., 1975. Computation and Interpretation of Biological Statistics of Fish Populations, Bulletin of the Fisheries Researh Board of Canada, 191:1-382.

Zar J.H., 1999. Biostatistical Analysis 4th ed. Prentice Hall. New Jersey, pp:929.

Abundance and Distribution of Picoplankton in the Northeastern Mediterranean Sea

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Pelagic microscopic flora is consisted mainly of picoplanktonic fraction of phytoplankton in the oligotrophic offshore waters of northeastern Mediterranean Sea lacking sufficient amount of dissolved nutrients in euphotic layer. Present study aimed to investigate temporal and spatial heterogeneity in eukaryotic picoplankton (small eukaryotes) as well as in marine cyanobacteria *Synechococcus* and *Prochlorococcus* in different sectors of the basin. Samples were collected from 50 different stations including eutrophic Mersin Bay, Göksu River discharge area and oligotrophic offshore waters during October 2017 and February 2018. Flowcytometric cell counts clearly indicated dominancy of P*rochlorococcus* over *Synechococcus* and small eukaryotes in the study area. At surface, abundance of small eukaryotes, *Synechococcus* and *Prochlorococcus* varied in the range >1084; 11059 – 53842; 51661 – 29975 cells/ml in October 2017 and in the range 186 – 8122; 1835 – 77334; 261 - 77535 cells/ml in February 2018. Small eukaryotes have been found to be most numerous near Göksu discharge area and could not compete with marine cyanobacteria in offshore waters. *Synechococcus* and *Prochlorococcus* profiles have displayed similar patterns with subsurface peaks observed at around 50-75 m depths in October 2017. Conversely to maximal abundance was reached at surface in February 2018 where abundance decreased with depth. It is concluded that *Prochlorococcus* is the most abundant group in the study area compared to small eukaryotes and *Synechococcus*.

Keywords: picoplankton, *Synechococcus*, *Prochlorococcus*, abundance, northeastern Mediterranean

Introduction

Nutrient and chlorophly-*a* content of Mediterranean decrease from west to east and south to north depending upon major current systems and decreasing riverine nutrient inputs, respectively. (Krom et al., 1991, Moutin and Raimbault, 2002; Ortenzio and Alcal, 2009). As a result, Northeastern Mediterranean is known as the most oligotrophic sea in the world (Yılmaz and Tuğrul, 1998; Krom et al., 1991). Because of this oligotrophic nature, primary productivity relies mostly on smaller forms of phytoplankton (picoplankton) in this basin (Yücel, 2013; Uysal and Köksalan, 2017). Therefore, knowing the picoplankton abundance is crucial to understand microbial food web dynamics in the system. The aim of the present study is to investigate spatial and temporal heterogeneity in small eukaryotes as well as in marine cyanobacteria *Synechococcus* and *Prochlorococcus* in areas with varying trophic capacity.

Material and Methods

In the present study, vertical and horizontal distribution of small eukaryotes and marine cyanobacteria *Synechococcus* and *Prochlorococcus* have been investigated in the northeastern Mediterranean. Sample collection was carried out at 50 different stations all covering partly the eutrophic Mersin Bay, Göksu River discharge area and oligotrophic offshore waters during October 2017 and February 2018 (Fig. 1).

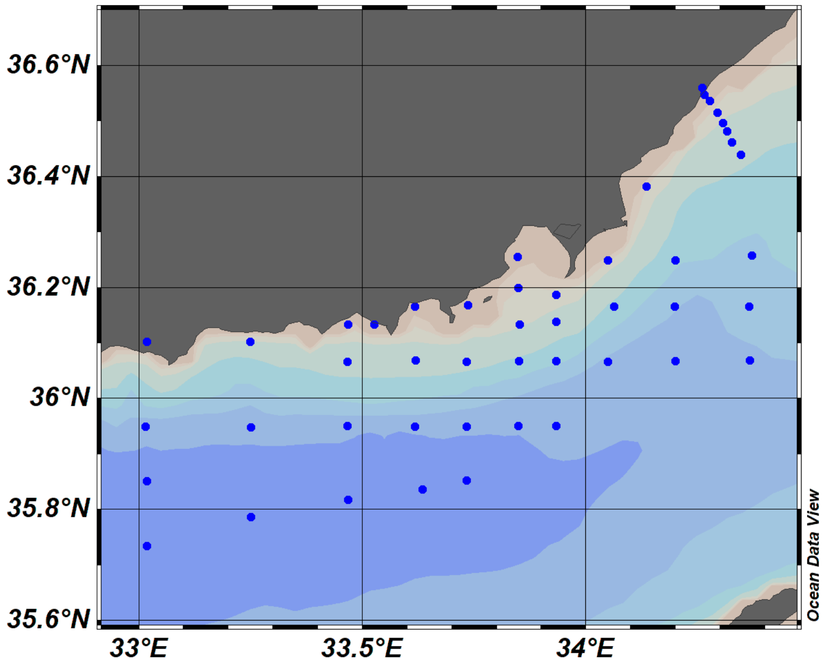

Fig. 1. Location of the sampling stations

Two cruises were undertaken on board R/V Bilim-2 of the Institute of Marine Sciences, Middle East Technical University in October 2017 and February 2018. Water samples from surface and various depths up to 200 meters were collected using 5 liters capacity Nansen closing bottles attached to a rosette sampler housing a Sea-bird Electronics-911 plus CTD probe. Samples taken from Nansen bottles were transferred into 50 ml dark glass bottles. Thereafter, 1.25 ml of 25% glutaraldehyde was added to provide a final concentration of 0.625%. Cell-counts were carried out using an Apogee brand flow-cytometry device.

Results and Discussion

Minimum and maximum abundance of small eukaryotes were found as 0-1084 cells/mL with an average of 160 cell/mL in October 2017 and 186-8.122 cells/mL with an average of 1.737 cells/mL in February 2018 (at surface). Results clearly showed that abundance of small eukaryotes increased in February as a result of winter conventional mixing. Profiles (not given here) indicated that abundance of small eukaryotes decreased with depth within the euphotic layer due to deficiency in dissolved nutrients. Eukaryotic microorganisms were found more abundant in coastal areas than offshore areas. However, they could not compete with cyanobacteria even in Göksu discharge area (Figure 2, Figure 3).

Surface minimum and maximum abundances of marine cyanobacteria, *Synechococcus,* were found as 11.059-53.842 cells/mL with an average of 11.059 cells/mL in October 2017 and 1.835-

77.334 cells/mL with an average of 17.963 cells/mL in February 2018. Similar to small eukaryotes, *Synechococcus* abundance was found greater in February. *Synechococcus* abundances observed recently have been found to be relatively less compared to the previous studies conducted in the same area (Uysal ve Koksalan, 2006; 2017; Uysal, 2006; Bayındırlı, 2007). Surface distribution of *Synechococcus* showed heterogenous distribution and dense populations were observed in both coastal and offshore waters in October 2017. However, in February 2008, *Synechococcus* population was only dense in coastal regions (Figure 4). Deep chlorophyll maximum (DCM) was observed at 50-75 meter depth range depending on station during October 2017 stratification period.

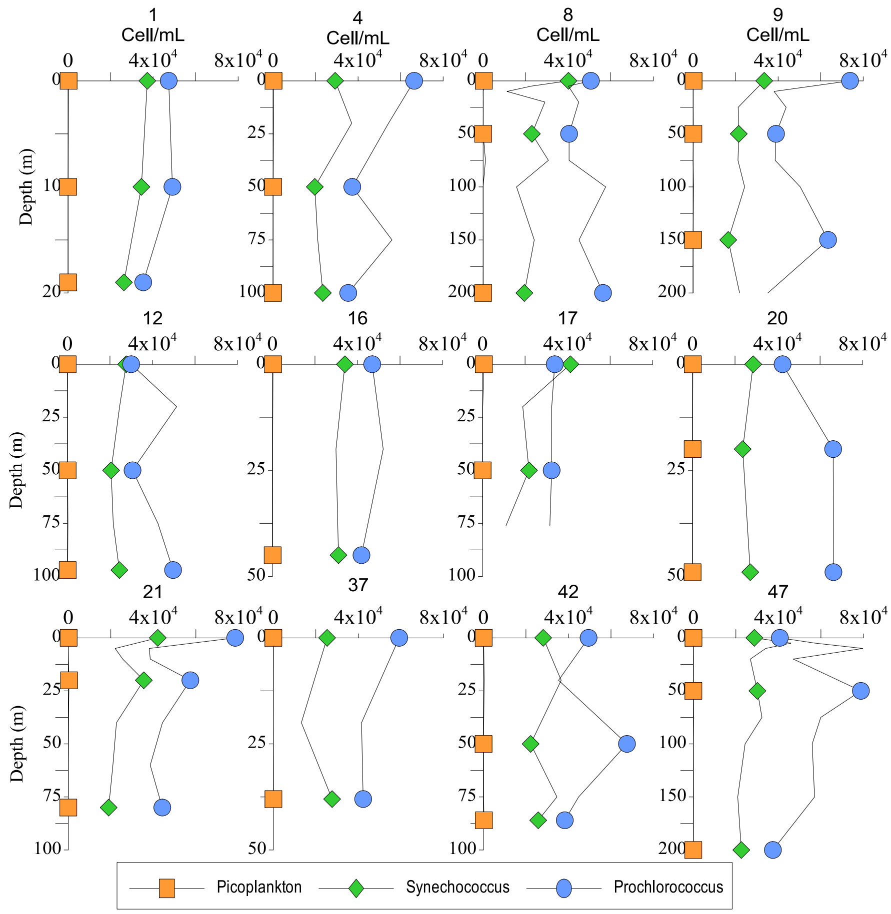

Figure 2. Vertical distribution of picoplankton (small eukaryotes), *Synechococcus* and *Prochlorococcus* in October 2017

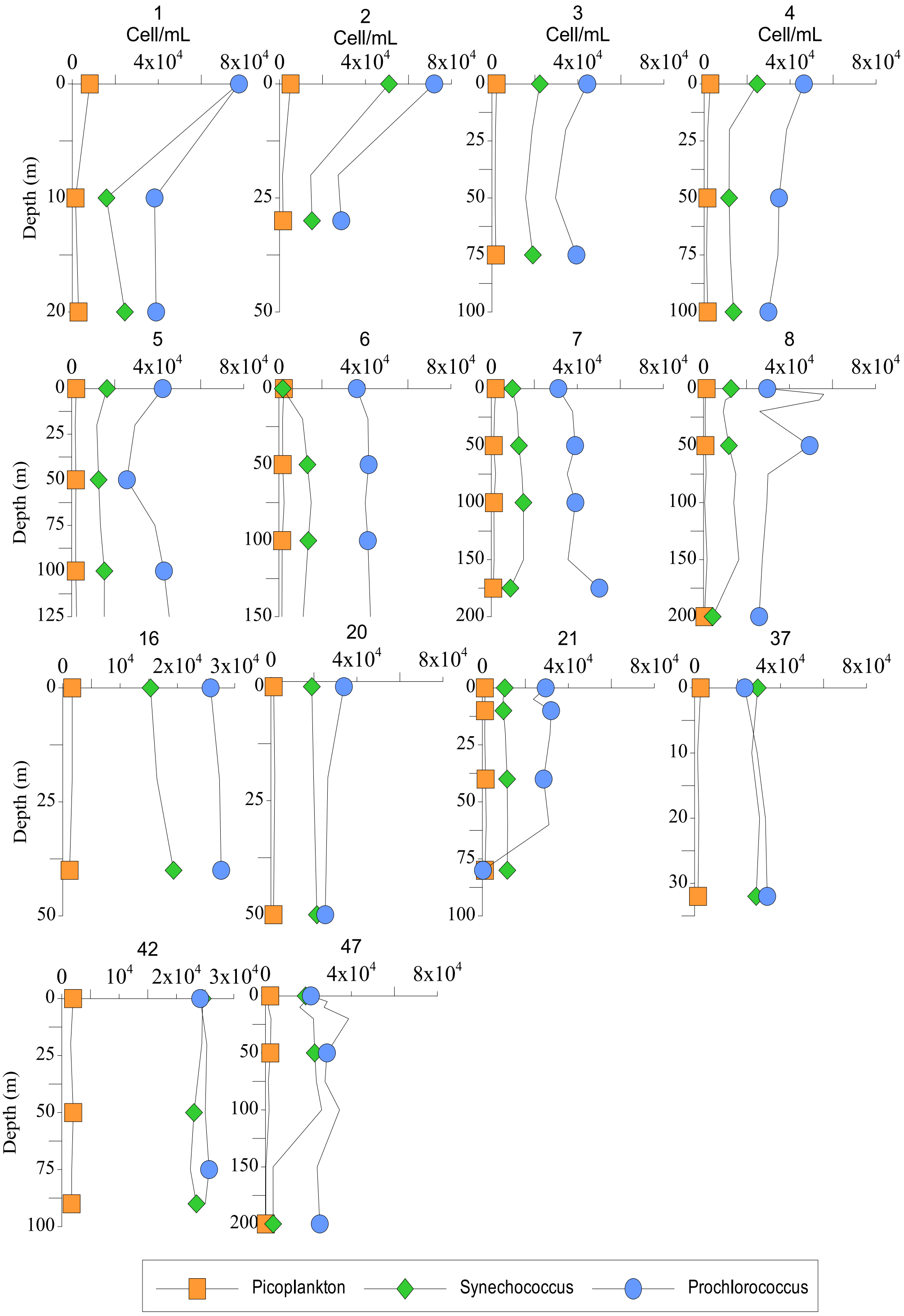

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Figure 3. Vertical distribution of picoplankton (small eukaryotes), *Synechococcus* and *Prochlorococcus* in February 2018.

Minimum and maximum abundance of *Prochlorococcus*, were found as 29.975 – 100.911 cells/mL with an average of 51.661 cells/mL in October 2017 and 261 – 77.535 cells/mL with an average of 31.134 cells/mL in February 2018 (at surface). Even though, average *Synechococcus* abundance was closer to the *Prochlorococcus* in February 2018, they could not compete with

Prochlorococcus in both offshore and coastal regions (Figure 3-4). Therefore, it could be said that *Prochlorococcus* was the most dominant group at all stations and at all depths sampled in the study area during both sampling periods (Figure 2 and 3). These results indicate that *Prochlorococus* is more tolerant to varying ambient conditions (from highly oligotrophic to eutrophic) than *Synechococcus* and small eukaryotes. Similar to *Synechococcus*, surface distribution of *Prochlorococcus* was more homogenous in February 2018 than October 2017.

Results showed that among the present groups studied *Prochlorococcus* is the most abundant microorganism in the study area. However, their contribution to the total phytoplankton biomass could be different depending on season and/or station. Li et al. (1993) found that *Prochlorococcus* pigment-biomass constitutes only 30 % of total in Sargossa Sea. Charles et al. (2005) found that contribution of marine cyanobacteria to the total picophytoplankton biomass is insignificant during December and January in the NW Mediterranean. Similarly, Buitenhuis et al. (2012), found that *Prochlorococcus*, *Synechococcus* and picoeukaryotes accounts for 17-39%, 12-15% and 49-69% of total biomass in the global ocean, respectively.

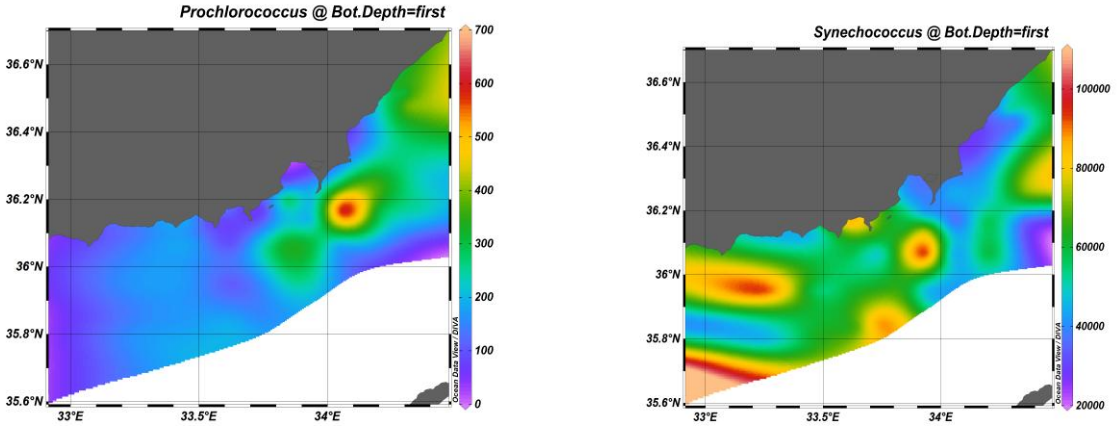

Figure 4. Surface distribution of *Prochlorococcus* and *Synechococcus* in October 2017

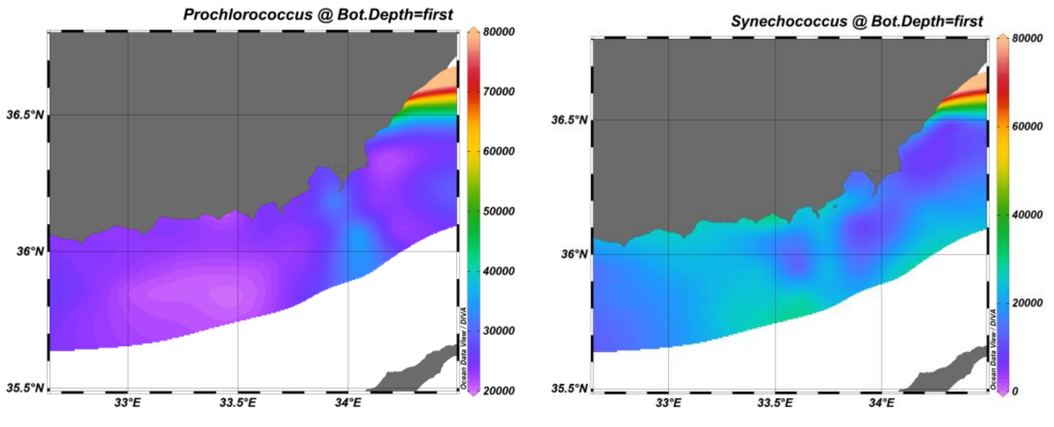

Figure 5. Surface distribution of *Prochlorococcus* and *Synechococcus* in February 2018

Relationships between small eukaryotes & marine cyanobacteria with ambient physical parameters (temperature, salinity, density, pH) were determined using Spearman rank corelation. Results showed that abundance of small eukaryotes depended on depth (negatively) and salinity (positively) for both seasons ($p<0.05$). On the other hand, temperature and density were only effective in October 2017 due to stratification period ($p<0.01$). Marine cyanobacteria *Synechococcus* abundance was strongly correlated with depth (negatively), temperature (positively) and salinity (positively) for both seasons

($p<0.01$). Additionally, there was a positive relationship between pH and density in February 2018. Lastly, even though *Prochlorococcus* abundance was only depended on depth in October 2017 ($p<0.05$), it is strongly posively depended on depth, temperature, pH and density on February 2018.

Table 1. Relationships between physical parameters and pikoplankton abundance based on Spearman's rank correlation coefficient

Abundance			Depth	Temprature	Salinity	pH	Density
October 2017	Small eukaryotes	Coefficient	-0.543	0.512	0.279	0.054	-0.509
		Significance	0.000	0.000	0.006	0.606	0.000
	Synechococcus	Coefficient	-0.720	0.334	0.507	-0.15	-0.325
		Significance	0.000	0.001	0.000	0.885	0.001
	Prochlorococcus	Coefficient	-0.238	-0.114	0.126	0.122	0.101
		Significance	0.020	0.272	0.225	0.239	0.328
February 2018	Small eukaryotes	Coefficient	-0.310	0,158	0,267	0,231	-0,188
		Significance	0.001	0.100	0.05	0.016	0.050
	Synechococcus	Coefficient	-0.329	-0.507	-0.339	0.440	0.342
		Significance	0.000	0.000	0.000	0.000	0.000
	Prochlorococcus	Coefficient	0.415	0.312	0.162	-0.518	-0.373
		Significance	0.000	0.001	0.093	0.000	0.000

Conclusion

This study is conducted to evaluate vertical and horizontal distribution of eukaryotic picoplankton, marine cyanobacterium *Synechococcus* and *Prochlorococcus* in contrasting regions. Flowcytometric cell counts showed that *Prochlorococcus* was most abundant than *Synechococcus* in offshore waters. While higher abundances of eukaryotic picoplankton and *Synechococcus* was found in winter, higher *Prochlorococcus* abundance was observed in fall. This study revealed that *Prochlorococcus* numerically is the major contributor to bulk phytoplankton in the northeastern Mediterranean which further needs to be studied in detail spatially and temporally.

Acknowledgment

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References

Bayındırlı, C. 2007. Monthly changes in the abundance and biomass of picoplankton (cyanobacteria Synechococcus & heterotrophic bacteria) in the Cilician Basin (Eastern Mediterranean). PhD Thesis. Middle East Technical University Institude of Marine Science, Mersin

Buitenhuis, E.T., Li, W.K., Vaulot, D., Lomas, M.W., Landry, M.R., Partensky, F., ... & Lantoine, F. (2012). Picophytoplankton biomass distribution in the global ocean. Earth System Science Data, 4(1): 37-46.

Charles, F., Lantoine, F., Brugel, S., Chrétiennot-Dinet, M. J., Quiroga, I., & Rivière, B. 2005. Seasonal survey of the phytoplankton biomass, composition and production in a littoral NW Mediterranean site, with special emphasis on the picoplanktonic contribution. Estuarine, Coastal and Shelf Science, 65(1-2): 199-212.

Krom, M.D., Kress, N., Brenner, S. & Gordon, L. 1991 Phosphorous limitation of primary productivity in the Eastern Mediterranean Sea. Limnol. Oceanogr., 36: 424–432

Li, W.K.W., Zohary, T., Yacobi, Y.Z., & Wood, A.M. 1993. Ultraphytoplankton in the eastern Mediterranean Sea: towards deriving phytoplankton biomass from flow cytometric measurements of abundance, fluorescence and light scatter. Marine Ecology Progress Series, 79-87.

Moutin T. & Raimbault P. 2002. Primary production , carbon export and nutrients availability in western and eastern Mediterranean Sea in early summer 1996 (MINOS cruise). *J. Mar. Sci.*, 33: 273–288.

Ortenzio, F.D. & Alcal M.R. 2009. On the trophic regimes of the Mediterranean Sea : a satellite analysis. *Biogeosciences*, 6 : 139–148

Uysal, Z. & Koksalan, I. 2006. The annual cycle of Synechococcus (cyanobacteria) in the northern Levantine Basin shelf waters (Eastern Mediterranean). Marine Ecology 27: 187–197.

Uysal, Z. & Koksalan, I. 2017. Short term temporal & spatıal fluctuatıons ın marıne cyanobacterıum synechococcus abundance ın olıgotrophıc deep shelf waters (Northeastern Medıterranean). Fresenıus envıronmental bulletın, *26*(8): 5115-5124.

Uysal, Z. 2006. Vertical distribution of marine cyanobacteria Synechococcus spp. in the Black, Marmara, Aegean, and eastern Mediterranean seas. Deep-Sea Research II, 53:1976–1987.

Yılmaz, A. & Tuğrul, S. 1998. The effect of cold- and warm-core eddies on the distribution and stoichiometry of dissolved nutrients in the Northeastern Mediterranean. Journal of Marine Systems, 16 (3-4):253-268.

Yücel, N. 2013. Monthly changes in primary and bacterial productivity in the North – Eastern Mediterranean shelf waters. PhD Thesis. Middle East Technical University Instiude of Marine Science, Mersin

Do Habitat Preferences of Two Native Ponto-Caspian Gobies Explain Establishment Success of Their Non-Native Populations?

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In this study, the habitat preferences of two gobiid species, namely the Monkey goby *Neogobius fluviatilis* and the Western tubenose goby *Proterorhinus semilunaris*, was studied in natural lakes of the Marmara Region (NW Turkey). Habitat choices were highly similar amongst lakes, except for *P. semilunaris* in Lake Uluabat and were mostly similar to non-native populations of *P. semilunaris* but not of *N. fluviatilis*. The results suggest variability in the habitat choices of the gobiids, which can opportunistically utilise available habitats.

Keywords: Monkey goby, tubenose goby, Point Abundance Sampling, CQO

Introduction

Introductions of non-native fish are a significant issue due to their impact on biodiversity and socio-economic structure (Simberloff *et al*. 2013). To establish a robust invasion risk assessment, information on the ecology, impact and management of the target species is needed (Gozlan *et al.*, 2010). Whilst the assessment can be informed by ecological information from the species' native range (Ribeiro *et al*. 2008), most invasive species tend to be studied mainly in their non-native range (Tarkan *et al*. 2018). In recent years, Ponto Caspian goby species, which expanded to America and Europe through ballast waters of transoceanic cargo-ships have received a considerable attention because of their fast spread and potential negative impact (Dougherty e*t al*. 1996; Dillon *et al*. 2001; Antsulevich 2007; Konečná 2012). Two of these species, Western tubenose goby *Proterorhinus semilunaris* and monkey goby *Neogobius fluviatilis* have relatively been less studied compared to other invasive gobiid species, e.g. *N. melanostomus* (Kornis *et al*. 2012). Amongst the other features, habitat preferences of these species should have a crucial importance for understanding invasion success, direction, speed and impact of expansion because colonization depends on availability of suitable habitats (Veech *et al.* 2011, Kornis & Vander Zanden 2010). Therefore, our aim was to assess the habitat preferences of native *P. semilunaris* and *N. fluviatilis* across some native lakes that provided a gradient of environmental characters and to discuss these preferences in the context of their potential invasiveness.

Material and Methods

P. semilunaris and *N. fluviatilis* were sampled in four large natural lakes between August 2014 and May 2015. *P. semilunaris* in Lake Manyas were caught in very low numbers so they were excluded from the further analyses, whereas *N. fluviatilis* do not occur in Lake İznik. Sampling was conducted in habitats selected haphazardly by Point Abundance Sampling (PAS: Nelva *et al.* 1979) with electrofishing. This method provides reproduceable and quantifiable samples and is efficient along the entire range of catchable fish sizes (Copp 1989). Measurements of microhabitat variables after Top *et al.* (2016): (i) depth (cm), (ii) substratum composition (visually estimated as: mud, < 50 μm; silty sand, >50 μm to 0.06 cm; sand, >0.06–0.2 cm; gravel, >0.2–2.0 cm; mud + stone, >2.0–20.0 cm; rock, >20 cm, (iii) distance from bank (cm), (iv) distance from vegetation (cm), (v) submersed aquatic vegetation, (vi) submersed woody structure (roots or other ligneous material), (vii) plant cover (all in % of point area), (viii) water velocity, (ix) turbidity (estimated visually as: low, medium and high blurry), and (x) light intensity (at the water surface and categorised as: shady, sunny-shady, and sunny). Fish-habitat relationships were analysed by Constrained Quadratic Ordination (CQO) (Yee, 2004) that has been applied successfully to fish–habitat relationships studies (Vilizzi *et al.* 2012; Top *et al*. 2016). CQO estimates an optimal linear combination of the microhabitat variables and regresses the species' data upon the latent variable axis using a quadratic curve fitted across the species' scores. In this study, each response curve in the ordination diagram represents the distributional range of the species across the microhabitat gradient (i.e. the latent variable), hence the relative position of the curve along the gradient indicates the preference of the species for certain values of the microhabitat variables summarised into the microhabitat gradient, and as determined by the species' probability of occurrence. In order to determine the optimum value, along the microhabitat gradient at which the highest probability of occurrence for that species is recorded (Yee, 2004). Depth, substratum composition, distance from bank, distance from vegetation, submersed aquatic vegetation, submersed woody structure, plant cover, velocity, turbidity and light intensity were the ten descriptors identifying the microhabitat latent variable. CQO was fitted under a binomial model of rank 1, with three non-linear degrees of freedom and unequal tolerances and after choice of the 'best' 100 models (Yee, 2006). Models were run in R x64 v3.0.3 (R Development Core Team, 2015) using library VGAM v0.9-7).

Results

Based on CQO, the optimum habitat structure for *P. semilunaris* individuals (-0.02) in Iznik Lake was near the area where the vegetation is high and the individuals were avoiding sunlight (Fig. 1). The habitat preferences for the two coexisting gobies in Lake Sapanca differed (Fig. 2). While there is no optimal area preferred by *P. semilunaris* (optimum = N/A), *N. fluviatilis* individuals (optimum = 0.4) were found to avoid the deeper and running waters. Also, *N. fluviatilis* individuals were observed more frequently in the habitat types with less sand and light with vegetation covers (Fig. 2). The habitat choice of *N. fluviatilis* individuals (5.48) in Lake Manyas for optimum conditions was blurry waters, which were close to the vegetation, and where the woody materials were found while they were avoiding as much as possible from light and velocity. Besides this, *N. fluviatilis* individuals were found in more shallow grounds where there was less flow and larger stones (Fig. 3). The habitat preferences were similar for the two gobiid species examined in Lake Uluabat. *P. semilunaris* (optimum = 1.75) individuals preferred water with more turbid and woody structures than *N. fluviatilis* (optimum = 0.7) individuals. In addition, both species are caught more in shady and calm waters with light. Unlike other lakes, they preferred smaller stones (Fig. 4).

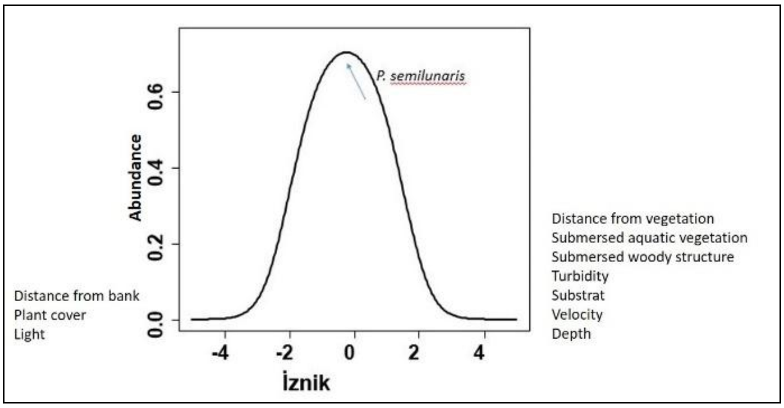

Figure 1. Constrained Quadratic Ordination CQO plot for *P. semilunaris* in Lake Iznik. A summary indication of the main microhabitat features is provided on the negative and positive boundaries of the microhabitat (latent) variable axis.

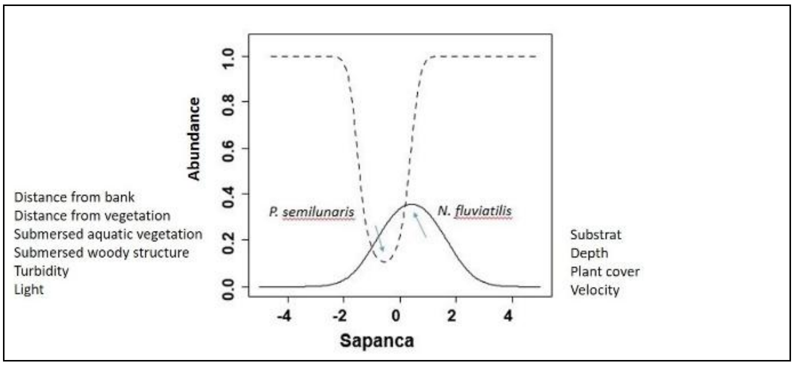

Figure 2. Constrained Quadratic Ordination CQO plot for *P. semilunaris* and *N. fluviatilis* in Lake Sapanca. A summary indication of the main microhabitat features is provided on the negative and positive boundaries of the microhabitat (latent) variable axis.

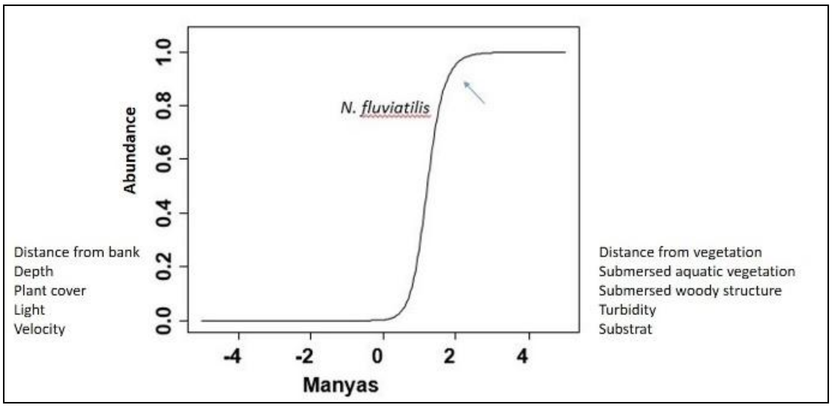

Figure 3. Constrained Quadratic Ordination CQO plot for *N. fluviatilis* in Lake Manyas. A summary indication of the main microhabitat features is provided on the negative and positive boundaries of the microhabitat (latent) variable axis.

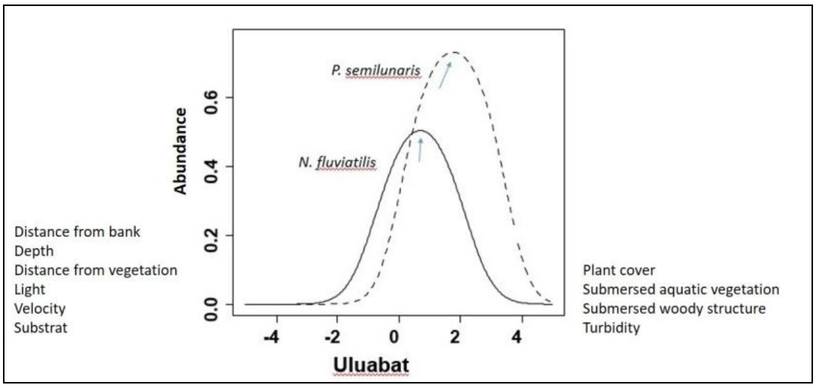

Figure 4. Constrained Quadratic Ordination CQO plot for *P. semilunaris* and *N. fluviatilis* in Lake Uluabat. A summary indication of the main microhabitat features is provided on the negative and positive boundaries of the microhabitat (latent) variable axis.

Discussion

One of the most important gap in the literature for both species examined by the present study is the habitat preferences of the species, especially in their native range, as the literature research has revealed very little information on this issue. In their non-native range *P. semilunaris* was reported to prefer clear waters, large stones and rocks and macrophyted habitats in Lake Erie, North America (Kocovsky *et al.* (2011), and differently from these preferences; medium size stones, slower currents and shallow waters were also noted in Danube basin (Janac *et al*. 2012) however in two small streams in native range of the species in Turkey, silt, sand, smaller sized stones (e.g. pebbles and cobbles) and relatively deeper waters were reported to be most significant habitat requirements (Gürsoy Gaygusuz *et al*. 2010). In the present study, these preferences were accordance with the populations in the non-native range for Sapanca and İznik lakes but not with those in Lake Uluabat where more similar preferences were observed with native stream populations (i.e. Gürsoy Gaygusuz *et al*. 2010). *N. fluviatilis* is usually found to have preferences unlike *P. semilunaris* in their non-native range, i.e. more specialized to sandy substrata in shorelines (Erös *et al.* 2005), which was supported by its morphological structure (Capova *et al*. 2008) and this was also shown as a limiting factor its spread in non-native range (Capova *et al*. 2008). Our findings for *N. fluviatilis* in native range do not corroborate this, as it was observed to usually avoid sandy substrates but showed another specialization to vegetation and woody structures. Overall, our results simply suggest that both species have very variable (i.e. flexible) habitat choices in their native range and they partly are in harmony in *P. semilunaris* with their non-native populations, whereas this was not the case for *N. fluviatilis*. Regardless, the observed plasticity in habitat preferences of both species could facilitate their potential spread in the non-native ranges.

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References

Antsulevich, A. (2007). “First records of the tubenose goby *Proterorhinus marmoratus* (Pallas, 1814) in the Baltic Sea”, Aquatic Invasions 2, 468-470.

Beyer, K., Copp, G.H., Gozlan, R.E. (2007). Microhabitat use and interspecific associations of introduced topmouth gudgeon *Pseudorasbora parva* and native fishes in a small stream. Journal of Fish Biology 71, 224–238.

Bollen K.A. (2002). Latent variables in psychology and the social sciences. Annual Review Psychology 53, 605–634.

Čápová, M., Zlatnická, I., Kovač, V., and Katina, S. (2008). Ontogenetic variability in the external morphology of monkey goby, *Neogobius fluviatilis* (Pallas, 1814) and its relevance to invasion potential. *Hydrobiologia* 607, 17–26.

Copp, G.H. (1989). Electrofishing for fish larvae and juveniles:equipment modifications for increased efficiency with short fishes. Aquaculture and Fisheries Management 20, 453–462

Dillon, A., Stepien, C. A. (2001). “Genetic and Biogeographic Relationships of the Invasive Round (*Neogobius melanostomus*) and Tubenose (*Proterorhinus marmoratus*) Gobies in the Great Lakes Versus Eurasian Populations”, Journal of Great Lakes Research 27, 267–280.

Dougherty, J. D., Moore, W. S., Ram, J. L. (1996). “Mitochondrial DNA analysis of round goby (*Neogobius melanostomus*) and tubenose goby (*Proterorhinus marmoratus*) in the Great Lakes basin”, Canadian Journal of Fisheries and Aquatic Sciences 53, 474–480.

Erös, T., A. Sevcik & B. Toth, (2005). Abundance and night-time habitat use patterns of Ponto-Caspian gobiid species (Pisces, Gobiidae) in the litoral zone of the river Danube, Hungary. Journal of Applied Ichthyology 21, 350–357.

Gozlan, R. E., Britton, J. R., Cowx, I. G., and Copp, G. H. (2010). Current knowledge on non-native freshwater fish introductions. Journal of Fish Biology 76, 751–786.

Gürsoy Gaygusuz, Ç., Tarkan, A. S., Gaygusuz, Ö. (2010). Diel changes in feeding activity, microhabitat preferences and abundance of two freshwater fish species in small temperate streams. Ekoloji 19,15-24.

Janáč, M., Valová, Z. Jurajda P. (2012). Range expansion and habitat preferences of nonnative 0+ tubenose goby (Proterorhinus semilunaris) in two lowland rivers in the Danube basin. Fundamental Applied Limnology 181/1, 73–85.

Kocovsky, P. M., Tallman, J. A., Jude, D. J., Murphy, D. M., Brown, J. E. & Stepien, C. A., (2011). Expansion of tubenose gobies *Proterorhinus semilunaris* into western Lake Erie and potential effects on native species. – Biologic Invasions 13, 2775–2784.

Konecna, M., Jurajda, P. (2012). “Population structure, condition, and reproduction characteristics of native monkey goby, *Neogobius fluviatilis* (Actinopterygii: Perciformes Gobiidae), in the Bulgarian Danube”, Acta Ichthyolgica et Piscatoria 42(4), 321–327.

Kornis, M. S. & Vander Zanden, M. J., (2010, Forecasting the distribution of the invasive round goby (*Neogobius melanostomus*) in Wisconsin tributaries to Lake Michigan. Canadian Journal of Fisheries and Aquatic Sciences 67, 553–562.

Kornis, M. S., Mercado-Silva, N., and Vander Zanden, M. J. (2012). Twenty years of invasion: a review of round goby *Neogobius melanostomus* biology, spread and ecological implications. Journal of Fish Biology 80, 235–285.

Naseka, A. M. (2005). “New data on the historical and expanded range of *Proterorhinus marmoratus* (Pallas, 1814) (Teleostei: Gobiidae) in eastern Europe”, Journal of Applied Ichthyology 21, 300–305.

Nelva A, Persat H, Chessel D. (1979). Une nouvelle méthode d'étude des peuplements ichtyologiques dans les grands cours d'aeu par échantillonnage ponctuel d'abodance. Comptes Rendus Academie de Sciences III Paris 289, 1295–1298.

Ribeiro, F., Elvira, B., Collares-Pereira, M. J., and Moyle, P. B. (2008). Life-history traits of non-native fishes in Iberian watersheds across several invasion stages: a first approach. Biological Invasions 10, 89–102.

Rizevsky, V., Pluta, M., Leschenko, A., Ermolaeva, I. (2007). “First record of the invasive Ponto-Caspian tubenose goby *Proterorhinus marmoratus* (Pallas, 1814) from the River Pripyat, Belarus”, Aquatic Invasions 2, 275-277.

Simberloff, D., Martin, J. L., Genovesi, P., Maris, V., Wardle, D. A., Aronson, J., Courchamp, F., Galil, B., García-Berthou, E., Pascal, M., and Pyšek, P. (2013). Impacts of biological invasions: what's what and the way forward. Trends in Ecology & Evolution 28, 58–66.

Tarkan, A. S., Karakuş, U., Tepeköy, E. G., Top, N., Yalçın-Özdilek, Ş., Partal, N., and Britton, J. R. (2018). Trophic interactions of two Ponto-Caspian gobies in the Turkish part of their native range. Turkish Journal of Fisheries and Aquatic Sciences (in press).

Top, N., Tarkan, A. S., Vilizzi, L., Karakuş U. (2016). Microhabitat interactions of non-native pumpkinseed *Lepomis gibbosus* in a Mediterranean-type stream suggest no evidence for impact on endemic fishes. Knowledge and Management of Aquatic Ecosystems 417, 36.

Veech, J. A., Small, M. F. & Baccus, J. T., (2011). The effect of habitat on the range expansion of a native and an introduced bird species. Journal of Biogeography 38, 69–77.

Vilizzi, L., Stakėnas, S., Copp, G.H. (2012). Use of constrained additive and quadratic ordination in fish habitat studies: an application to introduced pumpkinseed (*Lepomis gibbosus*) and native Brown trout (*Salmo trutta*) in an English stream. Fundamental Applied Limnology 180, 69–75

Wiesner, C. (2005). “New records of non-indigenous gobies (*Neogobius* spp.) in the Austrian Danube”, Journal of Applied Ichthyology 21, 324–327.

Yee, T.W. (2004). A new technique for maximum-likelihood canonical Gaussian ordination. Ecological Monographs 74, 685–701.

Yee, T.W. (2006). VGAM Family Functions for Reduced-Rank Regression and Constrained Ordination. Beta version 0.6-5. http://www.stat.auckland.ac.nz/∼yee/VGAM/doc/rrvglm.pdf

Who is the winner? Non-native *Carassius gibelio* or endemic *Capoeta aydinensis*: a preliminary study of competitive interactions in ex-situ conditions

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Understanding the impacts of non-native freshwater fishes can be difficult in wild conditions. Thus, the aim of the study is to find out how two freshwater fishes (a non-native, *Carassius gibelio* and an endemic, *Capoeta aydinesis*) will interact under experimental circumstances. Different number of specimens and two temperature regimes (17-25°C) were used to understand the effects of non-native fish by examining differences in spesific growth rates. The results indicated that non-native fish grew faster at high temperature and slower at low temperature, which was opposite for endemic fish. At low temperature, endemic fish showed suppresive effects on non-native fish, which was an expected outcome.

Keywords: Cyprinid species, global warming, experimental conditions

Introduction

The survival and establishment of non-native fishes in new environments can result in their sharing of habitat and prey resources with native fishes. This can result in ecological impacts and suppression of native populations. Whlist the introduced fish may be more successful and exploit resources more effectively (Ruetz *et al.* 2003), growth rates of resident fish may reduce (Britton *et al.* 2011) or they shift their diet preferences through partitioning (Guo *et al.* 2014). Understandings of the results of this interaction can be difficult in the wild, due to environmental factors (Britton *et al.* 2011). For this reason, studies in controlled conditions can be helpful to understand the interactions between fishes (Korsu *et al.* 2009).

During a decade of research in Tersakan stream (Muğla, Turkey), non-native *Carassius gibelio* was captured by electrofishing only several times (Karakuş *et al.* 2013) while endemic *Capoeta aydinensis* were captured most frequently (Akbaş, 2015). Thus, in this study, the interaction between these two fish were investigated in experimental conditions to understand whether *Capoeta aydinensis* is responsible for this failure. Also, as water temperatures have significant and positive effects on the growth and foraging rates of fishes, effect of temperature was also tested. Spesific growth rate differences were analyzed according to temperature and abundance (i.e. number of specimens).

Material and Methods

In this study, co-habitation aquaria experiments were used in controlled conditions to more accurately quantify the consequences for the growth rates of *Carassius gibelio* of their feeding interactions with *Capoeta aydinensis*. The experimental design used controls and treatments that were each replicated three times. *Carassius gibelio* were sourced from a reservoir by using electrofishing and were all the same size approximately. The controls were an allopatric context where 2 marked *Carasisus gibelio* and 2 marked *Capoeta aydinensis* were added seperately. The treatments were sympatric contexts, which had the opposed number of specimens (2 *Carassius gibelio* + 4 *Capoeta aydinensis*, 4 *Carassius gibelio* + 2 *Capoeta aydinensis*) (Figure 1). All fish were measured (fork length, FL, nearest mm) and weighed (TW, to 0.01 g), then the experiment was performed at water temperatures of 17 and 25°C to identify whether these temperatures influenced the outcome of the trials. They were completed in aquaria of 100 l volume, arranged in columns of three shelves (one aquarium per shelf) on re-circulating systems. The experimental period lasted 65 days during which the fish were fed daily with a fixed food ration of pelletised fishmeal at 2% mean all fish body weight of the control and the treatments, as this was above maintenance but below ad libitum. At the conclusion of the experiment, all of the fish were re-measured and weighed. To quantify the consequences for growth in the controls and treatments at both temperatures, the growth metrics of specific growth rate (SGR) was determined from [(lnWt+1) lnWt)/t] * 100, where Wt = starting weight of fish, Wt+1 = end weight and t = number of days. Linear mixed effects models (LMEM) were then used to test for differences in the growth metrics between the control and treatments, and between the temperatures.

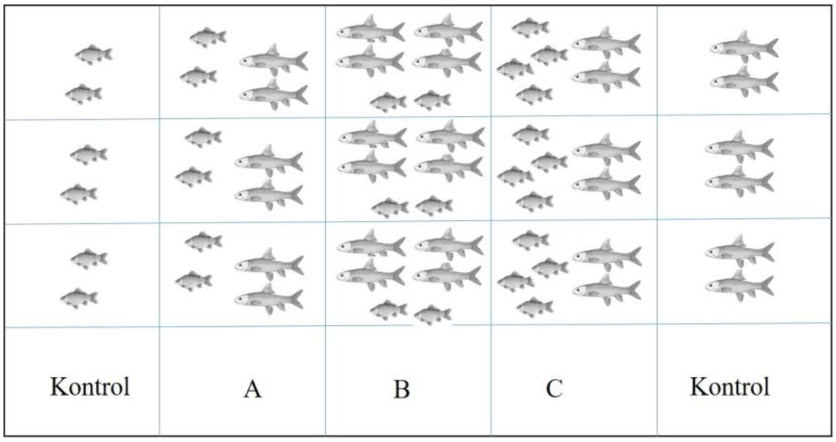

Figure 1. Experimental design of controls and treatments.

Results

There were no significant differences between temperature and number of specimens and number of specimens on spesific growth rate between species ($P > 0.05$). However, temperature and species related growth differences were significant ($P = 0.0001$). Temperature related spesific growth rates of two fish species after 65 days were indicated in Figure 2, which shows similar growth patterns according to temperature regimes, but faster growth at high temperature for *Carassius gibelio*.

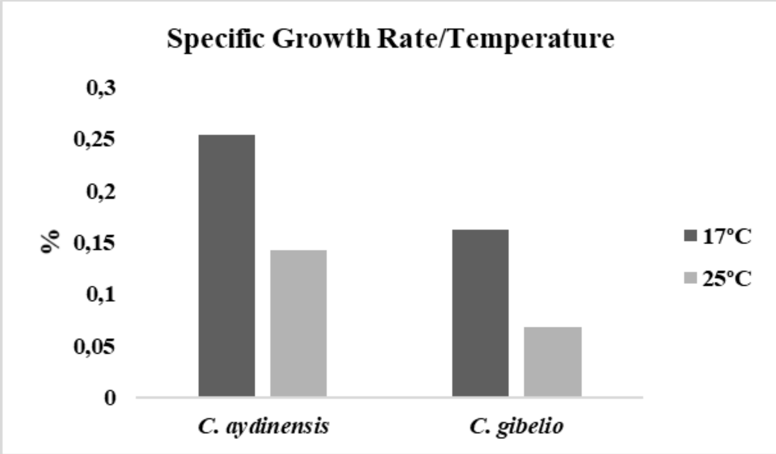

Figure 2. Spesific Growth Rate differences of *Capoeta aydinensis* and *Carassius gibelio* under two temperature regime.

Discussion

In both treatments, differences in growth rates were not significant in the sympatric context (*P* > 0.05). Thus, the changing the temperature resulted in significantly depressed growth of *Carassius gibelio*. Experimental outputs revealed that, at low temperature endemic fish (*Capoeta aydınensis*) grows better than non-native fish (*Carassius gibelio*). Notably, sympatric context (different number of specimens) was not an effecting factor for the experiment though temperature was a significant issue. In this study, there were no competitive interaction between species. Although habitat preferences are similar for both fishes (Top, 2018), water temperature regime of Tersakan stream (Akbaş, 2015) may not be suitable for *Carassius gibelio* for better growth or establishing a sound population. Indeed, when considering the distribution of *Carassius gibelio* in Turkey, southern populations are not in well situation especially in Muğla province, probably due to low genetic diversity (Ağdamar, 2017) and poor adaptation to river ecosystems of the species (Tarkan *et al.* 2012). Further, the difference might relate to the experimental conditions providing a limiting food supply, whereas in wild conditions, the sympatric species might have been in resource partitioning (Guo *et al*. 2014). Consequently, this experimental system may explain the failure of a high-risk invader. However, an issue with experimental co-habitation studies is that outcomes do not always match field observations as the spatial experimental constraints can result in unnaturally intense interactions, and there is a lack of complexity compared with natural situations (Korsu *et al*. 2009).

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References

Ruetz, C.R., Hurford, A.L. & Vondracek, B. 2003. Interspecific interactions between brown trout and slimy sculpin in stream enclosures. Transactions of the American Fisheries Society 132: 611–618.

Akbaş, F (2015). Endemik tatlısu balığı *Capoeta cf. bergamae* Karaman, 1969 'nin Tersakan Deresi'ndeki biyoekolojik özellikleri ve habitat tercihleri. MSKU, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, 57 s

Busst G. M. A., & Britton J. R. (2014) Quantifying the growth consequences for crucian carp *Carassius carassius* of competition from non-native fishes. *Ecol freshw Fish* 24: 489-492.

Guo, Z., Liu, J., Lek, S., Li, Z., Zhu, F., Tang, J. & Cucherousset, J. 2014. Trophic niche differences between two congeneric goby species: evidence for ontogenetic diet shift and habitat use. Aquatic Biology 20: 23–33.

Britton JR, Cucherousset J, Grey J, Gozlan RE (2011) Determining the strength of exploitative competition from an introduced fish: roles of density, biomass and body size. *Ecol Freshw Fish* 20: 74–79.

Karakuş, U., Ağdamar, S., Tarkan, A.S., Özdemir, N., (2013) "Range extension of the invasive freshwater fish species, gibel carp *Carassius gibelio* (Bloch, 1782) in western Turkey", BioInvasions Records 2: 153–157.

Korsu K, Huusko A, Muotka T (2009) Does the introduced brook trout (*Salvelinus fontinalis*) affect the growth of the native brown trout (*Salmo trutta*)? *Naturwissenschaften* 96: 347–353.

Tarkan, A. S., Copp, G.H., Top, N., Özdemir, N., Önsoy, B., Bilge, G., Filiz, H., Yapıcı, S., Ekmekçi, G., Kırankaya, Ş., Emiroğlu, Ö., Gaygusuz, Ö., Gürsoy Gaygusuz, Ç., Oymak, A., Özcan, G. & Saç, G. 2012. Are introduced gibel carp *Carassius gibelio* in Turkey more invasive in artificial than in natural waters? Fisheries Management and Ecology 19: 178-187.

Trophic Positions of Potential Invasive Ponto-Caspian Gobies in their Native Range

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Ponto-Caspian (P-C) gobiids have expanded from their native distribution ranges to Europe and North America, resulting in ecological impacts on native fauna. Since information on their bio-ecological features in their native range is still poor, the trophic ecology of some P-C gobies (monkey goby *Neogobius fluviatilis*, Western tubenose goby *Proterorhinus semilunaris* and Caucasian dwarf goby *Knipowitschia caucasica*) was studied in four natural lakes in the Marmara Region of NW Turkey (İznik, Manyas, Sapanca, Uluabat) using the stable isotopes of $\delta^{13}C$ and $\delta^{15}N$. All gobies studied were closely associated with benthic resources, which is consistent with their feeding guild (i.e. benthic feeders). The trophic positions of all gobies were highly divergent amongst the studied lakes as well as in the same lake (i.e. Lake Sapanca). Trophic position (TP) of both *P. semilunaris* and *N. fluviatilis* was higher in Lake Sapanca than those in Lake İznik and Lake Uluabat, respectively. However, TP of *N. fluviatilis* is slightly higher than that of *P. semilunaris* in Lake Sapanca.

Keywords: Monkey goby, tubenose goby, isotopic niche, niche plasticity, trophic relationships

Introduction

The Ponto-Caspian (P-C) region is a major source area for some invasive gobiid species (Roche *et al*. 2013), having expanded from their native distribution ranges via ballast water to the upper and middle Danube river in Europe (Jepsen *et al.* 2008) and to the Great Lakes of North America (Brown & Stepien 2009). The spread of these species has also coincided with a sharp decline in several native species, suggesting potential adverse impacts (Kornis *et al.* 2012). Some of these gobies from Black Sea Region of Turkey, Western tubenose goby *Proterorhinus semilunaris* (Heckel, 1837), monkey goby *Neogobius fluviatilis* (Pallas, 1814) and Caucasian dwarf goby *Knipowitschia caucasica* (Berg, 1916), are an important component of the native fish communities of Turkish inland waters but they are (i.e. *P. semilunaris* and *N. fluviaitlis*) also considered potential invaders in Europe and North America. In North America, *N. fluviatilis* has been listed as one of five potential high-impact non-native species for the Great Lakes Basin (Pagnucco *et al*. 2015), with *P. semilunaris* already recorded from the St. Clair River (Dougherty *et al*. 1996) and Lake Erie (Dillon & Stepien 2001).

In both their native and invasive range, studies on their trophic relationships are very limited (Grabowska *et al.* 2009; Vašek *et al.* 2014). Thus, their invasion risk assessments and risk-based management are poorly informed on aspects of their potential ecological impacts. Therefore, to identify the utility of knowledge on the trophic relationships of non-native species in their native range for informing their management in their invasive range, the aim here was to assess the trophic ecology of native *P. semilunaris*, *N. fluviatilis* and *K. caucasica* across four lakes that provided a gradient of environmental characters and fish assemblages.

Material and Methods

Sampling of the fish communities was conducted between 06 and 08/01/2016 and completed in littoral areas from four natural large lakes (İznik, Manyas, Sapanca and Uluabat), with electric fishing (SAMUS-725G) and seine netting within their rocky shorelines in depths of up to 1.5 m (Table 1). Apart from the targeted gobiids, fish putative food resources (periphyton, macrophytes, zooplankton, macrobenthos, detritus) were also collected from each sampling site for Stable Isotope Analysis (SIA). *P. semilunaris* was caught from Lake İznik and Lake Sapanca, *N. fluviatilis* from Lake Uluabat and Sapanca, and *K. cauasica* from Lake Manyas.

Table 1. Latitude, longitude, surface area (km^2), mean and max depth (m) of four lakes in Marmara Region where *Proterorhinus semilunaris*, *Neogobius fluviatilis* and *Knipowitschia caucasica* were captured.

Lake	Latitude	Longitude	Area	Mean depth	Max depth
İznik	40°27'	29°32'	308	30	65
Manyas	40°12'	27°56'	178	1.5	3.6
Sapanca	40°42'	30°15'	47	26	55
Uluabat	40°10'	28°35'	136	2.5	4.5

After preparing fish muscle and putative food resources, SIA was then completed at Davis, University of California, using an elemental analyser (Flash EA, 1112 series, Thermo-Finnigan) coupled to a continuous flow isotope ratio mass spectrometer (Finnigan MAT DeltaPlus, Thermo-Finnigang). The trophic position (TP) of the fishes was calculated by an R package “TROPHICPOSITION” that incorporates a Bayesian model at the population level using stable isotopes with two baselines (Quezada-Romegialli *et al*. 2017). This package was also used to compare posterior trophic position of the studied species between the lakes, and between the species in the same lake (i.e. Lake Sapanca where both *P. semilunaris* and *N. fluviatilis* co-exist). Finally, the SIAR package in R was used to estimate the relative contribution of each resource to the fish diet by Bayesian mixing models.

Results

In all lakes under study, all studied gobies had variable TPs (Fig. 1). However, *N. fluviatilis* showed a similar TP in Lake Sapanca and Uluabat, whereas *P. seminularis* was differently positioned in Lake İznik and Lake Sapanca (Fig. 1). As expected, all examined species were closer to benthic resources due to their feeding guilds. These preferences were apparent by the mixing models that indicated food component choices of all species under study (Fig. 2).

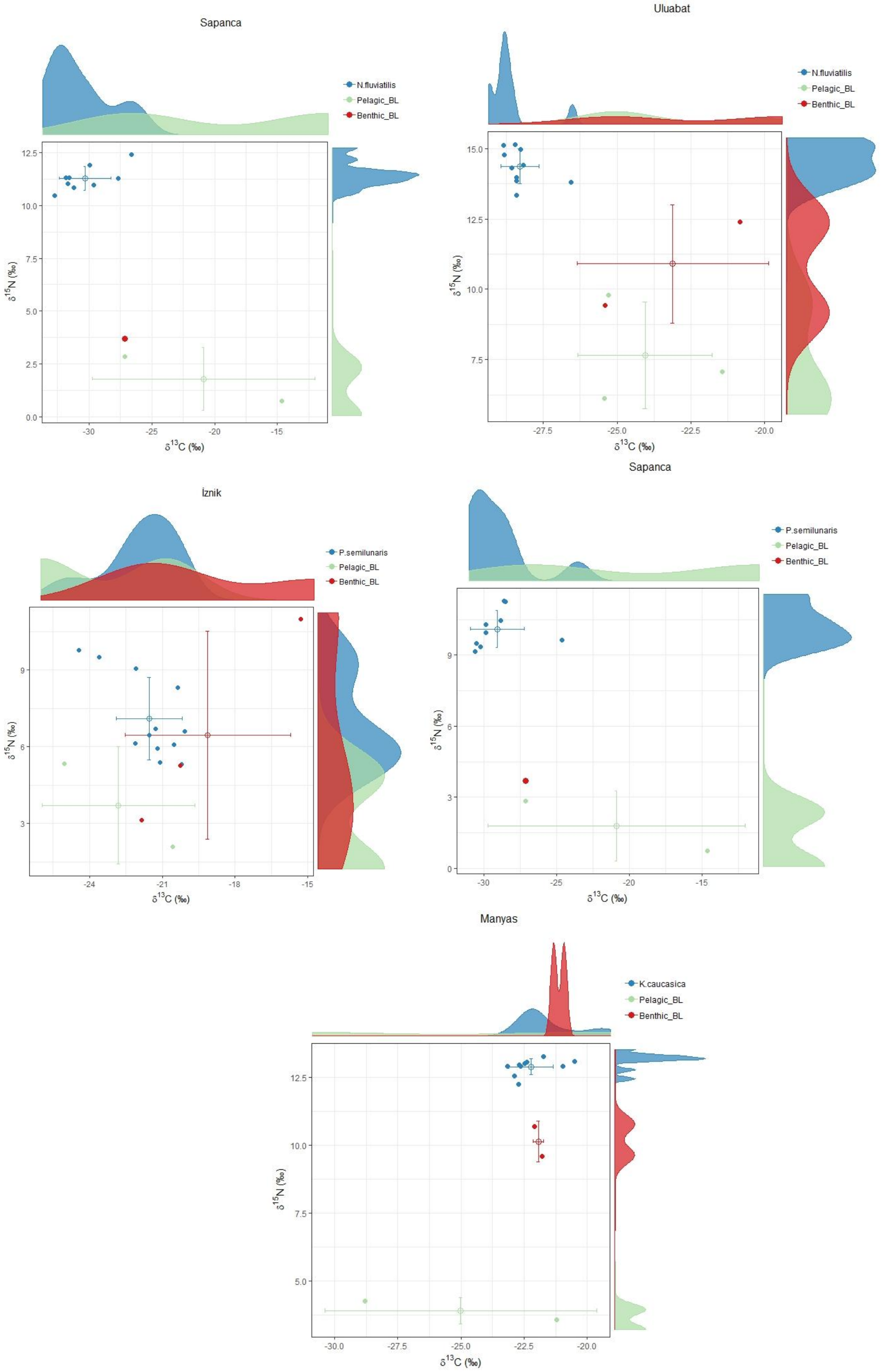

Figure 1. Isotopic bi-plot showing variation in $\delta^{13}C$ and $\delta^{15}N$ in consumers (fish species present in the environment) and potential food resources as benthic and pelagic baselines for four lakes in Marmara Region. Error bars show 95% confidence limits.

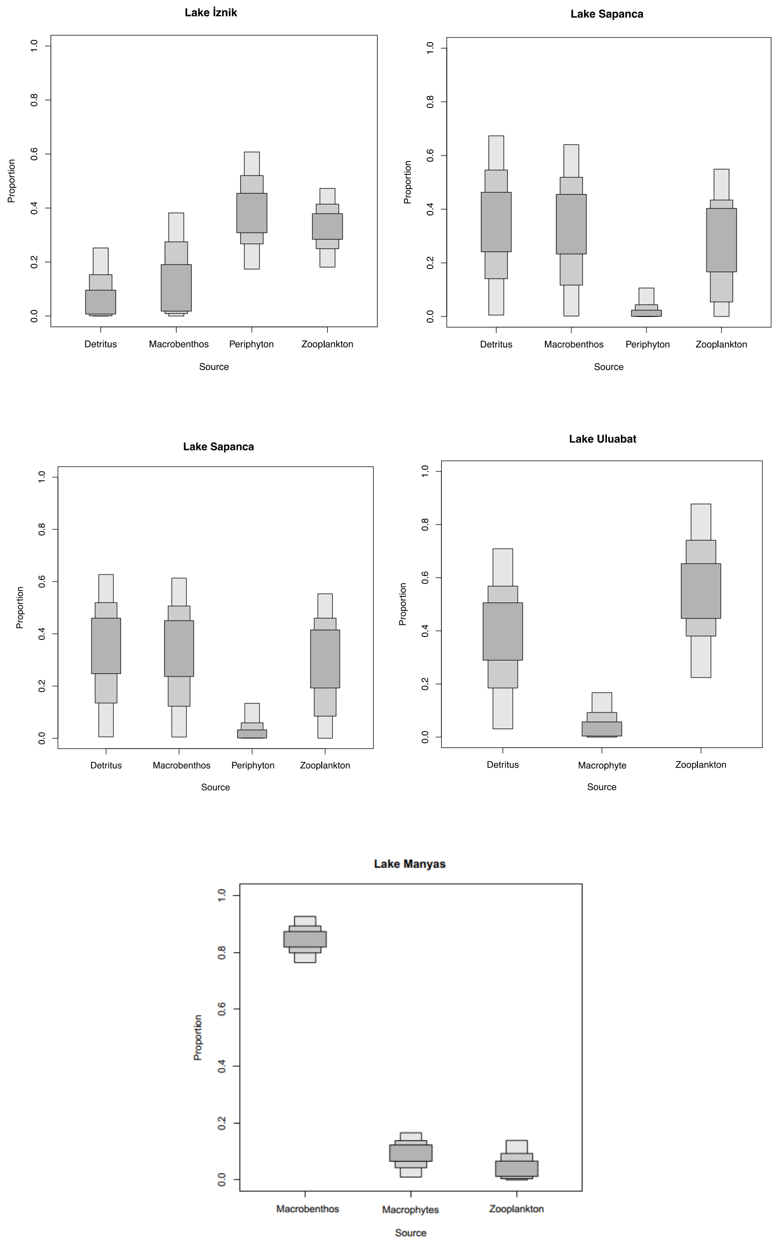

Figure 2. Boxplots for each lake, showing estimated contribution of different carbon sources to the diet of *Proterorhinus semilunaris* (upper), *Neogobius fluviatilis* (middle) and *Knipowitschia caucasica* (lower); dark grey box represents the 50% of the data, posterior light grey box 75 % of the data and the outer light grey box 95 % of the data.

Trophic position (TP) of both *P. semilunaris* and *N. fluviatilis* was higher in Lake Sapanca than those in Lake İznik and Lake Uluabat, respectively. However, TP of *N. fluviatilis* is slightly higher than that of *P. semilunaris* in Lake Sapanca (Fig. 3).

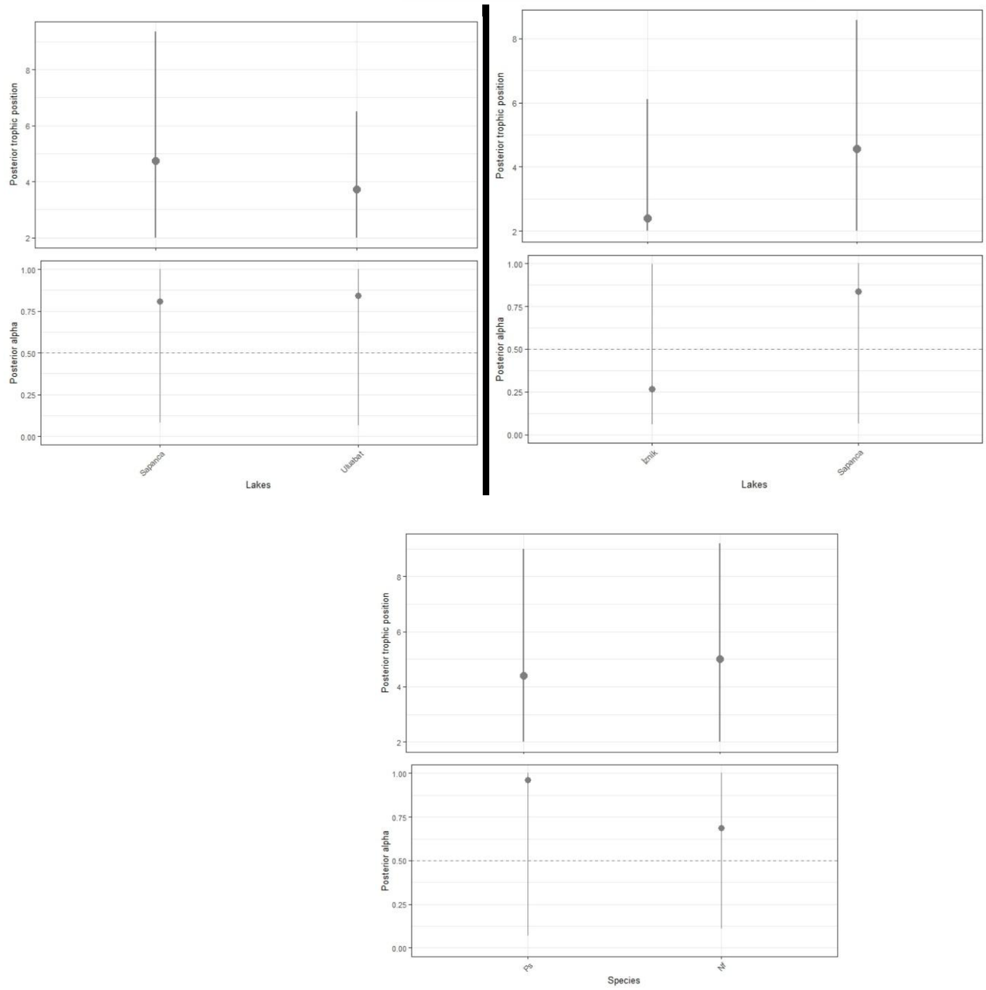

Figure 3. Posterior trophic positions and alpha for *Neogobius fluviatilis* (upper left) and *Proterorhinus semilunaris* (upper right) between the lakes and between the species in Lake Sapanca (lower).

Discussion

Recent isotopic and traditional stomach analyses of *P. semilunaris* and another invasive gobiid *N. melanostomus* in their non-native range showed a consistent pattern that *N. melanostomu*s had broader niche and trophic position than *P. semilunaris* (Vašek *et al.* 2014; Pettitt-Wade *et al.* 2015). Indeed, a similar pattern was found for trophic position in the present study where *N. fluviatilis* had a higher trophic position relative to *P. semilunaris*. Traditional diet studies of the studied gobiids in both non-native and native regions (Kakareko *et al.* 2005; Adámek *et al.* 2007; Gaygusuz *et al.* 2007; Grabowska *et al.* 2009; Piria *et al.* 2016) are in line with SIA results obtained in the current study. Only exception was the plant material that was one of the important groups found in SIA for *P. semilunaris* and *N. fluviatilis* in İznik and Uluabat lakes (Fig. 2). However, the dominance of food groups was represented differently between stomach contents and SIA, which might relate to the latter providing a time-integrated analysis of assimilated diet sources (Thomas & Crowther 2015), whereas stomach content analysis provides only a snapshot of ingested food resources at the time of sampling (e.g. Cucherousset *et al.* 2012).

Overall, our results indicated that the tropic positions of all studied gobies were variable between the lakes that suggest some context dependency and consistent with the prediction on the opportunistic feeding strategy of the gobies that was inferred from stomach contents analysis of the fishes in both their native and invasive range (Grabowska *et al.* 2009; Vašek *et al.* 2014). Regardless, this study provides important baseline information on the trophic interactions of *P. semilunaris*, *N. fluviatilis* and *K. caucasica* in their native range that has utility for understanding their consequences in their invasive range.

Acknowledgements

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References

Adámek Z, Andreji J, Gallardo J.M. (2007). Food habits of four bottom-dwelling Gobiid species at the confluence of the Danube and Hron Rivers (South Slovakia). International Review of Hydrobiologica 92, 554–563.

Brown J.E, Stepien C.A. (2009). Invasion genetics of the Eurasian round goby in North America: tracing sources and spread patterns. Molecular Ecology 18, 64–79.

Cucherousset J, Bouletreau S, Martino A, Roussel J.M, Santoul F. (2012). Using stable isotope analyses to determine the ecological effects of non-native fishes. Fisheries Management and Ecology 19, 111–119.

Dillon A.K, Stepien C.A. (2001). Genetic and biogeographic relationships of the invasive round (*Neogobius melanostomus*) and tubenose (*Proterorhinus marmoratus*) gobies in the Great Lakes Versus Eurasian populations. Journal of Great Lakes Research 27, 267–280.

Dougherty J.D, Moore W.S, Ram J.L. (1996). Mitochondrial DNA analysis of round goby (*Neogobius melanostomus*) and tubenose goby (*Proterorhinus marmoratus*) in the Great Lakes basin. Canadian Journal of Fisheries and Aquatic Sciences 53, 474–480.

Gaygusuz Ö, Gürsoy Gaygusuz Ç, Tarkan A.S, Acıpınar Z, Türer Z. (2007). Preference of Zebra mussel, *Dreisena polymorpha* in the diet and effect on growth of gobiids: a comparative study between two different ecosystems. Ekoloji 17, 1–6.

Grabowska J, Grabowski M, Kostecka A. (2009). Diet and feeding habits of monkey goby (*Neogobius fluviatilis*) in a newly invaded area. Biological Invasions 11, 2161–2170.

Jepsen N, Wiesner C, Schotzko N. (2008). Fish. In "Technical report with results from the fish sampling and analyses from the Joint Danube Survey 2007" Liška I, Wagner F, Slobodník J. (eds.), ICPDR, Vienna, p. 72–81.

Kakareko T, Zbikowski J, Zytkowicz J. (2005). Diet partitioning in summer of two syntopic neogobiids from two different habitats of the lower Vistula River, Poland. Journal of Applied Ichthyology 2, 292–295.

Kornis M.S, Mercado-Silva N, Vander Zanden M.J. (2012). Twenty years of invasion: a review of round goby *Neogobius melanostomus* biology, spread and ecological implications. Journal of Fish Biology 80, 235–285.

Pagnucco K.S, Maynard G.A, Fera S.A, Yand N.D, Nalepa T.F, Ricciardi A. (2015). The future of species invasions in the Great Lakes-St. Lawrence River basin. Journal of Great Lakes Research 41(Supplement 1), 96–107.

Pettitt-Wade H, Wellband K.W, Heath D.D, Fisk A.T. (2015). Niche plasticity in invasive fishes in the Great Lakes. Biological Invasions 17, 2565–2580.

Piria M, Jakšić G, Jakovlić I, Treer T. (2016). Dietary habits of invasive Ponto-Caspian gobies in the Croatian part of the Danube River basin and their potential impact on benthic fish communities. Science of Total Environment 540, 386–395.

Quezada-Romegialli C, Jackson A.L, Hayden B, Kahilainen K.K, Lopes C, Harrod C. (2018). tRophicposition, an R package for the Bayesian estimation of trophic position from consumer stable isotope ratios. Methods in Ecology and Evolution 9, 1592–1599.

Roche K.F, Janáč M, Jurajda P. (2013). A review of Gobiid expansion along the Danube-Rhine corridor – geopolitical change as a driver for invasion. Knowledge and Managament of Aquatic Ecosystems 411, 01.

Thomas SM, Crowther T.W. (2015). Predicting rates of isotopic turnover across the animal kingdom: a synthesis of existing data. Journal of Animal Ecology 84, 861–870.

Vašek M, Všeticková L, Roche K, Jurajda P. (2014). Diet of two invading gobiid species (*Proterorhinus semilunaris* and *Neogobius melanostomus*) during the breeding and hatching season: no evidence of extensive predation on fish eggs and fry. Limnologica 46, 31–36.

Otolith Size – Standart Length Relationship of the Brond – Snout (Chondrostoma regium (Heckel, 1843)) in Tigris River, Şırnak, Turkey

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In this study, the relationships between standard length and otolith biometry of *Chondrostoma regium* (Heckel, 1843) from Güçlükonak Location of Tigris River. Sampling was carried out every month using nets from January to December 2015. A total of 375 specimens provided otolith samples for analysis. Samples consisted of fish varying in total length from 13.0 to 28.0 cm, otolith length from 2.03 to 4.56 mm and otolith weight from 0.0018 to 0.0114 g. Analysis for the relation between right and left otolith did not reveal any significant differences (t-test, p>0.05). While the relationships between fish length and otolith length had the highest coefficient of determination (R^2=0.732) and the relationships between fish length and otolith weight had the lowest coefficient of determination (R^2= 0.661). There was a stronger and postive linear relationship between the otolith size and standard length.

Keywords: Otolith, *Chondrostoma regium*, Brond-snout, Tigris River, Şırnak

Introduction

The genus *Chondrostoma* Agassiz, 1832 was applied to an heterogeneous assemblage of species, which had in common the presence of a well developed rostral cap covering most of upper lip and a more shapes, expected to represent distinct lineages. *Chondrostoma* are splender fishes, which inhabit fast flowing waters, near or on the stone bottom (Kottelat and Freyhof, 2007). These genus is widespread from most of Europe to Black Sea and Hazar Sea Basins, Tigris and Euphrates Rivers (Geldiay and Balık, 2007).

There are many studies on age, growth and reproduction of *C. regium* (Oymak, 2000; Alagöz-Ergüden et al., 2010; Suiçmez et al., 2011; Mahboobi-Soofiani et al., 2014; Saylar and Yılmaz, 2014; Yüce et al., 2015; Kiani et al., 2016; Keivany et al., 2018; Serdar and Özcan, 2018), also on otolith biometry (Aydin et al., 2004; Yılmaz et al., 2015). However, there are no published information on otolith biometry of this species from Güçlükonak Location of Tigris River. The aim of this study was to provide new information regarding the relationship between otolith length and fish length.

Materials and Methods

Sampling was carried out every month using nets from January to December 2015. A total of 375 specimens provided otolith samples for analysis. Standard length (SL) was measured to the nearest 1 mm. Otolith length and otolith width were measured to the nearest 1 µm using (Olympus SZ61TR+Olympus LC20). The rigth and left otoliths were dealt with separately. Broken and damaged otoliths were excluded from the calculations. Otolith weight measured by using digital balance to the nearest 0.0001 g. Differences between the lengths of the right and left otoliths for each species were tested using paired t-test. The relationships between otolith length and fish length were calculated using least squares regression equations to predict the standard length and and weight of the original fish from otolith length. The otolith dimensions-standard length relationships were examined by using the following equation: (y=a+b*x), where *y* is otolith length, *x* is fish standard length, *a* is intercept value, *b* is coefficient value (Basusta et al., 2013).

Results

In this study, total 375 specimens of *C. regium* from Güçlükonak Location of Tigris River have been examined. Samples consisted of fish varying in standard length from 13.0 to 28.0 cm, otolith length from 2.03 to 4.56 mm and otolith weight from 0.0018 to 0.0114 g (Table 1).

The relationship between fish length (SL) and otolith length (OL) was as y=5.468x +3.434 (R^2=0.7321) (Fig. 1), between fish length (SL) and otolith width (OW) was as y=5.827x +2.548 (R^2=0.715) (Fig. 2), between fish length (SL) and otolith weight (OWe) was as $y=93.559x^{0.298}$ (R^2=0.661) (Fig. 3).

Table1. Descriptive statistics of *C. regium* from Güçlükonak Location of Tigris River

Parameter	MeanValue ±SD	Min-Max Value
Fish Standard Length (cm)	17.70±0.102	13.0-28.0
Otolith length (mm)	2.61±0.017	2.03-4.56
Otolith width (mm)	2.59±0.014	1.99-4.15
Otolith weight (g)	0.0039±0.000065	0.0018-0.0114

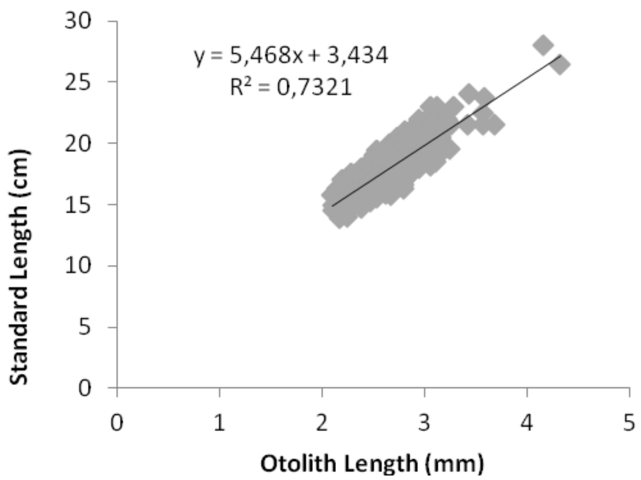

Figure 1. Fish standard length and otolith length relationship in *C. regium*

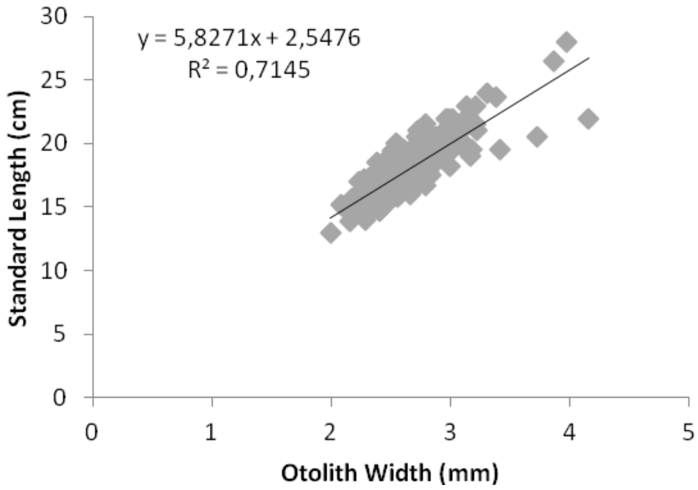

Figure 2. Fish standard length and otolith width relationship in *C. regium*

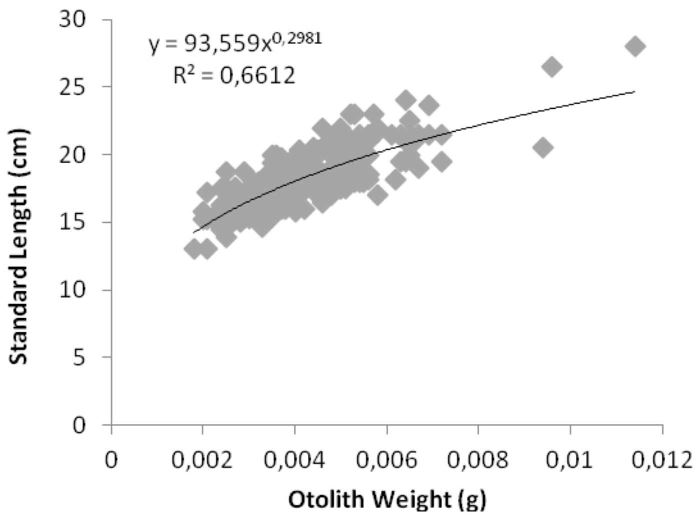

Figure 3. Fish standard length and otolith weight relationship in *C. regium*

Discussion

Otoliths are a powerful tool for stomach content analysis because of their stable structures and species-specific features (Polito et al., 2011; Zan et al., 2015). In this study, relationship between fish standard length and otolith length, otolith width and otolith weight was analyzed from Güçlükonak Location of Tigris River.

The maximum size of *C. regium* was 28.0 cm standard length in all specimens in Şırnak. Alagöz-Ergüden et al., (2010); Mahboobi-Soofiani et al., (2014); Saylar and Yılmaz (2014); Yılmaz et al., (2015); Kiani et al., (2016); Keivany et al., (2018) reported that the maximum size of brond-snout was between 19.7 and 24.5 cm. These values were lower than our values, but were close to those found by Oymak (2000); Aydin et al., (2004); Suiçmez et al. (2011). The biggest individual was reported as 35.60 cm total length for Keban Dam Lake (Yüce et al., 2015) and 33.0 cm total length for Karasu River (Serdar and Özcan, 2018).

Former studies were generally focused on the relationship between otolith length or otolith height and fish length of *C. regium* (Aydin et al., 2004; Yılmaz et al., 2015). The relationship between fish length and otolith length and width have been determined stronger and positive linear, this situation were reported by Aydin et al., (2004), Yılmaz et al., (2015) for *C. regium*.

In this study on the relationship between otolith weight and fish length of *C. regium* were examined and there was a strong positive correlation (R^2=0.6612). This study provides additional information by considering otolith weight. Consequently, the present study shows that otolith length is the best index for estimating fish length or vice versa (R^2=0.7321) for *C. regium*.

References

Alagöz-Ergüden, S., Göksu, M.Z.L., Avşar, D., 2010. Seyhan Baraj Gölü'ndeki (Adana) *Chondrostoma regium* (Heckel, 1843)'un büyüme özellikleri. Journal of FisheriesSciences.com, 4(4): 391-399.

Aydin, R., Calta, M., Sen, D., Coban, M.Z., 2004. Relationships between fish lengths and otolith length in the population of *Chondrostoma regium* (Heckel, 1843) inhabiting Keban Dam Lake. Pakistan Journal of Biological Sciences, 7(9): 1550-1553.

Basusta, A., Bal, H., Aslan, E., 2013. Otolith biometry- total length relationships in the population of hazar bleak, *Alburnus heckeli* (Battalgil, 1943) inhabiting Lake Hazar, Elazığ, Turkey. Pakistan J. Zool., 45(4): 1180-1182.

Geldiay, R., Balık, S., 2007. Türkiye Tatlısu Balıkları. Ege Üniv. Su Ürün. Fak. Yayınları no: 46, Ders kitabı dizini no:16, İzmir.

Keivany, Y., Mortazavi, S.S., Farhadian, O., 2018. Age and growth bround-snout, *Chondrostoma regium* in Beheshtabad River of Chaharmahal & Bakhtiari Province of Iran (Teleostei: Cyprinidae). Iran J. Ichthyol., 5(1): 30-42.

Kiani, F., Keivany, Y., Paykan-Heyrati, F., Farhadian, O., 2016. Age and growth of king nase, *Chondrostoma regium* (Heckel, 1843) from Bibi-Sayyedan River of Semirom, Isfahan, Iran. Iranian Journal of Fisheries Sciences, 15(3): 1214-1223.

Kottelat, M., Freyhof, J., 2007. Handbook of European freshwater fishes. Kottelat, Cornol, Switzerland and Freyhof, Berlin, Germany.

Mahboobi-Soofiani, M.N., Pooramini, M., Asadollah-Nasrabadi, S., Ahmadi, S., Hatami, R., (2014). Age, growth and reproduction of *Chondrostoma regium* (Heckel, 1843) from Zayandeh Roud River, Iran. Iranian Journal of Fisheries Sciences, 13(4): 810-822.

Oymak, S.A., 2000. Atatürk Baraj Gölü'nde yaşayan *Chondrostoma regium* (Heckel, 1843)'un büyüme özellikleri. Turk J. Zool., Ek sayı, 24: 41-50.

Polito, M.J., Trivelpiece, W.Z., Karnovsky, N.J., Ng, E., Patterson, W.P., Emslie, S.D., 2011. Integrating stomach content and stable isotope analyses to quantify the diets of pygoscelid penguins. Plos ONE, 6, e26642.

Saylar, Ö., Yılmaz, S., 2014. Some of the biology features of the bround-snout (*Chondrostoma regium* (Heckel, 1843)) living in Lake Ladik (Samsun, Turkey). Ankara Univ. Vet. Fak. Derg., 61, 141-146.

Serdar, O., Özcan, E.İ., 2018. Length-weight, length-length relationships and condition factor of *Chondrostoma regium* (Heckel, 1843) and *Barbus lacerta*, Heckel, 1843 from Karasu River (East Anatolia, Turkey). Turkish Journal of Agriculture-Food Science and Technology, 6(6): 729-732.

Suiçmez, M., Yılmaz, S., Şeherli, T., 2011. Age and growth features of *Chondrostoma regium* (Heckel, 1843) from Almus Dam Lake, Turkey. SDU Journal of Science (E-Journal), 6(2): 82-90.

Yılmaz, S., Yazıcıoğlu, O., Yazıcı, R., Polat, N., 2015. Relationships between fish length and otolith size for five cyprinid species from Lake Ladik, Samsun, Turkey. Turk J Zool., 39: 438-446.

Yüce, S., Aydın, R., Gündüz, F., Demirol, F., Şeker, T., Çoban, M.Z., Şen, D., 2015. Keban Baraj Gölü'nde yaşayan *Chondrostoma regium* (Heckel, 1843)'un büyüme özellikleri. Fırat Üniv. Fen Bilimleri Dergisi, 27(2): 29-36.

Zan, X.X., Zhang, C., Xu, B.D., Zhang, C.L., 2015. Relationships between fish size and otolith measurements for 33 fish species caught by bottom trawl in Haizhou Bay, China. J. Appl. Ichthyol., 31: 544-548.

Spatial Analysis of Marine Accidents in the Region of Antalya Using Geographic Information System

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The main objective of the study was to determine the risk level of the marine areas considering maritime accidents in the region of Antalya using Geographic Information System (GIS) instruments. Within this scope, the data including a total of 115 ship accidents between 2001 and 2016 was provided by Turkish Main Search and Rescue Coordination Center (TMSRCC) database. The spatial analysis of marine accident was performed by MapInfo 8.0 software which is based on Geographic Information System (GIS). A total of 115 major and minor ship accidents involving 11 ship types and 11 accident types around region of Antalya used in this study. As a result, the ship accidents were mostly occurred near the shore and also inner areas of the port. Yachts (n=39;34%) and recreational vessels (n=26, 23%) were the ship types mostly involved in ship accidents. 69% (n=79) of the vessel involved in the accidents were Turkish flagged. Capsizing was the most frequent risks (25%) in the region. In this study, the region of Antalya was divided into 30-minute polygons and four risk levels were defined to determine risky areas according to the ship accident frequency. With respect to this classification, marine areas were classified as low risk (0 <x <3), medium risk (3 <x <6), high risk (6 < x <9), very high risk (9<x) regions. Finally, Port of Akdeniz, Kaleiçi Marina and Kemer Marina have been identified as very high risk (VHR) zones depending on the number of ship accidents. Suggestions were made to minimize the risks in the identified regions, to improve the legislation and standards for the safety of life and marine environment at sea thereby preventing the repetition of similar accidents and reducing the adverse effects and consequences of ship accidents.

Keywords: GIS, Region of Antalya, Ship accidents, Spatial analysis, Risk level.

Introduction

Accidents usually cause serious consequences such as loss, damage, death, injury or pollution regardless of which industry they occur in. Marine accidents, in particular, have the potential to cause enormous economic, environmental and political consequences although it has highly regular safety practices (Şahin & Şenol, 2015: 162; Hetherington et al., 2006: 401). In this respect, it is considered that the safety of navigation and prevention of marine accidents are one of the most important and apprehension issues for the maritime industry (Akyüz & Çelik, 2014: 20; Akyüz, 2017: 17). Human factor, technical failures and environmental factors are mentioned in related literature as a widely highlighted agent causing to marine accidents and threatening to safety of navigation (Uğurlu et al., 2015: 163; Kristiansen, 2013).

Many studies in related literature are mainly based on summary statistics such as accident frequency, accident types and reasons of accidents (Fabiano et al., 2010; Romer et al., 1995; Wang et al., 2005). In addition to these topics, in this study, spatial analysis of a total of 115 major and minor marine accidents involving 11 ship types and 11 accident types provided by Turkish Main Search and Rescue Coordination Center (TMSRCC) database and occurred in the Antalya Region between 2001 and 2016 has been investigated to reveal the risk level of the marine regions.

Antalya has potential for alternative tourism, such as sport tourism, marine and medical tourism, thanks to its assets in natural beauty locations and travel destinations. Antalya Region which includes the Gulf of Antalya, the largest gulf of the northern Levantine Sea and geographically located in the eastern Mediterranean Sea and southern coast of Turkey (Özbek et al., 2013: 25), is determined as a research area to be investigated. The research area of Antalya is divided into 3 regions which is named east, west and center. The borders of the western region include the westernmost from Kemer, while the borders of the eastern region cover the area from the Belek region to the easternmost.

Figure 1. Research area.

Material and Methods

In spite of the enormous efforts of different maritime organizations to achieve a safe and secure maritime transport system, the number of maritime accidents is still increasing. As has been widely understood, marine accidents can be related to human factors, natural, technical or a combination thereof all these factors. The aim of the study is to identify the risk level of the marine areas including marine accidents in the region of Antalya using Geographic Information System (GIS) instruments.

Geographic information systems are large-scale geographical data, software and methods developed for storing, processing, spatial analysis, interrogation and accordingly a wide variety of imaging processes intended to solve complex social, economic and environmental problems on earth (Burrough, 1986; Goodchild, 1992; Huissman & De By, 2009:32). It is broadly known that GIS systems offer a powerful frames of techniques for spatial analyses (provides the possibility of querying, allows flexible data retrieval, addition and subtraction of map layers, and the creation of isomorphic buffer zones around a feature) (Burrough et al., 2015). In addition, this system has become a frequently used method in recent years in terms of identifying the risky areas where accidents are likely to occur. Spatial analyses are a general ability to manipulate spatial data in different forms such as coordinates, volumes or lengths and ultimately make additional sense (Bailey, 2005: 9; Haining, 2005: 26). In order to perform spatial analyses in Mapinfo, the longtitude and latitude of the marine accidents are especially necessary. However, some marine accidents have lack of data. This part of missing information is limitation of research.

Within this objective, Mapinfo 8.0 software which is based on Geographic Information System has been used to perform spatial analyses. Initially, the most important part of this phase is to express the statistical data to be analyzed in the field correctly. In the second step of spatial analyses of marine accident is used "Point density analyses" which is identified and visualized point distribution of data in the region. This analyze creates a risk map according to the intensity of the number of marine accidents on each 10 km or 30-minute polygon cell. In this study, the region of Antalya has been divided into 30-minute polygons and four risk levels have been defined to determine risky areas according to the ship accident frequency. With respect to this classification, marine areas have been classified as low risk ($0 < x < 3$), medium risk ($3 < x < 6$), high risk ($6 < x < 9$), very high risk ($9 < x$) regions (Uğurlu & Yıldız, 2016; Uğurlu et al.,2013).

Results

In this study, Antalya has been designated as a research area, which is an intensive maritime traffic area in terms of yachts and recreational crafts in addition to being the port of call for commercial vessels. The marine accident data set includes coordinates, ship type, flag, gross tonnage, accident cause, accident type, time period of accident provided Turkish Maritime Search and Rescue Coordination Centre (TMSRCC) between 2001-2016 years. The data also includes a total 115 major and minor marine accident contained 11 ship types, 11 accident cause, 23 different country flag.

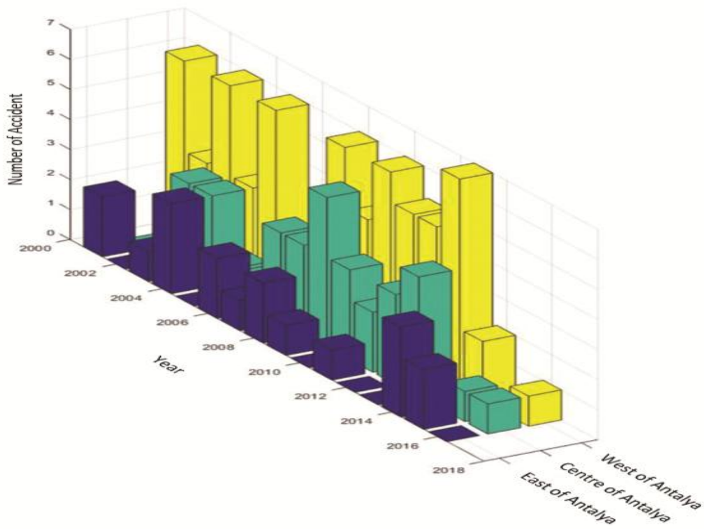

Figure 2. Distribution of ship accidents by year and regions.

Figure 2 is shown that distribution of ship accidents by year and regions. When the statistics of ship accidents have been examined, it has been found that between the years 2001 and 2016, ship accidents on the eastern part of Antalya (19; 17%) and in the Antalya gulf area (34; 30%), but totally (62; 53%) ship accidents occurred in the western region. On the basis of years, it has been determined that the homogeneous distribution of ship accident is not. In particular, the 2008, 2009 and 2013 have been found to have frequent marine accidents. Yacht class boats and recreational crafts are the foreground in the marine accidents data on specified years.

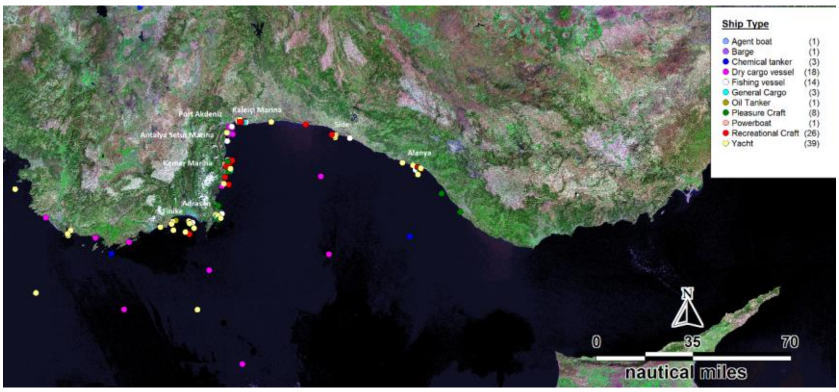

Figure 3. Spatial analyses of ship accident according to ship types.

Figure 3 is shown that the geographical distribution of ship accidents by ship types as a result of the spatial analysis using the Mapinfo software. It can be seen that yacht (39, 34%) and recreational crafts (26, 23%) are mostly located in coastal and inner ports. It is the crucial part that when the spatial analysis of ship accidents according to ship types is examined, it is observed that commercial vessels caused accidents in offshore, but yachts, fishing vessel or recreational crafts occurred in coastal of research area.

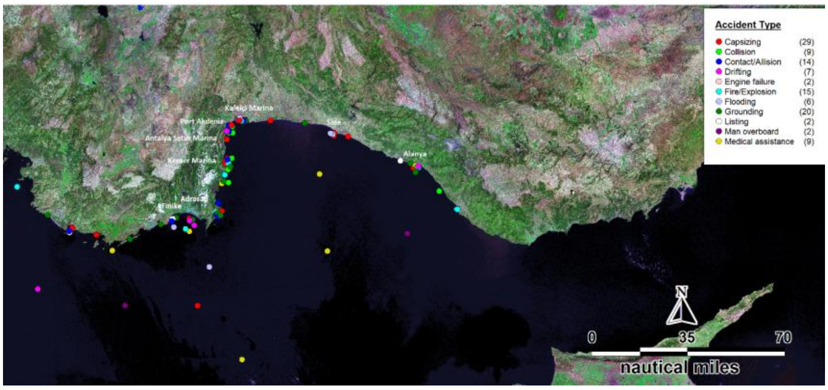

Figure 4. Spatial analyses of ship accident according to accident types.

As seen in Figure 4, Capsizing (29; 25%) and Grounding (20; 13%) have been mostly observed in coastal side. Fishing vessel (10; 35%), yachts (7; 24%) and recreational crafts (7; 24%) were more likely to experience capsizing emergency situations.

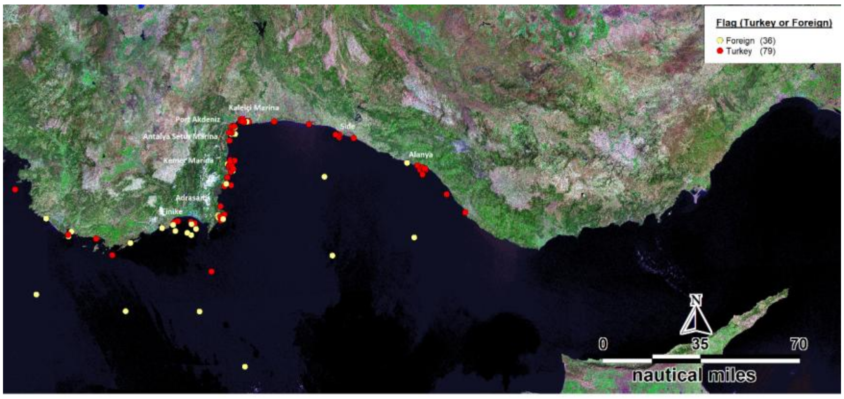

Figure 5. Spatial analyses of ship accident according to flag (Turkey or Foreign)

Figure 5 is shown that the spatial analyses of ship accident according to flag type. It has been observed that Turkish flagged ships and boats (79; 69%) experienced more frequently marine accidents. It is also seen that the large commercial vessels (6; 5%) coming out of the offshore are foreign flagged.

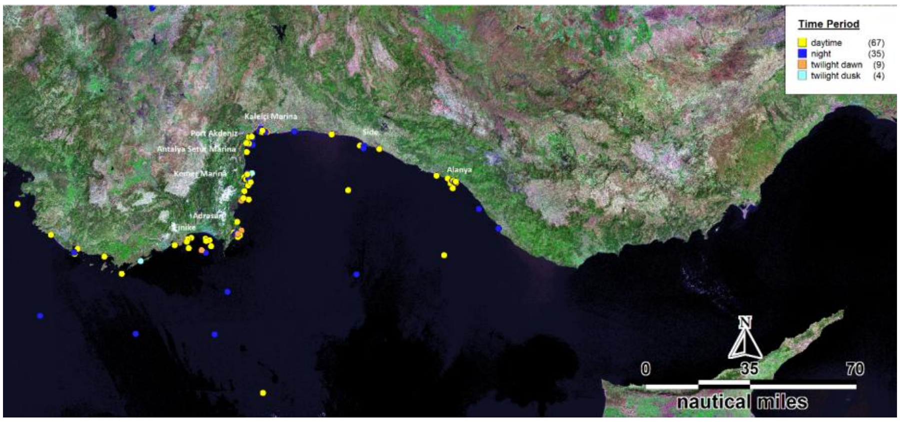

Figure 6. Spatial analyses of ship accident according to accident type period.

As seen Figure 6, It has been observed that ship accidents occurred less frequently during the twilight time (13; 11%), but more frequently during daytime (67; 58%), especially when the yacht and recreational crafts were beginning to sail.

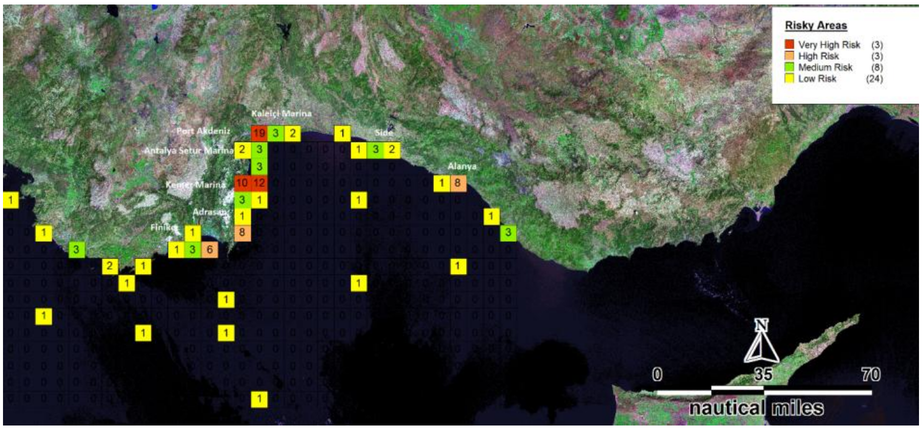

Figure 7. Risk levels of marine areas.

After the spatial analysis of ship accidents by using GIS, the risk levels have been divided into 10 km of polygon areas of the Antalya region. These risk levels include very high risk, high risk, medium risk and low risk marine areas. The geographical distribution of the risky areas for marine accidents investigated in the study is shown in Figure 7.

The port of Antalya plays an important role in Turkish international maritime trade. The port of Antalya, a multi-purpose port including the cruise port, container harbor, bulk freight and marina, is located in the first place among the highest ports of Turkey's development potential. Unfortunately, it is observed that Port of Akdeniz is very high risk areas due to occurring a more frequent experience of marine accidents. Kaleici Marina and Kemer Marina have been identified as very high risk (VHR) zones depending on the number of ship accidents while areas of Gelidonya lighthouse (Adrasan) has been identified high risk (HR) marine areas. Collision (3; 38%) and fire/ explosion (3; 38%) emergency situations took places in port of Alanya, so this place is characterized high risk (HR) marine areas. Konyaaltı is identified medium risk (MR) areas where collision and contact emergency situations frequently occurred. Low risk (LR) marine areas are other parts of region.

Conclusion

In conclusion, when the ship accident statistics have been examined, it has been observed that yacht-class boats have been caused marine accidents due to bad weather conditions but large-tonnage commercial vessels experienced accidents due to technical reasons. Therefore, small-tonnage navigation boats must not navigate during bad weather conditions and necessary precautions must be taken by marinas. To be prepared for an emergency situation such as heavy weather condition and navigational failure, trainings for mariners should be provided. Marina personnel should conduct risk assessments for each hazard situation and have a team against possible threats at marinas. In chief, emergency response stations and the recruitment of qualified personnel are needed to minimize bad effects of accidents and inspected boats in terms of possible emergency situations and safety precautions.

In brief, marine tourism is one of the largest industries in Turkey and it plays a crucial role in the economic development of the country. But, marine pollution from marine tourism vehicles is mostly due to fire and capsizing. Sewage, slops or petroleum derivatives that enter the sea from vessels following capsizing can cause marine pollution. Even though there is no intensive pollution information resulting from the accident from marine tourism vehicles, it will affect the tourism activities of the region negatively and adversely. Antalya is one of the region of attraction in terms of both touristic and maritime tourism activities. The frequency of marine accidents occurring in this region will also affect regional tourism negatively. It is necessary to comply with the rules in terms of navigational safety and security in both port and touristic areas and risk assessments will inevitably be made.

References

Akyüz, E. 2017. A marine accident analyzing model to evaluate potential operational causes in cargo ships. Safety science, 92(2017): 17-25.

Akyüz, E. & Çelik, M. 2014. Utilisation of cognitive map in modelling human error in marine accident analysis and prevention. Safety science, 70(2014): 19-28.

Bailey, T. C. 2005. A review of statistical spatial analysis in geographical information systems. Spatial analysis and GIS, 8-25.

Burrough, P. A. 1986. Principles of geographical information systems for land resources assessment. Oxford University Press, United Kingdom.

Burrough, P. A., McDonnell, R., McDonnell, R. A. & Lloyd, C. D. 2015. Principles of geographical information systems (Third Edition). Oxford University Press, United Kingdom.

Fabiano, B., Curro, F., Reverberi, A. P. & Pastorino, R. 2010. Port safety and the container revolution: A statistical study on human factor and occupational accidents over the long period. Safety Science, 48(8): 980-990.

Goodchild, M. F. 1992. Geographical information science. International journal of geographical information systems, 6(1): 31-45.

Haining, R. 2005. Designing spatial data analysis modules for geographical information systems. Spatial analysis and GIS, 26-37.

Hetherington, C., Flin, R. & Mearns, K. 2006. Safety in shipping: The human element. Journal of safety research, 37(4): 401-411.

Huisman, O. & De By, R. A. 2009. Principles of geographic information systems. ITC Educational Textbook Series, The International Institute for Geo- Information Science and Earth Observation Publication, Hengelosestraat, Netherlands.

Kristiansen, S. 2013. Maritime transportation: safety management and risk analysis. Routledge, United Kingdom.

Özbek, E. Ö., Kebapçıoğlu, T. & Çardak, M. 2013. Spatio-temporal patterns of abundance, biomass and length-weight relationship of white grouper, Epinephelus aeneus (Geoffroy Saint-Hilaire, 1817) (Pisces: Serranidae) in the Gulf of Antalya, Turkey (Levantine Sea). Journal of Black Sea/Mediterranean Environment, 19(1): 23-45.

Rømer, H., Petersen, H. S. & Haastrup, P. 1995. Marine accident frequencies–review and recent empirical results. The Journal of Navigation, 48(3): 410-424.

Sahin, B. & Senol, Y. E. 2015. A novel process model for marine accident analysis by using generic fuzzy-AHP algorithm. The Journal of Navigation, 68(1): 162-183.

Uğurlu, Ö., & Yıldız, S. 2016. Evaluation of Passenger Vessel Accidents and Spatial Analysis. Journal of ETA Maritime Science, 4(4): 289-302.

Uğurlu, Ö., Köse, E., Yıldırım, U. & Yüksekyıldız, E. 2015. Marine accident analysis for collision and grounding in oil tanker using FTA method. Maritime Policy & Management, 42(2): 163-185.

Uğurlu, O., Yıldırım, U., & Yüksekyildiz, E. 2013. Marine accident analysis with GIS. Journal of Shipping and Ocean Engineering, 3(1-2): 21.

Wang, J., Pillay, A., Kwon, Y. S., Wall, A. D. & Loughran, C. G. 2005. An analysis of fishing vessel accidents. Accident Analysis & Prevention, 37(6): 1019-1024.

Exploration of Factors Causing Ship Accidents in Mersin Bay through Root Cause Analysis

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Mersin Bay as the most concentrated region of Turkey in terms of shipping traffic has become a region where marine accidents occur quite often. The Mersin International Port (MIP) as one of the leading ports in Turkey and in the East Mediterranean with great cargo handling capacity is located at inner part of the bay. In this scope, the main purpose of this study is to explore root causes of ship accidents in Mersin Bay. To do this, the Root Cause Analysis methodology was carried out on the data provided by Turkish Main Search and Rescue Coordination Center (TMSRCC).
In this context, a total of 60 ship accidents in the region between 2001 and 2016 were used in the research. As a result, it is seen that the most frequent accidents in the region are collision and contact (28%) caused by navigation failure as (83%) human error. Besides, grounding accidents in the region are the second most common accidents (21%) due to heavy weather conditions (60%). As a result, the root-cause analysis shows that human error is still leading factor in ship accidents. Finally, necessary precautions have been offered to minimize risk levels of human errors and suggestions for further studies have been made.
Keywords: Mersin bay, root-cause analysis, ship accidents, TMSRCC.

Introduction

The rapid increase for cargo carried by ships has led to the maritime transport being considered as a very risky activity where even a single ship accident can cause catastrophic consequences (Aarsaether, 2011). Some regions in the world such as Mediterranean, Baltic Sea, and China sea are referred to as risky regions in terms of sea accidents due increased ship traffic (Coppini *et al.*, 2011; Zodiatis *et al.*, 2016). Eastern Mediterranean was found to be the second risky area after the Sea of China for accidents involving ships (WWF, 2018). With its strategic position, the Mersin Bay plays an important role in the maritime transport in the eastern Mediterranean region. The bay is hosting the Port of Mersin as one of the emerging gateway ports with great cargo handling capacity in the East Mediterranean (Merk & Bagis, 2013). In this study, it is aimed to determine the root causes of the ship accidents in the Bay of Mersin, where ship accidents are frequently experienced.

Literature review

In the literature, there are many studies investigating the root causes of ship accidents. Amrozowicz *et al.* (1997) used FTA and Event Trees Analysis (ETA) incorporating The Human Error Rate Prediction (THERP) data to quantify individual errors. Antão & Soares (2006) tried to find out the factors that cause accidents on passenger ships (Ro-Pax) and the impact of human failure in these factors. Wu *et al.* (2014) developed a Grounding and Collision Analysis Toolbox (GRACAT) in order to analyze the probabilities of ship accidents in Southeast Texas Waterways. Ugurlu *et al.* (2015) conducted a study using Fault Tree Analysis (FTA) in order to find root causes of collision and grounding of oil tankers. Arslan *et al.* (2018) utilized FTA method to find out the root causes of tanker accidents during loading and unloading operations in terminals. Guan *et al.*, (2016) tried to build a model of fault tree taking into account of fires and explosions on a dual fuel ship.

Materials and Method

In this study, the FTA method as one of the most commonly used risk assessment technique was carried out to investigate probability of root causes and their impact level on grounding accidents in Mersin Bay.

FTA Method

The FTA method is used to calculate the probability of incidents that are the result of failures. The system uses a deductive approach in order to calculate the impact values of each sub-factor. The system begins with the event of interest, the top event, and is developed from the top down (Chen *et al.*, 2015). A Fault Tree is the graphical representation of the Boolean (logical) equation, which links the individual component states to the whole system state. A simple fault tree is shown in Figure 1.

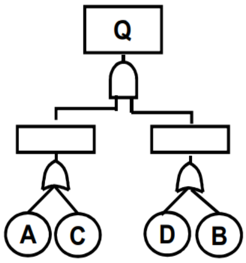

Figure 1. A simple fault tree design
Source: Vesely & Roberts, 1981.

Algebraic representation is: $Q = (A \cup C) \cap (D \cup B)$ $\cup$ or gate $\cap$ and gate

The main determinants of a Fault Tree are composed of the top event, primary events, intermediate events and logic gates (Antao & Soares, 2006). The FTA method serves for Qualitative and Quantitative purposes. With qualitatively, Minimal Cut Sets (MCS) are used to build main fault tree in order to show the relationship between events. For quantitative analysis, absolute probabilities of each events are calculated and their impact level on the top event are presented (Perez & Ugarelli, 2014).

Study Site

In this study, the Mersin Bay, which is considered as the most concentrated region of Turkey in terms of shipping traffic, has been selected as study site.

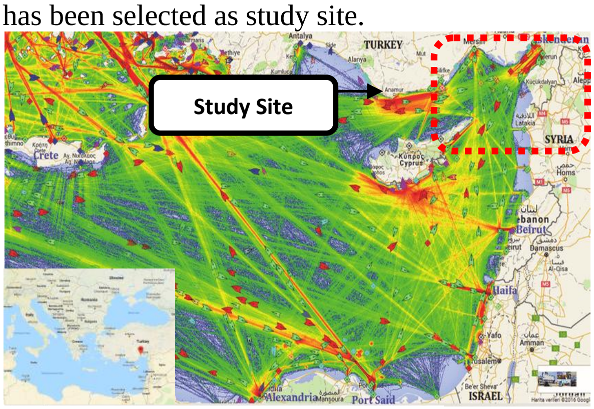

Figure 2. Ship traffic density map in the eastern Mediterranean Sea
Source: Marine Traffic (2016)

As can be seen in the figure, Bay of Mersin is the region with the highest density of ship traffic in Mediterranean region of Turkey. Port of Mersin is one of the biggest 10 ports in Europe with being the largest port in Turkey. The probability of ship accident in the Mersin Bay region will always be high, simply due to the large quantity of cargo transported in the region (Toz & Buber, 2018).

Table 1. Accident causes and frequency of their occurrence

Accident Cause	Accident Type								
	Capsizing	Collision	Drifting	Fire	Flooding	Grounding	Listing	Medical Assistance	TOTAL
Failure in Loading							1		1
Generator Failure		2		1				1	3
Engine Failure		2				2			3
Maintenance Failure					1				1
Lack of Attention	1			1		1			2
Inappropriate Voyage Planning	4	1				1			5
Fatigue		1				1		1	1
Heavy Weather Conditions	2	2				2		1	13
Violation of Safety Rules								8	8
Alcohol Abuse		1						1	1
Steering Gear Failure	1	5				2			18
Maneuvering Failures	1	1				1			2
Faulty Procedure		1		1		1			1
Violation of COLREG		2	1			1			1
Poor Visibility		2				1			
TOTAL	9	20	1	3	1	13	1	12	60

According to the database, accident due to collision-contact damage represents more than 30% of the total number of accidents. Therefore, this paper performs fault tree analysis on these categories to calculate the probability of such an accident. In order to construct fault tree, the Open FTA software, frequently used software for FTA modelling, has been selected. This software has been developed for serving in several fields such as aviation, space, medical materials, nuclear materials, and defense (GNU, 2011).

The total contribution and probability values for these root causes were calculated by using the following formulas (Arslan *et al.*, 2018):

$$TCAC = \frac{1}{RC_1} + \frac{1}{RC_2} + ... + \frac{1}{RCn} \qquad (1)$$

TCAC: Total Contribution of Accident Cause
RC_1: A total Number of Root Causes in Ship Accident 1

$$PVAC = \frac{TCAC}{SN \times TY} \qquad (2)$$

PVAC: Probability Value of Accident Cause
SN: Ship Number
TY: Total Year

The total contribution rates and probabilities of root causes according to the above formulation are shown in Table 2.

Table 2. Accident causes and frequency of their occurrence

No	Accident Cause	Frequency	Total Contribution	Probability
1	Steering Gear Failure	5	10/3	3.47E-03
2	Violation of COLREG	2	3/2	1.56E-03
3	Maneuvering Failure	1	1/5	2.08E-04
4	Engine Failure	2	3/2	1.56E-03
5	Heavy Weather Conditions	2	6/5	1.25E-03
6	Fatigue	1	1/4	2.60E-04
7	Alcohol Abuse	1	1/6	1.74E-04
8	Poor Visibility	2	3/2	1.56E-03
9	Faulty Procedure	1	1/7	1.49E-04
10	Inappropriate Voyage Planning	1	1/2	5.21E-04
11	Generator Failure	2	7/12	6.08E-04

A total of 11 root causes in 20 collision accidents between 2001 and 2016 has been defined with the analysis of accident reports provided by Turkish Main Search and Rescue Coordination Center (TMSRCC).

Findings and Results

In this study, the collision accidents in Mersin Bay have been considered for evaluation. A total of 20 events caused by 11 factors were determined. Initially the fault tree including main, intermediate and root causes was constructed then, the probabilities of sub-events and their impact level were calculated with the application of Open FTA software. The details of the accidents are shown below.

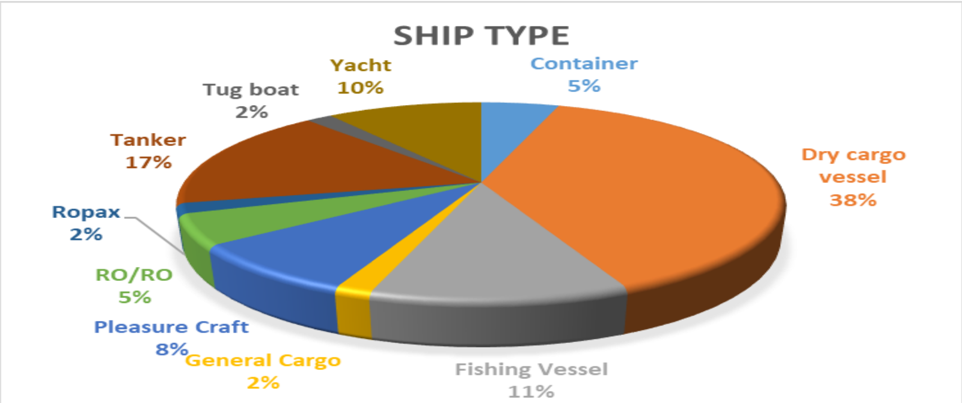

Figure 3. Collisions regarding to the ship types

It is seen that a large part of the vessels are dry cargo vessels. The fact that this area is an important trading area and at the same time hosting a port serving international ships. The ship accidents were tested with Monte Carlo Simulation using Open FTA program. Contribution ratios and importance levels for each root cause were obtained. A total of 28 failure modes from 11 initial events were found for grounding accidents. The values for these data are given in Table 3.

Table 3: Monte carlo simulation initial event contribution rates for grounding accidents

No	Initial Event	Failure Contribution	Importance Level	Percentage Rate (%)
1	X1 (Steering Gear Failure)	3.487112E-003	30.95	31.07
2	X4 (Poor Visibility)	1.621310E-003	14.39	14.45
3	X2 (Engine Failure)	1.575115E-003	13.98	14.03
4	X6 (Violation of COLREG)	1.530048E-003	13.58	13.63
5	X5 (Heavy Weather Conditions)	1.202180E-003	10.67	10.71
6	X3 (Generator Failure)	5.926400E-004	5.26	5.28
7	X7 (Inappropriate Voyage Planning)	5.340520E-004	4.74	4.76
8	X11 (Fatigue)	2.568858E-004	2.28	2.29
9	X8 (Maneuvering Failure)	2.028046E-004	1.80	1.81
10	X10 (Alcohol Abuse)	1.746373E-004	1.55	1.56
11	X9 (Faulty Procedure)	1.340764E-004	1.19	1.19

As understood from the table that X1 which is named as “Steering Gear Failure” is the most important factor and has the biggest contribution in collision accidents. “Poor Visibility” and “Engine Failure” are the second and the third important factors in those accidents. In addition, although the bay is located in a natural protected area, bad weather conditions nevertheless caused collision. Again, the results show that the effect of human error on accidents is lower than the others. Besides, many boats engaged in fishing in the area and their captains who do not know the rules of Colreg cause the ships to collide. As well as other types of boats causing accidents due to lack of information on restricted passage conditions for ships.

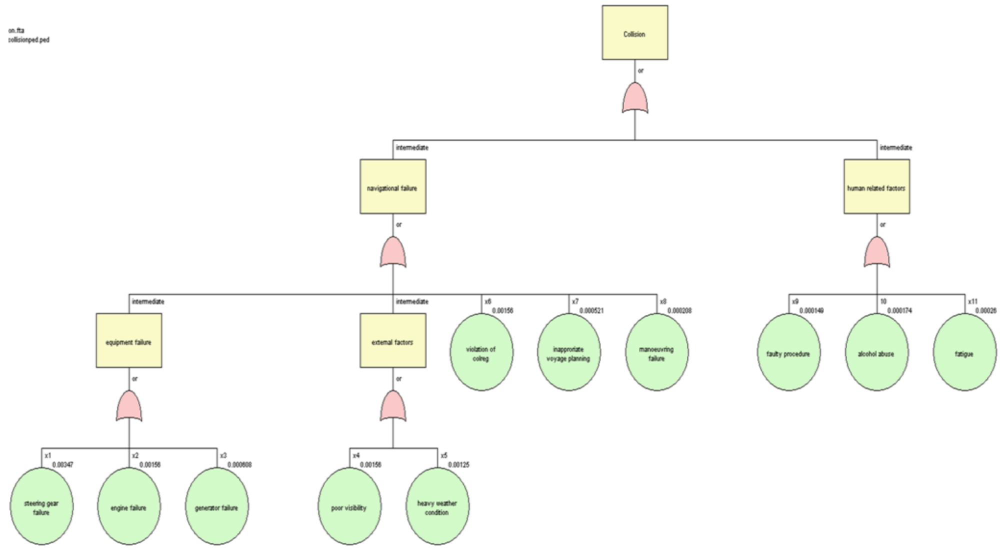

Figure 4. Fault tree for collision accidents

Conclusions

In this study, a total of 20 collision accidents in the Bay of Mersin between 2001 and 2016 have been investigated. It has been resulted that ship accidents, which result in collision due to navigation failure are frequently experienced. Therefore, it is aimed to determine the precautions that should be taken in order to prevent these accidents from happening again. In this study, it is seen that the most important factor in the accidents is the steering failure under equipment failure. Although these failures seem to be caused by malfunctions on their own, it is known that the inadequate maintenance measures may also cause this fault. In all cases, regular maintenance operations should be carried out and inspections should be conducted by authorities. Although the number of accidents resulting directly from human error seems to be small, it is not possible to keep it strictly separate from other factors. Besides, poor visibility is the other environmental factor in collision accidents. In order to minimize the environmental effects in the area, the parties engaged in weather information services should inform the mariners in time.

The most important limitations of the study are the insufficient and incomplete data of the accident reports provided. A more comprehensive study can be carried using reports with more detailed information. In this study, FTA was used as a risk assessment method. Different methods can be used in future studies for better solutions.

References

Aarsaether, K. G., 2011. Modeling and analysis of ship traffic by observation and numerical simulation. Doctoral dissertation, NTNU.

Amrozowicz, M. D. and others. A probabilistic analysis of tanker groundings. In: *The seventh international offshore and polar engineering conference*. International Society of Offshore and Polar Engineers. 1997.

Antão, P. & Soares, C. Fault-tree models of accident scenarios of Ro-Pax vessels. In: Int J. Auto. Comput. 2006. 3. 107

Arslan, O. and others. Fault tree analysis of tanker accidents during loading and unloading operations at the tanker terminals. In: *Journal of eta maritime science*. 2018. 6. 3-16.

Chen, Pengfei & Mou, J & Li, Y. (2015). Risk analysis of maritime accidents in an estuary: a case study of Shenzhen waters. 42. 54-62.

Coppini, G., De Dominicis, M., Zodiatis, G., Lardner, R., Pinardi, N., Santoleri, R., Colella, S., Bignami, F., Hayes, D.R., Soloviev, D., Georgiou, G., Kallos, G. (2011). Hindcast of oil-spill pollution during the Lebanon crisis in the Eastern Mediterranean, July–August 2006. Marine Pollution Bulletin, 62(1), 140-153. https://doi.org/10.1016/j.marpolbul.2010.08.021

GNU. 2011. FTA. Accessed October 19. http://www.openfta.com.

Guan, Y. & others. Fault tree analysis of fire and explosion accidents for dual fuel (diesel/natural gas) ship engine rooms. In: Journal of marine. sci. appl. 2016. 15. 331.

Marine Traffic (2016). Live Map. Accessed: 01 May 2018,https://www.marinetraffic.com/

Merk, O. & Bagis, O., 2013, « The Competitiveness of Global Port-Cities: the Case of Mersin - Turkey », OECD Regional Development Working Papers, 2013/01, OECD Publishing,

Pérez, A. I. N., & Ugarelli, R., 2014.Fault tree analysis as a tool for risk assessment and its use for Infrastructure Asset Management in water utilities. 2014. 492-499.

Tang, L. & Guobin, W., 2009. Fault tree analysis on ship drift emergency of three Georges lock. In: *Proceedings of IEEE*. 2009. pp. 4244-4639.

Toz, A. C., & Buber, M. (2018). Performance evaluation of oil spill software systems in early fate and trajectory of oil spill: comparison analysis of OILMAP and PISCES 2 in Mersin bay spill. *Environmental monitoring and assessment*, *190*(9), 551.

Ugurlu, O. and others. Analysis of grounding accidents caused by human error. In: *Journal of marine sciences*. 2015. 23(5). 748-760.

Vesely, W. E. and Roberts, N. H. Fault tree handbook. United States Nuclear Regulatory Commision. 1981.

Wu, X. and others. Probability analysis of vessel collisions and groundings in southeast texas waterways. In: *Transportation research record: journal of the transportation research board*. 2014. 44-53.

WWF, 2018. https://www.sail-world.com/Australia/Worlds-most-dangerous-waters-by-the-WWF-and-Allianz/-115413?source=google.tr

Zodiatis, G., De Dominicis, M., Perivoliotis, L., Radhakrishnan, H., Georgoudis, E., Sotillo, M., Lardner, R.W., Krokos, G., Bruciaferri, D., Clementi, E., Guarnieri, A., Ribotti, A., Drago, A., Bourma, E., Padorno, E., Daniel, P., Gonzalez, G., Chazot, C., Gouriou, V., Kremer, X., Sofianos, S., Tintore, J., Garreau, P., Pinardi, N., Coppini, G., Lecci, R., Pisano, A., Sorgente, R., Fazioli, L., Soloviev, D., Stylianou, S., Nikolaidis, A., Panayidou, X., Karaolia, A., Gauci, A., Marcati, A.,Caiazzo, L.& Mancini, M., 2016. The Mediterranean decision support system for marine safety dedicated to oil slicks predictions. Deep Sea Research Part II: Topical Studies in Oceanography, 133, 4-20. https://doi.org/10.1016/j.dsr2.2016.07.014

Assessment of Pb, Cd and Fe bioaccumulations in muscle tissues of five fish species from eastern coast of Libya

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Bioaccumulation of three heavy metals (lead, cadmium, iron) in muscle tissues of five fish species (*Sparus aurata*, *Mugil cephalus*, *Oblada melanura*, *Oreochromis niloticus* and *Diplodus vulgaris*) were evaluated in this study. The fishes were collected from three sites at the eastern coast of Libya (Al hanya, Susa and Umm hufain) fish landing areas during the summer season of 2017. The results indicated that the concentration of iron was ranged from 1.573±0.159 ppm in *S. aurata* to 21.969±14.469 ppm in *O. niloticus*. The cadmium accumulation was ranged from 0.0834±0.0847 to 0.145±0.0125 ppm in *M. cephalus*, *O. melanura* respectively, while the concentration of lead showed higher concentration in *O. niloticus* (0.772±0.340 ppm), and the lower concentration was 0.006±0.007 ppm in *M. cephalus*. The correlation coefficient between the total length and the concentration of lead was slightly strong (R^2 =0.74) in *M. cephalus*, while the bioaccumulation of all detected heavy metals were less than the permissible levels of FAO/WHO, except the concentration of lead which was slightly higher in *O. niloticus*.

Keywords: Heavy metal, bioaccumulation, fish, muscle tissue, Libya

Introduction

Fishes are one of the major sources of protein; fishes typically have rich contents of essential minerals, vitamins, low saturated fat and sufficient omega-3 fatty acids which are known to support good health (Medeiros *et al*., 2012). Fishes also act as bio-indicator of heavy metal levels in aquatic environment. Essential heavy metals like Cr, Mn, Co, Cu, Fe and Zn play important biochemical roles in the life processes of many organisms. For example iron is one of the essential components of hemoglobin, which is responsible for the transportation of oxygen in the body, (Vinikour & Goldstein, 1987; kakulu *et al* .,1980), but at high concentrations it can cause pathological events such as the iron oxides deposition in Parkinson disease (Matusch *et al*., 2010; Altamura & Mukenthaler, 2009) other metals like Pb, Cd and Hg have no known role in biological system and are toxic even at low concentration. Fishes can uptake trace metals by two main routes, by adsorption from water through the gills, and from food absorbed through the digestive tract (Farkas *et al*., 2003; Terra *et al*., 2008; Rozon-Ramilo *et al*., 2011).

Metals present in water show different bio-availabilities, both for fish and their prey. Water chemistry properties like salinity, dissolved and suspended organic carbon, pH and temperature are important modifiers of metal bio-availability and toxicity to aquatic organisms (Paquin *et al*., 2002; Niyogi & Wood, 2004). In addition ecological needs, sex, age, spawning status and size play significant roles in metal bio-accumulation (Andres *et al*., 2000; Canli & Atli, 2003; Farkas *et al*., 2003). this study aims to determine the levels of Pb, Cd and Fe in muscles of *S. aurata, M. cephalus, O. melanura, O. nilotics and D. vulgaris* from eastern Libya, to relate these levels to fish total length and to find whether these levels are within the permissible limits to human consumption.

Material and Methods

Collection of fish samples:

Five fish species were purchased from local fishermen at three sites on eastern coast of Libya: Al hanya, Susa and Umm hufain (Fig.1) during summer, 2017. The collected species were: gilt-head sea bream *S. aurata*, flathead gray mullet *M. cepalus*, saddled bream *O. melanura*, Nile tilapia *O. nilotics* and two-banded sea bream *D. vulgaris*. Total length and weight were measured to the nearest millimeter and gram.

Figure 1. Sites from which the samples were collected.

Analysis of heavy metals in fish muscle

Five grams of samples were taken from the trunk muscle of each fish and placed in digestive tube. Each sample was digested with 5 ml of HNO_3, then 5 ml of $H_2 SO_4$ was added to it and the reaction was allowed to proceed for 5 min. It was then placed in a hot-block digestion apparatus and heated at 60^0C for 30 min. then removed from the hot-block and allowed to cool. Ten ml of HNO_3, was added and the mixture returned to digestion rack and heated slowly to 120 ^{0}C then increased to 150 ^{0}C, then removed and allowed to cool, then 1 ml of H_2O_2 was added. Finally the tubes removed and made up to 50 ml with deionized water and analyzed for Cd, Fe and Pb using the Atomic Absorption Spectrophotometer. Measurements of the heavy metals were done in 5 replicates for *S. aurata*, 5 replicates for *M. cephalus*, 12 replicates for *D. vulgaris*, 28 replicates for *O. nilotics* and 24 replicates for *O. melanura*.

Statistical analysis

The Length-Weight relationship were determined according to the following power equation:$W=aL^b$ (Beckman, 1948) Where:W; fish total wet weight in (gm),L ; fish length in (cm),b ; coefficient of allometry varying between 2 and 4 in different species and a ; constant. The relation between the concentration and the length were determined by the following linear equation: $Y=a+bx$ where: Y; concentration of heavy metals (ppm), x; TL. And a and b constant. SPSS package programs were used to get the statistical analysis (one way ANOVA-Duncan).

Results and Discussion

Heavy metals concentration in the ***fish muscles***

The sites of fish collection, the species used in the study, their total length and total weights are shown in table 1**.** The level of Fe, Cd and Pd in muscle tissue of examined fishes from Susa, Al hanya and Umm hufain are given in Table 2. The iron concentration the was highest in all collected muscle fish samples compared to concentration other metals, it ranged from 1.573 ± 0.0713 to 21.969 ± 2.734 ppm in *S. aurata* and *O. nilotics* respectively. Cadmium values ranged from 0.083 ± 0.0379 to 0.1453 ± 0.0025 ppm in *M. cephalus* and *O. melanura* respectively. The values of lead ranged from 0.0062 ± 0.0032 to 0.772 ± 0.0643 ppm in *M. cephalus* and *O. nilotics*. Average element concentration of heavy metals in muscle displayed the same order in all species: Fe> Cd > Pd. The only exception was *D. vulgaris* and *O. nilotics*, in which Pd had the second highest concentration.

This study showed that there was no significant differences in lead concentrations between the studied fish species expect *O.nilotics* which were collected from Umm hufain lagoon.It also noted that the concentration of cadmium in the samples were vary between all the studied fishes, this result agreed with what was reported by Tepe *et al* .,(2017) who stated that the Cd and Co concentrations differ in the same species collated from tow lagoons (Tuzla, Camlik), these differences may be due to feeding habits and difference in regions .These feeding differences also imply different degree of contact with sediment, which represents a remarkable source of trace metals for aquatic organisms (Alagarsamy, 2006; Demirak *et a*l., 2006; Noel *et al*., 2013). In the same line Kilgour (1991) indicated that animals which have close relationship with sediment, show relatively high body concentrations of cadmium. Ecological needs of fishes also represent one of the most important factors in the accumulation of heavy metal. For example, in the eel *Anguilla anguilla,* whiting *Merlangius merlangius,* flounder *Platichthys flesus* and plaice *Pleuronectes platessa,* levels of Zn, Cu, Pb and Cd in the muscle ranged considerably (Wharfe & Van Der Broek, 1977) They indicated that in general the levels in the bottom dwelling eels are higher than in plaice and flounder, which in turn are higher than levels in whiting. This may indicate the contamination of both different fishes feed and position of water column. The present study showed also that, iron concentrations varied among the fishes, this Agreed with Quazi *et al*., (1995) who reported that Iron and zinc concentrations may vary between different fish species as a result of their biological needs. Tepe *et al* .,(2017) in their research they, found iron were the highest level in all tissues

Windom *et al.* (1987) found even lower concentrations of Cd, Pb, in the muscle of *Coryphaenoides armatus* sp fish from the Atlantic and the Pacific Ocean, between 0.025-0.027 and 0.012-0.016 ppm dry weight respectively. Compared with the current study level Cd and Pd are a little higher that reported by Kalay *et al.*, 1999. Romeo (1987) also found relatively low concentrations of Cu, Zn, Cd and Pb in the muscle of *Mugil cephalus* from the northern coast of Mauritania in the Atlantic Ocean. However, this is not surprising because oceans are less contaminated marine environments compared to seas that generally face human impact more than oceans.

Table 1. Biometric measuring of all fish from Susa, Umm hufain and Al hanya.

Site	Species	No. of specimens	Total Length(cm)		Total Weight (gm)	
			Min-max	Mean	Min-max	Mean
Susa	*Sparus aurata*	5	24.3-24.9	24.58	332.47-368.01	344.69
	Mugil cephalus	5	28.8-34	31.12	209.25- 280.97	249.79
	Diplodus vulgaris	12	13.5-21.9	15.77	46.5-200.6	76.29
Umm hufain	*Oreochromis nilotics*	28	13.5-20.5	17.41	37-145.9	87.42
Al hanya	*Oblada melanura*	24	14.7-23.3	17.61	47.9-178	80.69

Table 2. Heavy metal concentrations in the flesh of the 5 fish species

Species	Fe	Pd	Cd
O.melanura	17.665 ± 0.749^{b}	0.0880 ± 0.0156^{a}	0.1453 ± 0.0025^{a}
O.nilotics	21.969 ± 2.734^{b}	0.7730 ± 0.0643^{b}	0.1152 ± 0.0014^{b}
D.vulgaris	4.254 ± 0.647^{a}	0.1424 ± 0.0506^{a}	0.1125 ± 0.0017^{b}
M.cephalus	3.318 ± 0.822^{a}	0.0062 ± 0.00325^{a}	0.0835 ± 0.0379^{c}
S.auratus	1.573 ± 0.0713^{a}	0.0203 ± 0.0080^{a}	0.1412 ± 0.0244^{a}

Vertically, letters a, b and c show differences among the different species ($p< 0.05$) Mean±SE metal concentration ppm.

Relationship between* metal *accumulation and fish total length

The length weight relationship of *O.melanura*, *D.vulgaris* and *O.nilotics* has b values of 3.041, 2.860 and 2.823 consecutively, indicating isometric growth *M.cephalus* and *S.aurata* have negative allometric growth . The concentration behavior of lead, cadmium and iron with the fish length was examined in terms of correlation coefficient (R^2) ,shown in Table.3, in *M. cephalus* there is positive correlation coefficients between total length and concentration of lead (R^2 =0.74), as total length increased lead concentration increased , the R^2 value indicated that the relationship was strong as the change in total length accounted for 74% of the change in lead concentration. But iron (R^2= 0.052) and cadmium (R^2= 0.129) showed poor positive correlation with fish length, In contrast Canli and Ali (2003) showed negative relation between lead concentration (R^2= -0.127) and total length for *M. cephalus*. However Eroglu *etal*.,(2017) found positive relationship in all elements accumulation in the muscle of *M.mastacembelus*.

There was a very weak positive correlation between total length and the concentration of iron in *O.melanura* (R^2=0.110), lead in *D.vulgaris* (R^2= 0.270), *O.nilotic* (R^2= 0.064). Cadmium concentration and total length in all species, this result agreed with Arizhibowa (2011),he reported that the relationship between total length and the concentration of lead and cadmium were poor positive in O. *niloticus*, he also concluded that the weak relationships and variation in trends amongst the metals tender an development of consumption guidelines based on fish size impractical. There was a very poor negative correlation between fish total length and concentrations of lead in species *O.melanura* and *S.aurata* (R^2= -0.108), (R^2= -0.335) respectively. Iron (R^2= -0.016),(R^2= -0.010) in *O.nilotics* and *D.vulgaris*. however, ALyousuf *et al*.,(2000) showed a strong negative correlation it was (R^2= -0.896)for cadmium suggesting metabolic regulation at older fish age, Furthermore Vinikour *et al*.,(1980)reported the new tissues also could be formed at a great rate than metals transported into the tissues to establish a steady state concentration. Nussey *etal*.,(2000) found the accumulation of metal (Cr, Mn, Ni and Pd) decreased with an increase in the length of fish *L. umbratusin* the same line Farkas *et al.*,(2000) were showed they in most case a negative relationship exist for each organ and metal in all studied species. Negative relationships probably due to size-specific metabolic rates related to fish growth and foraging methods (Naeem *et al*., 2011; Merciai *et al.*,2014).

Table 3.Relationshipe between total length; TL and Total weight; TW and relation Total length with Y is concentration of heavy metal (Fe, Pd and Cd) in muscle.

	TW vs. TL		Con Fe. vs. TL		Con Pd vs.TL		Con Cd vs. TL	
Species	Power equation	R^2	Linner equation	R^2	Linner equation	R^2	Linner equation	R^2
O. melanura	$TW=0.012TL^{3.041}$	0.981	Y=0.001L+9.007	0.110	Y=-0.010L+0.270	-0.108	Y=-0.001L+0.122	-0.066
O. nilotics	$TW=0.026TL^{2.823}$	0.854	Y=-0.864L +37.03	-0.016	Y=-0.040L+0.074	-0.064	Y=-0.000L+0.107	-0.016
D. vulgaris	$TW=.026TL^{2.860}$	0.957	Y=-0.080L+5.522	-0.010	Y=0.031L+0.350	0.270	Y=-0.001L-0.096	-0.238
M.cephalus	$TW=0.341TL^{1.849}$	0.837	Y=0.215L-3.372	0.052	Y=0.003L-0.092	0.741	Y=0.015L-0.397	0.129
S. auratus	$TW= 2E+07TL^{-3.451}$	0.548	Y=0.515L-11.08	0.490	Y=-0.048L+1.206	-0.335	Y=1.69L-4.026	0.452

Health-risk assessment for consumption of the five fish species

Muscles are not an active site for metal biotransformation and accumulation (Elnabris *et al.*, 2013), but the increase in accumulation levels of heavy metals in food can result in serious systemic health problems in humans (Oliver.1997). The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) propose the permissible limit of metals to evaluate human risk from food consumption and the values are as follows: 0.5 µg/g for lead, 0.5 µg/g for cadmium and 100µg/g for iron. The results of this study show that there is no threat or any hazard to humans from consuming the five fish species except for *O. nilotics* from Umm Hufain because its lead content is higher than the permissible limits.

References

Alagarsamy R. ,2006. Distribution and seasonal variation of trace metals in surface sediments of the Mandovi estuary, west coast of India. Estuary. Coast. Shelf Science.67:333–339.

Altamura S., & Muckenthaler M.U., 2009. Iron toxicity in diseases of aging: Alzheimers disease, parkinsons disease and atherosclerosis.J.Alzheimer.Dis. 16:879-895.

Andres S., Ribeyre F., Tourencq J.-N.,& Boudou A., 2000.Interspecific comparison of cadmium and zinc contamination in the organs of four fish species along a polymetallic pollution gradient(LotRiver,France).Sci. Total Environ.248, 11–25.

Arizhibowa F., 2011. A Human Health Risk Assessment of Heavy metal Bioaccumulation in Nile Tilapia *Oreochromis niloticus* from Lake Chivero, Zimbabwe. MSC. These, faculty of science. University of Zimbabwe.

Beckman, W. C., 1948**.** The weight–length relationship factors of conversion between standard and total lengths and coefficient of condition for seven Michigan fishes. Trans. Amer .Fish. Soc.75: 237-256.

Canli M., & Atli G., 2003.The relationships between heavy metal (Cd, Cr, Cu, Fe, Pb, Zn) levels and the size of six Mediterranean fish species.Environ.Pollut.121, 129–136.

Demirak A.,Yilmaz F.,Tuna A.L., & Ozdemir N.,(2006) Heavy metals in water ,sediment and tissues of *Leuciscus cephalus* from a stream in south western Turkey. Chemo- sphere.63; 1451–1458.

Eroglu M., Dusukean M. , Canpolat O. Calta M. & Sen D.,2017.Determination of some heavy metals in *Mastacembelus mastacembelus* (Banks &Solander,1794) in terms of public health.E-ISSN:1165X/P-ISSN:0145-5680.

FAO/WHO. 1989. Evaluation of certain food additives and the contaminants mercury, lead and cadmium;. WHO Technical Report Series No. 505.

Farkas A., Salanki J., & Varanka I., 2000.Heavy metal concentrations in fish of Lake Balaton. lakes&Reservoirs:Research& Management,vol.5,Issue.4, p 271-279.

Farkas A., Salánki J. & Specziár A., 2003.Age-and size-specific patterns of heavy metals in the organs of fresh water fish *Abramis brama* L. populating a low- contaminated site. Water Res.37: 959–964.

Kalay M., Ay Ö. & Canli M.,1999. Heavy metal concentrations in fish tissues from the northeastMediterreneanSea.Bull.Environ.Contam.Toxicol.63:673–681.

Kakulu S.E., Osibanjo O. & Ajayi S.O., 1980. Determination of heavy metal in aquatic food. Environ.Toxicol.24:727-734.

Kilgour B.W., 1991. Cadmium uptake from cadmium-spiked sediments by four freshwater invertabrates. Bull Environ Contam Toxicol 47:70-75.

Matusch A.,Depboylu C.,Palm C.,Wu,B. Gunter U., Hoglinger G.U. Schafer M.K. & Becker J.S. ,2010.Cerebral bioimaging of Cu,Fe, Zn, and Mn in the MPTP mouse Model of Parkinsons Disease Using Laser Ablation Inductively coupled Plasma Mass spectrometry (LA-ICP-MS),J.Am.Soc.Mass spec ., 21(1),16-171.

Medeiros R.J., Dos santos L.M., Freire A.S., Santelli R.E., Beaga AMCB, Krauss T.M. et al. ,2012. Deterrmination of inorganic trace elements in edible marine fish from Rio de Janeiro state, barzil.food control .23:535-41.

Merciai R., Helena G., Awadhesh K.,Sergi S. & Garcia-Berthou E., 2014.Trace metal concentration and fish size:Variation among fish species in a mediterranean river.Ecotoxicolgy and Environmental safety .107,154-161.

Naeem M., Salam A., Tahir S. S. & Rauf N., 2011. The Effect of Fish Size and Condition on the Contents of Twelve Essential and Non-Essential Elements in *Aristichthys nobilis.* Pakistan Vertinary Journal, 31 (2) : 109-112.

Niyogi S., & Wood C.M., 2004.Biotic ligand model,a flexible tool for developing site-specific water quality guide lines for metals.Environ.Sci.Technol.38, 6177–6192.

Noël L., Chekri R., Millour S., Merlo M., Leblanc J.-C., & Guérin T., 2013. Distribution and relationships of As, Cd, Pb and Hg in freshwater fish from five French fishing areas.Chemosphere.90:1900–1910.

Nussey G., Van Vuren J.H.J.& du Preez H.H., 2000. Bioaccumulation of chromium, manganese, nickel and lead in the tissues of the moggel, Labeo umbratus (Cyprinidae), from Witbank dam, Mpumalanga.Water Sa. 26: 269–284.

Oliver M.A., 1997.Soil and human health: a review European journal of soil science,48,573-592.

Paquin P.R., Gorsuch J.W., Apte S., Batley G.E., Bowles K.C., Campbell P.G.C., Delos C.G., DiToro D.M.,Dwyer R.L., Galvez F., Gensemer R.W., Goss G.G., Hogstrand C., Janssen C.R., Mcgeer J.C.,Naddy R.B., Playle R.C., Santore R.C., Schneider U., Stubblefield W.A., Wood C.M. & Wu K.B., 2002.The biotic ligand model: ahistorical overview.Comp.Biochem.Physiol.C133,3–35.

Quazi S., Banu C.P, Rahman M.M. & Sayeed S. ,1995. Mineral content of fresh water and marine fish species. Proceedings of the third Asia-Pacific food analysis Network Conference on Food Analysis. P.2.

Romeo M., 1987.Trace metals in fish roe from the Mauritania coast. Mar Pollut Bull 18:507-508.

Rozon-Ramilo L.D., Dubé M. G., Squires A. J. & Niyogi S.,2011.Examining water borne and dietborn eroutes of exposure and their contribution to biological response patterns in fathead minnow(*Pimephales promelas*). Aquat.Toxicol. 105,466–481.

Tepe Y., Turkmen A., & Turkmen M.,2017.Comparison of heavy metal accumulation in tissues of economically valuable fish species two nearby lagoons in Mediterranean coastal area .Indian J.MAR.SCL.46(7).133-1338.

Terra B.F., Araújo F.G., Calza C.F., Lopes R.T., & Teixeira T.P., 2008.Heavy metal in tissues of three fish species from different trophic levels in a tropical Brazilian river. Water Air Soil Pollut.187: 275–284.

Vinikour W.S. & Goldstein R.M., 1987. Concentration of metallic ions in fish. Environ. intern.3:247-251.

Vinikour W.S. , Goldstein R.M. ,& Anderson A.R.V. ,1980.Bio concentration patterns of zinc, copper, cadmium and lead in selected fish species from the Fox River, Illinois. Bull Environ Contam Toxicol; 25:727-734.

Wharfe J.R. & Van don Broek W.L., 1977. Heavy metals in macro invertebrates and fish from the lower Medway Estuary, Kent. Mar Pollut Bull 8: 3l-35.

Windom H., Stein D., Sheldon R., & Smith R., 1987.Comparison of trace metal concentrations in muscle tissue of a benthopelagic fish *(Coryphaenoides armatus)* from the Atlantic and Pacific oceans. Deep-Sea Research 34: 213-220.

Monitoring two Natricine snakes from Lake Işıklı (Denizli/Turkey): Preliminary results of summer activities

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The home range and movements of two natricine snakes *Natrix tessellata* and *N. natrix* were studied in Lake Işıklı (Çivril/Denizli, Turkey). The radio transmitters were implanted eight *N. natrix* and eight *N. tessellata* between March 2018 and June 2018. The data were collected at least twice a month. The home range calculated as 0.32 (0.04 – 1.33) ha for *N. tessellata* and 1.99 (0.03 – 5.8) for *N. natrix*. The mean home range of *N. natrix* is nearly six times greater than *N. tessellata*. The movement distances per relocation higher in *N. natrix*. The mean movement distances of *N. tessellata* and *N. natrix* is 44.8 m and 173.5 m respectively. There was a positive correlation between body size and home range in *N. tessellata* (0.451) and a negative but statistically insignificant correlation in *N. natrix* (-0.046).

Keywords: *Natrix tessellata*, *Natrix natrix*, home range, activity, Turkey

Introduction

The Dice snake (*Natrix tessellata*, Laurenti 1768) and Grass snake (*Natrix natrix*, Linnaeus 1758) are semiaquatic species and inhabits most watercourses and lakes. These snakes were found almost all suitable water bodies in Turkey. Although many studies were conducted on monitoring Natricine snakes in European countries (e.g. Madsen, 1984, Lelièvre et al., 2010, Conelli et al., 2011; Neumann & Mebert, 2011), there is limited data on their ecology in Anatolia.

The aim of this ongoing study is to improve our knowledge of the ecology of these two freshwater snakes by radio-telemetry. We hope that the collected data constitute a base for the elaboration of recommendations for the management of wetlands and watercourses in Turkey.

Material and Methods

Study site

Study was conducted in Lake Işıklı (Çivril/Denizli) where located in Çivril plain in the south of Akdağ on the sources that feed the Great Menderes River. The maximum depth is about 7 meters and the surface area is about 9749 ha. Lake Işıklı has been used as a water reservoir for large-scale irrigation made in the plain for last 40 years. The western, southern and eastern coasts of the lake are surrounded by man-made block stones. These block stones constitute the main shelter and basking habitats of the snakes.

We studied at two stations on the lake. First station is located on the northwest side of the lake and consists of a rocky terrain; the second station consists of forests and croplands on the southwest coast of the lake.

Implantation and Data Acquisition

Eight *N. natrix* and eight *N. tessellata* were selected among captured individuals for the radio transmitter implantation during field studies. Finding suitable specimens and performing implants were start in March 2018 and continued until June 2018. In order not to affect the mobility of the snakes due to the radio transmitter, the specimens weight should be more than 100 g (transmitter weight do not to exceed 5% of the total body weight of the specimen) as accepted in the literature. Transmitters are 13/24/7 (wide/length/depth) mm in dimensions and 3.6 g in weight. All the snakes weight more than 150 (155-324) g. Mass percentage of transmitter weight is between 1.11% and 2.32% for selected individuals.

Surgical implantations were performed by a specialist vetenerian according to known techniques (e.g. Parker & Brown, 1972; Reinert & Cundall, 1982; Weatherhead & Anderka, 1984). After surgery, the snakes were monitored in a terrarium for approximately 48-96 hours and then released at the same location of their capture.

Relocation of snakes were made at least twice a month. In order to record the movement pattern of tagged snakes, we applied crossing-bearing method (Neumann & Mebert, 2011). Most of the research area consists of dense reed fields and was difficult or impossible to access. So, the snakes located usually indirectly by crossing-bearing. Signals were tracked and coordinates were recorded at the highest level of signal location. Occasionally, snakes were visually encountered. Coordinate data were mapped and if sufficient data were obtained, home range and movement analyzes were performed in BIOTAS (vers. 2a).

Results

Eight mature Dice snakes and eight mature Grass snakes were tagged with transmitters, whereof only five individuals from each species provided sufficient data till now for further analysis. A total of 101 location coordinates were recorded during the study period (Figure 1).

Figure 1. General (above) and detailed (below) view of the located specimens.

Table 1. The summary statistics of the tagged snakes (SVL: Snout-Vent Length, W: Weight)

		Mean	Min	Max	Std. Dev.
N. tessellata	SVL (mm)	793.8	654	885	72.30
	W (g)	252.2	175	300	34.98
N. natrix	SVL (mm)	798.4	686	890	87.05
	W (g)	245.1	155	324	62.79

According to minimum convex polygon analyses (MCP), the calculated home range is 0.32 (0.04 – 1.33) ha for *N. tessellata*, and 1.99 (0.03 – 5.8) for *N. natrix*. The mean home range of *N. natrix* is nearly six times greater than *N. tessellata*. Correspondingly, the movement distances per relocation higher in *N. natrix*. The mean movement distances of *N. tessellata* and *N. natrix* is 44.8 m and 173.5 m respectively (Figure 2). We also tested the relation between body size and home range. There was a positive correlation in *N. tessellata* (0.451) and a negative but statistically insignificant correlation in *N. natrix* (-0.046). Descriptive statistics of body size and weight were given in Table 1.

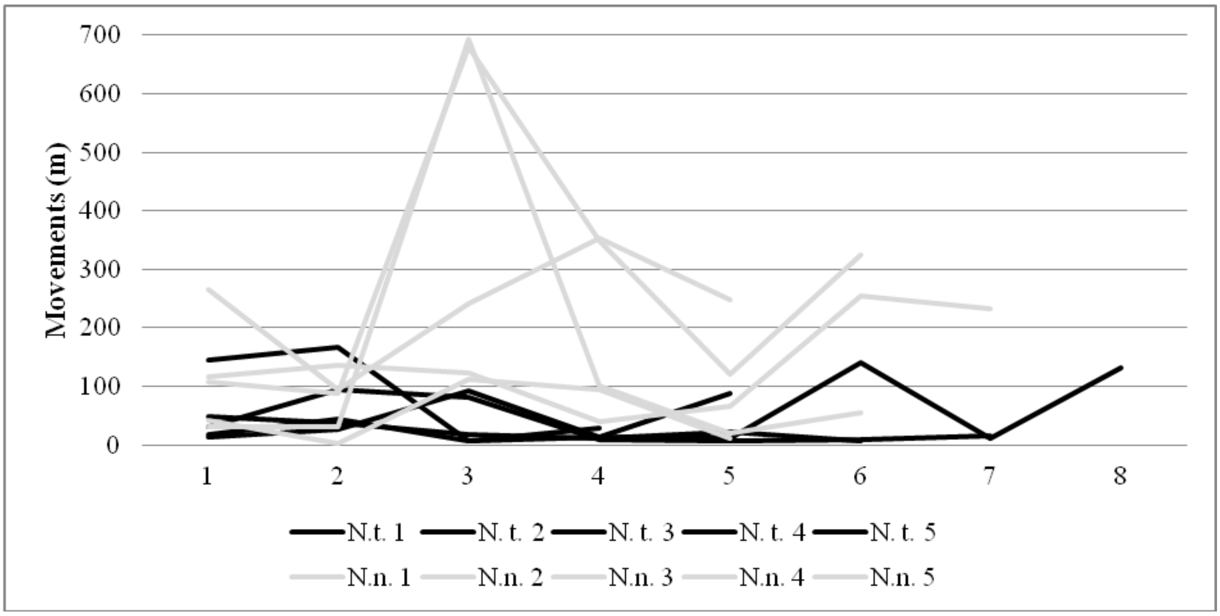

Figure 2. Line graphs of movement distances of the samples per relocation.

Discussion

The annual activities of snakes show great changes in parallel with seasonal changes. After emerging from the hibernation, *Natrix* species show reproductive behavior in the next few months and their outdoor activity is quite intense. However in summer session high temperatures force them to be estivated. Similar observations have been made by several authors (e.g. Neumann and Mebert, 2011). Therefore outdoor presence and also the probability to encounter/relocate the snakes are very low in this period.

In comparison with *N. natrix* (Madsen 1984; Wisler, 2006), the habitat of *N. tessellata* appears to be closer associated with water and its terrestrial niche is limited to a narrow, linear stretch along the shoreline (Conelli et al. 2011). In parallel with our results, *N. natrix* have much more terrestrial niche than *N. tessellata*. *N. natrix* can occupy a home range of up to 30 ha (Madsen, 1984) or 15-120.5 ha (Wisler, 2006) in case *N. tessellata* occupy an area of up to 2 ha only (Neumann & Mebert, 2011, Conelli et al., 2011).

In Lake Işıklı, radio telemetric data indicated that the home range in Dice snake *N. tessellata* is to be relatively small in comparison to the syntopic Grass snake *N. natrix* congruently with literature. Low levels of home range and movements are associated with the monitoring in summer periods. Snakes spend most of their time in a shelter and rarely leave their home. With the next field surveys, total period of monitoring across an entire year going to enable the identification of seasonal variation of habitat use of these freshwater snakes.

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References

Conelli, A. E., Nembrini, M., Mebert, K. 2011. Different habitat use of dice snakes, *Natrix tessellata*, among three populations in Ticino Canton, Switzerland. A radiotelemetry study Mertensiella, 18: 100-116.

Lelièvre, H., Blouin-Demers, G., Bonnet, X., & Lourdais, O. 2010. Thermal benefits of artificial shelters in snakes: a radiotelemetric study of two sympatric colubrids, Journal of Thermal Biology, *35*(7), 324-331.

Madsen, T. 1984. Movements, home range size and habitat use of radio-tracked grass snakes (*Natrix natrix*) in southern Sweden, Copeia, 707-713.

Neumann, C., & Mebert, K. 2011. Migration behavior of endangered dice snakes (*Natrix tessellata*) at the River Nahe, Germany, Mertensiella, 18: 39-48.

Parker, W. S., & Brown, W. S. 1972. Telemetric study of movements and oviposition of two female Masticophis t. taeniatus, Copeia, 1972(4): 892-895.

Reinert, H. K., & Cundall, D. 1982. An improved surgical implantation method for radio-tracking snakes, Copeia, 1982(3): 702-705.

Weatherhead, P. J., Anderka, F. W. 1984. An improved radio transmitter and implantation technique for snakes, Journal of Herpetology, 18 (3): 264-269.

Wisler, C. 2006. Habitat Requirements of the Grass snake (*Natrix natrix* L.) in a Landscape Dominated by Intensive Farmland: A First Appreciation of Conservation Needs. – M.S. thesis, University of Bern, Switzerland.

POSTER PRESENTATIONS

A New Record of the Invasive Freshwater Jellyfish (*Craspedacusta sowerbii* Lankester, 1880) from Turkey, with an Overview for its Distribution in SE Europe and Middle East

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A new locality for the invasive freshwater jellyfish (*Craspedacusta sowerbii* Lankester, 1880) was found during a study conducted in a mesotrophic dam lake (Ürkmez Reservoir, western Anatolia, Turkey). The study was focused on the limnological characteristics of the reservoir and conducted in monthly intervals between March 2014 and February 2015. In the August and September 2014 jellyfish specimens were just beneath the surface (3-4 specimens/m^2). In the remaining period of the study, no jellyfish specimens were found in pelagic zone of the reservoir.

C. sowerbii is rarely observed in Turkish freshwaters. The present record is the westernmost point of its distribution in Turkey. A map showing the actual distribution of freshwater jellyfish in SE Europe and Middle East is presented.

Keywords: Reservoir, jellyfish, invasive species, İzmir, Turkey.

Another New Amphipod Species from Peynirlikönü Cave (EGMA Sinkhole): *Gammarus egmao* sp. nov.

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Another new amphipod species, *Gammarus egmao* sp. nov., was identified from Peynirlikönü Cave [Evren Günay Mehmet Ali Özel (EGMA) Sinkhole]. The specimens of the new species were sampled at a depth of 350 m inside the sinkhole entrance. This is the second new species identified from the cave in addition to *Gammarus ustaoglui* Özbek and Güloğlu, 2005. There are only two adult female specimens sampled from the locality. The newly identified species has the following characteristic features; a) small eyes, b) two segmented accessory flagellum, c) rod like structures on the flagellum segments of antenna 1, d) reduced armaments in distal part of palp of maxilla 1 e) very short inner lobe of uropod 3 and reduced setation on both sides of both lobes of uropod 3. Detailed descriptions of holotype female and illustrations of the extremities were presented. Additionally, differences from the related species were discussed.

Keywords: Sinkhole, Cave animals, New species, Amphipoda, Crustacea, Turkey.

Effects of using various ice forms on the shelf life of European sea bass (*Dicentrarchus labrax*) inside of expanded polystyrene boxes on transportation.

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The aim of the study was to increase the shelf life of packed cultured sea bass which were prepared for transportation inside of a polystyrene boxes with ice. In this context different ice concentrations were applied not only to determine the shelf life of iced and packed seabass but also determining the potential effects of ice mixing. As a raw material aquacultured sea bass (*Dicentrarchus labrax*) samples were chosen. For this aim 5 different groups were used in the study structure; Group A (100% flake ice), Group B (75% flake ice and 25% dry Ice), Group C (50 % flake and dry), Group D (25 % flake and 75 % dry ice) and Group E(100% dry ice). Microbial (Total Aerobic mesophilic Bacteria Counts, Anaerobic Bacteria Counts and Psychrophilic Bacteria Counts), chemical (Total Volatile Base Nitrogen, Trimethylamin nitrogen Thiobarbituric acid reactive substances) and sensorial quality control analyzes were performed until the shelf life of the groups were completed. Due to the taken results control group (Group A) exceeded the limit of consumption on an 8-day storage period, group D with 75% dry ice and 25% flake ice had a shelf life of 12 days. Due to the taken data extra shelf life for the groups which have both ice in different concentrations were observed. Obtained results can be defined as pioneer in terms of literature and the sea food processing sector.

Keywords: dry ice, sea bass, shelf life, flake ice, quality

Acknowledge: This study was supported by Ege University Scientific Research Project Coordination Unit (BAP) Project No. 2016-SÜF-030.

Determination of features oocytes on pipefish species (*Synganthus abaster* and *Syngnathus acus*) in the one breeding period from the Lake Bafa (Muğla)

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In this study, oocyte characteristics of 86 individuals in 176 specimens with captured beach seine net were determined for single breeding period (*Synganthus abaster*; 69, *Syngnathus acus* 107) from the Lake Bafa coastal area between November 2014 and March 2016. Thirty-four adult individuals in *S. abaster* and 52 adult individuals in *S. acus* were considered for the examination of oocyte during the breeding period characteristics. The gonad weights were calculated 0.001-0.13 g and 0.0001-0.053 g respectively. The brood pouch size values of were examined 20.76 – 36.02 mm *in S. abaster* and 17.28 – 38.64 mm in *S. acus*. In *S. abaster*, developing and mature oocyets in female ovary and on the other hand, hydrated oocytes, fertilized eggs, pre- post larvae were found in male's brood pouches. Egg diameter values were calculated as 0.37-2.00 mm. In the *S.acus*, oocyte were considered as; mature, hydrated, fertilized and eggs of the next year, developing eggs. Oocyte diameter values were varied between 0.25-1.89 mm. The mean hydrated eggs number were 42 ± 1.5 (SD) in *S. abaster* and 33 ± 7.3 (SD) in *S. acus*. The relationship between total length and mature eggs size in the samples was found to be linear N = 0.2364TL-7.9291 (r = 0.47) in *S. abaster* and N = 0.6858TL-49.149 (r = 0.62) in *S.* acus only one breeding period. This study shows that, the success of the lake pipefish continue breeding in the region despite its low reproductive potential**.**

Keywords: Greater Pipefish, Black Striped pipefish, oocyte diameter

POSTER PRESENTATION

Seasonal Variability of Gillnet Selectivity in Red Mullet (*Mullus surmuletus*) in North Aegean Sea, Turkish Waters

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This study examines the seasonal variability in gillnet size selectivity for red mullet (*Mullus surmeletus*) fishery off the coast of The North Aegean Sea, Turkish waters. The field works were carried out between March 2008 and August 2009. In the trails, totally nine gillnets with of 18, 20 and 22 mm nominal mesh size and having three different hanging ratios (E = 0.4, 0.5 and 0.6) were used. The SELECT method was used in determining selectivity parameters. By comparing the deviances of five different models of SELECT method, lognormal model gave the best fit for all seasons. Modal lengths and spread values. The determined modal lengths and spread values of the different mesh size for red mullet were found to be lowest in the spring season which is the reported spawning season for this fish when this values are compared with the values obtained in other seasons. For the gillnet with 18, 20 and 22 mm mesh sizes, the selectivity range in Spring season was 14.48 – 19.22 cm, 16.1 – 21.36 cm and 17.71 – 23.49 cm, respectively. It was determined that the selectivity ranges of gillnet with 18, 20, 22 mm mesh sizes are greater than the total length at first maturity of this fish. The season in which the spread of the selectivity curves of the nets is highest is determined as the summer season.

Note: This study was supported by TUBITAK project 106Y021.

Keywords: Seasonal variation, gillnet selectivity, red mullet, The North Aegean Sea

Catch Composition and Fishing Efficiency of Gillnets Caught by Drive-in Fishing Method in The North Aegean Sea

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The study was conducted on the Northern Aegean Coast between 2007 and 2010 at depths of 0-40 m. In the study, 5 different types of gillnets were used. Gillnets had E=0.50 hanging ratio, 210 d/3 number of twine thickness, 100 meshes depth, 20 mm, 22 mm, 23 mm, 25 mm and 28 mm mesh size. Nets are used by drive-in fishery method.

A total of 12118 number and 1390.369 kg fish were caught in the study. 49 species were caught in total and the most caught species were bogue (*boops boops*), saddled seabream (*Oblada melanura*), round sardinella (*Sardinella aurita*), bluefish (*Pomatamus saltatrix*), Mediterranean horse mackerel (*Trachurus meditterraneus*), Atlantic bonito (*Sarda sarda*), salema (*Sarpa salpa*), chub mackerel (*Scomber japonicus*), common two-banded seabream *(Diplodus vulgaris*), Atlantic horse mackerel (*Trachurus trachurus*).

The amount of catch per unit effort (CPUE) of gillnets used in the study was calculated with the following formula; Total number of fish and the weight of the fish caught by per gillnet / (number of operations x net length). 20 mm mesh sized gillnets had the highest CPUE all of target species, non-target species and amount of total catch. In terms of number of fish in the total CPUE the maximum catch rates were 20 mm, 23 mm, 22 mm, 25 mm, 28 mm gillnets respectively, while the maximum catch rates were 20 mm, 23 mm, 25 mm, 22 mm, 28 mm respectively in weight.

Keywords: gillnets CPUE, catching efficiency, catch composition

Note: This study was supported by the TÜBİTAK 106Y021 project number

Sperm Cell Kinematics of Zebrafish, *Danio rerio* by Computer Assisted Sperm Analysis (CASA)

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This study was aimed to determine sperm cell kinematics of Zebrafish, *Danio rerio* by using computer assisted sperm analysis system (CASA). The sperm samples were collected by abdominal massage and diluted inactive solution (IS). Total sperm samples were 7 fish individual and activated under microscope with activation solution (AS).
In results, the kinematics such as VSL (µm/s), VCL (µm/s), VAP (µm/s), STR (%), LIN (%), BCF (Hz), ALH (µm) and MAD of zebrafish sperm cells were determined as 46.61±1.77, 117.02±4.07, 58.21±3.73, 48.97±5.11, 33.67±7.38, 5.85±0.83, 24.91±2.34, 64.71±7.75 and 0.04±0.004, respectively.

Keywords: zebrafish, kinematics of sperm cells, CASA

Heavy metals in a Fish from Lake Skadar (Montenegro/Albania): a review

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Lake Skadar and its basin located in the western Balkans faces varying states of pollution by heavy metals which originates mainly from the sewage waters and industrial waste. In this paper an overview of the present knowledge of heavy metals in fish from Lake Skadar are given. Moreover their potential as agents for environmental monitoring are discussed. Up to now, seven fish species from Lake Skadar have been investigated for heavy metals contents. The contents of heavy metals in the fish species (*Cyprinus carpio*, *Carassius gibelio*, *Perca fluviatilis*, *Rutilus prespensis*, *Anguilla anguilla*, *Alburnus scoranza*, *Scardinius knezevici*) from Lake Skadar decreases in the following order: Zn> Fe> Al> Mn> Cu> Hg> Cr> Co> Ni> As> Pb> Cd. So far available studies on heavy metals in fish from Lake Skadar have shown that the concentrations are below the maximum permitted levels according to national and international FAO/WHO standards, meaning that they can be used for consumption without risk for a human health.

Keywords: Heavy metals, fish, Lake Skadar, bioindicator

Determination of Antibiotic Resistance Sensitivity of *Aeromonas salmonicida* Isolated from Rainbow Trout (*Oncorhynchus mykiss*)

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The furunculosis is a disease caused by *A. salmonicida* can show an asymptomatic (porter) course along with acute (sudden death, bleeding foci in the base of the fins and subcutaneous tissues) subacute and chronic forms (blood boils, ulceration and scatrix areas) which can be 90% mortality in all the aquatic environments. In this study, it was determined that the bacterial strains obtained from Rainbow Trout (*Oncorhynchus mykiss* Walbaum, 1792) were Gram-negative, rod-shaped. VITEK-2 compact system is used for identification. The bacterial strain was diagnosed as *Aeromonas salmonicida*. Antibiotic susceptibility of *A. salmonicida* was determined by disk diffusion method. Enrofloksasin (5 µg), Streptomisin (10 µg), Sefkuinom (30 µg), Trimetoprim-Sulfametaksazol (25 µg), Amoksisilin-Klavulanik asit(30 µg), Sefalotin (30 µg), Ampisilin (30 µg), Eritromisin (30 µg), Sefaleksin (30 µg), Linkomisin (2 µg), Penisilin (10 µg) were used as antibiotic discs in the test. Resistance profiles against 11 different antibiotics of the isolate were determined. The bacterial subculture obtained for this purpose were planted with spreading method and taking 0.1 ml of each of the suspensions to Müeller-Hinton agar, according to the McFarland 0.5 standard. Then antibiotic discs were placed on the feeder with a sterile clamp and inculcated at 24 °C for 24-48 hours. The inhibition zone diameters around the post-incubation discs were measured and results compared with the zone table suggested by (NCCLS). The antibiotic inhibition zone diameters resulted in the end of 24 ° C for 24-36 h incubation were measured as millimeters by placing antibiotic discs on the Mercker-Hinton medium. It was seen that *A. salmonicida* was resistant to sulfamethoxazole-trimetoprim, erythromycin and lincomicine and was to susceptible the other 8 antibiotics. In the studies of Aksit et al., that is been reported *A. salmonicida* is moderate sensitive to oxytetracycline and sulfamethoxazole-trimethoprim 50% and erythromycin is moderate to 83.3%.Kirkan et al. were found that *A. salmonicid*a was sensitive to ciprofloxacin and resistant to tetracycline and erythromycin and can be susceptible or resistant to sulfamethoxazole-trimethoprimide by the method used. In this study, it was seen that *A. salmonicida* was susceptible to sulfamethoxazole-trimetoprim, erythromycin and lincomicine and was resistant to the other 8 antibiotics It was reported taht in various parts of the world resistance occurs againist various antibacterial drugs frequently and similar resistance differences have been reported in *Aeromonas sp.*, isolated from fish. As a result, it can be suggested that bacterial disease-fighting studies may be throughout the year if the hygienic conditions of farms can be ensured as well as avoiding the surplus stocks and the use of unconscious antibacterial drugs.

Keywords: Rainbow trout, *Aeromonas salmonicida*, Antibotic Resistance.

A Furunculosis Case in a Trout Farm in Malatya

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The furunculosis is a disease caused by *Salmonicida* can be seen as an asymptomatic (porter) course with acute (sudden death, the base of the fins and bleeding points in subcutaneous tissues), subacute and chronic forms (blood boils, ulceration and scatrix areas) which can be 90% mortality in all the aquatic environments.
In this study a disease notice was reported in a trout breeding farm in Malatya . By going to the farm, oxygen was measured at 8,41 mg / L, pH was 8,95 and water temperature was 12,2 ° C with YSI device. It was observed that the water was sedimentary and cloudy. The fish suspected of being infected were brought in the water to microbiology laboratory of Elazig Fisheries Research Institute. Fish were anesthetized with clove oil. After the trout was anesthetized, the body surface was disinfected with 70% ethyl alcohol. Fish were necropsied and sown on Tryptic Soy Agar (TSA) medium from gills, liver, kidney and intestines by sampling with the help of extract. The media were left to incubate for 72 hours at 24 ° C. At the end of this period, bacterial colonies were formed on the agar and pure cultures were obtained with making passages from the obtained bacterial cultures. Then, this young colonies put into plastic tubes (12x75 mm) which has 3 ml sterile buffer salt solution (%0,45-0,50 NaCl, pH 4.5-7.0) and prepared to homogenous bacterial suspensions at 0.65-0.85 Mc farland concentrations. Gram negative identification card for Gram (-) and rod-shaped bacteria determined by gram staining was placed in Vitek-2 system and data entry was made.
As a general symptom in fish, there were side swim and swim around and swimming and opening in color. A furunkul was seen in the head area of the fish. In necropsy, there was a blood-serous fluid accumulation in the abdominal cavity and pale in the gills and liver. Using the Vitek 2 compact system, bacterial identification was carried out both at the species and genus level. *A. Salmonicida*, which is effective against furunculosis, has been identified.
In addition to emphasizing the importance of hygiene on the basis of treatment or control of bacterial diseases in aquaculture, vaccination and immune system stimulating drug applications have also been reported. It is stated that in some aquculture conditions, bacterial growth may occur in some internal organs and the immune system is weakened when the fish are constantly affected by stress factors.In the studies of Aksit et al., *A. Salmonicida* and *V. anguillarum* have been isolated especially during winter months and they reported that the illness may appear to be latent during the year and that the disease may occur in adverse conditions (water temperature, pH, stress). In this study, the same data were obtained as the water was cloudy and sedimentary and the disease appeared in winter.

Keywords: Rainbow Trout, Trout Farm, Furunculosis, *A. salmonicida*

Assessing the Water Quality and Trophic Levels of the Lower Basin of Sakarya River (Turkey)

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In order to assess the water quality and trophic levels of the lower basin of Sakarya River (Turkey), two field studies were conducted at 10 stations in 02-06 June 2014 and 02-08 July 2014. During the field studies, both benthic macroinvertebrates and water samples were taken. Benthic organisms were sampled with an Ekman-Birge grab and 0.5 mm mesh sized kick net. Water temperature, pH, electrical conductivity, dissolved oxygen, NH_4^+-N, NO_3^--N and total phosphorus values were measured.

Benthic organisms were identified in family levels, BMWP and ASPT indices were calculated in addition to Margalef diversity index for each sampling station. Additionally, abundance (ind./m^2) values and water quality levels of the stations were presented.

Totally, 18 benthic macroinvertebrate groups were determined (Physidae, Unionidae, Gammaridae, Oligochaeta, Chironomidae, Coenagrionidae, Erpobdellidae, Siphlonuridae, Aeshnidae, Viviparidae, Hydrobiidae, Gomphidae, Potamanthidae, Hydropsychidae, Ephemerellidae, Calopterygidae, Hirudinidae, Potamidae). The minimum and maximum values of BMWP, ASPT and Margalef indices were 2-67, 2.0-10.0, 0.0- 2.139 respectively. Similarly, abundance values were changed between 1 ind./ m^2 and 273 ind./ m^2. As a result, the water quality levels of the lower basin of Sakarya River fluctuated between IIIrd and Vth class (according to National Surface Water Regulations).

Keywords: Ecology, river, benthos, water quality, biotic index.

Fish biodiversity and its conservation in water bodies of specially protected natural territories of the Northern Russia (example of Kenozersky National Park)

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Kenozersky National Park (KNP) is located in the Arkhangelsk region in the North-West of Russia. This area is unique in its location and natural characteristics. Since 2004, KNP is a part of the UNESCO World Network of Biosphere Reserves.

Lakes and rivers of the Park are inhabited by 2 species of lamprey and 29 species of fish. One of the main tasks of the National Park is to preserve its unique nature, including the biodiversity of fish. Studies conducted have shown that over the last thirty years there were serious changes in the structure of the KNP fish populations and assemblages, caused by natural and anthropogenic factors. For instance, one of the valuable species, the whitefish, decreased in number. At the same time, the number of cyprinids increased significantly. Some alien species (*Sander lucioperca* and *Oncorhynchus gorbuscha*), appeared in the reservoirs of the National Park.

There are three main factors affecting the qualitative and quantitative changes in the fish community of the KNP aquatic ecosystems. One of them is, in our opinion, the global climate change. Another factor is the natural dispersal of fish from their places of artificial breeding. One more important factor is an intensive amateur and sport fishing. Analysis of the local fishermen catch statistics showed that the fishery is aimed at extracting the most valuable fish species National Park - *Coregonus lavaretus, Esox Lucius* and *Lota lota*. As a result, according to our data, there is a decrease in the number and rejuvenation of populations of these species.

Thus, the importance of long-term ichthyological and ecological monitoring of the KNP water bodies becomes clear. Understanding of the main factors influencing the biodiversity of the freshwater communities of the National Park will allow to predict the negative consequences and to minimize them.

Keywords: Kenozersky National Park, fish biodiversity, global climate change, invasive species, fisheries

Alien Fish of the Turkish Seas

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In this review, the updated list of alien fish species inhabiting the Turkish seas and their migration routes have been given. Additionally, it has also been mentioned how these alien species, which inhabit out of their natural distribution areas for various reasons, affected the native species in the same region. A connection was established between the Indian Ocean and the Mediterranean Sea through the Red Sea, a tropical sea, after the Suez Canal that was opened in 1869. Via this channel, the Red Sea originated immigrants have began to migrate to the Mediterranean since 1900s. There has been an increase in these migrations especially in recent years. Naturally, alien species are likely to share the niches of indigenous species. Because of the high tolerance limits of the alien species, they endanger the chance of indigenous species to survive, providing absolute superiority on indigenous species in the region where they live as sympatric. In the long period, this cause a serious threat to species diversity. The first species to be affected by this threat are the endemic species with a very limited tolerance and the species classified as sensitive and endangered by the International Union for Conservation of Nature (IUCN). Despite the increase in the number of alien species, scientists think that the effect of the Red Sea originated species is not positive. Because the Red Sea species are more contentious, which creates distress on indigenous species and as a result the indigenous species are gradually moving away from the area where they inhabit. At present time, 75 alien fish species belonging to 46 families were determined from the Turkish seas, this amount constitute about 15% of Turkey's total marine fish fauna. While the vast majority of alien species participated to the ihtiyofauna of Turkey is the Indo-Pacific originated fish migrating through Suez Canal (Lesepsian Migrant), some species have been added to the fauna as a result of the aquarium (*Heniochus intermedius* and *Platax teira*) and aquaculture (*Planiliza haematocheila*) activities.

Keywords: Lessepsien, Fish, Mediterranean, Redsea, Indo-Pasific

Changes in Salinity and Macroalgal Flora in Bafa Lake

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Lake Bafa is the biggest lake in Aegean Region of Turkey with a big importance on biological diversity and history. Overall there are 237 genera, 325 species, 22 subspecies and 7 varieties of 80 animal and plant familia and also 16 endemic species determined in the region of Lake Bafa. Due to the discharge of Büyük Menderes River into the lake pollution in Bafa Lake has increased. According to previous studies the salinity of Bafa Lake also increased from ‰5.4 to ‰16 since 1957. This salinity increase may be the result of rubber dam, overuse of Büyük Menderes River for irrigation, drought and hatchery facilities around the lake. We monitor the physical parameters of Bafa Lake every month for two years between July 2015 and June 2017. Macroalgal flora was investigated at the same time from 8 different sampling points. Sample collection was carried out from boat for deeper sampling points and by hand from coast line. Collected samples were preserved in 4% formaldehyde solution until examination.

The effects of increased salinity levels in Bafa Lake was demonstrated by several studies via determining the changes in phytoplankton community and fish populations. In our study we investigated if salinity increase effects the macroalgal flora of the lake. The salinity levels were showed different patterns according to seasons and sampling points. The highest salinity level measured on September while the lowest was on January. Four marine macrolagal taxa *Ulva intestinalis*, *Cladophora glomerata*, *Ectocarpus sp.*, *Colaconema daviesii* and *Polysiphonia sp*. were identified during sampling. Mainly the macroalgae species which prefers salt water found dominant in the lake. In this study, we demonstrated the changing macrolagal flora of Bafa Lake in concurrence with increasing salinity levels.

Keywords: Bafa Lake, salinity, macroalgae

This study was supported by the grant TUBITAK 114Y249.

Investigation of temporal variations of nutrients in surface water of Durağan İkiz Ponds (Sinop, Turkey)

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The İkiz Ponds were built in 1990 and consist of two interconnected ponds. Akbel Stream feeds these ponds. These ponds were used for irrigation purpose in the following years after their construction. Nowadays, it serves as a recreation area. In this study, annual changes in nutrient concentrations in İkiz Ponds were examined. For this purpose, surface water samples were collected monthly between January 2016 and December 2016. In the samples orthophosphate, nitrite, nitrate and ammonium measurements were carried out by standard methods. The minimum and maximum values are: 0.001-0.554 mg o-PO_4-P/L for orthophosphate, BDL-0.004 mg NO_2^--N/L for nitrite, BDL-0.0017 mg NO_3^--N/L for nitrate and BDL-0.0017 mg NH_4^+-N/L for ammonium. Nitrogen forms were found below the detection limits in winter and autumn. The annual average values for orthophosphate, nitrite, nitrate and ammonium are 0.12 mg o-PO_4-P/L, 0.0014 mg NO_2^--N/L, 2.10 mg NO_3^--N/L and 0.0008 mg NH_4^+-N/L, respectively. The values were evaluated according to Turkey's Ministry of Forestry and Water Affairs Surface Water Environmental Quality Standards Directive. Consequently, the water quality was established as "good level" for orthophosphate, while "very good level" for the nitrate and ammonium.

Keywords: İkiz Ponds, nutrients, surface water, nitrogen, ortophsphate.

Distribution Pattern of Waterbirds in the central Hauts Plateaux Wetlands of Algeria

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The Central Hauts Plateaux contains more than ten wetlands cover more than 500 000 ha varied between natural and artificial sites. Most of these are vast, shallow salt lakes that have been little studied and are poorly known. These wetlands known by its habitat diversity (Chott, reservoir, daya, dam…). Many of them are classified as wetland of international importance under the Ramsar Convention and as Important Bird Area (IBA).

Waterbirds diversity and distribution of Central Hauts Plateaux wetlands area remain poorly known, where there are few studies were carried out in some sites in this region such as Boughzoul reservoir.

A total of 52 waterbird represent 34 genera and 16 bird families, were recorded in this study. The species richness was varied from site to other where the high value was observed at Boughzoul reservoir with 51 species representing 16 families. However the low richness was observed at Ouled Touati Dam, with only 6 species representing 4 families.

Anatidae was the best represented with 11 species, followed by Scolopacidae with 9 species, then by Ardeidae with 8 species. Charadriidae, Laridae and Sternidae were represented by 4, 3 and 3 species respectively. However, a seasonal distribution of waterbrids species showed the importance of each site for breeding or for wintering. Our results shows remarkable changes in the diversity and presence of several species between study sites.

Keywords: Waterbirds, Central Hauts Plateaux, Distribution pattern, Wetlands, Algeria.

Spatio-temporal variations of phytoplankton in surface waters of the Golden Horn Estuary (Sea of Marmara)

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The seasonal and spatial variations of phytoplankton in surface waters of the Golden Horn estuary were investigated between August 2011 and July 2012. A total of 78 phytoplankton taxa belonging to 8 taxonomical classes were identified. Among these, 38 taxa (48.7%) were diatoms, 30 taxa (38.5%) were dinoflagellates and 10 taxa (12.8%) were phytoflagellates. Phytoplankton abundance increased generally from the lower to the upper estuary, while number of species and species diversity decreased. The highest phytoplankton abundance was found at the upper estuary in late May, while the highest number of species was found in the lower estuary in August. Total number of species (S) were mostly harmonious with Shannon diversity index (H'). The abundance and number of species of diatoms decreased markedly at the upper estuary except in August, while dinoflagellates and phytoflagellates were generally more abundant and diverse at the middle and upper estuary. Low water transparency and variable environmental conditions at the upper estuary influenced the phytoplankton composition. The results of this study will contribute to understand the phytoplankton dynamics in this eutrophic estuary where has a potential of algal blooms.

Keywords: phytoplankton, biodiversity, algal blooms, estuary, Golden Horn, Sea of Marmara

Road map of sustainable ecosystem in Archipelago of Marmara Sea

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Prince's Islands, as one of the historical and remaining natural reserves of the Istanbul Metropolitan area, with necessity of strict protection measures, while enabling urban development to support the needs and trade of the archipelago's residents. The Archipelago constitutes a biodiversity hotspot due to the proximity to mainland and geological and bathymetrical features. It has a dynamic oceanography driven by the Bosphorus inflow and is located on fish and bird migration route. In this context, a workshop entitled "Marine Protection in the Shadow of Urbanization: Prince's Islands Case" was organized and NGO's, citizens, policy makers, business representatives and researchers were participated. Dedicated workshop was a part of MARINA project which is funded by EU H2020 programme. Political, economic, social, technological and environmental measures for protecting the marine ecosystem around the Archipelago were discussed. Feedback from the participants provided main outputs of the workshop to generate a road map for sustainable environmental economy in Prince's Island. The main goals of the road map were defined as monitoring ecosystem, bringing into force control mechanisms, promoting responsibility via social events and raising public awareness.

Keywords: Sustainable ecosystem, Prince's Island, Urbanization

Distribution of Polychaetes (Annelida) in Soft Substratum of Sinop (western Black Sea, Turkey)

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Polychaeta fauna were investigated on soft substratum of the coast of Sinop (Black Sea) in October 2013. For this purpose, benthic samples were collected using a Van Veen Grab as 3 replicates in 7 stations. A total of 65 species belonging to 24 families were identified. Of these, *Rhodine loveni* Malmgren 1865 is new to the Black Sea fauna and *Galathowenia oculata* (Zachs, 1923) is new for the Turkish coast of the Black Sea. Spionidae was the best represented family in the field area. The characteristic species of the study area were *Prionospio* (*Minuspio*) *maciolekae* Dagli & Çinar, 2011 (34.8%), *Micronephthys stammeri* (Augener, 1932) (22.94%) and *Protodorvillea kefersteini* (McIntosh, 1869) (14.89%). The most frequent species were *M. stammeri* (100%), *P. maciolekae* (85.71%) and *Heteromastus filiformis* (Claparède, 1864) (85.71%). The community parameters varied between stations; the lowest mean number of species was found in G3 station (7 species) and the highest number of species was found in G2 station (25 species). The lowest mean number of individuals found in G5 station (343 individuals/m²) and the highest was found in G6 station (8257 individuals/m²). The mean diversity index value (H') ranged from 1.47 to 3.17 and the mean Evenness index value (J') varied from 0.48 to 0.74. All stations, except G3 and G5, were clustered with a similarity value of 59%.

Keywords: Polychaeta, Annelida, diversity, ecology, new record, Black Sea

Spatial Distribution of Macrozoobenthic Communities along the Black Sea Coast of Turkey with Evaluation of Ecological Quality Status

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The macrozoobenthic community structure was described in the soft-bottoms of the Turkish coast of the Black Sea. Benthic samples were collected at 20 stations (depth-range: 8–69 m) in July 2017 using a Van Veen Grab. A total of 187 macrozoobenthic species and 23802 individuals belonging to 13 taxa were identified. Among them, three alien species [polychaete *Polydora cornuta* Bosc, 1802 and molluscs *Anadara kagoshimensis* (Tokunaga, 1906) and *Rapana venosa* (Valenciennes, 1846)] were found. Polychaeta had the highest number of species (30% of total species) and individuals (57% of total individuals). The most dominant species were *Aricidea* (*Strelzovia*) *claudiae* Laubier, 1967 and *Heteromastus filiformis* (Claparede, 1864). The most frequent species were *H. filiformis, Prionospio maciolekae* Dagli & Cinar, 2011 and *Micronephthys stammeri* (Augener, 1932). The macrozoobenthic community parameters and environmental variables were well correlated. Main factors affecting the community were sediment texture and nutrient levels. The biotic indices (H', M-AMBI, and TUBI) calculated show that the ecological status of the coast of the Turkish Black Sea varies from poor to high.

Keywords: Benthos, diversity, ecological quality, benthic indices, Black Sea

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Antimicrobial Activity of *Nannochloropsis* spp. in Aquaculture

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Nannochlopsis spp., are important photosynthetic organisms of aquatic ecosystems, which are the primary sources of many bioactive compounds such as proteins, carbohydrates, lipids, vitamins and enzymes. These organisms are nowadays used directly in the food, cosmetic and pharmaceutical industry and in aquaculture sector. *Flavobacterium psychrophilum* is a fish diseases which cause of rainbow trout fry syndrome affecting hatchery reared rainbow trout fry and fingerlings. Finding effective way to control fish pathogens is crucial in a country like Turkey which has production capacity of about 240 thousand tons of cultured fish. In our study, we tested the antimicrobial activity of *Nannochloropsis* spp. against some fish pathogens *Flavobacterium psychrophilum* that are major agents of rainbow trout fry syndrome in farms. Agar disk diffusion test method was used for studying antimicrobial activity on pathogens. *Flavobacterium* spp. have shown antimicrobial activity positively as the inhibition zones were 9-15 mm respectively. According to our primary results, we could use this organisms to control of fish disases as an alternative environmental friendly chemotropic reagent for sustainable aquaculture.

Keywords: Antimicrobial test, Fish diseases, Nannochloropsis, *Flavobacterium psychrophilum*

Polychaeta (Annelida) Fauna Associated with Mussel Beds in Sinop (western Black Sea, Turkey)

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Polychaeta fauna associated with mussel beds were determined in May 2014 at 5 station along the coast of the Sinop Peninsula (Black Sea). The mussel beds were collected as three replicates at each station in 4-5 m depth by scraping off an area of 400 cm^{-2} using a spatula. A total of 31 species belonging to 13 families were identified in the assemblages. Among them, spionid *Polydora cornuta* Bosc, 1802 is alien species for Turkish coasts. Syllidae is the best represented family in the field area. The characteristic species of the mussel beds were *Neodexiospira pseudocorrugata* (Bush, 1905) (29.7%), *Nereis zonata* Malmgren, 1867 (21.1%) and *Platynereis dumerilii* (Audouin & Milne Edwards, 1833) (10%). The most frequent species were *N. zonata* (100%), *Eumida sanguinea* (Örsted, 1843) (93.3%), *Syllis hyalina* Grube, 1863 (86.7%) and *Syllis krohni* Ehlers, 1864 (86.7%). The community parameters varied between stations; the lowest mean number of species (7 species) was found in M2 station and the highest number of species (19 species) was found in M3 station. The lowest mean number of individuals was found in M2 station (783 individual/m^2) and the highest was found in M3 station (12800 individual/m^2). The diversity index value (H') ranged from 1.4 to 3.3 and the evenness index value (J') varied from 0.40 to 0.96.

Keywords: Polychaeta, Annelida, diversity, mussel, new record, Black Sea

Acknowledgement: This work has been supported by TUBITAK 2209-A.

POSTER PRESENTATION

Biomonitoring of macro- and trace elements using brown algae *Cystoseira* along the Crimean peninsula (the Black Sea)

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Levels of 22 macroelements and trace elements (Na, Mg, Al, Cl, K, Ca, Sc, V, Mn, Fe, Co, Ni, Zn, As, Br, Rb, Sr, Sb, I, Cs, Ba, U) were determined in brown algae *Cystoseira barbata* and *C. crinita*, and 8 of them (Al, V, Mn, Fe, Co, Ni, Zn and As) are used in accordance with the recommendation of the Bucharest Convention (1996) and WFD (2000/60/EC, 23.10.2000). The samples of 1–3 year old thalli of *Cystoseira* spp. were taken in the coastal zone of the Crimean peninsula, in marine protected areas and sites with different levels of anthropogenic load. The concentration of elements was measured using neutron activation analysis performed in the radioanalytical laboratory of the JINR at IBR-2 fast pulsed reactor. According to the result of *Cystoseira* spp. biomonitoring, the coastal water areas of Crimea were identified as: 1 – relatively clean; 2 – with low level of anthropogenic pollution; 3 – with high level of anthropogenic pollution and 4 – with high concentration of some trace elements being natural sources. This data should be applied to the land use planning of the Crimean peninsula coastal zone, and to biomonitoring using *Cystoseira* spp. in other regions of the Black Sea with different levels of pollution.

Key words: bomonitoring, *Cystoseira*, trace elements, Black Sea.

Determination of catch composition of European pilchard Big scale Sand Smelt trotline used in Çanakkale Region

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This study was made in the Çanakkale coast between April 2015 and March 2018. Number 11, 12, 13, 14 hooks were used in the trotline. White, gray, yellow, green, orange and mixed color used as feather color. Leaders with 10 cm length and 0.10 mm diameter which were equipped with hooks were knotted to 0.15 mm diameter to mainline and distance between leaders were 15 cm. According to sea stream, 100-500 gr weight is used.
The target species *Atherina boyeri* (Risso, 1810) (Big-scale sand smelt) (414; 70.29%) are the most commonly caught species. The other target species, *Sardina pilchardus* (Walbaum, 1792) (European pilchard), was caught 13 individuals (2.21%). As the non-target species, the most caught species was *Scomber japonicus* (Houttuyn, 1782) (Chub mackerel) (59) (10.02%). 427 target species and 162 non-target species were caught in this target trotline. According to this study, number 12 hook has maximum catch rate (168 individuals) and number 14 has minimum catch rate (123 individuals). According to catch effect of feathers color, white color has maximum catch rate (200 individual) and green color has minimum catch rate (81 individuals).

Keywords: trotline, catch composition, Çanakkale, Big-scale Sand Smelt, Sardine

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Cartilaginous fishes (Pisces, Chondrichthyes) caught by demersal longline in the Northeastern Aegean Sea

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This study was carried out on cartilaginous fish caught with demersal longline at the depth of 0 – 400 m in the Northeastern Aegean Sea (coast of Gallipoli Peninsula, Çanakkale strait and Saroz Bay) between January 2012 and January 2013. A total of 40 fishing operations with 3 longline boxes having 240 hooks were performed and a total of 51 osteichthyes and others species (1627 individuals; 66.64%),10 elasmobranch species (211 individuals; 11,48%) were caught. Among the chondrichthyes, the most captured species were *Myliobatis aquila* (33.17%), *Raja clavata* (29.38%) and *Scyliorhinus canicula* (10.42%), respectively. 10 individuals (4.74%) belonging to *Odontaspis forex* which was economically evaluated by the local fishermen were caught. Some of captured cartilaginous fishes were observed to be survived after they were released to the sea environment again. The aim of further studies must be to increase on post-release survival of elasmobranchs caught in demersal longline gear types.

Keywords: Demersal longline, chondrichthyes, Northeast Aegean Sea

Note: This study was supported by TAGEM 11-ARGE/16 project

POSTER PRESENTATION

BEnthic fAuna Surveys daTabase (BEASTs1.0): a new valid instrument for data management in the ecological studies

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Answer to fundamental ecological questions or assess ecological status of the biological communities require the use of large data-sets that may come from different projects, sampling years, geographical regions or researcher groups. The uniformation of such type of data is time consuming and is very laborious increasing the possibility of human error. To overcome these possible problems, the BEASTs software was developed as a computerized system for organizing, storing and undertaking some preliminary analyses of the benthic datasets. BEASTs make you able to filter, retrieve and visualize your data in few seconds avoiding wasting time. The additional advantages during its dataset management are: 1) all data automatically stored in an external database avoiding several Excel files; 2) data consistency and standardization, that means all data organized in the same way; 3) easy searching and filtering procedures making the data retrieval and exploration a very intuitive and easy process and 4) import and export procedures of data in a format appropriate to the various statistical softwares. The BEASTs software with its easy interface will facilitate also data sharing among benthic researchers and the achivement of new perspectives and challenges in the marine ecology.

Keywords: benthos, data management, ecological surveys, database, BEASTs,

First application of DNA Barcoding to Holothurians from Turkey: a case study in Gökova Bay (Muğla, Turkey)

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In this study, genetic biodiversity and haplotypes distribution of Holothurians Species from Gökova Bay (Muğla, Turkey) were investigated by means of DNA barcoding methods. The analysed samples were found to belong to two different species and different haplotypes: *Chiridota laevis* (2 haplotypes) and *Holothuria poli* (4 haplotypes). On phylogenetic tree both species, clearly separated into two distant genetic groups, showed a low genetic intra-populations variability across Gökova Bay let suppose a propagation from a limited genetic pool. This study represents the first DNA barcoding study on Holothurians from Turkish waters and the achieved genetic sequences registered on GenBank are the first reference for these species from Turkey.

Keywords: Sea Cucumbers, Gökova Bay, DNA Barcoding, COI.

Introduction

Holothurians (also known as sea cucumbers) are a group of Echinoderms inhabiting the marine environments, from abyssal depths to intertidal and shallow waters. These slow-moving invertebrates are able to live on sand, mud, rock and reef flats, habitually associated with other organisms as seaweeds, sea grasses and corals (Wen et al., 2011). Holothurians are mostly detritivores and play a strategic role within the marine ecosystem as they conduct functions including nutrient recycling (Uthicke, 2001) and bioturbation (Uthicke, 1999). Holothurians are widely distributed around the world with 37 different species known to occur within the Mediterranean basin (Fischer et al., 1987). Oztoprak et al. (2014) reported a total of 22 different species of Holothurians occurring along the Turkish seas whereas Aydın (2016) detected only 8 species. The fishery of sea cucumber in Turkey started in 1996 reaching an annual production of 550000 Kg in 2014 (González-Wangüemert et al., 2014) mainly exported dried or frozen for consumption (González-Wangüemert et al., 2015). Although the sea cucumber fishery is regulated in Turkey, some signals of over-exploitation on these target species showed a loss of the largest and heaviest individuals that can lead to a consequent decrease of genetic diversity (González-Wangüemert and Godino, 2016).
DNA barcoding is a method based on a universal biological identification system for all species using the Chytochrome c Oxidase subunit I (COI) gene, a standardized region with species-specific discrimination power (Krees and Erickson, 2008) that can be simply amplified with primers designed for many vertebrate and invertebrate organisms (Folmer et al., 1994; Waugh, 2007; Hanner and Gregory, 2007). DNA barcoding methods have been widely used in last decade to allow a fast and

reliable species identification and to assist the resolution of phylogenetic relationships between different groups.

Although their wide distribution and abundances, no previous studies on DNA barcoding of Holothurians, or more generally on Echinoderms, are known from Turkey.

The aim of this study was to analyse genetic biodiversity and haplotypes distribution of Sea Cucumber Species from Gökova Bay (Muğla, Turkey) by means of DNA barcoding methods.

Material and Methods

Samplings were carried on in 2015-2016 by diving and catching in different stations throughout Gökova Bay (Muğla, South-West Turkey). The stations were chosen to be as remote or isolated from each other as possible and allow identifying the highest genetic biodiversity. For each collected sample a small part of tissue was removed, put in 70-90% ethanol and send refrigerated to the Department of Fisheries and Aquaculture, Faculty of Agriculture (Ankara University, Turkey) for genetic analyses. DNA isolations were performed using Gene MATRIX DNA Purification Kit, following the protocol recommended by the manufacturer. The isolated DNA were then analysed for purity by spectrophotometer (Colibri).

Different combinations of EchinoF1, HCO2198, COIer and EchinoR1 primers were used for PCR amplification of the cytochrome c oxidase subunit I (COI) gene. DNA sequences for all samples were aligned using ClustalW (Thompson et al., 1994), MEGA 6 (Tamura et al., 2013) and Sequencher 5.0 software with reference sequences from GenBank and BOLD databases. For each species mean genetic distance analyses among groups were analysed by MEGA 6 and Arlequin 3.5 softwares using Kimura 2-parameter model (Kimura, 1980). Standard error was estimated by bootstrapping analysis with 1000 replicates. For the analysis of evolutionary relationships, MEGA 6, PAUP 4.0 (Swofford, 2002) and PHYLIP (Felsenstein, 1993) software were used. The results were validated by the standard neighbour joining (NJ) method followed by bootstrapping tests with 1000 replicates to assess the reliability of the generated trees.

Results

The results of comparison of aligned sequences with BLAST from the NCBI GenBank reference database highlighted two different species: *Chiridota laevis* (O. Fabricius, 1780) and *Holothuria poli* Delle Chiaje, 1823. For both species different haplotypes have been detected: 2 (D2, E2) for *C. laevis* and 4 (D4, B4, C4, G4) for *H. poli*. Analysing the mean genetic distances, the lowest value between species was 0.372 and the highest was 0.389 (Table 1). For intra-species distance comparison, the lowest value was 0.000 (between C4, D4 for *H. poli*) and the highest was 0.017 (between E2 and D2 for *C. laevis*) (Table 1). Phylogenetic tree showing the evolutionary relationships of the identified species by Kimura 2-parameter given in Fig. 1.

Table 1. Genetic distance values.

	D2	D4	E2	B4	C4	G4
D2		0.031	0.005	0.031	0.031	0.031
D4	0.386		0.030	0.002	0.000	0.002
E2	0.017	0.372		0.030	0.030	0.030
B4	0.389	0.002	0.375		0.002	0.002
C4	0.386	0.000	0.372	0.002		0.002
G4	0.389	0.002	0.375	0.003	0.002	

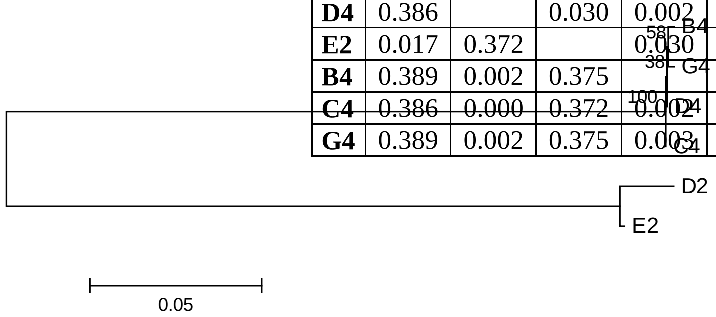

Figure 1. Phylogenetic tree showing the evolutionary relationships of the identified species and drawn by Kimura 2-parameter

Discussions

The phylogenetic trees underlined a clear separation between *C. laevis* and *H. poli* but different haplotypes for each species. The low values of intra-species nucleotide pair distances among the samples collected in the same station can be probably due to originate from a single genetic source. More interesting was the absence of genetic differences between some samples of the same species collected in different stations throughout Gökova Bay. This let suppose that different populations have originated from a single genetic source or originated from a limited genetic pool. The results demonstrated that the COI region can be successfully used to identify DNA barcodes of Holothurians species at both species and population level and reports the first DNA barcoding data for Holothurians from Turkish waters. The obtained results, recorded both in BOLD and NCBI GenBank international databases, represents the first available reference for further studies and comparisons with other populations of the studied species. Further researchers are encouraged to increase the knowledge on distribution and genetic biodiversity of these species that are fundamental for the whole marine ecosystem.

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References

Aydın M. 2016. Sea Cucumber (Holothuroidea) Species of Turkey. Journal of Maritime and Marine Sciences 2(1): 49-58

Felsenstein, J. 1993. PHYLIP (Phylogeny Inference Package) Version 3.5c. Distributed by the author. Department of Genetics, Univ. of Washington, Seattle

Fischer, W., Schneider, M. & Bauchot., M.L. 1987. Méditerranée et Mer Noire (Zone de Pêche 37). Fiches FAO d'identification des espèces pour les besoins de la pêche. Rev.1. (2 volumes).

Folmer, O., Black, M., Hoeh, W., Lutz, R. & Vrijenhoek, R. 1994. DNA primers for amplification of mitochondrial Cytochrome c oxidase subunit I from diverse metazoan invertebrates. Molecular Marine Biology and Biotechnology 3(5): 294-299.

González-Wangüemert, M., Aydin, M. & Conand, C. 2014. Assessment of sea cucumber populations from the Aegean Sea (Turkey): First insights to sustainable management of new fisheries. Ocean Coastal Management 92:87-94.

González-Wangüemert, M., Valente, S. & Aydın, M. 2015. Effects of fishery protection on biometry and genetic structure of two target sea cucumber species from the Mediterranean Sea. Hydrobiologia 743(1): 65-74.

González-Wangüemert, M. & Godino, J.D. 2016. Sea cucumbers as new marine resource in Europe. Front. Mar. Sci. Conference Abstract: IMMR (International Meeting on Marine Research).

Hanner, R. & Gregory, T.R. 2007. Genomic diversity research and the role of biorepositories. Cell Preservation Technology 5: 93-103.

Kimura, M., 1980. A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. Journal of Molecular Evolution 16: 111-120.

Kress, W. J. & Erickson, D. L. 2008. DNA barcodes: Genes, genomics, and bioinformatics. Proceedings of The National Academy of Sciences 105(8): 2761-2762.

Öztoprak, B., Doğan, A. & Dağlı, E. 2014. Checklist of Echinodermata from the coasts of Turkey. Turkish Journal of Zoology 38(6): 892-900.

Swofford D.L. 2002. PAUP. Phylogenetic Analysis Using Parsimony (and other methods). Version 4.0b10. Sunderland, MA, USA: Sinauer Associates.

Uthicke, S. 1999. Sediment bioturbation and impact of feeding activity of *Holothuria* (*Halodeim*a) *atra* and *Stichopus chloronotus*, two sediment feeding holothurians, at Lizard Island, Great Barrier Reef. Bulletin of Marine Science 64 129-141.

Uthicke, S. 2001. Nutrient regeneration by abundant coral reef holothurians. Journal of Experimental Marine Biology and Ecology 265: 153-170.

Waugh, J. 2007. DNA barcoding in animal species: progress, potential and pitfalls. Bioessays 29: 188-197.

Wen J., Hu C., Zhang L. & Fan S. 2011. Genetic identification of global commercial sea cucumber species on the basis of mitochondrial DNA sequences. Food Control 22: 72-77.

Determination of microbial contaminants in cultured black mussel (*Mytilus galloprovincialis*) after depuration treatment

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Depuration can be used to treat shellfish due to microbial contamination. After harvested, shellfish are placed into tanks which involve high quality sea water. Shellfish remove contaminants stored in their gut in a few days. This study was conducted in two stages; firstly, black mussels were harvested from culture area in the Marmara Sea and secondly mussels were moved to commercial depuration plant. Then mussels were placed to depuration tanks for reducing microbial contents during 72 hours. Moreover, first sample of mussels was collected immediately before depuration treatment and others were taken 24, 48 and 72 hours, respectively. The amount of Total Mesophilic Aerobic Bacteria (TMAB), total coliform, *Salmonella* spp. and *Vibrio parahaemolyticus* were analysed in all samples. The amount of TMAB was $5{,}1\times10^3$ cfu/g in without depuration treatment, whilst this was $2{,}75\times10^3$, $0{,}75\times10^3$ and $0{,}25\times10^3$ in 24th, 48th and 72th hours, respectively. The amount of total coliform bacteria was 170 MPN/100g in before depuration treatment, and also it was found 90 MPN/100g and 20 MPN/100g in 24^{th} and 48^{th} hours, respectively, however it was not detected any coliform bacteria in 72th hours. On the other hand, before and after depuration treatment, *Salmonella* spp. and *V. parahaemolyticus* were not found in all samples. As a result, this study indicated that mussels from cultured area have not contain any microbial contaminants above the legal limit during the harvesting period. In addition to this, after depuration, mussels remove contaminants approximately 47.0 %, 88.0 % and nearly totally after 24th, 48th and 72th hours, respectively. Therefore, it is thought that if mussel is produced in cultured area, it is more safety and healthy for human consumption.

Keywords: Depuration, mussel, culture, *Vibrio parahaemolyticus*

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Length-Weight Relationships of 10 Crustacean species in Yumurtalık Bight (Iskenderun Bay, Northeastern Mediterranean), Adana, Turkey

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Study aim was to assess length-weight relationship-LWR of 10 crustacean species in Yumurtalık Cove (Iskenderun Bay), Turkey. Samples were collected monthly from July 2014 to June 2015 (except February), using bottom trawl into 0-50 m. In this study the relationships between Carapace length (CL), Carapace Width (CW), and Total Weight (TW) of 4 crab species (*Charybdis longicollis*, *Portunus segnis*, *Callinectes sapidus*, *Ixa monodi*), 2 stomatopod species (*Clorida albolitura*, *Erugosquilla massavensis*) and four shrimp species (*Penaeus semisulcatus*, *Metapenaeopsis aegyptia*, *Metapenaus monocerus*, *Melicertus kerathurus*). For each species, regression coefficients and parameters, “a” and “b” was calculated with 95% confidence interval. The LWR parameter b for all species ranged from 0.957 to 3.912, with r^2 ranging from 0.737 to 0.966. The pattern of relative growth for both species *Ixa monodi* and *Portunus segnis* was positive allometric with b was 3.208 for *P. segnis* and 3.912 for *I. monodi*. Other species showed negative allometric growth.

Keywords: Length-Weight Relationship, Crustacea, Iskenderun Bay, Northeastern

A preliminary assessment of the histopathology of kidney pathology in *Atherina boyeri* from Köyceğiz Lake

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Atherina boyeri, the big-scale sand smelt, is a euryhaline marine fish native to coastal and estuarine waters in Mediterranean, Black, Azov and Caspian Sea basins. The species inhabits naturally in all coasts and lagoons of Turkey and it was also translocated to freshwater lakes isolated from sea.

This study reports the incidence of histological alterations in the kidney of sand smelt collected from Köyceğiz Lake, located on Aegean Sea coast. Histological slides of the kidneys were prepared and dyed with Hematoxylin & Eosin. Whole kidney sections were examined for each individual fish and severe lesions on kidneys were observed in 37% of the specimens.

The kidneys are one of the primary organs involved in excretion and osmoregulation of teleost fish. Histological alterations in organs such as gill and kidney affect osmoregulation potential, thus the survival rate of the population. Kidney lesions were observed in over 1/3 of the sand smelt specimens. This high ratio could be considered as a risk for the sustainability of the population in Köyceğiz Lake, which is a natural habitat of this species.

Alterations on kidneys are also an indicator of environmental quality in aquatic systems. According to studies on fish kidney histopathology, alterations and lesions in kidney tissues mainly arrised from poor water quality caused by elevated heavy metal concentrations, waste water pollution etc., both in urban streams and in situ experiments. Results of this preliminary study indicates that, although the specific causative factors for the observed alterations are unknown, the incidence of histological alterations in the kidney of sand smelt is an evidence of the poor environmental quality of this lake. Further studies are required in order to detemine the reasons of the observed lesions and measure of the damage.

Keywords: *Atherina boyeri*, kidney histology, kidney lesions.

Investigation of genetic diversity of Sea Sponges Species in Gökova Bay (Muğla, Turkey) by DNA Barcoding Methods

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In this study, genetic diversity of sea sponges species throughout Gökova Bay (Muğla, South West Turkey) was analysed by DNA Barcoding methods. As a result, 3 different species were identified: *Sarcotragus spinosulus, Ircinia variabilis* and *Aplysina aerophoba.* The distribution of the diverse haplotypes for each species underlined a low genetic intra-populations variability across Gökova Bay probably due to their origin by a common ancestor or a narrow genetic pool. The project represents the first study on DNA barcoding of Porifera from Turkish waters.

Keywords: Porifera, Gökova Bay, DNA Barcoding, COI.

Introduction

Sponges are one of the most important groups in the Mediterranean Sea in terms of biodiversity with a total of 681 species recorded (Coll *et al.*, 2010). With regard to Turkey, up to now, a total of 132 species have been reported from Turkish coasts (Topaloğlu & Evcen, 2014; Gözcelioğlu *et al.,* 2015). Sea sponges have been worldwide studied for their potential application in pharmaceutical industry (Anjum *et al.*, 2016) and their molecular systematics (Solé-Cava & Thorpe, 1986). DNA barcoding is a methodology widely used in last decade to allow a fast and reliable species identification (Hebert *et al.*, 2003). The main feature that differentiates DNA barcoding from other methods is that it has a universal biological identification system principle for all animal species using the single Chytochrome c Oxidase subunit I (COI) gene region (Hebert *et al.*, 2003). The availability of the COI gene region for identification at species level is now accepted for many vertebrate and invertebrate groups (Waugh, 2007) and it is a recommended practice in the characterization of materials in biodiversity databases (Hanner & Gregory, 2007). Although this, these techniques have not yet been applied to sea sponges and more generally on Echinoderms from Turkey. The aim of this study was to investigate the genetic diversity and haplotypes distribution of sea sponges in Gökova Bay by t DNA barcoding methods.

Material and Methods

Samples collection was carried on in 2015-2016 by diving from different locations throughout Gökova Bay (Muğla, South-West Turkey). To detect the highest genetic differences between populations, the sampling stations were chosen throughout Gökova Bay to be as remote or isolated from each other as possible. After collection, the tissue samples were stored in 70-90% ethanol and sent to the Evolutionary Genetics Laboratory (Ankara University) for genetic analyses. Here, DNA was extracted using Qiagen DNeasy Kits and analysed by NanoDrop ND-1000 spectrophotometer. COI gene was amplified by PCR with different combination of the primers: EchinoF1, HCO2198, Colin and EchinoR1. The sequences were edited and aligned by ClustalW (Thompson *et al.*, 1994), MEGA 6 (Tamura *et al.*, 2013) and Sequencher 5.0 software with reference sequences from GenBank and BOLD databases. For each species intra-group and inter-group genetic distance analysis was accomplished using Kimura 2-parameter model MEGA 6 and Arlequin 3.5 softwares and standard error was estimated by 1000 replication on bootstrapping analysis. Evolutionary relationships were analysed by MEGA 6, PAUP 4.0 (Swofford, 2002) and PHYLIP (Felsenstein, 1993) software and then validated using DNA barcoding standard neighbour joining (NJ) method. The reliability of the generated trees was assessed by bootstrapping tests with 1000 replications.

Results

Comparison of the results with the reference databases on NCBI GenBank, separed the samples into 3 different species: *Sarcotragus spinosulus* Schmidt, 1862, *Ircinia variabilis* (Schmidt, 1862) and *Aplysina aerophoba* Nardo, 1843. Analysing the mean intra-species genetic distances, the lowest value was 0.000 and the highest was 0.0556 (Table 1). Phylogenetic tree showing the evolutionary relationships of the identified species by Kimura 2-parameter are given in Fig. 1.

Table 1. Genetic distance values.

		Ircinia variabilis			*Aplysina aerophoba*			*Sarcotragus spinosulus*		
		A2	**B2**	**C2**	**G2**	**H2**	**A4**	**H4**	**A6**	**B6**
	A2		0.000	0.000	0.031	0.031	0.031	0.010	0.009	0.009
Ircinia variabilis	**B2**	0.000		0.000	0.031	0.031	0.031	0.010	0.009	0.009
	C2	0.000	0.000		0.031	0.031	0.031	0.010	0.009	0.009
	G2	0.375	0.375	0.375		0.000	0.000	0.031	0.030	0.030
Aplysina aerophoba	**H2**	0.375	0.375	0.375	0.000		0.000	0.031	0.030	0.030
	A4	0.375	0.375	0.375	0.000	0.000		0.031	0.030	0.030
	H4	0.056	0.056	0.056	0.378	0.378	0.378		0.003	0.003
Sarcotragus spinosulus	**A6**	0.049	0.049	0.049	0.367	0.367	0.367	0.007		0.000
	B6	0.049	0.049	0.049	0.367	0.367	0.367	0.007	0.000	

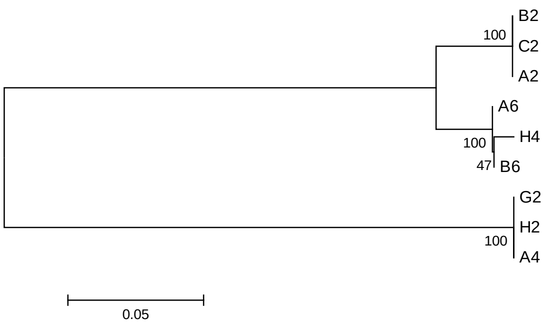

Figure 1. Phylogenetic tree showing the evolutionary relationships of the identified species and drawn by Kimura 2-parameter

Discussions

This study represents the first attempt of DNA barcoding study on marine sponges from Turkey. The results underlined the efficiency of COI gene as a DNA barcoding tool to identify the sea sponges' populations to species level. In the phylogenetic tree, the three species resulted clearly separated from each other as expected. The low genetic differences within the samples obtained from different stations revealed a low genetic variability among the populations of the species throughout the Bay suggesting a similar genetic origin from a common ancestor for each of the species. The presence of the three species was already reported by previous studies: *A. aerophoba* and *Ircinia variabilis* were reported for Aegean Sea (Geldiay & Kocataş, 1972, Ergüven *et al.*, 1988; Ergen *et al.*, 1994) and Levantine Sea (Gözcelioğlu, 2011 and Evcen & Çınar, 2012) whereas *Sarcotragus spinosulus* was to date reported only for Levantine sea (Gözcelioğlu, 2011, Evcen & Çınar, 2012). The results of this study added more information about the distribution of these species and the obtained sequences, recorded in NCBI GenBank international database, represent the first available reference for these species from Turkey. Future studies to increase the overall knowledge on genetic diversity and distribution of these species are kindly encouraged.

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References

Anjum, K., Abbas, S.Q., Shah, S.A.A., Akhter, N., Batool, S. & Hassan, S.S. 2016. Marine Sponges as a Drug Treasure. Biomoleculer & Therapheutics, 24: 347-362.

Coll, M., Piroddi, C., Steenbeek, J., Kaschner, K., Lasram, F.B.R., Aguzzi, J., Ballesteros, E., Bianchi, C.N., Corbera, J., Dailianis, T. & Danovaro, R., 2010. The biodiversity of the Mediterranean Sea: estimates, patterns, and threats. Plos One: 5(8): e11842.

Ergen, Z., Kocataş, A., Katağan, T. & Çınar, M.E. 1994. Gencelli Limanı (Aliağa-İzmir) bentik faunası. Ege Üniversitesi Fen Fakültesi Dergisi, 16: 1047-1059 (in Turkish).

Ergüven, H., Ulutürk, T. & Öztürk, B. 1988. Gökçeada'nın Porifera (sünger) faunası ve üretim imkanları. İstanbul Üniversitesi Su Ürünleri Dergisi, 2: 173-189.

Evcen, A. & Çınar, M.E. 2012. Sponge (Porifera) from the Mediterranean Coast of Turkey (Levantine Sea, eastern Mediterranean), with a Checklist of Sponges from the Coasts of Turkey. Turkish Journal Zoology, 36(4): 460-464.

Felsenstein, J. 1993. PHYLIP (Phylogeny Inference Package) Version 3.5c. Distributed by the author. Department of Genetics, Univ. of Washington, Seattle.

Fischer, W., Schneider, M. & Bauchot., M.L. 1987. Méditerranée et Mer Noire (Zone de Pêche 37). Fiches FAO d'identification des espèces pour les besoins de la pêche. Rev.1. (2 volumes).

Folmer, O., Black, M., Hoeh, W., Lutz, R. & Vrijenhoek, R. 1994. DNA primers for amplification of mitochondrial Cytochrome c oxidase subunit I from diverse metazoan invertebrates. Molecular Marine Biology and Biotechnology, 3(5): 294-299.

Geldiay, R. & Kocataş, A. 1972. İzmir Körfezinin benthosu üzerine preliminer bir araştırma. Ege Üniv. Fen Bil. Monogr. Ser. 12: 3-33 (in Turkish).

Gözcelioğlu, B., Van Soest, R., Alvarez B.& Konuklugil B. 2015. New species of sponges (Porifera, Demospongiae) from the Turkish coast. Turkish Journal of Zoology, 39: 555-559.

Gözcelioğlu, B. 2011. Denizlerimizin Sakinleri. Ankara, Turkey: Gökçe Ofset (in Turkish).

Hanner, R. & Gregory, T.R. 2007. Genomic diversity research and the role of biorepositories. Cell Preservation Technology, 5: 93-103.

Hebert, P. D., Ratnasingham, S., & de Waard, J. R. 2003. Barcoding animal life: cytochrome c oxidase subunit 1 divergences among closely related species. Proceedings of the Royal Society of London B: Biological Sciences, 270(Suppl. 1): S96-S99.

Kimura, M., 1980. A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. Journal of Molecular Evolution, 16: 111-120.

Kress, W. J. & Erickson, D. L. 2008. DNA barcodes: Genes, genomics, and bioinformatics. Proceedings of The National Academy of Sciences, 105(8): 2761-2762.

Öztoprak, B., Doğan, A. & Dağlı, E. 2014. Checklist of Echinodermata from the coasts of Turkey. Turkish Journal of Zoology, 38(6): 892-900.

Pansini, M. & Longo, C. 2003. A review of the Mediterranean Sea sponge biogeography with a list of the demosponges hitherto recorded from this sea. Biogeographia, 24: 251-262.

Solé-Cava A.M. & Thorpe J.P. 1986. Genetic differentiation between morphotypes of the marine sponge *Suberites ficus* (Demospongiae: Hadromerida). Marine Biology, 93: 247-253

Swofford D.L. 2002. PAUP. Phylogenetic Analysis Using Parsimony (and other methods). Version 4.0b10. Sunderland, MA, USA: Sinauer Associates.

Tamura, K., Stecher, G., Peterson, D. Filipski, A., & Kumar, S. 2013. MEGA6: Molecular Evolutionary Genetics Analysis Version 6.0. Molecular Biology and Evolution, 30 (12): 2725-2729.

Thompson, J.D., Higgins, D.G., Gibson, T.J. 1994. CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. Nucleic Acids Research, 22(22):4673-80.

Topaloğlu, B. & Evcen, A., 2014. Updated checklist of sponges (Porifera) along the coasts of Turkey. Turkish Journal of Zoology, 38: 665-676.

Waugh, J. 2007. DNA barcoding in animal species: progress, potential and pitfalls. Bioessays, 29: 188-197.

Quality determination in fish sold on fish counters at county bazaars

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County bazaars are also preferred places to buy fish as well as fruit and vegetables. On the other hand, fish are known to deteriorate more easily, unlike vegetable, fruit or other meat types. It is always questionable how healthy the fish bought from the county bazaar is or whether the quality of the fish bought in the morning is better.
In this study, it is aimed to determine whether the fish sold in the two most-preferred county bazaars in Izmir are at risk of consumption by determining the quality of fatty and low-fat fish to be bought in the early morning hours and afternoon. With this aim, we performed microbiological [total mesophilic aerobic bacteria (TMAB), total psychrophilic aerobic bacteria (TPAB)] and chemical [pH, thiobarbituric acid (TBA), total volatile basic nitrogen (TVBN)] analyses. The initial results are shown in Tables 1, 2.

Table 1. Chemical and microbiological analysis (Sardine)

	Bazaar 1		Bazaar 2	
	Morning	Afternoon	Morning	Afternoon
TVB-N (mg TVB-N $100g^{-1}$)	20.39±0.88	31.32±1.02	26.60±0,88	31.03±1.77
TBARS (µmol malondialdehyde $100g^{-1}$)	0.57±0.05	7.87±0.02	0.23±0.04	7.79±0.13
pH	6.30±0.0	6.30±0.01	6.21±0.02	6.40±0.04
TMAB (cfu/g)	$1.0x10^4$	$3.6x10^4$	$7.0x10^4$	$2.3x10^5$

Table 2. Chemical and microbiological analysis (Whiting)

	Bazaar 1		Bazaar 2	
	Morning	Afternoon	Morning	Afternoon
TVB-N (mg TVB-N $100g^{-1}$)	35.46±1.53	43.44±0.88	33.39±1.35	42.85±1.84
TBARS (µmol malondialdehyde $100g^{-1}$)	0.18±0.0	1.02±0.14	0.33±0.02	1.14±0.02
pH	6.95±0.01	7.00±0.01	6.90±0.01	7.10±0.04
TMAB (cfu/g)	$3.2x10^5$	$2.6x10^4$	$>10^7$	$5.4x10^5$

This study will provide a significant contribution to the literature and will also guide the purchase of fish from the county bazaars. Research is still ongoing and detailed results will be shown at Marfresh2018.

Keywords: Fish, quality, county bazaar, public health, nutrition

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Morphometric analysis of *Ensis marginatus* (Pennant, 1777) from Gallipolli, Çanakkale, Turkey

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This study was carried out in the coast of Gallipoli-Çanakkale from May 2011 to April 2013. The main aim was to determine morphometric analysis of razor clam, *Ensis marginatus*. As a result of the present study, relationships between length and weight, length and height, length and width, length and diagonal length were investigated and negative allometry was found for each relationship and b values were determined as 2.6, 0.717, 0.911 and 0.932, respectively. The study provides new knowledge on morphometric relationship for the razor clam which is vital for management of fisheries and conservation, and decision–making process.

Keywords: *Ensis marginatus*, bivalvia, morfometric relationship, allometry, growth

Introduction

The razor clam, *Ensis marginatus* or formerly *Solen marginatus* Pennant (1777), is economically important and edible bivalvia mollusca. This species can be considered the most important commercial razor clam of Turkey than *Ensis ensis* and *Ensis siliqua*. It is buried in sandy, muddy and muddy-sandy in low intertidal and sub tidal areas (FAO 1987). The population of this species has globally distributed along the coasts of the Mediterranean Sea, Black Sea, Baltic Sea, the English Channel, southern Norway, and Atlantic Ocean down to Senegal. In Turkey, razor clam can be found on all the coasts. Since this species is a commercially high valued species, the interest has increased from the past to the present (Diaz *et al.*, 2011). On the other hand, fishing pressure has increased at the same time. But in Turkey, there is no reported in fisheries statistics about razor clam production. The most important reason; fishermen and production areas have not been controlled by the government. Razor clam species are conventionally produced by fishing from natural stocks for mostly bait of Sparidae species and rarely human consumption. Although we have no data about basic information such as age, growth, morphology and morphometric relationship as we know that natural stocks have begun to show clear sign of overexploitation. Such available knowledge can be helpful for conservation of the species, ecosystem management, regulation of fishing activity, determining minimum legal harvest size and improving the selectivity of fishing gears.

Material and Methods

The razor clam was collected by hand with metal wire from Çanakkale-Gallipoli (Aegean Sea, Turkey) between May 2011 and April 2013 (Figure 1). Collected individuals were transported to the laboratory. The shell length (L) (anterior-posterior), shell height (H) (dorsa-ventral), shell width (Wi), shell diagonal length (DL) (axis of grater growth from hinge to the ventral margin) and total weight (W) were measured. The relationship between length and height, length and width, length and diagonal length were determined by linear regression (Ricker, 1977).

$$Y = a + bX$$

Where Y: height, width, and diagonal length, *X*: length, *a*: a constant, *b*: the regression coefficient.

The length and total weight relationship was calculated using the expression given below (Pauly, 1983)

$$Y = a \times X^b$$

Regression analysis was performed on weight-length, width-length, height-length and diagonal length-length measurements of *E. marginatus* (n=316 individuals). Morphometric relationships (isometric: b slope=1 or 3; positive allometry: b slope>1 or 3; negative allometry: b slope <1 or 3) were assessed according to Gaspar *et al.* (2002). *t*-test (H_0: b=1 or 3) with a confidence level of %95 was used. The computing was performed using the Statistical Package for Social Sciences (SPSS) software version 20.

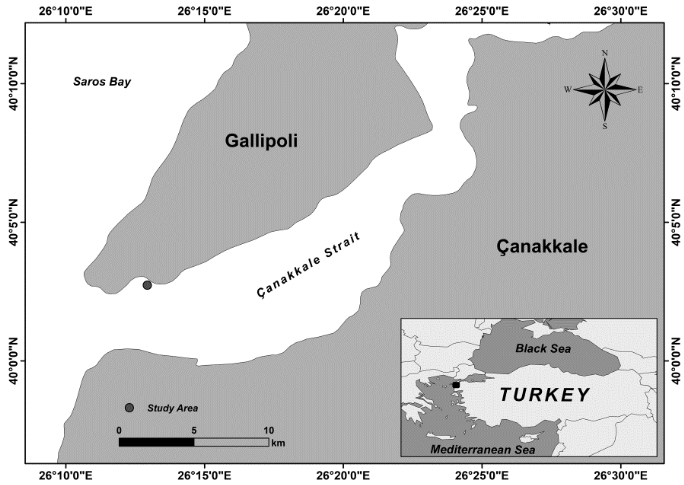

Figure 1. Map of the study area

Results

The results showed that morphometric relationships for height/length, width/length and diagonal length/length have negatively allometric growth. Likewise, the relationship between weight-length was determined as negatively allometry. Correlation coefficient of weight-length and width-length, height-length and diagonal length-length were r^2 =0.824, r^2 =0.768, r^2 =0.601, and r^2 =0.913, respectively (Table 1).

Discussion

Bivalve shell growth and shape are affected by environmental factors and physiological factors. Environmental parameters are temperature, salinity, chlorophyll-*a* concentration (Acarli *et al.*, 2011a; Acarli *et al.*, 2011b; Acarli *et al.*, 2012; Caill-Milly *et al.*, 2014), latitude or geographical variation (Costa *et al.*, 2008; Rufino *et al.*, 2013), type of sediment (Thomson & Gannon, 2013), offshore and inshore localization (Nakamura *et al.*, 2002). On the other hand, genetic variability is also considered as a physiological factor (Arias *et al*., 2011).

In this study, the W/L, H/L, Wi/L and DL/L of b value shows negative allometric value which means that length of the individual increases faster than height, width, weight, and diagonal length (Table 1). Result of W/L is similar with the outcomes of Trisyani *et al*. (2016) and Park & Oh (2002). In contrast, Gaspar *et al*. (2001), Barón *et. al.* (2004) and Vasconcelos *et al.* (2018) were found isometric relationship between length and weight. The negative allometric growth was determined for the relationship between H/L, Wi/L and DL/L in the present study while other authors declared that relationship of H/L, Wi/L and DL/L was positive allometric growth or isometric growth (Gaspar *et al.*, 2002; Barón *et al.* 2004) (Table 1.)

The differences on morphometric characteristics of *E. marginatus* were determined in this study compared to other investigations that carried out with different species at different locations (Table 1). This variation may be related to environmental parameters mainly food availability and quality. Beside effect of the food availability and quality, it is essential to evaluate together all of the other impacts to create a correct approach for strategy of conservation and fisheries activities. The outcomes of the present paper can also provide helpful consequences (knowledge) to establish appropriate management protocol for strategy of conservation and fisheries activities of this species.

Table1 Parameters of the morphometric relationship for Solenidae family species obtained from this study and available literature

Species	N	L mean ± SD (L min-L max)	Allometric relation	a	b	Determination confident(r^2)	SE of b (%95 CI of b)	Relationship (t-test)	Reference
Solen stricus	489	38.4-131.8	W/L	$2.7084x10^{-4}$	2.55	0.917	-	-allometry	Park & Oh (2002)
Solen regularis	2929	-	W/L	0.038	2.798	0.9	-	-allometry	Trisyani *et al.* (2016)
Ensis ensis	37	76.6±17.3	W/L	0.000006	3.072	0.974	3.072 (2.716-3.428)	isometry	Vasconcelos *et al.* (2018)
Ensis macha	270	55-165	W/L	-11.47	3.03	0.86	-	isometry	Barón *et al.* (2004)
Ensis macha	520	1.6-165	D/L	-0.11	1.01	0.99	-	isometry	Barón *et al.* (2004)
Ensis macha	412	11.2-165	H/L	-1.74	1.02	0.99	-	+allometry	Barón *et al.* (2004)
Ensis sliqua	225	98.05±27.45 (45.00-150.00)	W/L	0.0001	3.030	0.990	0.59 (2.909-3.152)	isometry	Gaspar *et al.* (2001)
Ensis sliqua	225	98.05±27.45 (45.00-150.00)	H/L	-0.967	1.054	0.937	0.018 (1.018-1.091)	+allometry	Gaspar *et al.* (2002)
Ensis sliqua	225	98.05±27.45 (45.00-150.00)	Wi/L	-1.727	1.339	0.872	0.034 (1.271-1.407)	+allometry	Gaspar *et al.* (2002)
Ensis marginatus	316	93.05±14.55 (48.3-133.59)	W/L	7E-05	2.670	0.825	0.067 (2.603-2.737)	-allometry	This study
Ensis marginatus	316	93.05±14.55 (48.3-133.59)	H/L	-0.2612	0.712	0.768	0.022 (0.669-0.755)	-allometry	This study
Ensis marginatus	316	93.05±14.55 (48.3-133.59)	Wi/L	-0.702	0.900	0.601	0.042 (0.818-0.982)	-allometry	This study
Ensis marginatus	316	93.05±14.55 (48.3-133.59)	D/L	0.932	0.143	0.919	0.016 (0.901-0.961)	-allometry	This study

(N: number of individuals; L: shell length (mm); H: shell height (mm); Wi: shell width (mm); W: total weight (g); SD: Standard deviation; SE: standard error; CI: confidence interval)

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References

Acarli, S., Lök, A., Küçükdermenci, A., Yildiz H., & Serdar, S., 2011a. Comparative Growth, Survival and Condition Index of Flat Oyster, *Ostrea edulis* (Linnaeus 1758) in Mersin Bay, Aegean Sea, Turkey. Kafkas Universitesi Veteriner Fakültesi Dergisi, 17 (2): 203-210.

Acarli, S., Lök, A., Yiğitkurt, S. & Palaz, M., 2011b. Culture of Fan Mussel (Pinna nobilis, Linnaeus 1758) in Relation to Size on Suspended Culture System in Izmir Bay, Aegean Sea, Turkey. Kafkas Universitesi Veteriner Fakültesi Dergisi, 17 (6): 995-1002.

Acarli, S., Lök, A. & Yiğitkurt, S., 2012. Growth and survival of *Anadara inaequivalvis* (Bruguiere, 1789) in Sufa Lagoon, Izmir, Turkey. The Israeli Journal of Aquaculture-Bamidgeh, IJA_64.2012.691:1-7.

Arias, A., Fernández-Moreno, M., Fernández-Tajes, J, Gaspar, M.B. & Méndez J., 2011. Strong genetic differentiation among east Atlantic populations of the sword razor shell (*Ensis siliqua*) assessed with mtDNA and RAPD markers. Helgoland Marine Research, 65: 81–89

Barón, P.J., Real, L.E., Ciocco, N.F. & Ré, M.E., 2004. Morphometry, growth and reproduction of an Atlantic population of the razo rclam *Ensis macha* (Molina, 1782). Scientia Maria, 68(2):211-217.

Caill-Milly, N., Bru, N., Barranger, M., Gallon, L. & D'amico, F., 2014. Morphological trends of four manila clam population (*Veneripus philippinarum*) on the French Atlantic coast: Identified spatial patterns and their relationship to environmental variability. Journal of Shellfish Research, 33(2):355-372.

Costa, C., Aguzzi, J., Menessati, F., Antonucci, V. Rimatori, & Mattoccia, M., 2008. Shape analysis of different population of clams in relation in to their geographical structure. Journal of Zoology, 2:98-104.

Diaz, A.G., Seijo, C.S., Gaspar, B.M., & Gonzalez F.C., 2011. Razor Clams: Biology, Aquaculture and Fisheries. Conselleia do Mar, Xunto de Galicia, 428s.

FAO 1987. Species identification sheets for fishery purpose Mediterranean and Black Sea Fishing Area 37 (Med. and Black Sea) Vol:II.

Gaspar, M.B., Santos, M.N. & Vasconcelos, P., 2001. Weight-length relationship of 25 species (Mollusca:Bivalvia) from the Algarve coast (southern Portugal). Journal of Marine Biological Association of the United Kingdom, 81:805-807.

Gaspar, M.B., Santos, M.N., Vasconcelos, P. & Monteiro, C.C., 2002. Shell morphometric relationship of the most common bivalve species (Mollusca:Bivalvia) of the Algarve coast (southern Portugal). Hydrobiologia, 477:73-80.

Nakamura, Y., Hagino, T., Hiwatari, A., Iijima, K., Kohata, A. & Furota, T., 2002. Growth of the Manila clam, *Ruditapes philippinarum* in Sanbanse, the shallow coastal area in Tokyo Bay. Fisheries Science, 68:1309-1316.

Park, K.Y. & Oh, C.W., 2002. Length-weight relationship of bivalves from coastal waters of Korea. Naga, The ICLARM Quarterly, 25(1):21-22.

Pauly, D., 1983. Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Technical Papers, Volume 235. Rome: FAO, pp. 1–52.

Ricker, W.E., 1973. Linear regression in the fishery research. Journal of Fisheries Research Board of Canada, 30, 409–434.

Rufino, M.M., Vasconcelos, P., Pereira, F., Fernándesz Tajes, J., Darriba, S., Méndez, J. & Gaspar, M.B., 2013. Geographical variation in shell shape of the pod razor shell *Ensis siliqua* (Bivalvia: Pharidae). Helgoland Marine Research, 67:49–58

Thomson, E. & Gannon, D.P., 2013. Influence sediment type on antipredator response of the softshell clam, *Mya arenaria.* Northeastern Naturalist, 20(3):498-510.

Trisyani, N., Herawati, E.Y., Widodo, M.S. & Setyohadi, D., 2016. The length-weight correlation and population dynamics of razor clams (*Solen regularis*) in Surabaya east coast, Indonesia. Biodiversitas 17: 808-813.

Vasconcelos, P., Moura, P., Pereira, F., Pereira, M.A. & Gaspar, B., 2018. Morphometric relationship and relative growth species of 20 uncommon bivalve species from the Algarve coast (Southern Portugal). Journal of Marine Biology Biological of the United Kingdom, 98(3):463-474.

A new species of *Maldivea* Gerlach 1962 (Oxystominidae) from Felidhoo atoll (Maldives, Indian Ocean)

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Maldivea Gerlach, 1962 is a possible endemic genus of the Maldivian archipelago for which only *M. xarifae* has been described so far. A new species of this genus, *M. complexa*, was recently found in Felidhoo atoll. It reveals a more complex structure of the gubernaculum than in type species that appears divided into two pieces: one is a sort of long wing in the ventral part of the spicule and the other one, more complex, is characterized by several curved stripes that envelop the dorsal side of the spicule distal part.

Keywords: Paroxystomininae, *Maldivea*, shallow subtidal habitats, Maldives.

ALIEN CSI: Increasing understanding of alien species through citizen science

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The challenges of gathering information on alien species (AS) are widely recognized. Recent developments in citizen science (CS) provide an opportunity to improve data flow and knowledge on AS while ensuring effective and high quality societal engagement with the issue of IAS (Invasive Alien Species). Advances in technology, particularly on-line recording and smartphone apps, along with the development of social media, have revolutionized CS and increased connectivity while new and innovative analysis techniques are emerging to ensure appropriate management, visualization, interpretation and use and sharing of the data. In early July 2018 we launched a European CO-operation in Science and Technology (COST) Action to address multidisciplinary research questions in relation to developing and implementing CS on AS. The Action will explore and document approaches to establishing a European-wide CS AS network. It will embrace relevant innovations for data gathering and reporting to support the implementation of monitoring and surveillance measures, while ensuring benefits for society and citizens, through an AS CS European network. We invite you to get involved with this exciting network.

Keywords: citizen science, Invasive Alien Species, AS CS European network

Effects of different levels of magnetic fields on development of egg and yolk sac larvae of gilthead sea bream (*Sparus aurata*)

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In this study the influence of three different magnetic fields investigated on embryonic development, growth parameters, digestive physiology (absorption of endogenous food reserves) and oxidative status (superoxide dismutase and catalase) of egg and yolk sac larvae in gilthead sea bream, *Sparus aurata*. In this sense *S. aurata* egg were obtained from breeders in natural spawning season and transferred to experimental tanks in four groups. Similarly, newly hatched yolk sac larvae of *S. aurata* were classified into four groups. Magnetic fields were established with neodymium magnets in three different levels, 1, 3 and 5 mT. Control groups were not exposed magnetic field. Embriyonic development of egg was accelerated in 3 and 5 mT groups, they hatched out relatively earlier than control and 1mT groups. Moreover, different magnetic fields did not affect enzymatic activities of superoxide dismutase and catalase and no significant differences were found among groups ($p>0.05$). In addition to these, absorption of oil globule and yolk sac were not influenced from different magnetic fields and there were no significant differences among groups ($p>0.05$). Besides, superoxide dismutase activities were not affected significantly in all groups ($p>0.05$), however, catalase activities presented different enzymatic profile among groups ($p<0.05$). As a result, higher magnetic fields especially 5mT exhibited better growth performance, digestive physiology and oxidative status in all experimental groups.

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Keywords: Magnetic field, egg, yolk sac larvae, growth parameters, oxidative status, *Sparus aurata*.

The species composition and structure of epiphytic synusia of *Cystoseira barbata* and *C. crinita* (Sevastopol Bay, the Black Sea)

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The species composition and structure of epiphytic synusia of *Cystoseira barbata* and *C. crinita* as indicator of biocenosis condition (WFD, 2000/60/EC) were investigated in a few sites of Sevastopol Bay. The material was taken in mixed *Cystoseira* communities from 1 to 10 m depth. The highest share of epiphytes in the biomass of communities was at 3 m depth (17–40%), and the minimum was at 1 m depth (5.5–7.9%). In total, 37 species of epiphytes were identified on both *Cystoseira* species, specifically 36 species on *C. barbata* and 22 species on *C. crinita*. The number of species of Rhodophyta and Chlorophyta were twice higher on *C. barbata*, compared with *C. crinita*, and Ochrophyta was similar. The maximum richness of *C. barbata* epiphytes was found at 1 and 5 m depths (28 and 31 species), and *C. crinita* was at 3 and 5 m depths (11 and 14 species), respectively. The epiphytes of *C. crinita* were attached mostly on the stems of thalli, and *C. barbata* dominated on the lateral branches and branchlets. The richness of *Cystoseira* spp. epiphytes have been related with the morphological features of the thalli and abundant branching. The data obtained are important for the recommendations by supporting of water quality and protecting the *Cystoseira* communities, which have high conservation status in the Black Sea.4

Keywords: *Cystoseira,* epiphytes, communities, Sevastopol Bay, the Black Sea.

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