****The George S. Wise Faculty of Life Sciences

Zoology school

Research proposal

**The alteration of the structure of marine fish's community in the eastern Mediterranean Sea, effected by global warming.**

By

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**Introduction**

In the last three decades, temperatures in the Mediterranean Sea have been rising, especially in the eastern Mediterranean (Keskin et al., 2014). The implications of temperature change on the marine biota are varied. Their response could be manifested at the species level by changes in body size (Van Rijn 2017), phenology (Cheung et al., 2013), size at maturity, productivity (Keskin et al., 2014), or the spawning period (Tiskliras et al., 2014). Responses might also occur at the community level through changes in the abundance and distribution of constitute species, leading to significant alterations in the community structure (Tiskliras et al., 2014). Another factor contributing to the change of the Mediterranean Sea community is the invasion of alien species of indo-pacific origin through the Suez Canal. Since the alien species are thermophiles, they are predicted to become more abundant as the sea temperature rise (Galili 2008). A better understanding of the responses of marine fishes to warming water is required to develop effective management and adaptation policies (Cheung et al., 2013).

There is a knowledge gap regarding the relative influence of alien species to the community structure compared to changes caused by adaptations of the indigenous species (expansion and extinction) to the warming. To estimate the change in the marine fish community structure, Cheung et al., 2013, proposed an index of the mean temperature of the catch (MTC). The index calculated form average inferred temperature preference of exploited species, weighted by their annual catch. The index points to effects of climate change on the marine fish structure, under the proposed that the warming leads to increased catches of thermophiles species and decreased catches of psychrophiles species.

Cheung found a correlation between changes in the MTC and changes in the sea surface temperature (SST). He further found that MTC has increased in most large marine ecosystems, including the Mediterranean Sea. The MTC index was further tested again in the Greek Sea and the Agean Sea (Tisklirad et al., 2015, Keskin et al., 2014), and was found to rise faster in the eastern Mediterranean Sea than in Cheung’s results for the Mediterranean Sea. One possible cause for the difference is the increased presence of alien species in the eastern Mediterranean.

In my research I will use the MTC to understand the community respond to warming water, indigenous and invasive species seperatly. The data will be based on high-resolution catch data from fishermen log-books recording thousands of fishing hauls (Itai van Rijn, 2017). I will calculate the MTC index for each haul and for invasive and indigenous species to examine the following hypotheses:

(1) Invasive species: whether the amount of thermophiles invasive species are rising compared to the psychrophiles invasive species or not. [Whether the MTC of the invasive species is significantly rising?]

(2) Indigenous species: Whether there are significant adaptation of the indigenous species to the warming, such as expansion of the thermophiles species and extinction of the psychrophiles species? [Whether the MTC of the indigenous species is significantly rising?]

Examination of these two hypotheses will provide a deeper understanding of the rising of the general MTC, combined form the indigenous and invasive species, as well as the processes occurring in the marine fish community.

The data I will analyze is based on fishing logs from the eastern Mediterranean Sea, but with the continuous northward and westward expansion of alien species within the Mediterranean basin, similar processes may occur at the whole Mediterranean basin (Van Rijn, 2017).

**The research purpose**

The research purpose is to achieve a deeper understanding of the processes occurring in the Mediterranean Sea, caused by the global warming. The study wishes to understand the connection between the warming and the stabilization of invasive species in order to develop effective management and adaptation policies for conservation of the marine ecosystem, enable sustainable fisheries, and protected natural valued in the Mediterranean Sea.

**Material and Methods**

The annual catches for the fishes on the Israeli cost, will be extracted from Van Rijn's data (Van Rijn 2017), from the log book of over 13,000 fishing hauls done by the same fishing vessel, the trawler 'Moti', using the same gear, and covered the period 1981-2013, with nearly daily reports on trawling location and catch composition. This vessel used beam trawl gear with 70~m horizontal distance between beams, and net of 40 mm diamond-shaped cod-end.

The occurrence of a temperature-induced change in species composition will be tested using the Mean Temperature of the Catch index (MTC), proposed by Cheung et al., 2013. Define as:

While Ci,yr is the catch of species i in a given region in year (yr); Ti is the median temperature preference of each species (from the Supplementary online Material of Cheung et al. 2013), *n* is the total number of species.

I will calculate the MTC on the data in three parts: the MTC of the invasive species only, the MTC of the indigenous species only, and the MTC of the entire community together. In each part, the species will be sorted in different segmentation, according to their temperature preferences.

The comparison between the three indexes could provide information about the changes in the fish's community structure and the influence of the alien speciesas a result of the Sea warming.

**Additional research directions**

an additional analysis that I wish to check in my data is seasonal differences in the species response to warming. My hypothesis is: Seasonal changes such as phenology adaptation and changes in the migration time could occur as a result of the warming. The changes could occur with or without a lag in the time of the response (Blonder et. Al, 2017).

In order to check if such change occur, I need to make two types of analyzes:

(1) Seasonal MTC. The index, as it is proposed by Chenge, is weighted by the fish's annual catch. I think it will be interesting to weight the index by seasonal catch, and looking for lag between the same seasons throughout the years, correlate to the warming. Such a lag will show there are phenology changes caused by the warming in the community level.

(2) Seasonal peaks in the catch of specific species. There are some reasons for a peak in the catches of a single species, such as migration time throughout the Mediterranean Sea, or season of activity and reproduction. Lag in the peaks of catch of specific species throughout the years, correlating with warming will show phenology and migration changes in the species level.

Combining the analysis of the community level with the species level, could find a better understanding of the seasonal adaptations to warming on the fish community in the eastern Mediterranean Sea.

**Schedule**

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| --- | --- | --- | --- |
| **another things in parallel** | **tasks** | **until date** | **from date** |
| Submissions for curses. Curse in Eilat | Reading, especially about the seasonal part, making presentation, preparing to the Tedex, maybe talk to the lab | 23.5.18, Tedex | 25.4.18 |
| Submissions for curses | Meeting with Itay, start working on the data | 14.6.18, End of the simester | 24.5.18 |
| exams | Working on the data - filtering and sorting, more reading | 4.7.18 | 15.6.18 |
| maternity leave | | 4.10.18 | 4.7.18 |
| exams | data analyzes - part 1 [MTC] | 1.1.19 | 5.10.18 |
|  | writing part 1 | 1.3.19 | 1.1.19 |
|  | data analyzes - part 2 [seasonal lag] | 1.6.19 | 1.3.19 |
|  | writing part 2 | 1.9.19 | 1.6.19 |
|  | editing, writing paper, editing paper | 30.10.19 | 1.9.19 |

**Refferences**

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