DATE OF PUBLICATION: XX.XX.1997

Distribution of Siphonophora in Lebanese waters (eastern Mediterranean)

S. Lakkis & R. Zeidane

Lakkis, S. & R. Zeidane. Distribution of Siphonophora in Lebanese waters (eastern Mediterranean). Proceedings of the 6th International Conference on Coelenterate Biology, 1995: 301-306, fig. 1, tab. 1.
Sami Lakkis and Raymonde Zeidane, Marine Research Centre, Plankton Ecology, P.O. Box 123, Jounieh, Lebanon. E-mail: slakkis@inco.com.lb.

Key words: Siphonophora; Physonectae; Calycophorae; Levantine Basin; Lebanese waters.

Abstract: Twenty-eight species of Siphonophora including five physonects and 23 calycophores were found in the Lebanese neritic waters between 1969 and 1994. Of these, 18 species are shared with the Red Sea fauna. *Nanomia bijuga* (Delle Chiaje, 1841) was the most common physonect. The most abundant calycophores were: *Eudoxoides spiralis* (Bigelow, 1911), *Sphaeronectes irregularis* (Claus, 1873), *Chelophyes appendiculata* (Eschscholtz, 1829), and *Diphyes dispar* Chamisso & Eysenhardt, 1821. Of these, *Eudoxoides spiralis* is also common in the southern Adriatic which might indicate that the eastern Mediterranean and the Adriatic are hydrologically connected.

Introduction

Studies to contribute to the knowledge of the composition and the structure of the plankton community in Lebanese waters (Levantine Basin) began in 1969 (Lakkis, 1971; 1982). Concerning the Siphonophora of the Levantine Basin, few data are available. Kimor & Wood (1975) recorded 12 species, Alvarino (1974) mentioned 21 species, and Dowidar & El-Maghraby (1970) mentioned five species from the vicinity of Alexandria. Rottini (1971) listed 21 species from the Ionian and Crete Seas. Most of the species found by these authors in the eastern Mediterranean are also present in the western basin (Ianora & Scotto di Carlo, 1981; Gamulin & Krsinic, 1993).

In spite of the rather high species richness (28 species found, cf. table 1), siphonophores are a less important component of the Levantine gelatinous zooplankton community, occupying the last place in importance after the Scyphomedusae, the Thaliacea and the hydromedusae. The present paper deals with the composition, the seasonal variation and vertical distribution of Siphonophora in Lebanese waters.

Hydrographic conditions

The Levantine Basin is considered as a warm temperate or subtropical sea. Two seasons characterize the annual hydrological cycle: a cool period (December-March) and a long hot and dry period (April-November). During the winter season the surface water temperature drops to a minimum of 16°C due to vertical mixing of water and upwelling currents creating an isothermic condition within the whole water column. The surface water salinity fluctuates between 38.75 and 39.50‰ according to the area, season and the amount of fresh water inflow. The general circulation pattern along the coast of Lebanon is a prevalent northward surface current most of the

year (December-September) with a maximum velocity, due to the local wind stress, of 0.50 m/sec. in February and a minimum of 0.15 m/sec. in August. In the autumn the current is often reversed and less strong. During the summer there is a decrease in the phytoplankton production because of the high water surface temperature (maximum 30°C in August), nutrient depletion and lack of deep water mixing. Temperature differences between inshore shallow water and offshore deep water are negligible. The water is very transparent and the Secchi disk does not disappear at 25 m depth at the offshore stations. Principal component analysis shows that during winter and spring there is a strong relationship between environmental factors (temperature changes, water transparency, chlorophyll content, phosphates and nitrates), and growth and distribution of the plankton community. During the summer, when the plankton biomass is low and productivity very low, these factors have less effect on plankton biomass and distribution of species.

Material and methods

Data are based on plankton samples collected over 25 years (1969-1994) from 22 inshore and offshore stations (fig. 1). Sampling stations covered various environments: harbour area (2 stations), polluted area (2 stations), estuaries (2 stations), neritic stations (6 stations) and deep oceanic waters (10 stations). Three types of net were used: a standard plankton net (diameter 57 cm; mesh size 200 µm) for subsurface sampling and vertical hauls from 50-0 m, a double Bongo-net (diameter 65 cm; mesh size 300 and 500 µm) for oblique vertical tows, and a closing WP2 net (diameter 57 cm; mesh size 200 µm) for deep vertical hauls: 300-50 m and 600-300 m.

Seventy-five percent of the samples were collected in surface and subsurface hauls taken from neritic stations and 15% from estuaries, harbour and polluted waters. The remainder were deep water samples taken from oceanic stations. Most of the sampling was done monthly during the morning time (8h-12h); other series of samples were collected weekly, especially during the plankton bloom periods (spring, autumn). In six stations, sampling was carried out occasionally or seasonally (fig. 1). In all cases hydrographic measurements (temperature, salinity, water transparency, phytoplankton biomass, chlorophyll content and nutrient analysis) were taken simultanuously with the sampling.

More details concerning the hydrological features of stations are reported in previous works (Lakkis, 1982; Lakkis & Zeidane 1988, 1993).

Samples preserved in 4% formaldehyde solution were submitted to qualitative and quantitative analysis. The basic reference works used for species identification were Totton (1954; 1965), Carré (1968), and Pagès & Gili (1992). Identifications and abundance of Calycophorae species were determined on the basis of the eudoxoid stages, and the anterior nectophores.

Results

During the whole period of survey 28 species including 23 Calycophorae and five Physonectae were identified from Lebanese waters (table 1).

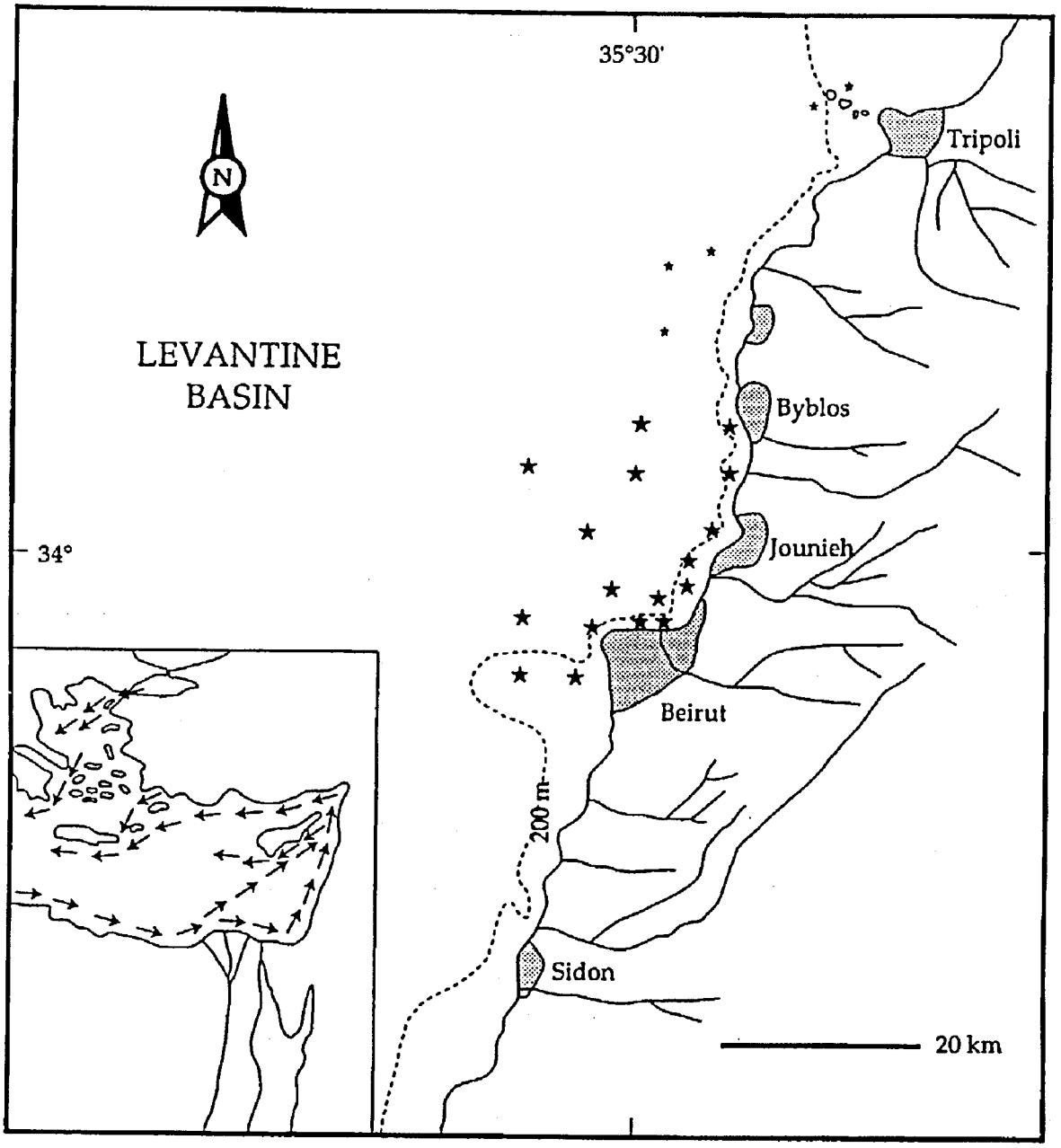

Fig. 1. Stations along the coast of Lebanon sampled during 1969-94. The insert shows the general surface circulation in the Eastern Mediterranean.
★ = stations sampled monthly or weekly; ⋆ = stations sampled occasionally or seasonally.

Physonectae

The five species of Physonectae occur also in the Red Sea (Halim, 1969) and in the Atlantic Ocean (Pagès et al., 1992). The most common species were *Nanomia bijuga* (Delle Chiaje, 1841); *Agalma elegans* (Sars, 1846) and *A. okeni* Eschscholtz, 1825, were found in moderate numbers. *Halistemma rubrum* (Vogt, 1852) and *Forskalia edwardsi* von Kölliker, 1853, were less abundant. All the year round nectophores were

Table 1. List of Siphonophora found in Lebanese waters (0-50 m) during 1969-94 and their mean abundance and frequency of occurrence in samples. * = also present in the Red Sea.

Species	Mean abundance ind./100 m^3	Frequency %
Calycophorae		
* 1. *Abylopsis eschscholtzi* (Huxley, 1859)	20	58
* 2. *Abylopsis tetragona* (Otto, 1823)	9	16
* 3. *Bassia bassensis* (Quoy & Gaimard, 1833)	40	66
4. *Chelophyes appendiculata* (Eschscholtz, 1829)	99	66
* 5. *Diphyes dispar* Chamisso & Eysenhardt, 1821	94	66
6. *Eudoxoides spiralis* (Bigelow, 1911)	250	83
* 7. *Enneagonum hyalinum* (Quoy & Gaimard, 1833)	4	16
8. *Hippopodius hippopus* (Forskål, 1775)	15	32
9. *Lensia campanella* (Moser, 1925)	12	32
10. *Lensia conoidea* (Kefferstein & Ehler, 1860)	11	48
* 11. *Lensia fowleri* (Bigelow, 1911)	15	33
* 12. *Lensia meteori* (Leloup, 1934)	2	16
* 13. *Lensia multicristata* (Moser, 1925)	2	8
14. *Lensia subtilis* (Chun, 1886)	72	83
* 15. *Lensia subtiloides* (Lens & van Riemsdijk, 1908)	2	8
* 16. *Muggiaea atlantica* Cunningham, 1892	58	32
17. *Muggiaea kochi* (Will, 1844)	25	25
18. *Sphaeronectes irregularis* (Claus, 1873)	167	66
* 19. *Sphaeronectes gracilis* (Claus, 1873)	77	50
20. *Sulculeolaria biloba* (Sars, 1846)	1	16
* 21. *Sulculeolaria chuni* (Lens & van Riemsdijk, 1908)	35	40
* 22. *Sulculeolaria quadrivalvis* Blainville, 1834	11	40
23. *Vogtia glabra* Bigelow, 1911	16	16
Physonectae		
* 24. *Agalma elegans* (Sars, 1846)	108	58
* 25. *Agalma okeni* Eschscholtz, 1825	116	66
* 26. *Forskalia edwardsi* von Kölliker, 1853	17	40
* 27. *Halistemma rubrum* (Vogt, 1852)	66	50
* 28. *Nanomia bijuga* (delle Chiaje, 1841)	133	75

present in moderate numbers. During the 25 years of survey one bloom of nectophores was noted at one coastal station in October 1982 (ca 1500 ind./m^3). Physonects show a certain preference for subsurface neritic water (0-10 m).

Calycophorae

The annual mean of calycophores for the whole period of survey ranged from 0.5 to 1 ind./m^3. No bloom was recorded during this period. The maximum population density was recorded between February and June and during December, the maximum number of species (12) in November. Six species contribute up to 95% of the total number of individuals above 50 m; these are by decreasing importance: *Eudoxoides spiralis* (Bigelow, 1911), *Sphaeronectes irregularis* (Claus, 1873), *Chelophyes appendiculata* (Eschscholtz, 1829), *Diphyes dispar* Chamisso & Eysenhardt, 1821, *Sphaeronectes gracilis* (Claus, 1873), and *Lensia subtilis* (Chun, 1886).

Vertical distribution

The layer 0-50 m is the richest in calycophores; numbers decrease with depth in the deeper layers 50-300 m and 300-600 m. *Diphyes dispar* and *Chelophyes appendiculata* are the most common species in the subsurface layer. Species with the same density in the 0-10 m and 10-50 m layers are: *Bassia bassensis* (Quoy & Gaimard, 1833), *Eudoxoides spiralis*, *Abylopsis eschscholtzi* (Huxley, 1859) and *Abylopsis tetragona* (Otto, 1823). Four species show a more pronounced distribution in the 10-50 m layer, viz. *Sphaeronectes irregularis*, *S. gracilis*, *Lensia subtilis*, *Sulculeolaria chuni* (Lens & van Riemsdijk, 1908). The most common species found in the deeper layers are: *Lensia campanella* (Moser, 1925), *L. conoidea* (Kefferstein & Ehler, 1860), *L. multicristata* (Moser, 1925), *L. subtiloides* (Lens & van Riemsdijk, 1908) and *Sulculeolaria biloba* (Sars, 1846).

Geographical distribution

Although it is difficult to classify Calycophorae into neritic and oceanic species (Ianora & Scotto di Carlo, 1981: 60), we have noted a higher concentration of individuals of the most common species in the Lebanese neritic waters than in the open sea. A drastic reduction in abundance and diversity was noted in polluted water and in harbours, showing that most Siphonophora avoid disturbed inshore water. In the stations of low salinity such as estuaries, *Lensia* species were almost absent; only the more euryhaline species *Chelophyes appendiculata* and *Eudoxoides spiralis* were regularly found in these areas.

Discussion and conclusion

With 52 species of siphonophores found in the South Atlantic Ocean by Pagès & Gili (1992), 30 species in the Suez and Panama canal regions (Alvarino, 1974) and 26 species in the Red Sea (Totton, 1954; Halim, 1969), we cannot attribute to the Levantine Basin "paucity in species".

Comparing the Siphonophora composition of the Levantine Sea with that of other Mediterranean areas, we observe the following differences:

– *Bassia bassensis* and *Diphyes dispar*, which are absent in the Tyrrhenean Sea (Gamulin & Krsinic, 1993), are major components of the Levantine Siphonophora; *Bassia bassensis* was reported rare in the Ionian and Crete Seas (Rottini, 1971).

– Whereas the three characteristic species of the western Mediterranean are *Lensia subtilis*, *Muggiaea kochi* (Will, 1844) and *Sphaeronectes gracilis*, five species are characteristic of the Levantine Sea, viz. *Eudoxoides spiralis*, *Lensia subtilis*, *Sphaeronectes irregularis*, *Diphyes dispar* and *Bassia bassensis*.

– *Lensia meteori* (Leloup, 1934), very common in the western Mediterranean, is very rare in the Levantine Basin, and present only in mesopelagic samples.

– *Eudoxoides spiralis*, the most common siphonophore in the Levantine Basin, has also been reported abundant in the southern Adriatic (Gamulin & Krsinic, 1993), which might indicate an hydrological connection between the two areas.

More investigations based on intensive spring and autumn sampling and open sea hauls from deep water (3000-1000 m) are our future target to improve the faunistic

inventary of the Siphonophora and to get more information on Lessepsian migrants from Indo-Pacific origin occurring in the Lebanese waters during the hot season.

References

Alvarino, A., 1974. Distribution of Siphonophores in the regions adjacent to the Suez and Panama Canals.— Fishery Bulletin 72, 2: 527-546.

Carré, C., 1968. Contribution à l'étude du genre *Sphaeronectes* Huxley, 1859.— Vie Milieu 19, 1A: 85-94.

Dowidar, N.M. & A.M. El Maghraby, 1970. The neritic zooplankton of the South Eastern Mediterranean at Alexandria. I: Distribution and Ecology of the zooplankton organisms with special reference to Copepoda. II: Consideration on the total zooplankton community.— Bull. Inst. Oceanogr. and Fish. 1: 225-305.

Gamulin, T. & F. Krsinic, 1993. On the occurrence of Calycophorae (Siphonophora) in the southern Adriatic and Tyrrhenian Sea: a comparison of the annual cycles off Dubrovnik and Naples.— J. Plankton Res. 3: 291-314.

Halim, Y., 1969. Plankton of the Red Sea.— Oceanogr. Mar. Biol. Ann. Rev. 7: 231-275.

Ianora, A., & B. Scotto di Carlo, 1981. The distribution and annual cycles of siphonophora calycophora in the Gulf of Naples and adjacent waters.— Arch. Oceanogr.- Limnol. 20: 51-65.

Kimor, B. & J.F. Wood, 1975. Plankton study in the Eastern Mediterranean Sea.— Mar. Biol. 42: 55-67.

Lakkis, S., 1971. Contribution à l'étude du zooplancton des eaux libanaises.— Mar. Biol 11 (2): 138-148.

Lakkis, S., 1982. Contribution à l'étude de l'écosystème néritique des eaux libanaises (Méditerranée Orientale). Ecologie descriptive des peuplements planctoniques avec référence particulière aux Copépodes: 1-505.— Thèse Doctorat d'Etat ès Sciences, Univ. Paris.

Lakkis, S. & R. Zeidane, 1988. Larves de Crustacés Décapodes des eaux côtières libanaises: Composition, diversité et cycle annuel.— Lebanese Sci. Bull. 4, 2: 5-33.

Lakkis, S. & R. Zeidane, 1993. L'Ichtyoplancton des eaux côtières libanaises: Composition et distribution des oeufs et larves de Téléostéens.— MAP Technical Reports Series, 73, UNEP, Athens: 81-100.

Pagès, F. & J.M. Gili, 1992. Siphonophores (Cnidaria, Hydrozoa) of the Benguela Current (southern Atlantic).— Sci. Mar. 56, 1: 65-112.

Rottini, L., 1971. Siphonophori del Mediterraneo Orientale: Mare di Creta e Jonio.— Boll. Pesca Piscic. Idrobiol. 26, 1e2: 199-208.

Totton, A.K., 1954. Siphonophora of the Indian Ocean together with systematic and biological notes on related specimens from other oceans.— Discovery Rep. 27: 1-162.

Totton, A.K., 1965. A synopsis of Siphonophora: i-vii, 1-230, pls I-XL.— British Museum (Natural History), London.