MEDWELL PUBLISHING
Journal of Animal and Veterinary Advances 8 (2): 229-234, 2009
ISSN: 1680-5593

Spatial and Temporal Distribution of Nereidae (Polychaeta: Annelida) along the Coast of the Turkish Eastern Black Sea in the Upper-Infralittoral Zone

Ahmet Mutlu Gözler, Ertugrul Agirbas and Cemalettin Sahin
Faculty of Fisheries, Rize University, 53100, Rize, Turkey

Abstract: A total of 99 benthic samples from four stations between Rize and Trabzon (on the Eastern Black Sea) were collected and analyzed according to their qualitative and quantitative aspects. Three genera and 6 species were identified: *Nereis zonata* and *Platynereis dumerilii* ranked first in dominance and frequency index values. Of the biotopes examined, *Cystoseira barbata* was highest in the number of species and diversity index values, whereas *Mytilaster lineatus* was the lowest. This study represents the first record of *Nereis rava* along the coast of the Turkish Black Sea.

Key words: Nereidae, Eastern Black Sea, Turkish Black Sea, species, diversity index

INTRODUCTION

Polychaetes, one of the most important taxa of soft and hard-bottom benthic communities in both the number of species and individuals (Çinar and Ergen, 1998), play an important role in transferring energy within a given ecosystem to plants and small invertebrates or in preying upon many benthic animals (Çinar and Ergen, 2001).

The Nereidae family is one of the most diverse and abundant taxa among benthic families both in marine and brackish water ecosystems. There is a great deal of information about taxonomy and ecology not only related to polychaetes but also to this family. Turkish Black Sea polychaetes have not been sufficiently studied up to now. The available data was especially obtained from studies of soft-bottom polychaetes along the Bosporus Strait (Rullier, 1963; Caspers, 1968; Kiseleva, 1981; Uysal *et al*., 2002). These studies mainly focus on the distribution of polychaetes along the Turkish Black Sea coast, reporting a total of 95 species belonging to 27 families (Çinar and Gönlügür-Demirci, 2005). Also, many papers are related to the faunistic and ecological aspects of polychaetes in other parts of the coast along the Black Sea (Arnoldi, 1941; Marinov, 1959, 1964 ; Kiseleva, 2004).

Similar studies have not been previously conducted along the coast of the Turkish Eastern Black Sea; in fact, more studies should be undertaken along the Black Sea to recognize actual polychaeta diversity and their functional roles in ecosystems. This present study aims to determine the distribution of the Nereidae (Polychaeta: Annelida) species in the upper-infralittoral zone along the coast of the Turkish Eastern Black Sea and to evaluate their spatio-temporal distribution patterns in *Cystoseira barbata* and *Mytilaster lineatus* habitats.

MATERIALS AND METHODS

To collect Nereidae individuals associated with brown alga *C. barbata* and mussel *M. lineatus*, four stations were chosen which represent the coast of the Eastern Turkish Black Sea (Fig. 1). For each habitat, samplings were grouped into three replicates using a quadrate of 20×20 cm (400 cm^2) for each season (July 2005; October 2005; January 2006 and April 2006). Samplings were taken by free diving. Environmental parameters such as temperature, salinity, oxygen, etc. were recorded regularly for each sampling period (Fig. 2).

The collected samples were first fixed in 4% formalin prepared with sea water, then rinsed in freshwater in the laboratory and sieved through a 0.5 mm size mesh. Afterwards, individuals were sorted and preserved in 70% ethanol, according to the classes. Polychaetes, especially Nereidae, were separated from the other systematic groups, identified and counted by dissecting and using stereomicroscopes. The wet weights of polychaetes from each sample were taken by using a sensitive balance (± 0.0001 g).

To specify the structure of the Nereidae species the following community indices were used: Shannon and Weaver's (1949) Diversity Index ('H'), Pielou's (1975, 1977), Evenness Index ('J') and Soyer (1970) Frequency Index (F) were applied to the Nereidae species.

Corresponding Author: Ahmet Mutlu Gözler, Faculty of Fisheries, Rize University, 53100, Rize, Turkey

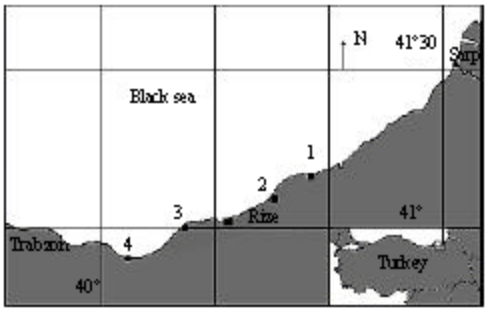

Fig. 1: Study area with the sampling points (1: Pazar, 2: Cayeli, 3: Iyidere, 4: Camburnu)

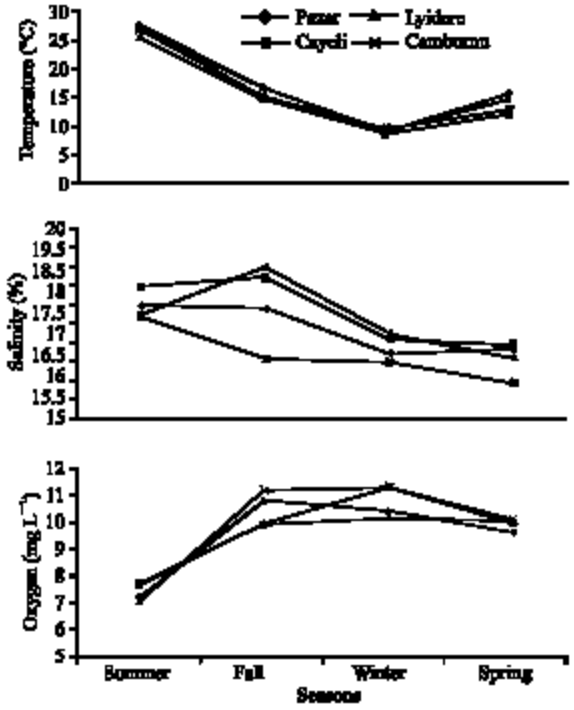

Fig. 2: Seasonal fluctuations of the physical parameters of the stations

For habitats, the numerical data was obtained at all stations in each season and analyzed by cluster techniques based on Bray-Curtis Similarity and by the Primer v5 package program (Clarke and Gorley, 2001).

- Constant, if F >50%
- Common, if 25% < F <50%
- Rare, if F <25%

RESULTS

Physicochemical analyses: Temperature values varied among stations and seasons, ranging from 8.7°C (Station 3, winter) to 27.6°C (Station 1, summer). Salinity values did not greatly vary among stations and seasons, ranging from 16.00% (Stations 4, spring) to 18.99% (Station 2, fall). On the other hand, dissolved oxygen values varied greatly among stations and seasons (Fig. 2).

A large fluctuation in the dissolved oxygen value was estimated at Station 4 (7.05 mg L^{-1}, summer) and Station 4 (11.20 mg L^{-1}, winter), which is greatly affected by open sea conditions. Station 4 is exposed to waves and the wind.

Faunistic and ecological analyses: The examined samples revealed a total of 6 species and an average of 503 individuals, m^{-2} belonging to 3 genera (Table 1 and 2). In this study, some of the individuals were able to identify at the genus level because of the poor condition of individuals. For example, *Nereis* sp. was found in all habitats, but all paragnaths were not visible (an important characteristic in the identification of Nereidae). Taking into consideration the total number of Nereidae species in each habitat, *C. barbata* had the highest number of species (6 species) while *M. lineatus* had the lowest (5 species).

Considering Soyer (1970) Frequency (F) Index, 3 out of 5 *C. barbata* sp. were classified as constant (F = 50), while 2 species were common (25<F<49). Four out of 5 *M. lineatus* sp. can be classified as constant and one species as common (Table 1 and 2).

Table 3 shows the total number of species and biomass values, the diversity and evenness indices, as well as the dominant species of all samples. In the present study, *Nereis zonata* and *Platynereis dumerilii* were dominant species in all habitats. The population densities of Nereidae ranged from 1,018 individuals m^{-2} (*C. barbata*, Winter) to 6,498 individuals m^{-2} (*M. lineatus*, Fall); biomass values from 37.24 g m^{-2} (*C. barbata*, Winter) to 154.17 g m^{-2} (*M. lineatus*, Spring); diversity index values from 0.69 (*M. lineatus*, Summer) to 1.60 (*C. barbata*, Winter) and evenness index values from 0.31 (*M. lineatus*, Fall) to 0.80 (on *C. barbata*, winter).

The average values of the population density, the biomass and the diversity index of the habitats, along with the seasons, are shown in Table 3. The mussel *M. lineatus* had the highest average values for population densities in all seasons, whereas *C. barbata* obtained the lowest in all seasons. *M. lineatus* had the highest biomass values in winter and spring, whereas *C. barbata* had the highest in summer and fall. The highest diversity index values were also estimated for *C. barbata* in all seasons, whereas *M. lineatus* obtained the lowest.

The Bray-Curtis cluster analyses of grouped species in the various habitats are shown in Fig. 3. As seen from the dendogram, three principal associated groups of species are recognized. The group containing the species

Table 1: Abundance of the Nereidae species found on *C. barbata*

Stations	Pazar				Cayeli			
Seasons	S	F	W	Sp	S	F	W	Sp
N. zonata	1417±12.3	575±16.4	75±2.9	180±4.1	142±6.2	1017±2.9	153±6.3	200±2.9
Pl. dumerilii	408±5.2	358±10.4	8±2.9	600±1.8	166±7.6	642±4.3	117±7.6	147±3.4
Nereis sp.	-	-	-	107±6.3	-	-	33±2.6	160±1.7
N. pelagica	-	-	-	-	-	-	-	-
N. rava	-	-	-	-	-	-	17±4.9	-

Stations	Iyidere				Camburnu						
Seasons	S	F	W	Sp	S	F	W	Sp	TI	F	Fv
N. zonata	1742±30.2	2900±20.7	192±2.6	207±3.1	-	67±2.1	25±2.9	236±3.4	9133	100	Co
Pl. dumerilii	258±9.9	267±1.0	68±2.9	79±3.1	138±7.6	308±9.4	167±7.6	217±3.4	3948	100	Co
Nereis sp.	-	-	108±6.2	113±2.9	-	-	-	-	733	100	Co
N. pelagica	-	50±5.4	17±3.8	-	-	-	-	-	67	25	Cm
N. rava	-	-	-	-	-	-	-	-	17	25	Cm

TI: Total Individual with standard errors, S: Summer, F: Fall, W: Winter, Sp: Spring, F: Frequency, Fv: Frequency value, Co: Constant, Cm: Common

Table 2: Abundance of the Nereidae species found on *M. lineatus*

Stations	Pazar				Cayeli			
Seasons	S	F	W	Sp	S	F	W	Sp
N. zonata	2592±10.0	1117±7.0	1108±3.5	-	867±15.0	783±4.3	1608±1.8	1893±1.5
Pl. dumerilii	117±8.6	42±1.3	8±1.7	-	-	33±3.8	225±0.8	573±1.7
Per. cultrifera	167±2.3	-	-	-	83±4.8	25±2.9	-	40±3.5
Nereis sp.	8±2.1	33±2.6	33±2.6	-	-	33±2.6	117±7.6	200±2.7
N. pelagica	-	-	-	-	-	8±2.1	-	-

Stations	Iyidere				Camburnu						
Seasons	S	F	W	Sp	S	F	W	Sp	TI	F	Fv
N. zonata	533±5.1	2200±2.2	877±7.4	906±5.7	250±2.1	1550±1.3	973±2.5	1030±3.3	18287	100	Co
Pl. dumerilii	133±5.1	333±7.9	350±4.1	355±2.9	110±4.2	158±6.2	125±5.1	176±5.1	2738	100	Co
Per. cultrifera	8±2.9	8±2.9	100±3.8	109±2.9	-	-	-	-	540	100	Co
Nereis sp.	-	58±1.6	42±1.3	67±1.8	-	117±7.6	-	-	708	100	Co
N. pelagica	-	-	-	-	-	-	-	-	8	25	Cm

TI: Total Individual with standard errors, S: Summer, F: Fall, W: Winter, Sp: Spring, F: Frequency, Fv: Frequency value, Co: Constant, Cm: Common

Table 3: Number of Species (S), Density (N), Biomass (B), Evenness index (J') and Shannon diversity index (H') estimated on each habitat and season with their most dominant species (%)

Season	Date	S	N (ind m^{-2})	B (g m^{-2})	J'	H'	Dominant species (%)
Cystoseira barbata							
Summer	23.07.05	2	4271	132.12	0.77	0.77	*Nereis zonata* (77.29)
Fall	17.11.05	4	6314	69.05	0.51	1.01	*Nereis zonata* (72.20)
Winter	22.02.06	4	1018	37.24	0.80	1.60	*Nereis zonata* (44.20)
Spring	16.05.06	4	2295	38.89	0.77	1.54	*Platynereis dumerilii* (45.45)
Mytilaster lineatus							
Summer	23.07.05	4	4868	77.34	0.35	0.69	*Nereis zonata* (87.14)
Fall	17.11.05	5	6498	59.24	0.31	0.71	*Nereis zonata* (86.95)
Winter	22.02.06	4	5921	152.61	0.50	0.99	*Nereis zonata* (77.12)
Spring	16.05.06	4	4994	154.17	0.54	1.08	*Nereis zonata* (76.67)

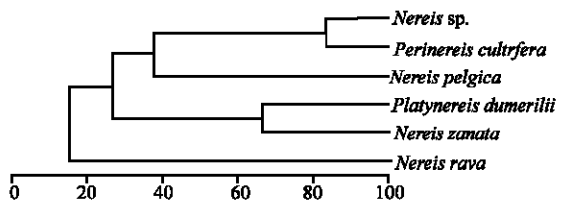

Fig. 3: Bray-Curtis similarity between species

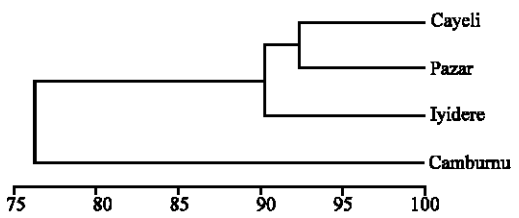

Fig. 4: Bray-Curtis similarity between station

N. zonata, Pl. dumerilii and *Per. cultrifera* was found in all habitats. The highest similarity (66.57%) was revealed between species *N. zonata* and *Pl. dumerilii*.

A Bray-Curtis cluster analysis between stations is shown in Fig. 4. As seen from the dendogram, three associated principal groups of species are recognized. Stations Cayeli and Pazar joined the same group at a high similarity level of 92.34%, both stations had high individual levels. Some samples of both stations involving similar species also reached a high level. The other associated stations, Iyidere and Cayeli-Pazar, had groupings at a similar level of 90.26%.

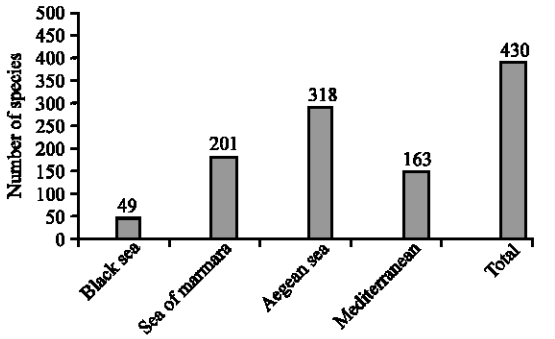

Fig. 5: Distribution of polychaeta number of species among the Turkish's Seas

DISCUSSION

In this study, Nereidae species associated with *C. barbata* and *M. lineatus* were examined according to their qualitative and quantitative aspects. The present study contributes to the knowledge of the distribution of Nereidae (Polychaeta-Annelida) fauna on the coast of the Eastern Black Sea and also represents the first record of *Nereis rava* along the coast of the Turkish Black Sea.

A great deal of the study related to *Cystoseira* sp. facieses was conducted in Turkey and abroad. In the Mediterranean, the fauna associated with *Cystoseira* sp. was studied in the following papers: Molinier (1960), Peres (1967) and Bellan-Santini (1962, 1964, 1969) investigated the *Cystoseira crinita*, Boudouresque (1969, 1971) investigated the *C. mediterranea*. In the Black Sea, the fauna associated with *Cystoseira* sp. was studied in the following papers: Milovidova (1966), Tiganus (1972), Abadjieva and Marinov (1977) and Andriescu (1977). Milovidova (1966) reported 14 polychaeta species of *C. barbata* collected from Novorossiysk Bay and outlined the relative importance of the *N. zonata*, *Pl. dumerilii* and *Pomatoceros triqueter* sp. within the community (Çinar and Gönlügür-Demirci, 2005). Tiganus (1972) observed that the different *Cystoseira* species had different benthic assemblages. Abadjieva and Marinov (1977) found the highest species density and biomass in *C. barbata* in the spring when the juveniles were recruited. Considering the Turkish coasts, the first study was conducted by Kocatas (1978). Researchers in this study, conducted in Izmir Bay, reported 48 polychaeta species. Ergen and Çinar (1994) reported that 200 species from the Aegean Sea were associated with *Cystoseira* sp. In that study, polychaeta had the highest (28%) qualitative dominance. Considering the quantitative aspects, *N. zonata* and *Pl. dumerilii* had high frequency values (Gönlügür-Demirci, 2003). In another study conducted in Izmir Bay by Ergen and Çinar (2001) on the *Cystoseira* sp. *Pl. dumerilii* (73.2%) ranked first, followed by *Ceratonereis costae* (11.5%) and *N. zonata* (3.8%). We have identified five Nereidae species in this study. Also, our study revealed that the highest specie densities were in the fall. When compared to Gönlügür-Demirci (2003) study associated with *C. barbata* conducted along the Sinop peninsula, four Nereidae species were found in the middle part of the Turkish Black Sea coast. This study reported 34 polychaeta species with *Pl. dumerilii, N. zonata* and *Nereidae juvenilleri* having dominance; our results are similar to their study.

A review of all the studies related to *Cystoseira* sp. revealed the similarities and differences in terms of bio-diversity. Resulting from our research, different species of *C. barbata* were studied from the Mediterranean and Aegean Seas.

Polychaetes inhabiting *M. lineatus* beds were studied poorly in the Black Sea and this present study is the first research on the distribution of polychaetes in the Turkish Eastern Black Sea region. We found that the *M. lineatus*, two species of *N. zonata* and *Pl. dumerilii* had a significantly higher abundance and biomass.

When considering the total Nereidae species and individuals between the stations, the Iyidere station had the most individuals but Cayeli station had the most species number (Table 1 and 2), which we think may be related to environmental factors (oxygen, temperature, salinity). Iyidere and Cayeli stations generally had the same salinity tendency in the whole year, but Cayeli station had the highest salinity among stations in summer. It is well known that environmental factors especially temperature and salinity have an important role on distribution, migration and reproduction of organisms. In this scope, when physical parameters according to stations have been compared, it was easily seen from Fig. 2. Pazar station generally had a bit higher than the other stations in terms of temperature. When evaluated salinity fluctuations, there has clear differences among the stations. Physical parameters also support to the Bray

Curtis similarity between stations (Fig. 2). It was seen easily from dendogram Cayeli and Pazar station had the highest similarity at 92,33 level. This similarity can be seen from salinity fluctuation in Fig. 5.

When considering the total number of polychaeta species, the Black Sea, among the other seas, has the lowest number of species (Fig. 5), which we think might be the result of insufficient studies related to the Black Sea coast. Therefore, studying these results is mandatory to understand this sea.

CONCLUSION

The present study improves our knowledge about the spatial and temporal distribution of Nereidae (Polychaeta) associated with rocky-shore benthic habitats along the coast of the Turkish Eastern Black Sea. However, it is not possible to compare this study to the regional characteristics because Turkish Black sea polychaetes have been poorly studied. Determining the similarities and differences should be undertaken simultaneously in other seas of Turkey.

ACKNOWLEDGEMENT

We thank to Prof. Dr. Zeki Ergen and Prof. Dr. Melih Ertan Çinar for identification of species from Ege University, Fisheries Faculty and to Prof. Dr. Muzaffer HARLIOĐLU from Fýrat University, Fisheries Faculty for their comments on the manuscript and for correcting the English of the text.

REFERENCES

Abadjieva, V.K. and T. Marinov, 1977. Zoobenthos in the Cystoseira biocenosis. Bulgarian Acad. Sci. Hydrobiol., 6: 76-88.

Andriescu, I., 1977. The zoobenthos of the ecosystem of the rock funds of the Romanian dimension of the Black Sea. Biologie des eaux saumatres de la Mer Noire, 1ére Partie, pp: 117-127 (in France).

Arnoldi, L.V., 1941. Materials on Quantitative Study of Zoobenthos in the Black Sea. Travaux de l'Institut Zoologique de l,'Académie des Sciences de l'URSS, 7 (2): 94-113 (in France).

Bellan-Santini, D., 1962. Floristic and faunistic study of which-ques settlements infralittoral of rock subsrate. Recueil des Travaux de la Station Marine d'Endoume, 34 (50): 249-261 (in France).

Bellan-Santini, D., 1964. Qualitative and quantitative study of the settlement of Cystoseira crinita Bory (preliminary Note). Recueil des Travaux de la Station Marine d'Endoume, 34 (50): 249-261 (in France).

Bellan-Santini, D., 1969. Contribution a study of the infralittoral settlement on rocky subsrate (Etude qualitative et quantitative de la frange supérieure). Recueil des Travaux de la Station Marine d'Endoume, 63 (47): 5-294 (in France).

Boudouresque, C.F., 1969. Qualitative and quantitative study of' Cystoseira mediterranea settlement in the area of Banyuls Sea (P-O). Vie et Milieu, 20 (2B): 437-452 (in France).

Boudouresque, C.F., 1971. Methods of qualitative and quantitative study of the benthos (in particular of the phytobenthos. Tethys, 3 (1): 79-104 (in France).

Caspers, H., 1968. Benthic Macrofauna of the Bosphorus and Problems of the infiltration of the Mediterranean elements in the Black Sea. Rapport de la Commission Internationale Exploration de la Mer Méditerranées, 19 (2): 107-115.

Çinar, M.E. and Z. Ergen, 1998. Polychaetes associated with the sponge Sarcotragus muscarum Schmidt, from the Turkish Aegean coast. Ophelia. Int. J. Marine Biol., 48 (3): 167-183. Ophelia Publications, Marine Biological Laboratory, Denmark.

Çinar, M.E. and Ergen, Z., 2001. On the ecology of the Nereididae (Polychaeta-Annelida) in the Bay of Ýzmir, Aegean Sea. Zool. Middle East, 22: 113-122.

Çinar, M.E. and G. Gönlügür-Demirci, 2005. Polychaeta assemlages on shallow-water benthic habitats along the Sinop peninsula (Black Sea, Turkey). Cah. Biol. Mar., 46 (3): 253-263.

Clarke, K.R. and Warwick, R.M., 2001. Change in Marine Communities: An Approach to Statistical Analysis and Interpretation. 2nd Edn. PRIMER-E: Plymouth Marine Laboratory, United Kingdom.

Ergen, Z. and M.E. Çinar, 1994. Qualitative and Quantitative Investigations on the Cystoseira Facies of the Eagean Sea, XII. National Biological Congress, Edirne (in Turkey).

Gönlügür-Demirci, G., 2003. The Qualitative and quantitative investigations on some facies of the upper-infralittoral zone of the Western Back Sea (Sinop) shores. The Graduate School of Natural and Applied Sciences of Aegean University, PhD Thesis, Ýzmir-Bornova. http://tez2.yok.gov.tr/tez.htm.

Kiseleva, M.I., 1981. Benthos of soft substratum of the Black Sea. (Bentos rykhlykh gruntov Chernogo moray) Naukova Dumka, pp: 164.

Kiseleva, M.I., 2004. Polychaetes (Polychaeta) of Black and Azov Seas (Mnogoshetinkovie chervil (Polychaeta) Chernogo i Azovskogo morey), Presidium of the Kola Scientific Centre, Apatity, pp: 409 (in Russian).

Kocatas, A., 1978. Contribution à l'étude des peuplements des horizons supérieurs de substrat rocheux du golfe d'Izmir (Turquie), Scientific monographs of the Faculty of Science, Ege University, 12: 1-93 (in Turkish).

Marinov, T., 1959. On the Fauna of Polychaetes of the Clusters of Mussels of the Black Sea. Compt. Rend. Acad. Sci. Bulg., 12: 443-446 (in France).

Marinov, T., 1964. Composition and Features of the polychaetous fauna off the Bulgarian Black Sea coast. Bulletin de l'Institut de Zoologie et Musée., 17: 79-107.

Milovidova, H.O., 1966. Deep biocenoses in the Novorosisk Gulf. Naukovaya Dumka, Kiev, pp: 75-89.

Molinier, R., 1960. Etude des biocénoses marines du Cap Corse, Thèse Doct. Sci. Natl., Univ. Paris, 9 (3-5): 121-312.

Peres, J.M., 1967. Les biocoenoses benthiques dans le systeme phytal, Recueil des Travaux de la Station Marine d'Endoume. Bulletin 42, Fasc., 58: 3-113.

Pielou, E.C., 1975. Ecological Diversity, John Wieley and Sons, 165, Wiley-Inter Science Publication, New York. ISBN: 0-471-68925-4.

Pielou, E.C., 1977. Mathematical Ecology, John Wiley and Sons Inc, 385, New York. ISBN: 0-471-01993-3.

Rullier, F., 1963. Les Annélides polychétes du Bosphore, de la Mer de Marmara et de la Mer Noire, en relation avec celles de la Méditerranée. Rapp. P.-v. Réun. Commn. Int. Explor. Scient. Mer. Méditerr., 17: 161-260.

Shannon, C.E. and V. Weaver, 1949. The mathmetical theory of communication. University of Illinois Press, Urbana and Chicago, pp: 101-117. ISBN: 0-25-272548-4. www.press.uillinois.edu.

Soyer, J., 1970. Bionomie benthique du plateau continental de la côte catalane française. III. Les peuplements de Copepodes harpacticoides (Crustacea), Vie et Milieu (Life and Environment), 21: 337-511.

Tiganus, V., 1972. Ecological observations on the fauna associated to the Cystoseira belt along the Romanian Black Sea coast. Cercetari Marine, I.R.C.M., Nr: 4: 153-167.

Uysal, A., A. Yüksek, E. Okus and N. Yilmaz, 2002. Benthic community structure of the Bosphorus and surrounding area. Water Sci. Technol., 46 (8): 37-44. IWA Publishing. http://www.iwaponline.com/wst/04608/wst046080037.htm.