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RESEARCH ARTICLE

TUBI (TUrkish Benthic Index): A new biotic index for assessing impacts of organic pollution on benthic communities

Melih Ertan Çinar[1*], Kerem Bakır[1], Bilal Öztürk[1], Tuncer Katağan[1], Ertan Dağlı[1], Şermin Açık[2], Alper Doğan[1], Banu Bitlis Bakır[2]

[1] Department of Hydrobiology, Faculty of Fisheries, Ege University, 35100, Bornova, İzmir, TURKEY
[2] Institute of Marine Sciences and Technology, Dokuz Eylül University, İnciraltı, 35340, İzmir, TURKEY

[*]**Corresponding autor**: melih.cinar@ege.edu.tr

Abstract

A new biotic index, TUBI (TUrkish Benthic Index) is proposed here to assess the impacts of organic enrichments on benthic community structures. This new index has two metrics; the Shannon-Weiver's diversity index (metric 1) and the relative abundance of ecological groups (metric 2). The ecological groups of species, which include five categories, were re-organized under three major categories here, namely, sensitive species (including GI and GII), tolerant species (GIII) and opportunistic species (GIV and GV). The metric 2 considers these groups with different weights and eliminates sensitive species in the calculation. Scores of TUBI vary between 0 and 5, and the benthic quality status increases with increasing TUBI scores. Benthic samples collected from Izmir Bay, and the Aegean and Levantine Seas were analyzed by using different biotic indices such as AMBI, M-AMBI, BENTIX, MEDOCC and TUBI, based on the national database for the ecological groups of benthic species. All biotic indices used, with some exceptions, discriminated poor and bad ecological status in the regions. The correlation analysis performed between the total organic carbon in sediment and total inorganic nitrogen in deep water, and biotic indices indicated that TUBI possessed the highest negative correlation values with these environmental variables, therefore better detecting the variability across a gradient of pollution-mediated impacts on benthic communities.

Keywords: biotic index, benthic index, organic enrichment, Mediterranean, Turkey

Introduction

Deteriorations in benthic environments due to waste-water discharges trigger changes in the compositions and functions of community structures that enable us to predict and estimate the magnitude of the impacts by using some biological tools such as the indicator species concept (Pockington & Wells 1992; Dean 2008; Marques *et al.* 2009). Indicator or opportunistic species are known to have a r-strategy life history trait (Pianka 1970; Heip 1995) and broader ecological valence (Vrijenhoek 1979), but a weak competitive ability that hinders them to form dense populations in pristine, healthy environments. However, they outburst their populations steadily to a level where they utilize optimally sources emerged in the newly re-established environment (Grassle and Grassle 1974; Tsutsumi *et al.* 1990). Both native and alien species can become opportunistic species. Through loading ballast water in polluted harbors and discharging it in the recipient, polluted harbor, ocean-going commercial ships enable opportunistic species to disperse across the world's oceans, and some of them (e.g. *Polydora cornuta* and *Pseudopolydora paucibranchiata*) have been classified both as invasive alien species and new pollution indicator species in the Mediterranean Sea (Çinar *et al.* 2012; Çinar and Bakir 2014).

The European Water Framework Directive (WFD: 2000/60/EC) commits member states to achieve at least a Good Environmental Status (GES) for all European water bodies by 2020 at the latest. The directive sets out eleven qualitative descriptors. The descriptor 6, namely the sea-floor entegrity, has 6 indicators, of which two are closely related to the ecological assessments of water bodies by using the presence of sensitive and tolerant species, and multi-metric indices (Rice *et al.* 2010). The directive encourages the usage of biotic indices to determine the benthic quality status across Europe (Blanchet *et al.* 2008; Van Hoey *et al.* 2010). For this aim, a number of biotic indices have been developed, most of which are based on the relative abundances of ecological groups of species within benthic communities (Borja *et al.* 2000; Simboura and Zenetos 2002). However, abundance-based indices such as the Shannon-Weiver's Diversity Index, which has been used traditionally in pollution monitoring studies in marine environments, were also used for classifying water bodies (Dauvin *et al.* 2007; Albayrak *et al.* 2010). Although there are some doubts in considering it as a biotix index, as its approach to produce a score does not match with the species indicator concept, it has been still used as a community descriptor together with the Pielou's Evenness Index (Çinar *et al.* 2006), as a complementary tool to predict possible effects of human-mediated pressures on marine benthic ecosystems (Rosenberg, 1976; Kocatas *et al.* 1985; Ergen *et al.* 2006; Simboura *et al.* 2014) or as a metric in multi-metric indices such as M-AMBI (Mixuka *et al.* 2007).

The usage of biotic indices to assess the benthic ecological status of water bodies is widespread in the Mediterranean, but choosing the most adequate one changes according to habitats, regions and countries. For instance, Greece prefers using BENTIX, Italy and Slovenia M-AMBI, and Spain AMBI and MEDOCC (Borja *et al*. 2009). These biotic indices, except for M-AMBI, are based on one metric that refers to the relative abundances of ecological groups in samples, to which species have been assigned according to literature knowledge and expert judgement. However, weights of the ecological groups in the calculations and groupings of ecological groups vary among biotic indices, which somewhat lead to different evaluations of water bodies. For example, BENTIX considers two groups, namely sensitive and tolerant ecological groups, and gives three times higher weight to sensitive species in the calculation (Simboura and Zenetos 2002). In contrast, AMBI and MEDOCC consider five and four (GIV and GV were joined together) ecological groups, respectively, and give higher weights to opportunistic species (Borja *et al.* 2000; Pinedo *et al.* 2012). In addition, these indices are recommended to be estimated by using software or an Excel macro, which have their own databases for ecological groups of benthic species. However, these databases represent some differences in attaining species to ecological groups. Therefore, it has been stressed the importance of using a similar, intercalibrated database for the calculations of biotic indices that would minimize bias derived from using different databases (Çinar *et al.* 2012).

Biotic indices based on one metric might lead to wrong conclusion if stations include only sensitive and the first order of opportunistic species. For example, as AMBI and MEDOCC eliminate sensitive species in their calculations, in this scenario, they would indicate a bad ecological status. Therefore, a balance in the formula is needed to consider also the presence of sensitive species in the area. M-AMBI has been developed for filling this gap, but the calculation of this index is very difficult as it needs scores of a factorial analysis from a special stastical programme. Although there is software at AZTI's web page (http://www.azti.es) to calculate M-AMBI, it uses the AMBI's database for ecological groups of species, thus it could be useless if a modified or different database (for different ecoregions) is required. Therefore, we have developed a new index here, which has two metrics and is easy to calculate and easy to use with different databases.

This paper describes this two-metric benthic index (TUBI) that involves both the Shannon-Weaver's Diversity Index and the relative abundances of ecological groups. The scores of TUBI were compared with those of the widely-used uni- and multi-metric indices in the Mediterranean and were validated using the environmental variables.

Materials and Methods

1. *Sampling sites*

The new index, TUBI, was tested along the coasts of Turkey. Macrobenthic data derived from two projects were used; 1) seasonal samples collected at eight stations in 2009 in Izmir Bay, and 2) samples taken from the Aegean (27 stations) and Levantine (26 stations) Seas within the framework of the national pollution monitoring study in 2011 (Figure 1). The faunistic data of the samples from Izmir Bay and the features of the stations have already given in Çinar *et al.* (2012). Polychaete data collected during the pollution monitoring study were also published by Çinar and Dagli (2013). The main features of the stations along the Aegean and Levantine Seas are given in Table 1.

The stations located in the outer-most part of Izmir Bay are far from any source of pollution and those located in the inner part of the bay are near pollution sources. Three replicates were collected seasonally at each station of Izmir Bay (except for station 4 in fall), whereas only one sample was taken at stations during the pollution monitoring study.

Benthic samples were taken by a standard Van Veen Grap, sampling an area of 0.1 m^2, and passed through 0.5 mm mesh, and the retained material on sieve was fixed with 4% formaldehyde in the field. In the laboratory, samples were washed with tap water and then sorted according to taxonomic groups under a stereomicroscope and then preserved with 70% ethanol. Specimens were identified under a stereo- and dissecting microscopes and counted.

Specimens were deposited in the Museum of Faculty of Fisheries, Ege University (ESFM).

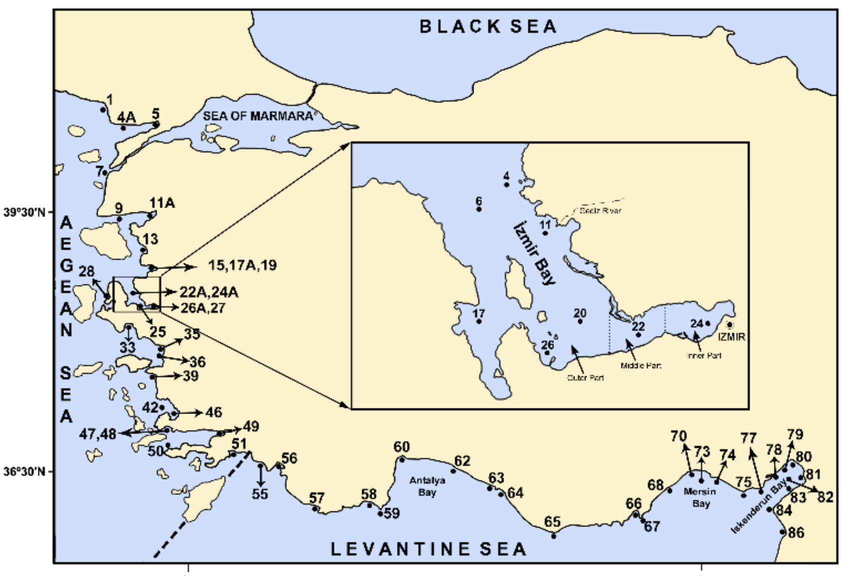

Figure 1. Map of the studied area with the locations of sampling sites

Table 1. The locality name, depth, salinity and temperature recorded at sampling stations in the Aegean and Levantine Seas

Station Number	Locality	Depth (m)	Salinity (‰)	Temperature (°C)
AEGEAN SEA				
1	Edirne Enez	20	38.41	17.91
4A	Gelibolu Peninsula	108	39.02	16.05
5	Gelibolu Peninsula	44	39.00	16.58
7	Bababurnu	18	39.14	18.20
9	Altınoluk	34	39.13	19.37
11A	Edremit	38	39.21	17.80
13	Dikili Bay	23	39.17	19.19
15	Bakırçay	4	34.83	18.71
17A	Çandarlı Bay	23	39.19	17.80
19	Aliağa	13	39.33	18.89
22A	Gediz	56	39.17	17.96
24A	İzmir Bay	39	39.19	18.47
25	İzmir Bay	24	39.61	23.03
26A	İzmir Bay	11	39.70	24.74
27	İzmir Bay	13	39.72	26.01
28	Çeşme	65	39.23	18.17
33	Sığacık	12	39.32	21.87
35	Küçük Menderes	23	39.33	22.41
36	Kuşadası	55	39.25	20.78
39	Büyük Menderes	45	39.16	20.93
42	Güllük	71	39.21	18.63
46	Güllük	51	39.18	20.52
47	Bodrum	37	39.06	22.65
48	Bodrum	19	39.22	24.56
49	Gökova Bay	73	39.15	19.45
50	Datça Bay	80	39.05	19.34
51	Marmaris	13	39.36	27.33
LEVANTINE SEA				
55	Dalaman	5	39.07	27.33
56	Fethiye Bay	325	38.89	14.33
57	Kaş	23	39.23	27.83
58	Finike Bay	55	39.01	22.55
59	Yardımcı Cape	108	39.08	18.45
60	Antalya Bay	45	38.99	24.98
62	Manavgat	5	39.21	29.20
63	Alanya	23	39.23	28.57
64	Dildare Cape	21	39.24	28.41
65	Anamur Cape	28	39.12	27.43
66	Taşucu Bay	24	39.31	29.13
67	Göksu	35	39.15	28.43
68	Erdemli	35	39.26	28.37
70	Mersin Bay	18	39.25	28.60
73	Mersin Bay	5	38.90	29.94
74	Mersin Bay	12	39.12	29.46
75	Karataş	22	39.26	28.45
77	İskenderun Bay	5	38.98	29.87
78	İskenderun Bay	17	39.10	29.33
79	İskenderun Bay	23	39.05	29.60
80	İskenderun Bay	22	39.08	29.55
81	İskenderun Bay	22	39.22	29.53
82	İskenderun Bay	60	39.07	26.60
83	İskenderun Bay	34	39.28	28.82
84	Akıncı Cape	22	39.21	28.85
86	Samandağ	4	39.19	28.90

2. *Metrics for TUBI*

Two metrics representing various features of macrobenthic communities were selected. Metric 1 is the Shannon-Weiver diversity index (H', log_2base) and metric 2 is the relative abundance of ecological groups. Metric 1 generally varies between 0 and 5 in marine benthic habitats, but sometimes receives scores higher than 5, even reaches to 6 in mixed sediments. To stabilize the metric scores, the maximum score of H' is fixed at the score 5 here.

Macro-zoobenthic species within a benthic community can be classified into five ecological groups according to their sensitiveness to disturbances (Glémarec 1986; Borja *et al*. 2000); Group I (GI, sensitive species), Group II (GII, indifferent species), Group III (GIII, tolerant species), Group IV (GIV, second order of opportunistic species) and GV (GV, first order of opportunistic species). In the calculation of the metric 2 of TUBI, three major ecological groups were considered; Group 1 includes sensitive and indifferent species (GI and GII), Group 2 includes tolerant species (GIII), and Group 3 includes opportunistic species (GIV and GV).

3. *The index (TUBI) and its boundaries according to the ecological status*

The formula of TUrkish Biotic Index (TUBI) is as follows:

$$\textbf{TUBI} = \frac{\text{Metric1} + (5 - \text{Metric2})}{2}$$

$$\textbf{TUBI} = \frac{H'^{\dagger} + \left[5 - \left(\frac{0xG1\% + 3xG2\% + 5xG3\%}{100}\right)\right]}{2}$$

$^{\dagger}H'>5 \Rightarrow H'=5$

This index produces scores from 0 to 5 and indicates the high ecological status when it goes towards the score 5, and denotes the azoic condition when it equals to 0. The class boundaries among the ecological status (from bad to high status) were estimated using the changes of the percentages of ecological groups (G1-G3) across the graded values of TUBI (Figure 2), from the least impacted situation to the most impacted one in seasonal samples taken (92 samples) from Izmir Bay. The point (TUBI=3) where G2 attained maximum values, and the curves of G1 and G3 meet each other (the junction point) is considered as a border between the moderate and good ecological status. The good-high ecological status boundary is formed at the score 4, where the sum of relative abundances of sensitive and indifferent species (placed in G1) at least account for 50% of total faunal populations and the opportunistic species comprise lesser than 20% of total faunal populations. The boundary between poor and moderate status is formed at a point (TUBI= 2) where the benthic community is largely dominated by opportunistic species, with low abundances of G1 and G2. If the percent dominance of opportunistic species are higher than 90% of total faunal populations (TUBI<1), the benthic ecological status can be classified as bad. The class boundaries and ecological quality ratio (EQR) of TUBI are shown in Table 2.

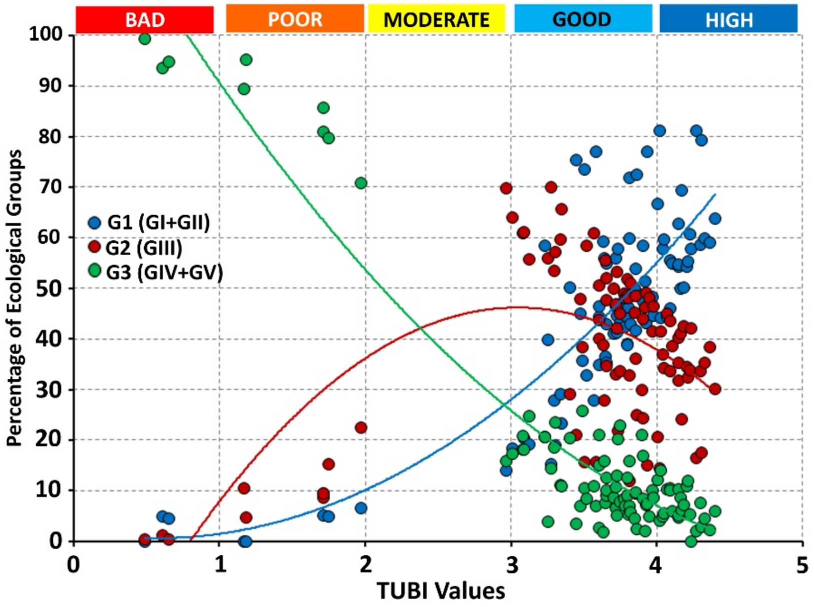

Figure 2. The percentages of ecological groups across the TUBI values

Table 2. The class boundaries of the ecological status and the ecological quality ratios based on TUBI.

WFD Status	Impact Status	Boundaries	EQR
HIGH	Non-affected	4 ≤ TUBI ≤ 5	0.80 ≤ TUBI ≤ 1
GOOD	Slightly affected	3 ≤ TUBI < 4	0.60 ≤ TUBI < 0.80
MODERATE	Moderately affected	2 ≤ TUBI < 3	0.40 ≤ TUBI < 0.60
POOR	Heavily affected	1 ≤ TUBI < 2	0.20 ≤ TUBI < 0.40
BAD	Extremely affected	0 ≤ TUBI < 1	0 ≤ TUBI < 0.20

4. *Validation of the TUBI*

The TUBI was evaluated by comparing it to the chemical properties in deep water and sediments at replicated seasonal samples collected at eight stations in Izmir Bay. Total organic carbon (TOC) concentrations in sediment, and total inorganic nitrogen (TIN), silica and dissolved oxygen concentrations in deep water were compared with TUBI, and other biotic indices that have been widely used in the Mediterranean Sea, such as the diversity index (H'), AMBI, M-AMBI, BENTIX and MEDOCC. The calculations of these indices were made by using the formula or methods given by Shannon and Weaver (1949) (for H'), Borja *et al.* (2000) (for AMBI), Mixuka *et al.* 2007 (for M-AMBI), Simboura and Zenetos (2002) (for BENTIX), and Pinedo *et al.* (2012) (for MEDOCC). For the calculation of M-AMBI, the reference conditions for the number of species (S), H' and AMBI in the Aegean and Levantine Seas were taken as 90, 5 and 0, respectively. The class boundaries of these indices were indicated in Table 3. The national database including ecological groups of species, which was prepared by the Turkish experts during a project (Dekos 2014), was used to avoid the incompatibility existing in the BENTIX and AMBI databases. The ecological groups of species found during the present study are indicated in Appendix 1.

Table 3. H', BENTIX, AMBI, M-AMBI and MEDOCC class boundaries and ecological quality ratios (EQR) associated with the different ecological quality status proposed for the European Water Framework Directive (WFD).

WFD Status	HIGH	GOOD	MODERATE	POOR	BAD
H'	5≥H'≥4	4>H'≥3	3>H'≥2	2>H'≥1	1>H'≥0
EQR	1≥H'≥0.80	0.80>H'≥0.60	0.60>H'≥0.40	0.40>H'≥0.20	0.20>H'≥0
AMBI	0≤AMBI≤1.2	1.2<AMBI≤3.3	3.3<AMBI≤4.3	4.3<AMBI≤5.5	5.5<AMBI≤7
EQR	1≥AMBI≥0.83	0.83>AMBI≥0.53	0.53>AMBI≥0.39	0.39>AMBI≥0.21	0.21>AMBI≥0
BENTIX	6≥BENTIX≥4.5	4.5>BENTIX≥3.5	3.5>BENTIX≥2.5	2.5>BENTIX≥2	2>BENTIX≥0
EQR	1≥BENTIX≥0.75	0.75>BENTIX≥0.58	0.58>BENTIX≥0.42	0.42>BENTIX≥0.33	0.33>BENTIX≥0
MEDOCC	0≤MEDOCC≤1.6	1.6<MEDOCC≤3.2	3.2<MEDOCC≤4.7	4.7<MEDOCC≤5.5	5.5<MEDOCC≤6
EQR	1≥MEDOCC≥0.73	0.73>MEDOCC≥0.47	0.47>MEDOCC≥0.20	0.20>MEDOCC≥0.08	0.08>MEDOCC≥0
M-AMBI	1≥M-AMBI ≥0.83	0.83>M-AMBI≥0.62	0.62>M-AMBI≥0.41	0.41>M-AMBI≥0.20	0.20>M-AMBI≥0
EQR	1≥M-AMBI ≥0.83	0.83>M-AMBI≥0.62	0.62>M-AMBI≥0.41	0.41>M-AMBI≥0.20	0.20>M-AMBI≥0

5. *Statistical analyses*

Scores of all biotic indeces were calculated by using the Microsoft Excel software, except for M-AMBI, which was estimated by using the software at AZTI’s web page (http://www.azti.es). After estimating the scores of the relative abundances of ecological groups (GI-GV), AMBI, S (number of species) and H', seperately, an Excel file was contructed including these scores and then in the software, using the function of “go to M-AMBI”, M-AMBI scores were calculated based on the Excel file prepared. The Pearson’s moment correlation analysis was used to determine the correlations among biotic indices and environmental variables. The results of biotic indices were mapped using Surfer 11 and data were interpolated via the *kriging* method.

Results

1. *Benthic samples from İzmir Bay*

Faunistic analysis of seasonal samples taken at eight stations located in different parts of İzmir Bay in 2009 revealed a total of 427 macrobenthic species belonging to 11 taxonomic groups. The most dominant species in the area were *Aricidea claudiae* (8.7% of total number of specimens), *Streblospio gynobranchiata* (8.2%), *Levinsenia demiri* (7.8%), *Sternaspis scutata* (6.2%) and *Lumbrineris geldiayi* (5.2%) (Appendix 1).

According to the national database for ecological groups of species, Group 3 (opportunistic species, including GIV and GV) was represented by 29 species in the area. Percentages of three ecological groups (sensitive, tolerant and opportunistic species) of the metric 2 of TUBI varied considerably among seasonal samples (Figure 3). Stations located in the outer parts of İzmir Bay had the lowest relative abundance of opportunistic species, whereas the station (station 24) in the inner part of the bay had the highest percentages of these species. At stations 4, 6, 11 and 17, the dominances of G1 were higher than 40%, except for fall samples taken from station 17, where G2 (tolerant species) dominated the benthic community. It is interesting to note that the polluted station (station 24) had higher percentages of G1 in summer samples, indicating a dynamic and fluctuated environment in this part of Izmir Bay. Except for some samples, winter samples had higher percentages of G1 at all stations. The highest percentages of tolerant species (G3) were encountered at station 22.

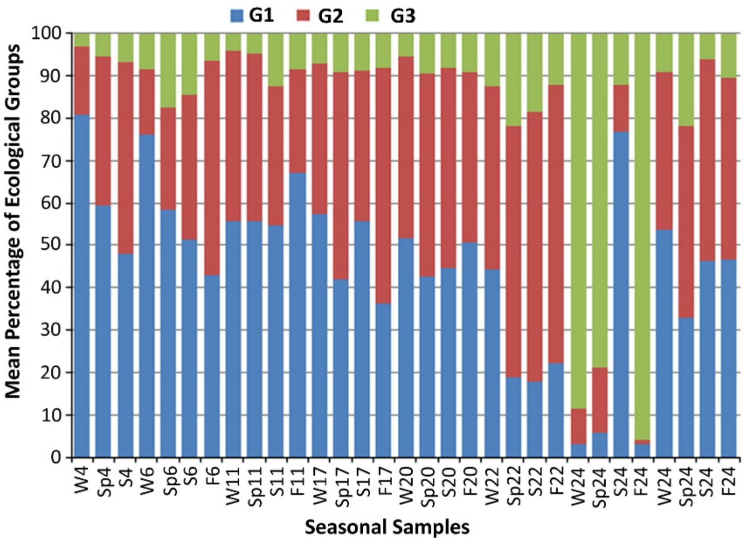

Figure 3. Mean percentages of the ecological groups G1 (including sensitive and indifferent species), G2 (tolerant species) and G3 (opportunistic species) at seasonal samples from İzmir Bay. W: Winter, Sp: Spring, S: Summer, F: Fall.

The mean values of TUBI in seasonal samples and the ecological status of stations are indicated in Figures 4 and 5. The standart error of the mean indicates little variations of TUBI values among replicates. In the area, three samples (station 24, fall) had the lowest TUBI scores, thus classifying the benthic quality status of the water body as bad, six samples (station 24, winter and spring) possessed TUBI scores that indicated poor ecological status. Moderate ecological status was rare in the area, but the majority of samples had TUBI values higher than 4, indicating good or high ecological status. Generally speaking, except for station 24, stations of İzmir Bay had good or high ecological status. TUBI values at station 22, which is situated between the outer and inner parts of the bay, were lower than those estimated at stations situated in the outer parts of the bay.

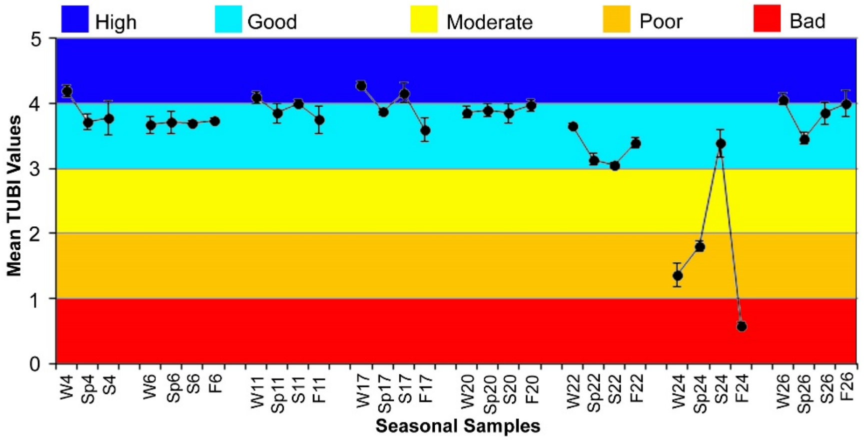

Figure 4. The mean values and ± SE of the TUBI calculated seasonally at stations of İzmir Bay. W: Winter, Sp: Spring, S: Summer, F: Fall.

In Figure 5, the mean values of biotic indices (H', AMBI, M-AMBI, BENTIX, MEDOCC and TUBI) and the benthic quality status at seasonal samples from İzmir Bay were compared. According to the scores of AMBI, M-AMBI and MEDOCC, there was no high benthic quality status in İzmir Bay, whereas H', BENTIX and TUBI detected high ecological status at stations in the outer bay. The inner part of İzmir Bay had generally poor or bad ecological status in spring, fall and winter according to all biotic indices used in this study. However, the ecological status of summer samples were classified as good or moderate (H' and M-AMBI), except for BENTIX that recognized the ecological status of the area as high.

Figure 6 shows the distributions of scores of biotic indices among seasonal samples. Samples were mainly clustered at good ecological status, which were mainly assigned by AMBI, MEDOCC and TUBI. At high ecological status, the majority of scores belonged to H'. M-AMBI scores were mainly concentrated at moderate ecological status, where TUBI classified only one sample (station 22, summer) as moderate. The benthic quality status classified as poor by TUBI was also classified as poor or bad by other biotic indices, except for some stations which had moderate ecological status according to the H' scores.

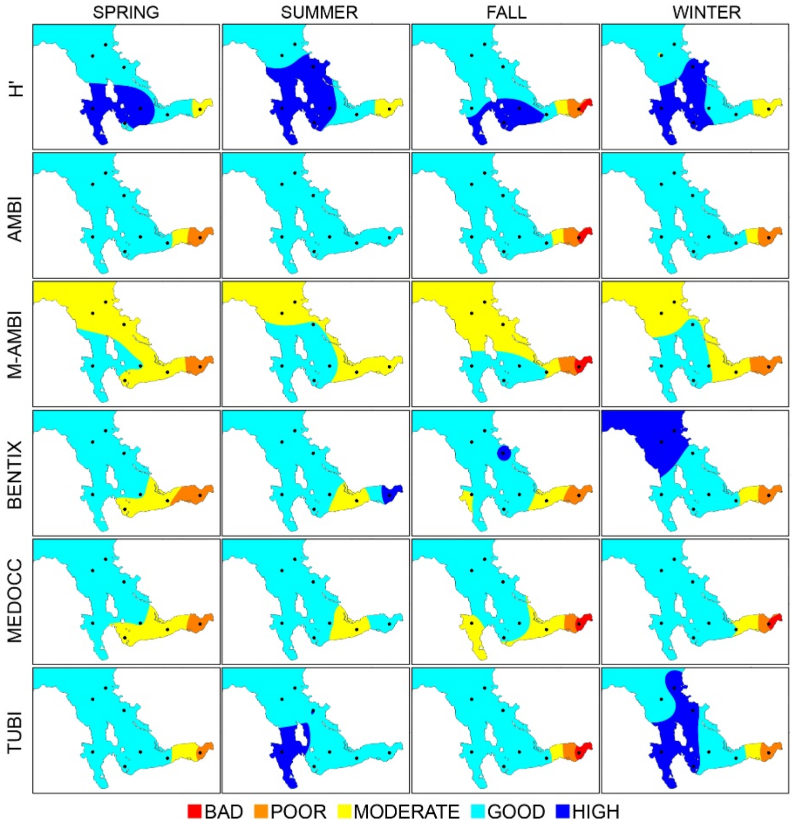

Figure 5. Seasonal benthic quality status of stations in İzmir Bay according to H', AMBI, M-AMBI, BENTIX, MEDOCC and TUBI

The correlation values and regression formulas between the ecological quality ratios (EQR) of TUBI and those of other biotic indices were indicated in Figure 7. The correlations between biotic indices were significant ($p<0.05$) and positive. The highest correlation values ($r>0.90$) were estimated between TUBI, and AMBI ($r=0.93$) and M-AMBI ($r=0.91$), the lowest values between TUBI and BENTIX ($r=0.75$) (Figure 7). The EQRs of MEDOCC were well correlated with the lowest scores of EQRs of TUBI, but those of H' were well correlated with the highest scores of EQRs of TUBI.

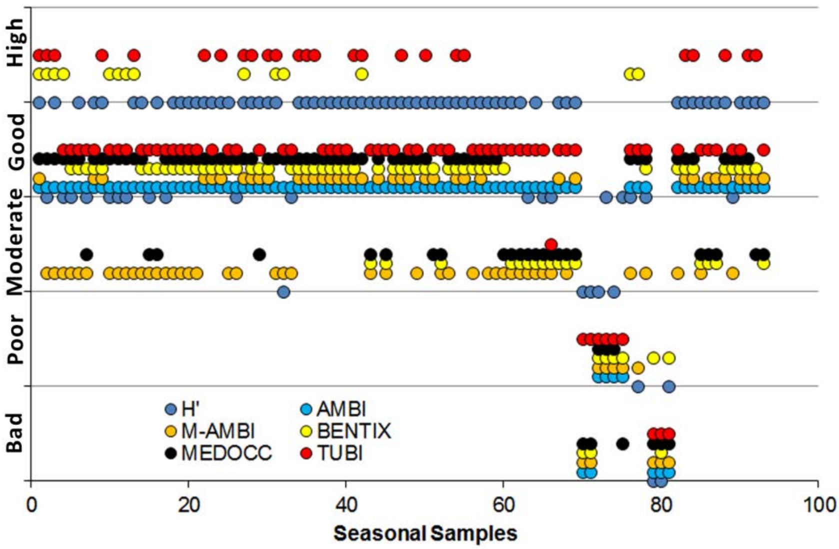

Figure 6. Distributions of samples to different ecological status according to scores of biotic indices

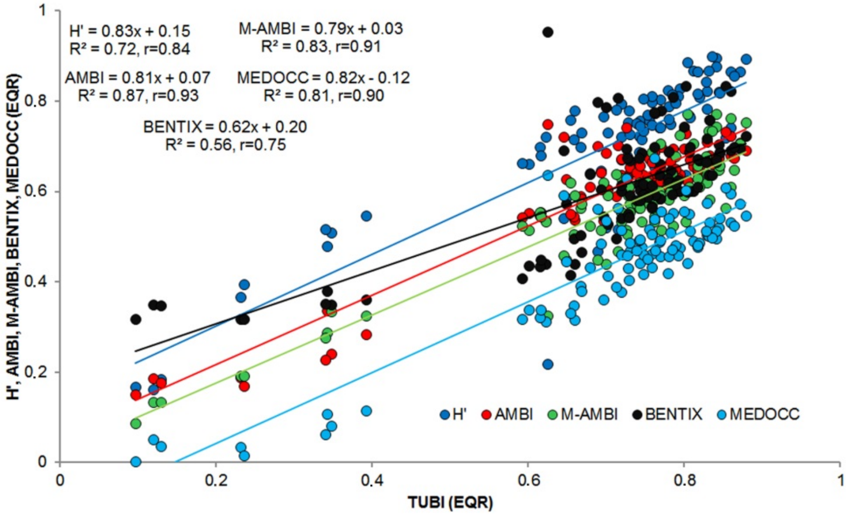

Figure 7. Correlations between ecological quality ratio (EQR) of TUBI and those of other biotic indices (H', AMBI, M-AMBI, BENTIX and MEDOCC).

The efficiency of the biotic indices was tested with the environmental variables in İzmir Bay, especially with the total organic carbon concentrations (TOC) in sediment and total inorganic nitrogen concentrations (TIN) in deep water. The correlation values between the biotic indices and TOC were negative and significant (Figure 8). The highest correlation value was found between TUBI and TOC (r= -0.77,p<0.05), and the lowest between BENTIX and TOC (r=-0.48) (Figure 8). TUBI and H' had the highest correlation value (r= -0.77) with TIN, whereas BENTIX and MEDOCC had weak but significant correlations with TIN (Figure 9). The silica concentration in deep water was also negatively and significantly correlated with all biotic indices, but the highest correlation values were found between silica, and TUBI (r= -0.73) and H' (r= -0.70). The correlation analysis performed between the dissolved oxygen concentrations (DOC) in deep water and biotic indices indicated that there was a positive and significant correlation between DOC and, H' (r=0.37, p<0.05), M-AMBI (r=0.32, p<0.05) and TUBI (r=0.30, p<0.05), and a positive but insignificant correlation between between DOC and, BENTIX (r=0.11, p>0.05), MEDOCC (r=0.12, p>0.05) and AMBI (r=0.14, p>0.05).

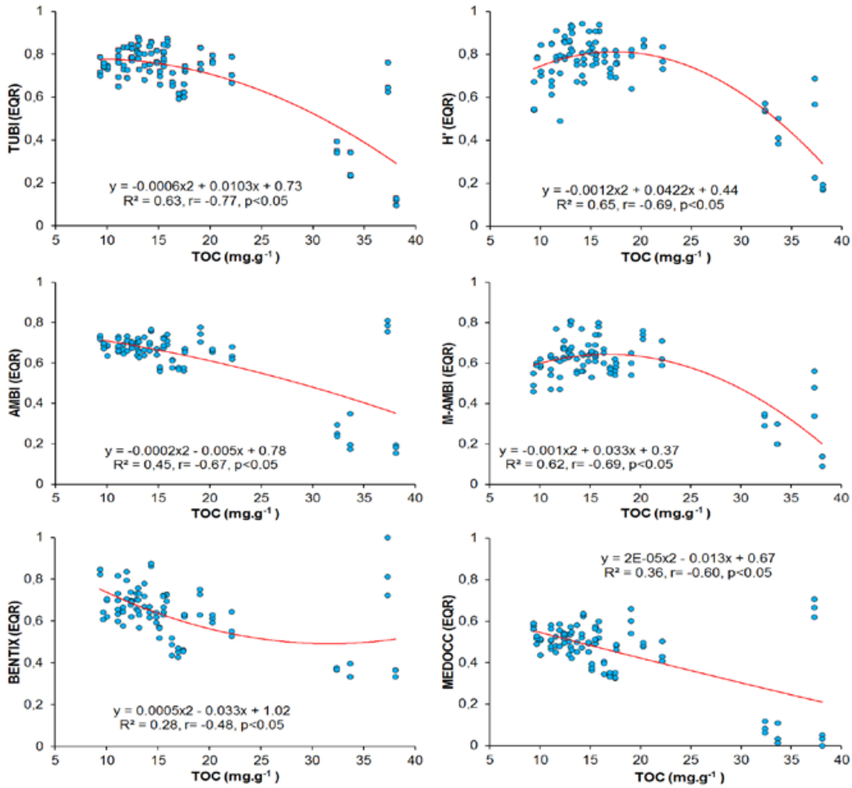

Figure 8. Correlations between total organic carbon (TOC) concentrations in sediment and ecological quality ratios (EQRs) of the biotic indices

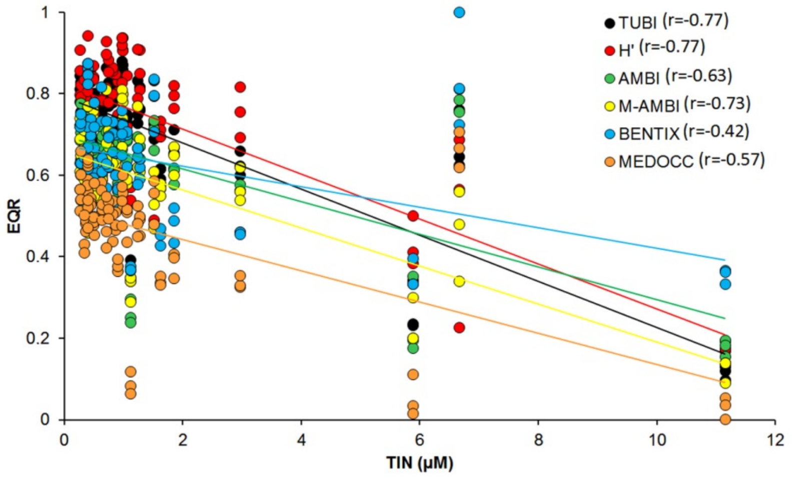

Figure 9. Correlations between total inorganic nitrogen (TIN) concentrations in deep water and the ecological quality ratios (EQRs) of biotic indices

2. *Benthic samples from the Aegean and Levantine Seas*

Faunistic analysis of benthic samples collected along the Aegean Sea revealed a total of 520 species belonging to 15 systematic groups (Appendix 1). Among the species, *Corbula gibba* (5.2% of total number of specimens), *Bittium reticulatum* (4.5%), *Lumbrineris geldiayi* (4%) and *Streblospio gynobranchiata* (3.3%) were the most dominant species, whereas *Monticellina heterochaeta* (present in 69% of samples), *L. geldiayi* (69%), *C. gibba* (66%), *Turritella communis* (55%) and *Leptochelia savignyi* (52%) were the most frequent species in the area. In the Aegean Sea, a total of 22 species belonged to the ecological group 3, of which *Polydora cornuta*, *S. gynobranchiata* and *Prionospio pulchra* were invasive alien species, dominating the station near the Alsancak Harbour located in the polluted inner part of İzmir Bay.

At stations along the Levantine coast of Turkey, 315 species belonging to 11 systematic groups were encountered, of which *Owenia fusiformis* (14.4% of the total number of specimens), *Sigambra tentaculata* (7%), *Bittium latreilli* (5%), *Monticellina heterochaeta* (4.4%) and *Prionospio depauperata* (4%) were the dominant species (Appendix 1). The most frequent species in the area were *P. depauperata* (present in 46% of samples), *Lumbrineris geldiayi* (42%), *Glycinde bonhourei* (42%), *S. tentaculata* (42%) and *Leptochela pugnax* (38%). In the area, 19 opportunistic species were found, of which *Ophiodromus pallidus*, *Schistomeringos rudolphi*, *Prionospio fallax*, *Pseudopolydora paucibranchiata*, *Heteromastus filiformis* and *Jassa marmorata* belongs to the first-order of opportunistic species.

The benthic quality status of stations in the Aegean and Levantine Seas were variable according to different biotic indices used in the present study (Figure 10). According to TUBI, there was no station representing bad ecological status, but one station from İskenderun Bay was in poor status and four stations from İskenderun and İzmir Bays had moderate status. The other stations had good or high ecological status. H' gave a more optimistic result from the area, determined only good or high ecological status at all stations of the Aegean Sea, whereas it detected 10 stations with moderate ecological status and one station with poor ecological status in the Levantine Sea. In contrast, M-AMBI produced scores indicating moderate ecological status at the majority of stations in the Aegean and Levantine Seas, and detected poor ecological status in the inner parts of İzmir and İskenderun Bays. The ecological status of some stations in İskenderun Bay was only recognized as poor by M-AMBI and TUBI.

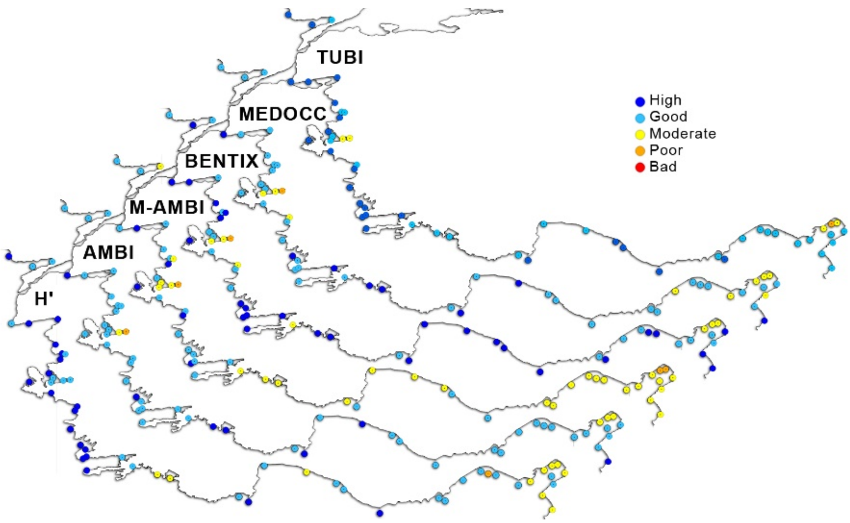

Figure 10. Benthic quality status of stations in the Aegean and Levantine Seas according to H', AMBI, M-AMBI, BENTIX, MEDOCC and TUBI.

The correlation values among biotic indices and the number of species (S) estimated at stations of the Aegean and Levantine Seas are indicated in Table 4. TUBI and M-AMBI were positively and significantly correlated with S and other biotic indices. However, TUBI was relatively well correlated with M-AMBI (r=0.84), AMBI (r=0.77) and MEDOCC (r=0.76), whereas M-AMBI was well correlated with S (r=0.90) and H' (r=0.92).

Table 4. Correlation between biotic indices and the number of species (S) estimated at stations from the Aegean and Levantine Seas. Values in bold are statistically significant ($p<0.05$).

	H'	AMBI	M-AMBI	BENTIX	MEDOCC	TUBI
S	**0.83**	0.11	**0.90**	0.09	0.10	**0.57**
H'		0.15	**0.92**	0.03	0.14	**0.71**
AMBI			**0.42**	**0.91**	**0.99**	**0.77**
M-AMBI				**0.32**	**0.41**	**0.84**
BENTIX					**0.92**	**0.69**
MEDOCC						**0.76**

Discussion

The present study proposed a new biotic index, TUBI (TUrkish Benthic Index), to assess the ecological status of water bodies based on the macro-zoobenthic assemblages of the soft bottom environments. The performance of this index has not been tested in hard substrata yet. TUBI have two metrics; the Shannon-Weiver's diversity index and the relative abundance of ecological groups. The second metric has been widely used in many biotic indices, including BENTIX, AMBI and MEDOCC. However, the assessment of ecological groups in formulas varies among them. BENTIX re-categorized the ecological groups under three groups, namely sensitive (Group I and Group II), tolerant (GIII and GIV) and the first order of opportunistic species (GV). However, it takes two major groups [GS (sensitive species, including GI and GII) and GT (tolerant species, including GIII-GV)] into account in the calculation (Simboura and Zenetos 2002). The ecological groups are considered separately in AMBI and have different weights in the formula (Borja *et al.* 2000). MEDOCC is also similar to AMBI, but combines the first and second orders of opportunistic species into one group (GIV) and gives different weights to ecological groups in formula. In TUBI, the number of ecological groups is decreased from five to three (sensitive, tolerant and opportunistic species) like BENTIX, but differs from it in the following ways; 1) TUBI estimates GIII (tolerant species) separately, whereas BENTIX combines its scores with the opportunistic species; 2) TUBI eliminates the percent abundance of sensitive species, gives moderate weight to G2 and high weight to G3 in the calculation, whereas BENTIX gives a high weight to the sensitive and indifferent species (GI and GII) and low weight to GIII-GV. This structure in BENTIX does not allow classifying water bodies as bad ecological status unless azoic zone is developed, whereas other biotic indices including TUBI can recognize water bodies with bad ecological status if opportunistic species heavily dominate the area. Decreasing ecological groups from five to three in TUBI has some advantages, mainly simplifying the calculation. In addition to this, the transition between some ecological groups is not sharp, hindering us to take an accurate decision in the assignments of species to the ecological groups. In the TUBI estimation, the first and second orders of opportunistic species were put into one large category (G3) as it is hard to categorize species as the first order or the second order. Borja *et al.*

(2000) explained that the group IV includes small-sized polychaetes which are sub-surface deposit feeders such as cirratulids and that the group V comprises surface deposit feeders that proliferate in reduced sediments. However, most of cirratulids and spionids that were attained to group IV in the AMBI database are infact surface deposit-feeders, with palps or tentacles fully extending over sediments to capture detritic material from ambient waters (Fauchald and Jumars 1979). Similarly, the separation of sensitive and indifferent species is not easy, because of insufficient knowledge about the biological and ecological features of many marine species. Therefore, combining these categories into major groups would decrease a possible wrong judgement related to the assignment of species to the ecological groups, thus would increase the realibility of the index to reflect the benthic quality status.

Among indices used in the present study, only M-AMBI is a multi-metric index. It combines the scores of the number of species, and H' and AMBI values of samples, and produces a score along a gradient from the highest and lowest scores by using factor analysis. As it uses more than one metric, it represents some advantages to reflect the ecological status of benthic environments in relation to the magnitude of deteriorations (Bigot *et al.* 2008; Borja *et al.* 2008) and has been proposed in some countries as a main index to assess the ecological quality status of water bodies. However, it is hard, sometimes impossible to calculate this index without using its software developed by AZTI. Therefore, users strictly bound to the AMBI's database for ecological groupings of species and cannot use the regional or national database to calculate M-AMBI scores or change the ecological groups of species when new data are accumulated for their life-history traits. In TUBI, there are two metrics and the estimation is based on the equal contribution of these metrics. However, this new index fixes the maximum score of H' at the score 5 in order to synchronize it with the other metric which varies from 0 to 5, and to restrict its weight in the estimation as it gets high scores in ecotone points, mixed sediments and even in samples which have abundance data homogenously distributed to the low number of species. In M-AMBI, the maximum and minimum scores of the diversity index should be specified for the region and the high scores of H' change the overall estimation of the index.

The benthic quality status of stations in Izmir Bay was evaluated differently by the biotic indices. For example, M-AMBI and MEDOCC did not detect any high ecological status in the area, whereas H' and TUBI recognized high benthic quality status at stations located in the outer bay especially in summer and winter. Bad ecological status was only determined at station 24 in İzmir Bay, but in summer this station had relatively high index scores and its ecological status was classified as good or moderate. However, according to the BENTIX scores, this station possessed a high ecological status in summer. It was mainly attributed to the fact that BENTIX gave a higher weight to the sensitive species (including GI and GII) rather than to the tolerant species in its formula, so as the summer samples had lesser number of species (<17 species), but had a high proportion of GII, the ecologic status of the benthic area was classified as high by BENTIX. This shows that if samples have a few number of species but a high percentage of GII, BENTIX leads to a wrong judgement. The other indices including AMBI and MEDOCC eliminate scores of GI in their calculations. Like BENTIX, TUBI creates a score by adding the scores of GI and GII in samples, but does not take it into account in the estimation. If a sample has a few number of species composed of GI and GII, the metric 2 takes 0, but H' detects the paucity in the species numbers and produces a low score, indicating bad or poor ecological status. Therefore, TUBI has two controls (metrics) in defining the ecological status of water bodies. At stations along the Aegean and Levantine coasts of Turkey, a similar pattern was encountered. The ecological status of the majority of stations was classified as moderate by M-AMBI and as high by H'. A consensus was reached among indices, except for H', that samples from the inner parts of İzmir and İskenderun Bays had moderate or poor ecological status. Unlike other indices, BENTIX and TUBI classified the ecological status of many samples as high in the area.

TOC (Total Organic Carbon) in sediments due to organic pollution has been used as an indicator for marine benthic quality (Hyland, *et al.* 2005; Çinar *et al.* 2012a). In İzmir (r= -0.54) and Mersin (r= -0.75) Bays, a negative but relatively high correlation was found between TOC and H'. TOC becomes toxic to benthic invertebrates at concentrations over 35 $mg.g^{-1}$ due to the deoxygenating effect of organic matter (Hyland *et al.* 2005). However, at low concentrations, like below 10 $mg.g^{-1}$, the benthic invertebrates cannot be much affected. In the present study, TOC concentrations varied from 9.3 (station 6) to 38 (station 24) $mg.g^{-1}$ at stations of Izmir Bay and bad ecological status was determined at TOC concentrations above 32 $mg.g^{-1}$. However, there is a discontinuity in the TOC concentrations between 32 and 22 $mg.g^{-1}$, so the ecoton point where scores of indices drop significantly from good to moderate or moderate to poor ecological status has not been determined, as the biotic indices indicated good or high ecological status at TOC concentration of 22 $mg.g^{-1}$ (station 17, summer). The indices that represented a high correlation with TOC were H', TUBI and M-AMBI. Magni (2003) found that H' was strongly correlated with TOC concentrations following a polynomial function and determined an initial increase of the curve at TOC concentrations around 10 $mg.g^{-1}$, followed by a marked decrease at TOC concentrations around 35 $mg.g^{-1}$. The increase in TIN (Total Inorganic Nitrogen) concentrations in deep water decreased the scores of all biotic indices in İzmir Bay and a sharp decrease was observed at TIN concentrations above 3 µM. Among the indices, TUBI was negatively but significantly correlated with TIN, indicating its power to represent the ecological quality status of benthic environments adequately.

In the present study, the biotic indices were estimated by using a similar database of ecological groups of species, and therefore the correlations among the biotic indices (BENTIX, AMBI and MEDOCC) with one metric were found to be high (r>0.90). The scores of AMBI was strongly correlated with those of MEDOCC (r=0.99) in the area. In contrast, low correlations (r<0.40) were reported between BENTIX and AMBI when different databases were used (Ponti *et al.* 2008; Simonini *et al.* 2009). The difference between the AMBI's and BENTIX's databases is obvious. For example, the polychaete species *Pectinaria koreni* is a sensitive species according to the BENTIX database, whereas it is a second-order opportunistic species according to the AMBI database. Similarly, all *Ancistrosyllis* and *Praxillella* species were classified as sensitive species by the BENTIX database, whereas they were considered as tolerant species by the AMBI database. If these species dominate a benthic habitat, the evaluation of its benthic quality status by these indices differs significantly.

TUBI, with two metrics, reflected well the actual status of benthic ecological status of the eastern Mediterranean sites in accordance with the environmental variables such as TOC and TIN values. This index discriminated stations according to different levels of degradation, therefore better confirming variability across a gradient of human-mediated impacts. Based on this study, we recommend to use TUBI to assess and monitor impacts of organic pollution on benthic communities. However, further studies are required to properly evaluate its strengths and weaknesses on a larger scale.

TUBI (Türk Bentik İndeks): Bentik kommuniteler üzerine organik kirliliğin etkilerini belirlemek amacıyla yeni bir biyotik indeks

Özet

Bentik kommunite yapıları üzerine organik zenginleşmenin etkilerini belirlemek amacıyla yeni bir biyotik indeks olan TUBI (Türk Bentik İndeks) bu çalışmada önerilmiştir. Bu yeni indeks 2 metriğe sahiptir; Shannon-Weiver çeşitlilik indeksi (metrik 1) ve ekolojik grupların nisbi bollukları (metrik 2). Toplam 5 kategori içeren türlerin ekolojik gruplar bu çalışmada, duyarlı türler (GI ve GII'yi içerir), toleranslı türler (GIII) ve fırsatçı türler (GIV ve GV) olmak üzere 3 ana kategori altında toplanmıştır. Metrik 2 bu grupları farklı ağırlıklarda ele almakta ve hesaplamalarında duyarlı türleri gözardı etmektedir. TUBI değerleri 0 ile 5 arasında değişmekte ve bentik kalite durumu, TUBI değerleri arttıkça artmaktadır. İzmir Körfezi, Ege ve Levanten Denizi'nde toplanan bentik örnekler, türlerin ekolojik grupları için hazırlanan ulusal bir veritabanı kullanılarak AMBI, M-AMBI, BENTIX, MEDOCC ve TUBI gibi çeşitli biyotik indeksler kullanılarak analiz edilmiştir. Bazı istisnalar hariç, kullanılan tüm biyotik indeksler bölgelerdeki kötü ve çok kötü ekolojik durumları belirlemişlerdir. Sedimentteki toplam organik karbon ve dip suyundaki toplam inorganik azot ile biyotik indekler arasında yapılan korelasyon analizi, TUBI'nin bu çevresel değişkenlerle en yüksek negatif korelasyon değerlerine sahip olduğunu göstermiştir. Bu nedenle bu indeks bentik

kommuniteleri üzerine kirlilik kaynaklı etkilerin gradasyonu boyunca oluşan değişimleri daha iyi belirlemektedir.

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Appendix 1. Species found in the present study and their total abundances in İzmir Bay (Iz), the Aegean Sea (Ag) and Levantine Sea (Le), and the ecological groups (EG) (GI-GV) they were assigned to. TUBI includes three ecological groups; G1 (GI+GII), G2 (GIII) and G3 (GIV+GV).

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Abra alba (W. Wood, 1802)	III	106	10	-	*Mangelia attenuata* (Montagu, 1803)	I	8	6	-
Abra nitida (O. F. Müller, 1776)	III	30	-	-	*Mangelia costata* (Pennant, 1777)	I	-	5	-
Abra prismatica (Montagu, 1808)	III	-	22	8	*Mangelia costulata* Risso, 1826	I	9	4	2
Acanthocardia paucicostata (G. B. Sowerby II, 1834)	II	1	2	-	*Mangelia fieldeni* (van Aartsen & Fehr-de Wal, 1978)	I	-	1	-
Acanthocardia tuberculata (Linnaeus, 1758)	I	-	1	-	*Mangelia stosiciana* Brusina, 1869	I	-	2	-
Acteon tornatilis (Linnaeus, 1758)	I	1	5	1	*Mangelia unifasciata* (Deshayes, 1835)	II	10	13	3
Aglaophamus agilis (Langerhans, 1880)	I	-	1	-	*Manzonia crassa* (Kanmacher, 1798)	I	1	-	-
Alitta succinea (Leuckart, 1847)	V	5	5	-	*Marphysa bellii* (Audouin & Milne Edwards, 1833)	II	31	32	-
Alpheus glaber (Olivi, 1792)	II	4	3	2	*Marphysa cinari* Kurt-Sahin, 2014	I	-	1	-
Alvania cancellata (da Costa, 1778)	I	-	1	-	*Marphysa fallax* Marion & Bobretzky, 1875	I	-	2	-
Alvania cimex (Linnaeus, 1758)	I	-	5	1	*Marphysa sanguinea* (Montagu, 1815)	II	1	-	-
Alvania colossophilus Oberling, 1970	I	-	2	4	*Marshallora adversa* (Montagu, 1803)	I	2	1	-
Alvania geryonia (Nardo, 1847)	I	3	39	-	*Medicorophium aculeatum* (Chevreux, 1908)	III	10	-	-
Alvania punctura (Montagu, 1803)	I	-	3	-	*Medicorophium runcicorne* (Della Valle, 1893)	III	6	2	-
Alvania testae (Aradas & Maggiore, 1844)	I	-	3	-	*Mediomastus cirripes* Ben-Eliahu, 1976	IV	14	3	91
Ampelisca brevicornis (Costa, 1853)	I	-	9	140	*Megalomma vesiculosum* (Montagu, 1815)	I	-	1	-
Ampelisca diadema (Costa, 1853)	II	2	-	-	*Megaluropus massiliensis* Ledoyer, 1976	I	-	1	9
Ampelisca jaffaensis Bellan-Santini & Kaim-Malka, 1977	I	22	-	-	*Megastomia conoidea* (Brocchi, 1814)	III	85	16	7
Ampelisca multispinosa Bellan-Santini & Kaim-Malka, 1977	I	-	14	6	*Melinna palmata* Grube, 1870	III	62	29	5
Ampelisca pseudosarsi Bellan-Santini & Kaim-Malka, 1977	II	-	10	2	*Melita valesi* Karaman, 1955	I	-	-	15
Ampelisca pseudospinimana Bellan-Santini & Kaim-Malka, 1977	I	3	-	-	*Metaphoxus simplex* (Bate, 1857)	I	11	10	5
Ampelisca ruffoi Bellan-Santini & Kaim-Malka, 1977	I	-	9	2	*Metaxia metaxa* (Delle Chiaje, 1828)	I	-	-	1
Ampelisca sarsi Chevreux, 1888	II	1	-	-	*Microdeutopus versiculatus* (Bate, 1856)	II	-	9	-
Ampelisca tenuicornis Lilljeborg, 1855	I	86	-	-	*Microjassa cumbrensis* (Stebbing & Robertson, 1891)	I	-	6	-
Ampelisca truncata Bellan-Santini & Kaim-Malka, 1977	I	-	35	14	*Micronephthys stammeri* (Augener, 1932)	III	107	10	2
Ampelisca typica (Bate, 1856)	I	73	-	-	*Microspio mecznikowianus* (Claparède, 1869)	III	1	1	-
Ampharete acutifrons (Grube, 1860)	II	3	-	-	*Mimachlamys varia* (Linnaeus, 1758)	I	-	2	-
Ampharete octocirrata (Sars, 1835)	II	-	3	-	*Mitrella gervillii* (Payraudeau, 1826)	I	-	1	-

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Amphicteis gunneri (M. Sars, 1835)	II	1	9	-	*Mitromorpha olivoidea* (Cantraine, 1835)	I	-	-	1
Amphictene auricoma (O.F. Müller, 1776)	I	2	-	-	*Modiolula phaseolina* (Philippi, 1844)	I	-	2	1
Amphictene auricoma (O.F. Müller, 1776)	I	-	1	-	*Moerella distorta* (Poli, 1791)	III	27	2	-
Amphiglena mediterranea (Leydig, 1851)	I	-	-	3	*Monocorophium acherusicum* (Costa, 1853)	III	6	-	-
Amphiodia obtecta Mortensen, 1940	III	-	-	1	*Monodaeus couchii* (Couch, 1851)	I	-	1	-
Amphipholis squamata (Delle Chiaje, 1828)	I	9	12	1	*Monticellina dorsobranchialis* (Kirkegaard, 1959)	III	-	6	159
Amphitrite cirrata (Müller, 1771 in 1776)	I	-	3	-	*Monticellina heterochaeta* Laubier, 1961	IV	458	143	35
Amphiura chiajei Forbes, 1843	III	38	30	6	*Monticellina tesselata* (Hartman, 1960)	III	-	-	2
Amphiura filiformis (O.F. Müller, 1776)	III	16	11	-	*Musculus costulatus* (Risso, 1826)	I	-	5	-
Ampithoe ramondi Audouin, 1826	III	4	1	-	*Musculus subpictus* (Cantraine, 1835)	I	-	4	-
Anapagurus bicorniger A. Milne-Edwards & Bouvier, 1892	II	1	-	-	*Myrianida brachycephala* (Marenzeller, 1874)	I	1	-	-
Anapagurus petiti Dechancé & Forest, 1962	I	1	-	-	*Myrianida langerhansi* (Gidholm, 1967)	I	-	6	-
Ancistrosyllis groenlandica McIntosh, 1879	II	10	4	-	*Myrtea spinifera* (Montagu, 1803)	II	23	11	-
Ancistrosyllis hamata McIntosh, 1879	II	43	-	-	*Mysia undata* (Pennant, 1777)	I	1	-	-
Anobothrus gracilis (Malmgren, 1866)	II	145	20	1	*Mysta picta* (Quatrefages, 1866)	II	2	3	2
Anomia ephippium Linnaeus, 1758	III	-	4	-	*Nannastacus longirostris* G.O. Sars, 1879	II	-	9	-
Antalis dentalis (Linnaeus, 1758)	I	56	20	3	*Nannastacus unguiculatus* (Bate, 1859)	II	-	3	-
Antalis inaequicostata (Dautzenberg, 1891)	I	30	3	-	*Nassarius corniculum* (Olivi, 1792)	II	2	-	-
Aonides oxycephala (Sars, 1862)	II	8	8	-	*Nassarius cuvierii* (Payraudeau, 1826)	II	-	-	1
Aphelochaeta filiformis (Keferstein, 1862)	III	13	12	-	*Nassarius incrassatus* (Strøm, 1768)	II	35	-	-
Apherusa alacris Krapp-Schickel, 1969	I	-	-	4	*Nassarius lima* (Dillwyn, 1817)	I	-	1	4
Apherusa chiereghinii Giordani- Soika, 1949	I	-	6	-	*Nassarius nitidus* (Jeffreys, 1867)	II	-	-	9
Apionsoma misakianum (Ikeda, 1904)	II	-	1	4	*Nassarius pygmaeus* (Lamarck, 1822)	IV	130	106	23
Apistobranchus tullbergi (Théel, 1879)	I	-	1	-	*Nassarius reticulatus* (Linnaeus, 1758)	II	1	-	-
Apocorophium acutum (Chevreux, 1908)	III	1	2	-	*Neanthes nubila* (Savigny, 1822)	III	-	11	-
Aponuphis bilineata (Baird, 1870)	II	-	3	6	*Nemertopsis bivittata* (Delle Chiaje, 1841)	II	2	-	-
Aponuphis brementi (Fauvel, 1916)	II	19	21	11	*Neogyptis mediterranea* (Pleijel, 1993)	I	3	1	-
Aporrhais pespelecani (Linnaeus, 1758)	II	9	8	-	*Nephtys caeca* (Fabricius, 1780)	I	1	-	-
Apseudopsis latreillii (Milne Edwards, 1828)	III	95	58	62	*Nephtys hombergii* Savigny in Lamarck, 1818	IV	4	31	15
Arabella iricolor (Montagu, 1804)	I	-	4	-	*Nephtys hystricis* McIntosh, 1900	II	23	-	-
Arbacia lixula (Linnaeus, 1758)	II	-	1	-	*Nephtys incisa* Malmgren, 1865	II	61	36	4
Arichlidon reyssi (Katzmann, Laubier & Ramos, 1974)	I	-	2	8	*Nereis rava* Ehlers, 1864	III	-	1	-
Aricidea suecica meridionalis Laubier & Ramos, 1974	II	1	1	2	*Neverita josephinia* Risso, 1826	I	-	-	2

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Aricidea annae Laubier, 1967	I	2	-	-	*Ninoe armoricana* Glémarec, 1968	I	11	1	-
Aricidea assimilis Tebble, 1959	III	7	11	3	*Nothria conchylega* (Sars, 1835)	II	2	1	-
Aricidea catherinae Laubier, 1967	I	-	2	7	*Notomastus aberans* Day, 1957	III	21	42	15
Aricidea cerrutii Laubier, 1966	II	1	-	2	*Notomastus latericeus* Sars, 1851	III	25	14	-
Aricidea claudiae Laubier, 1967	III	1366	97	1	*Notomastus lineatus* (Claparède, 1869)	III	-	7	-
Aricidea lopezi Berkeley & Berkeley, 1956	II	15	-	-	*Notomastus mossambicus* (Thomassin, 1970)	III	-	-	45
Aricidea pseudoarticulata Hobson, 1972	III	85	70	-	*Nucula nitidosa* Winckworth, 1930	II	19	20	-
Aricidea simonae Laubier & Ramos, 1974	I	3	-	-	*Nucula nucleus* (Linnaeus, 1758)	II	8	-	-
Ascobulla fragilis (Jeffreys, 1856)	I	-	1	-	*Nuculana pella* (Linnaeus, 1767)	II	1	2	-
Aspidosiphon muelleri Diesing, 1851	I	5	-	-	*Obesotoma laevigata* (Dall, 1871)	I	-	4	3
Aspidosiphon mexicanus (Murina, 1967)	I	9	-	3	*Ocinebrina aciculata* (Lamarck, 1822)	I	1	-	-
Astarte sulcata (da Costa, 1778)	I	-	1	-	*Octobranchus lingulatus* (Grube, 1863)	II	-	1	-
Asterina gibbosa (Pennant, 1777)	I	-	2	1	*Odontosyllis fulgurans* (Audouin & Milne Edwards, 1833)	II	-	1	-
Astropecten bispinosus (Otto, 1823)	I	1	-	-	*Odontosyllis gibba* Claparède, 1863	II	-	3	-
Athanas nitescens (Leach, 1813 [in Leach, 1813-1814])	I	1	1	-	*Odostomella doliolum* (Philippi, 1844)	I	-	2	-
Atys jeffreysi (Weinkauff, 1866)	I	-	-	2	*Odostomia unidentata* (Montagu, 1803)	I	-	1	-
Aurospio banyulensis (Laubier, 1966)	II	-	16	-	*Oestergrenia digitata* (Montagu, 1815)	III	145	9	-
Aurospio dibranchiata Maciolek, 1981	I	-	6	-	*Ogyrides mjoebergi* (Balss, 1921)	I	-	-	3
Axiothella constricta (Claparède, 1869)	I	-	-	2	*Onchnesoma steenstrupii steenstrupii* Koren & Danielssen, 1876	II	134	54	109
Barleeia unifasciata (Montagu, 1803)	I	-	-	2	*Ondina vitrea* (Brusina, 1866)	I	3	5	-
Bathyarca pectunculoides (Scacchi, 1835)	I	-	-	1	*Ondina warreni* (Thompson, 1845)	I	-	1	-
Bathyporeia megalops Chevreux, 1911	I	-	11	1	*Onuphis eremita* Audouin & Milne Edwards, 1833	II	-	3	11
Bela brachystoma (Philippi, 1844)	II	96	23	8	*Ophelina acuminata* Örsted, 1843	II	3	-	-
Bela nebula (Montagu, 1803)	I	1	-	-	*Ophelina cylindricaudata* (Hansen, 1879)	II	24	5	-
Bittium latreillii (Payraudeau, 1826)	II	4	134	168	*Ophelina modesta* Støp-Bowitz, 1958	II	34	-	-
Bittium reticulatum (da Costa, 1778)	II	56	248	135	*Ophiopsila aranea* Forbes, 1843	I	-	1	-
Bittium submamillatum (de Rayneval & Ponzi, 1854)	I	-	10	-	*Ophiothrix fragilis* (Abildgaard, in O.F. Müller, 1789)	I	-	6	-
Bodotria scorpioides (Montagu, 1804)	II	-	-	2	*Ophiura albida* Forbes, 1839	IV	4	-	6
Brachystomia eulimoides (Hanley, 1844)	II	1	-	-	*Ophiura ophiura* (Linnaeus, 1758)	II	1	2	-
Brachystomia scalaris (MacGillivray, 1843)	I	-	1	-	*Ophryotrocha labronica* Bacci & La Greca, 1961	IV	1	-	-
Branchiostoma lanceolatum (Pallas, 1774)	I	-	3	14	*Ophryotrocha puerilis* Claparède & Metschnikow, 1869	IV	1	-	-
Brevicirrosyllis weismanni (Langerhans, 1879)	I	-	-	2	*Opisthosyllis brunnea* Langerhans, 1879	II	-	-	1

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Brissopsis lyrifera (Forbes, 1841)	II	6	1	2	*Orchomene humilis* (Costa, 1853)	II	8	-	-
Bulla striata Bruguière, 1792	I	-	-	1	*Ova canaliferus* (Lamarck, 1816)	I	-	1	-
Callianassa subterranea (Montagu, 1808)	III	-	4	2	*Owenia fusiformis* Delle Chiaje, 1844	II	1	3	523
Calliostoma laugieri (Payraudeau, 1826)	I	-	-	1	*Oxydromus flexuosus* (Delle Chiaje, 1827)	III	4	-	-
Calocaris macandreae Bell, 1853	II	-	1	-	*Oxydromus pallidus* Claparède, 1864	V	5	1	12
Calyptraea chinensis (Linnaeus, 1758)	II	3	9	-	*Pagurus cuanensis* Bell, 1846	II	-	3	-
Campylaspis glabra Sars, 1878	II	-	2	-	*Papillicardium papillosum* (Poli, 1791)	II	1	-	-
Campylaspis legendrei Fage, 1951	II	-	1	-	*Paradialychone filicaudata* (Southern, 1914)	II	34	16	1
Capitella minima Langerhans, 1881	IV	-	-	1	*Paradoneis ilvana* Castelli, 1985	III	-	-	1
Capitella telata Blake, Grassle, Eckelbarger, 2009	V	66	2	-	*Paradoneis lyra* (Southern, 1914)	III	33	14	2
Caprella acanthifera Leach, 1814	II	-	7	-	*Paraehlersia ferrugina* (Langerhans, 1881)	II	-	1	1
Carangoliopsis spinulosa Ledoyer, 1970	I	3	-	-	*Paralacydonia paradoxa* Fauvel, 1913	I	30	132	3
Caulleriella alata (Southern, 1914)	II	-	1	1	*Paranthura costana* Bate & Westwood, 1866	I	-	-	2
Ceratia proxima (Forbes & Hanley, 1850)	I	4	5	-	*Paraonis tenera* Grube, 1872	I	1	-	-
Ceratonereis (*Composetia*) *costae* (Grube, 1840)	I	-	1	-	*Paraphoxus oculatus* (Sars, 1879)	I	4	9	-
Ceratonereis (*Composetia*) *hircinicola* (Eisig, 1870)	I	41	1	1	*Parapionosyllis brevicirra* Day, 1954	I	-	6	2
Ceratonereis mirabilis Kinberg, 1865	I	-	1	5	*Parapionosyllis elegans* (Pierantoni, 1903)	I	2	-	1
Cerithidium diplax (Watson, 1886)	II	-	-	28	*Parapionosyllis minuta* (Pierantoni, 1903)	I	1	-	1
Cerithiopsis minima (Brusina, 1865)	I	-	-	1	*Paraprionospio coora* Wilson, 1990	I	66	6	-
Cerithiopsis tubercularis (Montagu, 1803)	I	1	-	-	*Parexogone caribensis* (San Martìn, 1991)	I	6	3	-
Cerithium scabridum Philippi, 1848	II	-	-	6	*Parexogone hebes* (Webster & Benedict, 1884)	I	2	-	-
Cerithium vulgatum Bruguière, 1792	I	-	1	-	*Parhyale eburnea* Krapp-Schickel, 1974	I	-	1	-
Chaetopterus variopedatus (Renier, 1804)	I	-	1	-	*Parougia* cf. *caeca* (Webster & Benedict, 1884)	II	1	-	-
Chaetozone corona Berkeley & Berkeley, 1941	III	18	1	-	*Parthenina dollfusi* (Kobelt, 1903)	I	1	1	-
Chaetozone gibber Woodham & Chambers, 1994	III	7	7	-	*Parthenina emaciata* (Brusina, 1866)	I	2	1	-
Charybdis hellerii (*A. Milne-Edwards, 1867*)	II	-	-	2	*Parthenina interstincta* (J. Adams, 1797)	I	3	9	-
Chauvetia brunnea (Donovan, 1804)	I	-	1	-	*Parthenina juliae* (de Folin, 1872)	I	2	-	-
Chauvetia turritellata (Deshayes, 1835)	I	-	5	-	*Parthenina palazzii* (Micali, 1984)	I	1	-	-
Cheiriphotis mediterranea Myers, 1983	II	-	-	23	*Parthenina suturalis* (Philippi, 1844)	I	-	1	-
Chone collaris Langerhans, 1881	II	6	2	-	*Parthenina terebellum* (Philippi, 1844)	I	3	3	3
Chone duneri Malmgren, 1867	II	-	2	1	*Parvicardium exiguum* (Gmelin, 1791)	II	-	4	-
Chone dunerificta Tovar-Hernández, Licciano, Giangrande, 2007	I	-	-	1	*Parvicardium pinnulatum* (Conrad, 1831)	I	-	1	-
Chone longiseta Giangrande, 1992	I	-	1	-	*Parvioris ibizenca* (Nordsieck, 1968)	I	-	3	-
Cirolana neglecta Hansen, 1890	II	10	-	-	*Parvipalpus linea* Mayer, 1890	I	-	2	-

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Cirrophorus branchiatus Ehlers, 1908	III	36	2	-	*Perioculodes aequimanus* (Korssman, 1880)	II	2	-	-
Cirrophorus furcatus (Hartman, 1957)	III	19	49	2	*Perioculodes longimanus* (Bate & Westwood, 1868)	II	15	11	5
Clanculus cruciatus (Linnaeus, 1758)	I	-	4	-	*Phascolion strombus strombus* (Montagu, 1804)	I	2	3	-
Clausinella fasciata (da Costa, 1778)	I	1	1	1	*Phaxas pellucidus* (Pennant, 1777)	II	10	5	-
Clorida albolitura Ahyong & Naiyanetr, 2000	II	-	-	1	*Pherusa plumosa* (Müller, 1776)	II	-	1	-
Conomurex persicus (Swainson, 1821)	I	-	-	16	*Philine scabra* (O. F. Müller, 1784)	II	-	1	-
Conus ventricosus Gmelin, 1791	I	-	-	2	*Philocheras monacanthus* (Holthuis, 1961)	I	-	1	-
Corbula gibba (Olivi, 1792)	IV	74	290	14	*Pholoe inornata* Johnston, 1839	II	1	-	-
Cossura soyeri Laubier, 1964	III	779	92	35	*Phoronis psammophila* Cori, 1889	III	6	-	-
Crassopleura maravignae (Bivona Ant. in Bivona And., 1838)	I	-	-	3	*Photis longipes* (Della Valle, 1893)	I	-	1	-
Cumella limicola Sars, 1879	II	-	1	-	*Phoxocephalus aquosus* Karaman, 1985	I	9	-	-
Cyathura carinata (Krøyer, 1847)	III	-	2	10	*Phtisica marina* Slabber, 1769	III	1	16	-
Cylichna cylindracea (Pennant, 1777)	II	82	20	1	*Phyllodoce lineata* (Claparède, 1870)	II	2	1	-
Cymodoce spinosa (Risso, 1816)	I	-	1	-	*Phyllodoce maculata* (Linnaeus, 1767)	III	1	3	-
Cymodoce truncata Leach, 1814	I	-	5	-	*Phyllodoce mucosa* Örsted, 1843	III	1	-	-
Cymodoce tuberculata Costa in Hope, 1851	I	-	3	-	*Phyllodoce rosea* (McIntosh, 1877)	III	1	-	1
Deflexilodes acutipes (Ledoyer, 1983)	I	-	1	-	*Phylo foetida* (Claparède, 1869)	I	1	-	-
Deflexilodes gibbosus (Chevreux, 1888)	I	1	11	-	*Pilargis verrucosa* Saint-Joseph, 1899	III	98	11	3
Dexamine spinosa (Montagu, 1813)	II	1	13	-	*Piromis eruca* (Claparède, 1869)	III	-	12	-
Diastylis cornuta (Boeck, 1864)	I	-	2	-	*Pisidia bluteli* (Risso, 1816)	II	1	-	-
Diastylis neapolitana Sars, 1879	I	-	2	-	*Pisidia longicornis* (Linnaeus, 1767)	II	1	-	-
Diastylis rugosa Sars, 1865	I	-	1	-	*Pisione guanche* San Martín, López & Núñez, 1999	I	-	-	7
Diogenes pugilator (Roux, 1829)	II	-	1	-	*Pista cristata* (Müller, 1776)	I	3	12	-
Diopatra neapolitana Delle Chiaje, 1841	III	-	1	-	*Pista unibranchia* Day, 1963	II	5	1	-
Diplocirrus glaucus (Malmgren, 1867)	II	112	6	1	*Pitar rudis* (Poli, 1795)	I	-	6	-
Dipolydora coeca (Örsted, 1843)	III	18	1	-	*Platynereis dumerilii* (Audouin & Milne Edwards, 1834)	III	-	1	2
Dischides politus (S. Wood, 1842)	I	-	2	-	*Podarkeopsis galangaui* Laubier, 1961	IV	55	21	9
Ditrupa arietina (O. F. Müller, 1776)	I	-	-	6	*Podocerus variegatus* Leach, 1814	III	-	1	1
Donax semistriatus Poli, 1795	I	-	-	17	*Poecilochaetus fauchaldi* Pilato & Cantone, 1976	II	59	-	1
Dosinia lupinus (Linnaeus, 1758)	III	1	6	-	*Poecilochaetus serpens* Allen, 1904	II	15	48	2
Drilliola loprestiana (Calcara, 1841)	I	-	-	1	*Polydora cornuta* Bosc, 1802	V	133	12	-
Drilonereis filum (Claparède, 1868)	I	12	8	4	*Polydora hoplura* Claparède, 1869	III	-	5	-
Dynamene torelliae Holdich, 1968	II	-	-	1	*Polygordius appendiculatus* Fraipont, 1887	I	7	-	-

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Ebalia tuberosa (Pennant, 1777)	II	-	1	1	*Polygordius lacteus* Schneider, 1868	I	29	1	1
Echinocyamus pusillus (O.F. Müller, 1776)	I	-	1	-	*Polyophthalmus pictus* (Dujardin, 1839)	I	1	2	4
Edwardsia claparedii (Panceri, 1869)	III	49	4	2	*Pontogenia chrysocoma* (Baird, 1865)	II	-	2	-
Ekleptostylis walkeri (Calman, 1907)	I	1	-	-	*Praxillella gracilis* (M. Sars, 1861)	II	1	9	2
Elasmopus pocillimanus (Bate, 1862)	II	-	-	7	*Praxillella praetermissa* (Malmgren, 1865)	II	21	5	-
Electroma vexillum (Reeve, 1857)	II	-	-	2	*Prionospio anatolica* Dagli & Çinar, 2011	I	-	-	5
Eocuma sarsii (Kossmann), 1880	I	-	1	1	*Prionospio aucklandica* Augener, 1923	IV	-	-	12
Epitonium clathrus (Linnaeus, 1758)	I	1	1	-	*Prionospio caspersi* Laubier, 1962	III	-	-	11
Epitonium muricatum (Risso, 1826)	I	-	1	-	*Prionospio cirrifera* Wirén, 1883	II	-	9	-
Epitonium turtonis (Turton, 1819)	I	2	-	1	*Prionospio depauperata* Imajima, 1990	II	10	6	157
Ericthonius argenteus Krapp-Schickel, 1993	I	-	-	5	*Prionospio dubia* Day, 1961	I	31	7	1
Ericthonius punctatus (Bate, 1857)	II	3	2	-	*Prionospio ehlersi* Fauvel, 1928	I	4	6	-
Eriopisa elongata (Bruzelius, 1859)	I	5	-	-	*Prionospio ergeni* Dagli & Çinar, 2009	III	-	-	19
Euchone rosea Langerhans, 1884	II	3	2	-	*Prionospio fallax* Söderström, 1920	V	208	18	12
Euclymene collaris (Claparède, 1869)	I	-	2	-	*Prionospio maciolekae* Dagli & Çinar, 2011	II	174	24	-
Euclymene lombricoides (Quatrefages, 1866)	II	8	5	-	*Prionospio paucipinnulata* Blake & Kudenov, 1978	II	-	-	4
Euclymene oerstedi (Claparède, 1863)	II	2	1	-	*Prionospio pulchra* Imajima, 1990	V	72	25	-
Euclymene palermitana (Grube, 1840)	I	-	2	-	*Prionospio saccifera* Mackie & Hartley, 1990	II	-	-	123
Eudorella truncatula (Bate, 1856)	I	6	4	-	*Prionospio sexoculata* Augener, 1918	IV	-	-	15
Eulalia clavigera (Audouin & Milne Edwards, 1833)	I	2	-	-	*Prionospio steenstrupi* Malmgren, 1867	III	243	76	2
Eulalia mustela Pleijel, 1987	I	-	1	-	*Proceraea aurantiaca* Claparède, 1868	II	-	1	-
Eulima glabra (da Costa, 1778)	I	13	8	-	*Processa modica modica* Williamson in Williamson & Rochanaburanon, 1979	I	-	2	1
Eulimella acicula (Philippi, 1836)	I	11	1	-	*Processa nouveli nouveli* Al-Adhub & Williamson, 1975	II	23	-	-
Eulimella ventricosa (Forbes, 1844)	I	-	1	-	*Prosphaerosyllis marmarae* Çinar, Dagli & Acik, 2011	I	-	1	-
Eumida sanguinea (Örsted, 1843)	II	2	1	-	*Prosphaerosyllis xarifae* (Hartmann-Schröder, 1960)	I	18	1	-
Eunereis longissima Johnston, 1840	II	1	-	1	*Protodorvillea kefersteini* (McIntosh, 1869)	III	7	19	1
Eunice vittata (Delle Chiaje, 1828)	II	89	24	2	*Psamathe fusca* Johnston, 1836	II	-	2	-
Euparthenia humboldti (Risso, 1826)	I	-	1	-	*Psammechinus microtuberculatus* (Blainville, 1825)	I	-	1	-
Eurydice affinis Hansen, 1905	I	-	1	13	*Pseudofabriciola analis* Fitzhugh, Giangrande & Simboura, 1994	II	-	1	-
Eurydice pulchra Leach, 1815	I	-	2	-	*Pseudofabriciola longipyga* Fitzhugh, Giangrande & Simboura, 1994	I	3	9	1
Eurydice spinigera Hansen, 1890	I	-	2	1	*Pseudoleiocapitella fauveli* Harmelin, 1964	III	27	34	2
Eurynome aspera (Pennant, 1777)	I	-	1	-	*Pseudomystides limbata* (Saint-Joseph, 1888)	II	-	1	1

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Eurysyllis tuberculata Ehlers, 1864	I	-	1	1	*Pseudomystides spinachia* Petersen & Pleijel in Pleijel, 1993	I	13	1	2
Euspira nitida (Donovan, 1804)	II	15	3	-	*Pseudopolydora antennata* (Claparède, 1869)	II	-	-	1
Eusyllis assimilis Marenzeller, 1875	I	-	2	-	*Pseudopolydora paucibranchiata* (Okuda, 1937)	V	129	-	2
Eusyllis lamelligera Marion & Bobretzky, 1875	I	-	1	-	*Pseudopolydora pulchra* (Carazzi, 1893)	IV	9	5	-
Exogone dispar (Webster, 1879)	I	1	-	-	*Pteria hirundo* (Linnaeus, 1758)	I	-	2	-
Exogone cognettii Castelli, Badalamenti & Lardici, 1987	I	3	2	-	*Pterocirrus macroceros* (Grube, 1860)	I	1	-	-
Exogone gambiae Lanera, Sordino & San Martín, 1994	I	-	3	1	*Pusillina inconspicua* (Alder, 1844)	II	1	31	1
Exogone naidina Örsted, 1845	II	7	1	-	*Pusillina lineolata* (Michaud, 1830)	III	8	8	-
Exogone rostrata Naville, 1933	II	-	5	-	*Pusillina marginata* (Michaud, 1830)	I	-	3	2
Exogone verugera (Claparède, 1868)	I	20	5	6	*Pusillina radiata* (Philippi, 1836)	I	-	18	2
Fabricia stellaris (Müller, 1774)	II	3	1	-	*Pyrgiscus rufus* (Philippi, 1836)	II	2	2	-
Fauveliopsis adriatica Katzmann & Laubier, 1974	I	37	-	2	*Pyrgostylus striatulus* (Linnaeus, 1758)	I	-	1	-
Finella pupoides A. Adams, 1860	II	-	6	17	*Pyrunculus fourierii* (Audouin, 1826)	II	-	1	-
Flabelligera affinis M. Sars, 1829	I	-	1	-	*Pyrunculus hoernesii* (Weinkauff, 1866)	I	-	1	-
Flexopecten hyalinus (Poli, 1795)	I	-	2	-	*Raphitoma aequalis* (Jeffreys, 1867)	I	-	7	-
Folinella excavata (Phillippi, 1836)	I	-	1	-	*Raphitoma echinata* (Brocchi, 1814)	I	1	1	-
Fulvia fragilis (Forsskål in Niebuhr, 1775)	III	1	14	-	*Raphitoma linearis* (Montagu, 1803)	I	1	8	-
Fusinus rostratus (Olivi, 1792)	I	1	-	-	*Retusa crebrisculpta* (Monterosato, 1884)	I	-	1	-
Fusinus rusticulus (Monterosato, 1880)	I	-	1	-	*Retusa laevisculpta* (Granata-Grillo, 1877)	I	-	2	-
Fustiaria rubescens (Deshayes, 1825)	I	-	1	1	*Retusa minutissima* (Monterosato, 1878)	I	2	2	-
Galathea bolivari Zariquiey Álvarez, 1950	I	-	5	-	*Retusa truncatula* (Bruguière, 1792)	I	1	2	-
Galathea intermedia Lilljeborg, 1851	I	-	2	-	*Retusa umbilicata* (Montagu, 1803)	I	1	3	-
Galathowenia oculata (Zachs, 1923)	I	7	5	1	*Rhinoclavis kochi* (Philippi, 1848)	II	-	-	1
Gammarella fucicola (Leach, 1814)	III	-	1	-	*Rhodine loveni* Malmgren, 1865	III	44	16	9
Gastrosaccus sanctus (Van Beneden, 1861)	I	1	1	7	*Ringicula auriculata* (Ménard de la Groye, 1811)	I	3	1	-
Gibbula adansonii (Payraudeau, 1826)	I	-	-	1	*Ringicula conformis* Monterosato, 1877	I	24	6	-
Gibbula ardens (Salis Marschlins, 1793)	I	1	5	2	*Rissoa auriscalpium* (Linnaeus, 1758)	I	-	1	-
Gibbula divaricata (Linnaeus, 1758)	I	2	-	-	*Rissoa monodonta* Philippi, 1836	I	-	1	-
Glans trapezia (Linnaeus, 1767)	I	-	1	-	*Rissoa rodhensis* Verduin, 1985	I	-	-	2
Glycera alba (O.F. Müller, 1776)	III	13	14	7	*Rissoa variabilis* (Von Mühlfeldt, 1824)	I	-	4	-
Glycera fallax Quatrefages, 1850	III	47	32	16	*Rissoa violacea* Desmarest, 1814	I	-	1	-
Glycera tesselata Grube, 1840	II	-	-	2	*Roxania utriculus* (Brocchi, 1814)	I	-	2	-

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Glycera tridactyla Schmarda, 1861	III	-	3	-	*Rullierinereis anoculata* Cantone, 1983	I	2	-	-
Glycera unicornis Lamarck, 1818	III	9	22	1	*Saccella commutata* (Philippi, 1844)	II	-	1	10
Glycinde bonhourei Gravier, 1904	II	1	-	55	*Saccocirrus papillocercus* Bobretzky, 1872	I	-	-	1
Glycinde nordmanni (Malmgren, 1866)	II	2	-	-	*Salvatoria clavata* (Claparède, 1863)	II	-	-	1
Gnathia vorax (Lucas, 1849)	I	5	8	-	*Scalibregma celticum* Mackie, 1991	II	-	1	-
Goneplax rhomboides (Linnaeus, 1758)	III	8	3	-	*Schistomeringos rudolphi* (Delle Chiaje, 1828)	V	5	-	1
Goniada maculata Örsted, 1843	II	2	14	2	*Sclerocheilus minutus* Grube, 1863	I	-	2	-
Gouldia minima (Montagu, 1803)	I	1	3	-	*Scolelepis tridentata* (Southern, 1914)	III	11	-	-
Gourretia denticulata (Lutze, 1937)	II	5	3	2	*Scoletoma emandibulata mabiti* (Ramos, 1976)	II	34	6	8
Granulina clandestina (Brocchi, 1814)	I	-	3	-	*Scoletoma impatiens* (Claparède, 1868)	II	5	4	1
Granulina marginata (Bivona, 1832)	I	2	-	-	*Scoloplos armiger* (Müller, 1776)	III	-	1	-
Granulina occulta (Monterosato, 1869)	I	-	11	-	*Scoloplos chevalieri canadiensis* Harmelin, 1969	I	2	-	81
Guernea (Guernea) coalita (Norman, 1868)	I	9	3	-	*Scrobicularia plana* (da Costa, 1778)	I	1	-	-
Gyptis propinqua Marion & Bobretzky, 1875	I	1	-	-	*Sigalion mathildae* Audouin & Milne Edwards in Cuvier, 1830	II	-	2	12
Haedropleura septangularis (Montagu, 1803)	I	-	-	1	*Sigambra tentaculata* (Treadwell, 1941)	IV	566	79	249
Halocynthia papillosa (Linnaeus, 1767)	II	-	2	-	*Siphonoecetes (Centraloecetes) dellavallei* Stebbing, 1899	I	-	-	1
Haminoea hydatis (Linnaeus, 1758)	I	-	5	-	*Siriella clausii* G.O. Sars, 1877	I	-	2	-
Haplosyllis spongicola (Grube, 1855)	I	-	2	-	*Sirpus zariquieyi* Gordon, 1953	I	-	1	-
Harmothoe antilopes McIntosh, 1876	II	5	2	1	*Sosane sulcata* Malmgren, 1866	II	-	2	-
Harmothoe goreensis Augener, 1918	I	1	-	-	*Spatangus purpureus* O.F. Müller, 1776	I	2	2	2
Harmothoe spinifera (Ehlers, 1864)	I	-	1	-	*Sphaerodoridium claparedeii* (Greeff, 1866)	II	1	1	-
Harpinia crenulata (Boeck, 1871)	II	42	21	-	*Sphaerodoropsis minuta* (Webster & Benedict, 1887)	II	1	-	-
Harpinia dellavallei Chevreux, 1910	II	100	5	8	*Sphaerosyllis glandulata* Perkins, 1981	I	4	2	-
Harpinia truncata Sars, 1891	II	4	-	-	*Sphaerosyllis hystrix* Claparède, 1863	II	2	11	5
Hermodice carunculata (Pallas, 1766)	II	-	-	1	*Sphaerosyllis pirifera* Claparède, 1868	II	-	1	1
Hesiospina aurantiaca (M. Sars, 1862)	I	-	12	5	*Sphaerosyllis taylori* Perkins, 1981	I	42	1	-
Heteromastus filiformis (Claparède, 1864)	V	21	16	1	*Sphaerosyllis thomasi* San Martín, 1984	I	16	2	1
Hexaplex trunculus (Linnaeus, 1758)	I	1	-	-	*Spio decoratus* Bobretzky, 1870	IV	15	2	1
Hiatella arctica (Linnaeus, 1767)	I	-	1	-	*Spio filicornis* (Müller, 1776)	III	-	1	1
Hilbigneris gracilis (Ehlers, 1868)	III	-	2	1	*Spiochaetopterus costarum* (Claparède, 1869)	III	19	3	7
Hippomedon bidentatus Chevreux, 1903	I	1	-	-	*Spiophanes afer* Meißner, 2005	I	1	3	25
Hippomedon massiliensis Bellan-Santini, 1965	I	-	1	2	*Spiophanes bombyx* (Claparède, 1870)	II	1	-	3

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Holothuria tubulosa Gmelin, 1791	I	-	2	-	*Spiophanes kroyeri* Grube, 1860	II	4	1	2
Hyala vitrea (Montagu, 1803)	II	231	129	1	*Spiralinella incerta* (Milaschewich, 1916)	I	25	6	-
Hyale camptonyx (Heller, 1866)	I	-	-	9	*Spirobranchus triqueter* (Linnaeus, 1758)	II	-	1	-
Inachus parvirostris (Risso, 1816)	I	1	-	-	*Spirobranchus triqueter* (Linnaeus, 1758)	III	-	1	-
Inermonephtys inermis (Ehlers, 1887)	II	-	1	-	*Spisula subtruncata* (da Costa, 1778)	III	3	12	-
Iphimedia gibbula Ruffo & Schiecke, 1979	I	-	1	-	*Sternaspis scutata* Ranzani, 1817	III	971	108	-
Iphimedia minuta G.O. Sars, 1882	I	-	1	-	*Sthenelais boa* (Johnston, 1833)	II	-	3	2
Iphinoe douniae Ledoyer, 1965	III	29	24	9	*Streblospio gynobranchiata* Rice & Levin, 1998	V	1278	184	-
Iphinoe tenella Sars, 1878	II	41	-	-	*Striarca lactea* (Linnaeus, 1758)	I	-	-	1
Janira maculosa Leach, 1814	I	-	1	-	*Subadyte pellucida* (Ehlers, 1864)	II	6	-	1
Japonactaeon pusillus (Forbes, 1844)	I	1	-	4	*Sycon raphanus* Schmidt, 1862	I	-	2	-
Jassa marmorata Holmes, 1905	V	2	9	5	*Syllides edentatus* Westheide, 1974	II	-	1	-
Jujubinus exasperatus (Pennant, 1777)	I	1	9	1	*Syllides fulvus* (Marion & Bobretzky, 1875)	II	-	2	-
Jujubinus montagui (Wood, 1828)	I	-	1	-	*Syllides japonicus* Imajima, 1966	II	2	-	-
Jujubinus striatus (Linnaeus, 1758)	I	-	21	-	*Syllidia armata* Quatrefages, 1866	IV	3	1	-
Kurtiella bidentata (Montagu, 1803)	III	125	56	-	*Syllis alternata* Moore, 1908	I	-	2	-
Labioleanira yhleni (Malmgren, 1867)	I	1	-	-	*Syllis armillaris* (O.F. Müller, 1776)	III	3	2	-
Lacydonia miranda Marion & Bobretzky, 1875	I	-	1	2	*Syllis beneliahuae* (Campoy & Alquézar, 1982)	II	-	1	-
Laetmonice hystrix (Savigny in Lamarck, 1818)	I	-	4	-	*Syllis cruzi* Núñez & San Martín, 1991	I	-	2	1
Lagis koreni Malmgren, 1866	II	6	-	-	*Syllis ergeni* Çinar, 2005	III	4	-	-
Lanice conchilega (Pallas, 1766)	IV	6	2	-	*Syllis garciai* (Campoy, 1982)	III	47	41	5
Laonice bahusiensis Söderström, 1920	I	48	7	-	*Syllis gerlachi* (Hartmann-Schröder, 1960)	II	2	1	-
Laonice cirrata (M. Sars, 1851)	II	89	28	1	*Syllis gerundensis* (Alós & Campoy, 1981)	I	-	-	1
Laubieriellus salzi (Laubier, 1970)	I	-	2	-	*Syllis gracilis* Grube, 1840	II	1	1	-
Leiocapitella glabra Hartman, 1947	II	-	1	-	*Syllis hyalina* Grube, 1863	I	1	8	-
Leiochone leiopygos (Grube, 1860)	II	9	4	1	*Syllis krohni* Ehlers, 1864	II	2	-	-
Leonnates aylaoberi (Çinar & Dagli, 2013)	I	-	4	1	*Syllis pontxioi* San Martín & López, 2000	I	5	-	-
Leonnates persicus Wesenberg-Lund, 1949	II	16	-	8	*Syllis prolifera* Krohn, 1852	II	2	-	1
Leptocheirus mariae Karaman, 1973	III	27	2	3	*Syllis rosea* (Langerhans, 1879)	II	-	-	2
Leptocheirus pectinatus (Norman, 1869)	III	10	5	4	*Synchelidium haplocheles* (Grube, 1864)	II	1	-	1
Leptochela pugnax de Man, 1916	II	-	1	26	*Syrnola fasciata* Jickeli, 1882	II	-	1	1
Leptochelia savignyi (Krøyer, 1842)	III	11	101	20	*Tanais dulongii* (Audouin, 1826)	III	1	-	-
Leptopentacta elongata (Düben & Koren, 1846)	II	1	-	-	*Tellina albicans* Gmelin, 1791	II	2	1	-

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Leptopentacta tergestina (M. Sars, 1857)	I	-	2	-	*Tellina pulchella* Lamarck, 1818	III	29	16	-
Leucothoe lilljeborgi Boeck, 1861	I	34	1	-	*Tellina serrata* Brocchi, 1814	I	1	-	-
Leucothoe occulta Krapp-Schickel, 1975	I	-	4	-	*Terebellides stroemii* Sars, 1835	III	37	7	1
Leucothoe serraticarpa Della Valle, 1893	I	-	2	1	*Teretia teres* (Reeve, 1844)	I	-	3	-
Leucothoe spinicarpa (Abildgaard, 1789)	I	-	4	-	*Thelepus cincinnatus* (Fabricius, 1780)	II	-	2	-
Levinsenia demiri Çinar, Dagli & Acik, 2011	II	-	57	5	*Thracia phaseolina* (Lamarck, 1818)	I	1	-	-
Levinsenia gracilis (Tauber, 1879)	II	1214	-	-	*Thyasira flexuosa* (Montagu, 1803)	II	27	36	-
Levinsenia marmarensis Çinar, Dagli & Acik, 2011	II	-	1	-	*Thysanocardia procera* (Möbius, 1875)	I	3	-	-
Levinsenia materi Çinar & Dagli 2013	II	-	3	5	*Timoclea ovata* (Pennant, 1777)	I	3	1	1
Levinsenia tribranchiata (Çinar, Dagli & Açik, 2011)	II	-	3	-	*Tragula fenestrata* (Jeffreys, 1848)	I	-	3	-
Liljeborgia dellavallei Stebbing, 1906	I	4	-	-	*Trichobranchus glacialis* Malmgren, 1866	II	-	6	-
Lineus cf. *ruber* (Müller, 1974)	III	2	-	-	*Trophonopsis muricata* (Montagu, 1803)	I	-	-	3
Linucula hartvigiana (Dohrn, 1864)	II	2	1	-	*Trypanosyllis (Trypanosyllis) coeliaca* Claparède, 1868	II	-	1	-
Liocarcinus maculatus (Risso, 1827)	I	1	2	-	*Tryphosa nana* (Krøyer, 1846)	II	9	1	-
Litocorsa stremma Pearson, 1970	I	64	2	150	*Tubulanus linearis* (McIntosh, 1874)	III	155	19	1
Loripinus fragilis (Philippi, 1836)	III	5	2	1	*Tubulanus polymorphus* Renier, 1804	III	64	-	-
Lucifer typus H. Milne Edwards, 1837 [in H. Milne Edwards, 1834-1840]	III	1	-	-	*Turbonilla acuta* (Donovan, 1804)	I	1	-	-
Lucinella divaricata (Linnaeus, 1758)	I	1	8	1	*Turbonilla delicata* Monterosato, 1874	I	-	13	-
Lumbrineriopsis paradoxa (Saint-Joseph, 1888)	I	-	1	1	*Turbonilla gradata* Bucquoy, Dautzenberg & Dollfus, 1883	I	3	1	-
Lumbrineris coccinea (Renier, 1804)	I	-	4	-	*Turbonilla hamata* Nordsieck, 1972	I	1	-	-
Lumbrineris geldiayi Carrera-Parra, Çinar & Dagli, 2011	II	821	214	93	*Turbonilla jeffreysii* (Jeffreys, 1848)	I	1	-	-
Lumbrineris latreilli Audouin & Milne Edwards, 1834	II	12	18	3	*Turritella communis* Risso, 1826	II	427	109	1
Lumbrineris nonatoi Ramos, 1976	II	115	56	5	*Turritella turbona* Monterosato, 1877	I	-	5	1
Lumbrineris zonata Johnson, 1901	II	1	-	-	*Upogebia pusilla* (Petagna, 1792)	II	1	-	-
Lysianassa caesarea Ruffo, 1987	I	-	1	-	*Upogebia tipica* (Nardo, 1869)	II	4	-	1
Lysianassa costae (Milne Edwards, 1830)	I	-	7	-	*Urothoe elegans* (Bate, 1857)	I	-	6	-
Lysidice ninetta Audouin & H Milne Edwards, 1833	II	-	3	-	*Urothoe grimaldii* Chevreux, 1895	I	-	-	5
Lysidice unicornis (Grube, 1840)	II	8	13	3	*Urothoe intermedia* Bellan-Santini & Ruffo, 1986	I	-	20	2
Lysilla loveni Malmgren, 1866	II	-	6	-	*Vaunthompsonia cristata* Bate, 1858	I	-	4	-
Macrochaeta clavicornis (M. Sars, 1835)	II	-	4	-	*Vermiliopsis infundibulum* (Philippi, 1844)	II	-	1	-
Macrophthalmus graeffei A. Milne-Edwards, 1873	II	-	-	10	*Vexillum ebenus* (Lamarck, 1811)	I	-	3	1
Maera grossimana (Montagu, 1808)	I	-	1	-	*Vexillum granum* (Forbes, 1844)	I	1	-	1

Species	EG	Iz	Ag	Le	Species	EG	Iz	Ag	Le
Maera schmidti Stephensen, 1915	I	8	1	2	*Vexillum tricolor* (Gmelin, 1791)	I	-	-	1
Magelona alleni Wilson, 1958	II	55	1	1	*Vitreolina philippi* (de Rayneval & Ponzi, 1854)	I	1	-	-
Magelona johnstoni Fiege, Licher & Mackie, 2000	I	-	-	1	*Volvarina mitrella* (Risso, 1826)	I	-	1	-
Magelona minuta Eliason, 1962	II	295	42	13	*Volvulella acuminata* (Bruguière, 1792)	I	-	1	2
Maldane glebifex Grube, 1860	I	2	-	-	*Websterinereis glauca* (Claparède, 1870)	III	1	-	-
Malmgreniella lilianae Petttibone, 1993	II	34	4	-	*Weinkauffia turgidula* (Forbes, 1844)	I	-	2	7
Malmgreniella lunulata (Delle Chiaje, 1830)	II	13	1	-	*Westwoodilla rectirostris* (Della Valle, 1893)	I	1	8	1
Malmgreniella polypapillata Barnich & Fiege, 2001	II	11	-	-					