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Biodiversity from the upper slope demersal community of the eastern Mediterranean:
preliminary comparison between two areas with and without fishing impact

by

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Abstract

Univariate ecological indexes and multivariate analyses (cluster and MDS) were performed in order to evaluate biodiversity in two neighbouring areas of the eastern Mediterranean with different fishing impact. Data were taken during two trawl surveys (July and August 2000) carried out in two areas of the Ionian Sea: one off the south-eastern Italian coast, where trawl fishing occurs between 300 and 700 m targetting deep-sea shrimps A. antennatus and A. foliacea, the other off the northern Greece, where fishing is only carried out as far as 400 m of depth.

While univariate ecological indexes did not show convincing differences between the community structure of the two study areas considered as whole, the multivariate analysis showed a clear pattern linked to depths and areas highlighting the distribution of abundance of the various species. The depth play the main role in the group differentiation, indicating the existence of quite two distinct bathyal faunal assemblages: one in the upper slope, the other in the middle slope. The results on the geographic characterization of the biodiversity and of the assemblages were discussed considering the different fishing impact as well as the environmental conditions in the two areas of the same basin.

Introduction

The Ionian Sea is a basin of the Eastern Mediterranean limited westwards by the Italian coasts and eastwards by Greek ones. It communicates with the western Mediterranean through the Sicilian Channel, with the Adriatic through the Otranto Channel and with the Aegean Sea through the three straits of the Western Cretan Arc. Such a position determines a complex hydrology due to the occurrence of the three main water masses: the Modified North Atlantic Water, the Levantine Intermediate Water, and the Eastern Mediterranean Deep Water (Theocharis *et al*., 1993; Rabitti *et al*, 1994).

The knowledge on the distribution and abundance of the demersal fauna in the Ionian basin are mostly related to the Italian side, where since 1985 systematic surveys on the demersal resources have been carried out (e.g. Tursi & D'Onghia, 1992; Matarrese *et al*., 1996; D'Onghia *et al*., 1998). The groundfish fauna of the Greek Ionian Sea as well as the fauna of crustaceans decapods and cephalopods, have been studied only recently (Anon., 1999; Anon., 2000; Politou *et al*., 2000). While along the Italian coasts the demersal resources have long been intensively exploited as far as 800 m in depth (Tursi *et al*., 1998), off Greece the commercial fishery is only carried out up to depths of 400 m.

Although, both the hydrological features and the fishing impact could affect the distribution and abundance of many species, influencing diversity in the marine ecosystems, comparison studies on the faunistic assemblages between the two sides of the Ionian Sea (Italian and Greek) have never been conducted. Furthermore, although in the last decade many studies on the effects of fishing on ecosystem structure and process have been carried out (e.g., Jennings & Kaiser, 1998, and references therein; Hall, 1999, and references therein), the knowledge on the effects of trawl fishing on the fish communities in the Mediterranean are still rather scant (e.g. Stergoiu *et al*., 1997; Ungaro *et al*., 1998; Moranta *et al*., 2000; Pranovi *et al*., 2000).

The “INTERREG” project, funded in cooperation by the EC, the Italian and Greek governments, gave the opportunity to investigate two areas of the North Ionian Sea with different fishing impact: one off the South-eastern Italian coast, where deep-water fishing occurs, the other off Northern Greece, where there is no deep trawl fishing. In this paper, the preliminary observations concerning the faunal assemblages and the relative biodiversity are presented.

Materials and Methods

Data were collected during two trawl surveys (July and August 2000) carried out in two areas of the Ionian Sea (Eastern Mediterranean): one off the south-eastern Italian coast, the other off the northern Greece (Fig.1). In the former trawl fishing occurs between 300 and 700 m targetting deep-sea shrimps A. antennatus and A. foliacea (Tursi *et al*., 1998), in the latter fishing is carried out as far as 400 m of depth.

A total of 14 hauls, each lasting 1hour, were randomly taken in each area between 300 and 750 m. The same professional fishing vessel equipped with trawl net Italian type, with 20 mm stretched mesh size in cod-end, was used. Fishes, crustaceans, cephalopods and benthic species captured in each haul were sorted to species, counted and weighed. The data for each species was expressed as number and weight of individuals per hour of trawling. Each species was coded with a number. Hauls were coded considering geographic area (I = Italy; G = Greece). Species known to be tipically pelagic were omitted, unless a frequent and abundant finding was observed with the gear used. Biodiversity was computed using the following univariate ecological indexes: Shannon-Wiener diversity index H’; Margalef species richness D (by using Ln trasformation), and Pielou’s evenness J (Magurran, 1988). Both abundance (N/h) and biomass (Kg/h) data were used in the indexes computation. Assuming a normal distribution of diversity indexes (Odum, 1982), the t-test was applied in order to detect significant differences between the two areas.

Matrices with the numbers and weights per hour of each species from each station were compiled. Basic data were log-transformed to reduce influence of the most abundant species. Classification and ordination were performed in order to identify demersal faunal assemblages in the two geographic study areas. The former was made by means of cluster analysis using Euclidean distance coefficient and complete linkage method (Ludwig and Reynolds, 1988). The latter through non-parametric multi-dimensional scaling analysis (Kruskall, 1964). All these analyses were carried out using Statistica software (StatSoft, 1995).

Results

According to the selection criteria, 112 species were collected both in Italian and Greek area. The average hourly abundance (N/h) and biomass (Kg/h) for each of them are shown in Table 1.

Teleost fishes were represented with most species in both areas (42 off Italy and 46 off Greece), followed by crustaceans (36 and 27 in Italy and Greece respectively), cephalopods (12 along the Italian coasts and 14 along Greece ones) and other minor taxa.

Diversity indexes per each station are reported in Tab.2. H’ ranged from 0.87 and 2.43 in Italian waters and from 1.2 and 2.67 in Greek area. Species richness indexes D were between 2.88 and 3.76 in the Italian stations and 3.04 and 3.74 in Greek ones. Evenness values J resulted between 0.25 and 0.74 off Italy and 0.33 and 0.79 off Greece. Although higher values of each index were computed for Greek area, the differences were not statistically significant ($p>0.05$).

Concerning cluster analysis, the abundance value (N/h) produced a more efficient group separation than biomass (Kg/h), even though consistent results were obtained. Concerning abundance the resulting dendrogram among hauls indicated, at greater distance level (lower similarity), the presence of two main clusters related to depth (Fig. 2). One regards the uppermost stations (A), covering a depth range of 327-478 m, with a mean depth of 370 m. The other is related to deeper hauls (B), including the intermediate investigated depths between 513 and 683 m, with a mean depth of 572 m (B1), and the deepest stations, between 592 and 757 m, with a mean depth of 669 m (B2). For each of these clusters a lower distance (higher similarity) was shown within each geographic area. In fact, Italian and Greek hauls resulted well separated in each of them. However, in B2 cluster the deepest hauls of Italian and Greek waters showed a higher similarity than the shallowest in Italian waters (between 592-629 m).

The results of MDS (stress level= 0,05) as three-dimensional representation are shown in Fig. 3. The ordination of the 28 hauls was in agreement with clustering, confirming that the different stations fall into distinct groupings. In particular, MDS analysis highlights: a) a marked separation between the uppermost and middle slope stations; b) a marked geographic separation of the hauls in the uppermost slope; c) at lesser extent, a geographic characterization of the stations in the middle slope.

On the basis of both clustering and MDS analysis, the uppermost assemblage in Greek area was characterized by a great abundance of *Chlorophthalmus agassizii* and at lesser extent by *Hymenocephalus italicus*, *Plesionika heterocarpus*, *Parapenaeus longirostris*, *Gadiculus argenteus*, *Argentina sphyraena*, *Capros aper*, *Caelorhynchus caelorhynchus*, *Peristedion cataphractum*, *Galeus melastomus*, *Merluccius merluccius*, *Pagellus bogaraveo*, *Micromesistius poutassou*, *Scyliorhinus canicula*, *Raya oxyrinchus*, *Squalus blainvillei*. A total of 67 species in this assemblage determined a diversity index (H') of 1.5. The dominant species in the uppermost assemblage of Italian area were much less abundant than in Greece. They were: *Plesionika heterocarpus*, *Gadiculus argenteus*, *Hymenocephalus italicus*, *Nephrops norvegicus*, *Chlorophthalmus agassizii*, *Phycis blennoides*, *Helicolenus dactylopterus*, *Parapenaeus longirostris*, *Galeus melastomus*, *Micromesistius poutassou*. Apart from *G. melastomus* no elasmobranch species were found in this assemblage, which was constituted by 51 species. Its computed diversity index (H') was 2.5.

The assemblages in the middle slope showed a greater similarity between the two areas. The diversity index computed for the deepest group of stations (B2) was 2.48 in both areas. However, in addition to the different distribution of the species abundance, the geographic characterization also showed in the middle slope would seem mainly due to the dominance of *Aristaeomorpha foliacea* and *Helicolenus dactylopterus* in Greek waters and of *Plesionika martia* and *Aristeus antennatus* in Italian ones.

Discussion

The results of this study indicate that depth and geographic area are the main factors influencing faunal assemblages in the north-eastern Ionian Sea.

Univariate ecological indexes do not show convincing differences between the community structure of the two study areas considered as whole. Moreover, diversity index H' was found to be higher in the uppermost assemblage from the Italian area where trawl fishing occurs. The smaller value of H' shown in Greek assemblage, made up of a higher number of species, might most probably be due to the high dominance of one (*C. agassizii*) or few species. According to Murawski (2000), the greater H' value shown in Italian waters might be due to the exploitation which reducing dominance determines an increase of evenness and thus of diversity. On the deepest investigated bottoms the computed diversity index indicates a similar structure of the assemblages in the Italian and Greek waters, however it does not take account of the role of the different species in the two geographic areas.

On the contrary, the multivariate analysis shows a clear pattern linked to depths and areas highlighting the distribution of abundance of the various species. Particularly, the depth play the main role in the group differentiation, indicating the existence of quite two distinct bathyal faunal assemblages: one in the upper slope, the other in the middle slope. These results are in agreement with previous observations made in the western Ionian Sea (D'Onghia *et al*., 1998) and in other Mediterranean areas (e.g. Abellò *et al*., 1988; Biagi *et al*., 1989; Cartes *et al*., 1994; Abella and Serena, 1995; Stefanescu *et al*., 1994; Ungaro *et al*., 1995). They would confirm that the transition between an upper slope fauna and a strictly bathyal fauna is located at about 400-500 m (Pérès abd Picard, 1964; Abellò *et al*., 1988; Mura and Cau, 1994).

Concerning the geographic characterization of the stations showed in this study, the question is whether such a characterization, as shown in several case studies (Hall, 1999, and references therein), is due to the different fishing impact or to different environmental conditions.

With regard to the uppermost investigated depths, the lacking of fishing pressure in Greek area might explain the higher biomass computed for many species, the dominance of few species and the finding of a greater number of species and specimens of elasmobranchs. As know, sharks are species particularly vulnerable to the overexploitation because of their k-selected life-history strategy (e.g. Stevens *et al*., 2000). However, the fact that both *S. blainvillei* and *R. clavata* were never found in the north-western Ionian Sea, along the Italian coasts, since 1985 (Matarrese *et al*., 1996), while they are frequently caught in the neighbouring Sicilian Channel (Ragonese, personal communication), where demersal resources are intensively exploited, indicates that the local environmental conditions should also be considered in order to explain species occurrence and distribution. This might also be evidenced for other species, such as *Peristedion cataphractum*, which is abundant both along the Ionian coasts of Greece and in Sicilian Channel (Pizzicori *et al*., 1995), while it is rarely found along the Ionian coasts of Italy (Matarrese *et al*., 1996).

In the middle slope, the geographic characterization of the abundance and size structure of A. foliacea and A. antennatus populations was recently shown and correlated to the different hydrology and fishing impact in the two areas (Maiorano *et al*., submitted). With regard the hydrology, along the Greek coasts the water masses are warmer and have high salinity while along the Italian ones they are colder and barely less saline (Robinson and Golnaraghi, 1992; Theocaris *et al*., 1993, Rabitti *et al*., 1994). *A. foliacea* would be mainly linked to the former whereas *A. antennatus* mostly to the latter, according to Ghidalia and Bourgois (1961) and Bombace (1975). Although the hydrographic hypothesis of Ghidalia and Bourgois (1961) needs to be confirmed, the Mediterranean distribution of the two species would seem to support it (Relini and Orsi Relini, 1987; Murenu *et al*., 1994; Ragonese, 1995). However, there are no studies that have established other specific hypotheses on the different distribution of these two companion species.

Concerning the fishing impact, *A. foliacea* is more vulnerable to trawl fishing and less resilient than *A. antennatus* (Orsi Relini and Relini, 1985; Matarrese *et al*., 1997). In fact, while both juvenile and adult A. foliacea are almost exclusively distributed at depths where the bottom trawl fishing occurs, *A. antennatus* shows a wider vertical distribution. In addition to the deeper distribution and the lower availability to fishing of *A. antennatus* (Sardà, 1993), its higher density on the Italian side of the Ionian Sea and its higher fecundity (up to four times that of *A. foliacea* in the larger females, according to Orsi Relini and Semeria, 1983), seem to play an important role in the stock recovery. On the contrary, the lower density of *A. foliacea* along the Italian coasts together with its relatively shallower distribution and its low reproductive potential (Orsi Relini and Semeria, 1983), make it particularly vulnerable to trawling.

The lower abundance values recorded for *H. dactylopterus* in the Italian area seem to be the consequence of its exploitation since the early life stages on the continental shelf (D'Onghia *et al*., 1994). The higher similarity showed in the community structure of the two areas at the greatest depths might be explained by the presence of a high number of species with a wider depth distribution than trawling, such as macrourid fish, *H. mediterraneus*, *G. melastomus*, thus less vulnerable to the fishing pressure.

Finally, although the present results are still preliminary, they seem to evidence that the differences in biodiversity between the two study areas might be related to both fishing impact and environmental conditions. Further data collection and analysis are required in order to evaluate the role of each process and how they interact.

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Table 1. List of the species collected in Italian and Greek areas with indications of density (N/h) and biomass valeus (Kg/h).

Italy			Greece	
		SPONGES		
Kg/h	**N/h**		**N/h**	**Kg/h**
0.000	1.33	*Calthropella pathologica*	0.00	0.000
		CNIDARIANS		
0.590	38.45	*Actinauge richardi*	0.00	0.000
0.016	17.36	*Adamsia palliata*	4.00	0.000
0.220	21.00	*Brisingella coronata*	2.00	0.000
0.000	0.00	*Calliactis parasitica*	7.00	0.000
0.000	0.00	*Caryophyllia smithi*	7.00	0.000
0.000	0.00	*Desmophyllum cristagalli*	5.00	0.000
0.000	0.00	*Funiculina quadrangularis*	2.00	0.000
0.000	0.00	*Isidella elongata*	0.00	0.000
0.040	28.00	*Kophobelemnon leukarti*	0.00	0.000
0.040	25.00	*Pennatula rubra*	0.00	0.000
		BRACHIOPODS		
0.005	3.67	*Gryphus vitreus*	37.00	0.222
		SCAPHOPODS		
0.020	8.00	*Dentalium sp.*	0.00	0.000
		GASTEROPODS		
0.000	0.00	*Aporrhais pespelecani*	4.00	0.002
0.000	0.00	*Argobuccinum olearium*	1.00	0.000
0.046	2.00	*Cassidaria echinophora*	0.00	0.000
0.192	2.00	*Tethys fimbria*	0.00	0.000
		BIVALVES		
0.000	2.67	*Delectopecten vitreus*	0.00	0.000
		CEPHALOPODS		
0.005	1.00	*Abralia verany*	4.50	0.022
0.015	1.00	*Ancistroteuthis lichtensteinii*	0.00	0.000
0.009	1.00	*Brachioteuthis riisei*	0.00	0.000
0.182	2.00	*Histioteuthis reversa*	1.00	0.050
0.000	0.00	*Illex coindetii*	2.67	0.016
0.000	0.00	*Loligo forbesii*	21.33	5.100
0.020	1.00	*Neorossia caroli*	9.20	0.107
1.136	18.00	*Octopus salutii*	0.00	0.000
0.000	0.00	*Onychoteuthis banksii*	1.00	0.020
2.487	12.09	*Pteroctopus tetracirrhus*	9.50	4.100
0.000	0.00	*Rondeletiola minor*	4.00	0.007
0.274	4.00	*Rossia macrosoma*	10.00	0.300
0.038	3.00	*Scaeurgus unicirrhus*	2.67	0.040
0.000	0.00	*Sepia elegans*	24.00	0.227
0.000	0.00	*Sepia orbignyana*	2.67	0.040
0.005	1.00	*Sepia spp.*	0.00	0.000
0.473	102.00	*Sepietta oweniana*	132.00	0.452
15.030	45.33	*Todarodes sagittatus*	5.50	2.650
		SIPUNCULANS		
0.000	0.00	*Sipunculus nudus*	2.00	0.010
		CRUSTACEANS		
0.009	2.00	*Acanthephyra eximia*	0.00	0.000
0.007	2.00	*Acanthephyra pelagica*	0.00	0.000
0.038	25.00	*Aegeon lacazei*	4.00	0.004
6.084	671.67	*Aristaeomorpha foliacea*	3478.40	61.620
25.311	1141.00	*Aristeus antennatus*	382.20	12.163
0.018	3.00	*Bathynectes maravigna*	13.50	0.121
0.222	167.00	*Chlorotocus crassicornis*	25.33	0.045
0.000	0.00	*Dardanus arrosor*	2.00	0.062
0.216	3.09	*Geryon longipes*	0.00	0.000
0.232	103.00	*Macropipus tuberculatus*	4.00	0.016
0.045	13.00	*Monodaeus couchii*	0.00	0.000
0.026	11.00	*Munida intermedia*	1.00	0.003
0.000	0.00	*Munida iris*	68.00	0.060
0.017	9.09	*Munida perarmata*	1.00	0.003
0.011	6.00	*Munida spp.*	0.00	0.000
13.437	1170.97	*Nephrops norvegicus*	61.53	4.066
0.065	11.00	*Pagurus alatus*	2.00	0.000
0.026	8.09	*Pagurus prideaux*	2.00	0.000
0.000	1.00	*Pagurus spp.*	0.00	0.000
2.602	213.00	*Parapenaeus longirostris*	1545.40	7.274
0.586	2.09	*Paromola cuvieri*	2.00	0.930
0.177	32.00	*Pasiphaea multidentata*	4.40	0.023
0.007	6.09	*Pasiphaea sivado*	1.20	3.501
0.031	19.33	*Plesionika acanthonotus*	89.50	0.095
0.002	2.00	*Plesionika antigai*	602.33	0.514
0.000	0.00	*Plesionika edwardsii*	150.50	1.395
0.226	150.00	*Plesionika gigliolii*	269.17	0.324

Table 1. Continued.

4.840	2074.00	*Plesionika heterocarpus*	2492.00	4.121
49.915	11282.79	*Plesionika martia*	3943.60	17.403
0.010	2.00	*Plesionika narval*	0.00	0.000
1.532	732.67	*Polycheles typhlops*	119.50	0.557
0.022	13.00	*Pontophilus spinosus*	0.00	0.000
0.003	3.00	*Pontophyllus norvegicus*	0.00	0.000
0.200	184.00	*Processa canaliculata*	0.00	0.000
0.024	6.00	*Rissoides pallidus*	0.00	0.000
0.004	4.18	*Sergestes arcticus*	2.40	0.001
0.005	3.00	*Sergestes corniculum*	4.73	0.005
0.001	1.00	*Sergestes spp.*	0.00	0.000
0.009	7.00	*Sergia robusta*	24.20	0.049
0.622	320.27	*Solenocera membranacea*	0.00	0.000
		ECHINODERMS		
0.000	0.00	*Astropecten aranciatus*	1.00	0.200
0.000	0.00	*Astropecten irregularis penta.*	1.00	0.000
0.986	32.00	*Cidaris cidaris*	31.00	0.391
0.270	35.00	*Echinus acutus*	1.00	0.000
0.000	0.00	*Marginaster capreensis*	1.00	0.000
0.130	5.00	*Mesothuria intestinalis*	1.00	0.000
0.000	0.00	*Sclerasterios neglecta*	3.00	0.000
0.010	1.00	*Sphaeriodiscus placenta*	0.00	0.000
0.324	2.00	*Stichopus regalis*	0.00	0.000
		SELACHIANS		
0.000	0.00	*Centrolophus niger*	3.00	8.550
2.082	10.85	*Chimaera monstrosa*	0.00	0.000
0.208	1.00	*Dalatias licha*	0.00	0.000
11.869	350.64	*Etmopterus spinax*	29.20	1.954
111.692	735.70	*Galeus melastomus*	805.90	86.105
0.000	0.00	*Heptranchias perlo*	4.00	3.200
0.000	0.00	*Mustelus mustelus*	3.00	16.800
0.488	3.00	*Raja circularis*	0.00	0.000
0.000	0.00	*Raja clavata*	3.33	2.127
0.218	1.09	*Raja oxyrinchus*	17.33	10.476
0.000	0.00	*Raja spp.*	4.00	2.638
0.000	0.00	*Scyliorhinus canicula*	18.67	2.852
0.000	0.00	*Squalus blainvillei*	14.00	11.900
		FISH		
0.060	12.09	*Antonogadus megalokynodon*	2.00	0.015
0.100	4.00	*Argentina sphyraena*	714.00	9.892
0.003	3.18	*Argyropelecus hemigymnus*	6.70	0.028
0.000	0.00	*Arnoglossus rueppelli*	36.00	0.173
0.027	1.33	*Benthocometes robustus*	0.00	0.000
0.000	0.00	*Benthosema glaciale*	13.00	0.013
2.004	173.33	*Caelorhynchus coelorhynchus*	628.00	7.039
0.000	0.00	*Capros aper*	572.00	16.600
0.002	1.00	*Ceratoscopelus maderensis*	2.00	0.003
0.030	3.00	*Chauliodus sloani*	32.30	0.378
4.877	967.18	*Chlorophthalmus agassizii*	28443.67	239.601
9.720	14.00	*Conger conger*	28.00	0.600
0.000	0.00	*Diaphus holti*	1.20	0.002
0.000	0.00	*Diaphus metopoclampus*	1.00	0.010
0.002	1.00	*Diaphus rafinesquei*	0.00	0.000
0.000	0.00	*Epigonus constanciae*	10.00	0.202
0.075	3.00	*Epigonus telescopus*	0.00	0.000
4.815	1638.00	*Gadiculus argenteus*	993.33	3.987
13.717	426.61	*Helicolenus dactylopterus*	571.03	87.480
27.110	480.52	*Hoplostethus mediterraneus*	630.30	41.300
0.005	1.00	*Hygophum benoiti*	0.00	0.000
0.004	2.00	*Hygophum hygomii*	0.00	0.000
8.770	2703.24	*Hymenocephalus italicus*	3938.80	14.541
0.706	66.73	*Lampanyctus crocodilus*	332.83	3.819
0.270	2.00	*Lepidion lepidion*	0.00	0.000
3.100	2.00	*Lepidopus caudatus*	0.00	0.000
1.060	35.00	*Lepidorhombus bosci*	133.00	12.275
0.000	0.00	*Lepidorhombus whiffiagonis*	16.83	4.408
0.000	0.00	*Lepidotrigla dieuzeidei*	98.33	3.217
2.520	12.00	*Lophius budegassa*	7.20	9.650
32.750	4.00	*Lophius piscatorius*	3.70	49.640
0.140	340.00	*Maurolicus muelleri*	149.33	0.147
15.264	32.09	*Merluccius merluccius*	346.03	36.764
0.000	0.00	*Microichthys coccoi*	1.00	0.001
10.000	78.00	*Micromesistius poutassou*	85.00	10.100
1.230	30.00	*Molva dipterygia*	12.00	2.800
5.764	280.27	*Mora moro*	75.60	4.720

Table 1. Continued.

0.005	1.00	*Myctophum punctatum*	8.00	0.005
0.007	1.00	*Nemichthys scolopaceus*	0.00	0.000
0.880	17.00	*Nettastoma melanurum*	64.20	3.393
19.143	1606.85	*Nezumia sclerorhynchus*	595.60	6.549
0.461	31.09	*Notacanthus bonapartei*	0.00	0.000
0.016	1.33	*Oligopus ater*	0.00	0.000
0.003	2.00	*Ophidion barbatum*	0.00	0.000
0.000	0.00	*Pagellus acarne*	1.33	0.200
0.000	0.00	*Pagellus bogaraveo*	110.50	12.941
0.000	0.00	*Peristedion cataphractum*	520.67	12.030
38.159	596.82	*Phycis blennoides*	368.43	21.604
0.000	0.00	*Polyprion americanum*	1.00	3.900
0.010	1.00	*Stomias boa*	48.20	0.638
0.029	3.00	*Symbolophorus veranyi*	0.00	0.000
0.000	0.00	*Symphurus ligulatus*	3.00	0.008
0.020	2.00	*Symphurus nigrescens*	0.00	0.000
0.000	0.00	*Synchiropus phaeton*	61.00	0.230
0.000	0.00	*Trachurus trachurus*	1.33	0.733
17.762	72.00	*Trachyrhynchus trachyrhynchus*	0.00	0.000
0.000	0.00	*Trigla lucerna*	4.00	0.867
0.022	6.00	*Trigla lyra*	5.00	0.580

Tab. 2. Index of Diversity (H'), Richness (D), by using Ln transformation, and Evenness (J) calculated for each Haul in Italian and in Greek areas.

Italy					**Greece**				
Haul	Depth	H'	D	J	Haul	Depth	H'	D	J
8	555	0.87	3.43	0.25	27	478	1.20	3.66	0.33
7	549	1.29	3.46	0.37	8	37	1.48	3.74	0.40
4	593	1.37	3.61	0.38	12	573	1.60	3.58	0.45
3	513	1.42	3.55	0.40	49	683	1.69	3.29	0.51
9	523	1.66	3.49	0.47	19	583	1.83	3.49	0.52
23	592	2.04	3.40	0.60	33	552	1.91	3.61	0.53
5	654	2.09	2.88	0.72	31	553	1.91	3.33	0.57
25	757	2.12	3.29	0.64	15	365	2.02	3.52	0.57
2	613	2.17	3.40	0.64	4	505	2.02	3.66	0.55
24	629	2.18	3.29	0.66	20	725	2.07	3.40	0.61
20	621	2.25	3.04	0.74	39	651	2.14	3.08	0.69
16	655	2.31	3.25	0.71	32	697	2.41	3.04	0.79
6	343	2.41	3.63	0.66	30	605	2.64	3.46	0.76
1	38	2.43	3.76	0.65	60	745	2.67	3.43	0.78

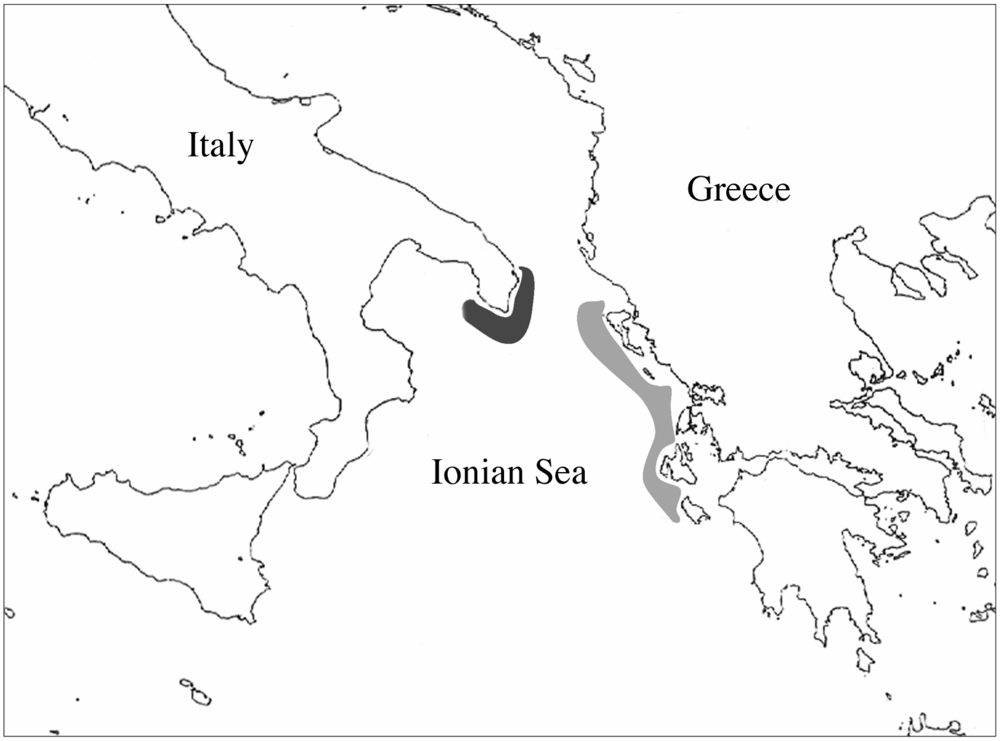

Fig. 1 – Investigated areas along Italian ■ and Greek ■ coast.

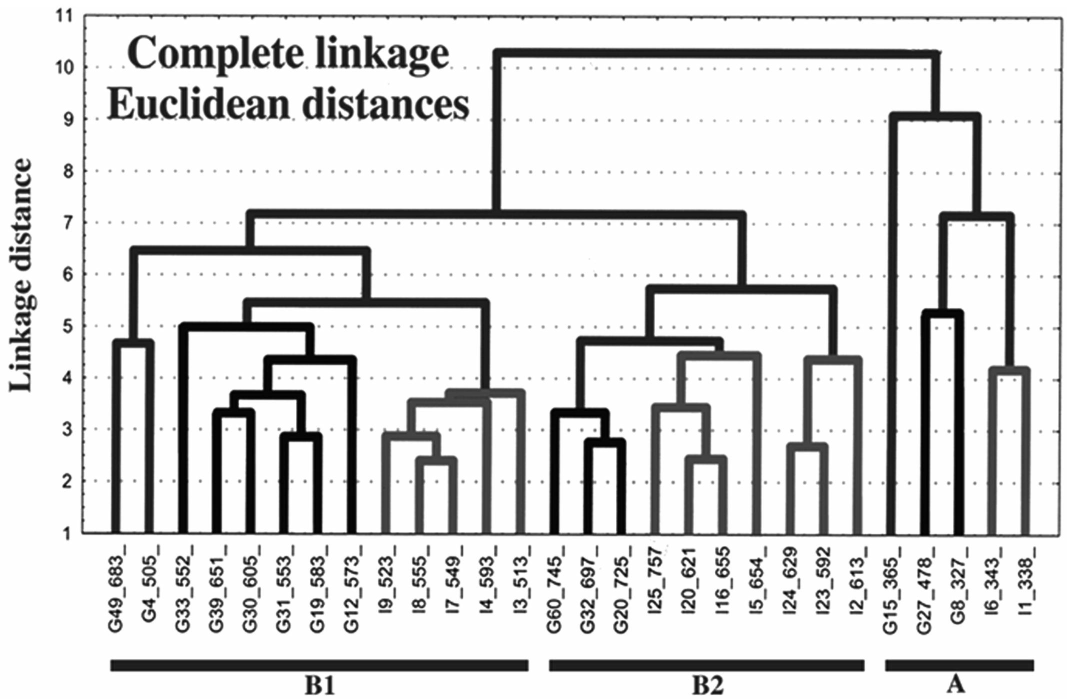

Fig. 2 – Dendrogram related to the density values (N/h by using Ln transformation) of species caught in the stations carried out in the Italian (I) and Greek (G) area of the Ionian Sea with relative depth.
A = uppermost stations; B1 = intermediate stations; B2 = deepest stations.

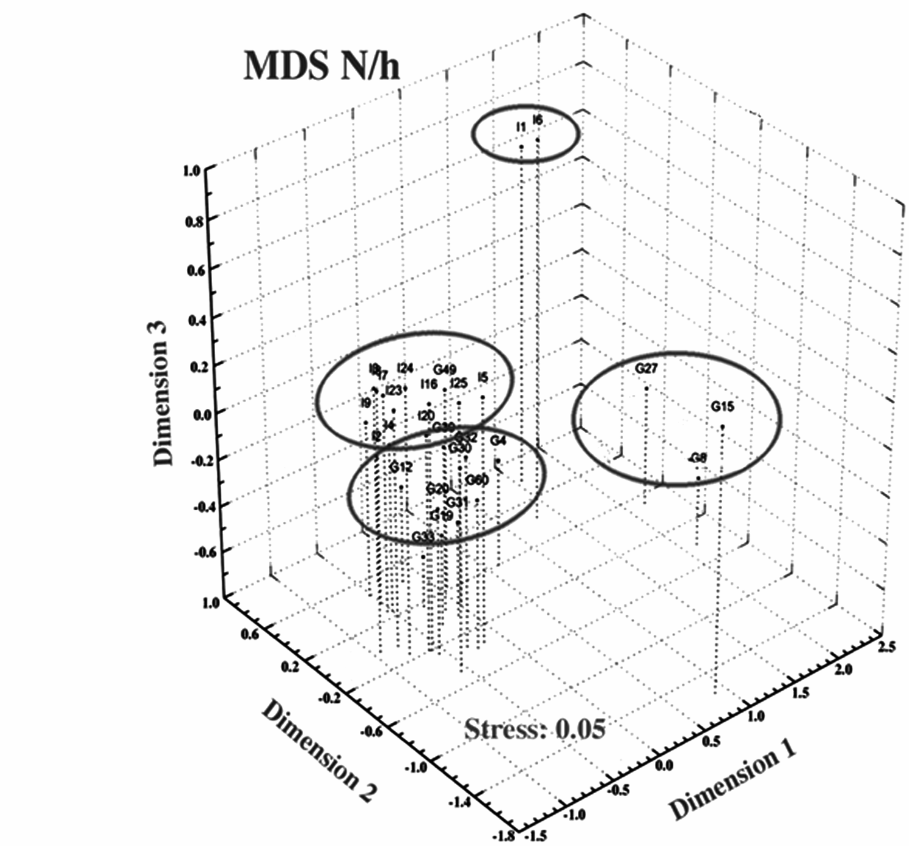

Fig. 3 – Non parametric multidimensinal scaling (nMDS) of different stations carried out in Italy (I) and in Greece (G) area of the Ionian Sea with relative depth.