

# Infralittoral Macrobenthos of the Patras Gulf and Ionian Sea II - Echinodermata

M.A. Pancucci & A. Zenetos  
National Centre for Marine Research  
Aghios Kosmas, Hellinikon, 16604 Athens (Greece).

**Abstract :** The study area consisted of four sectors : the Patras Gulf, Zakynthos and Kephallonia island and the Ionian coasts of the Northern Peloponnese. Dredging in the infralittoral zone of the above areas, carried out in the summers of 1981 and 1982, revealed 37 echinoderm species, while 22 more species are known from previous studies in the same areas.

The prevalent species in the study area as a whole are : *Echinocardium cordatum*, *Asterina gibbosa*, *Ophiura albida*, *Amphiura chiajei*, *Genocidaris maculata*, *Holothuria tubulosa*, *Amphiura brachiata*, *Amphipholis squamata* and *Astropecten jonstoni*.

The biogeographical distribution of all species is given, according to which there appear to be 3 distributional categories : a) an indigenous Mediterranean component (24,3 %), b) an Atlantic-Mediterranean component (64,8 %) and c) an Atlantic-cosmopolitan component (10,8 %).

Regarding the geographical distribution of all species recorded, special attention must be given to :

*Astropecten platyacanthus*, first record for the greek waters, *Leptosynapta galliennei*, a boreal-atlantic species that has only been recorded in the Adriatic sea so far, and *Amphiura lacazei*, recorded here for the first time after its description by Guille (1976) in the coast of Spain.

**Résumé :** La région étudiée comprenait quatre secteurs : le golfe de Patras, les îles Zakynthos et Kephallonia et les côtes Ioniennes du Peloponnèse du Nord. Des dragages ont été effectués en été 1981 et 1982 dans la zone infralittorale des régions ci-dessus et ont révélé 37 espèces d'Echinodermes. A noter que 22 autres espèces ont été signalées antérieurement dans les mêmes régions.

Les espèces abondantes dans toute la région étudiée sont : *Échinocardium cordatum*, *Asterina gibbosa*, *Ophiura albida*, *Amphiura chiajei*, *Genocidaris maculata*, *Holothuria tubulosa*, *Amphiura brachiata*, *Amphipholis squamata* et *Astropecten jonstoni*.

La distribution biogéographique de toutes les espèces est présentée, selon laquelle il paraît exister trois catégories : a) un composant indigène méditerranéen (24,3 %), b) un composant atlanto-méditerranéen (64,8 %) et c) un composant atlantique cosmopolitain (10,8 %).

En ce qui concerne la distribution géographique des espèces trouvées, on doit mentionner que :

*Astropecten platyacanthus* est signalée pour la première fois dans les eaux grecques, ainsi que *Leptosynapta galliennei*, espèce atlanto-boréale qui n'a été signalée jusqu'à présent qu'en mer Adriatique, et *Amphiura lacazei*, qui a été trouvée pour la première fois dans la région étudiée après sa description par Guille (1976) sur la côte espagnole.

## INTRODUCTION

The only published data on the Echinodermata of the study area has been that of Pérès & Picard (1958), Kilian & Strauss (1981), Kaspiris & Tortonese (1982) and Bogdanos & Nicolaidou (1985).

Sparse recordings of Echinodermata of Eastern Mediterranean are found in Carus (1885), Tortonese (1946, 1953-54), Vamvakas (1970), Demetropoulos & Hadjichris-

tophorou (1976), while Koukouras & Sinis (1981) made the first effort to record systematically the Holothurioidea and Crinoidea of the North Aegean Sea.

The Gulf of Patras was chosen for our initial survey work because it had been the area studied in circalittoral surveys carried out by the National Centre for Marine Research (Bogdanos & Nicolaidou, 1985). The ultimate aim will be to provide materials for a synthesis of the biota encountered in the two surveys. In our second survey year (1982), the boundaries were expanded to take in the Ionian coast of the Peloponnese and the islands of Zakynthos and Kephallonia. This expansion has enabled comparisons to be made of different environmental conditions within the same biogeographic area.

Our aim was to examine the echinoderms of the area, relate animal distribution to certain abiotic parameters and to quantify endemism.

## MATERIALS AND METHODS

The only published data relevant to the present study show that the water temperatures in the harbour at Patras ranged from 13 to 17°C in January and from 22 to 26°C in August (Souri-Kouroubali, 1976). The surface water salinity measured approximately 38 ‰ throughout the year (Piper & Panagos, 1979).

The Patras Gulf samples were taken in July and August, 1981 ; the other sites were sampled in July and August, 1982 (Fig. 1). Depth was determined by cable or sonar. At each site dredge-samples were taken at two stations, 5 and 15 m deep, using a Forster's anchor dredge (Holme & McIntyre, 1971), which is a semiquantitative sampler having a biting depth of 15-25 cm (Gage, 1972). The total number of sites sampled was 175 ; 2-4 separate dredge-hauls were obtained from each station. Subsamples were preserved in dilute (4 %) formalin with dissolved Rose-Bengal for sorting in the Athens laboratory. Other aliquots were kept for grain-size analysis, following the method of Bowles (1978).

Our salinity measurements (made using a refractometer) normally ranged from 38 to 41 ‰. In close proximity to the inlets of Evinos and Alfios the salinity dropped locally to 25,5 and 18 ‰ respectively.

Surface water temperatures in the shallow waters of the Patras Gulf and its immediate vicinity tended to fluctuate diurnally. In the Gulf proper the diurnal range was 19-27 ° C ; in the Ionian Sea sector it was 24-27° C ; around Zakynthos, it was 25-28° C and around Kefallonia, it was 26-27,5° C (July-August measurements).

## RESULTS

### SEDIMENTOLOGY

The distribution of sediment types in the four sectors : Gulf of Patras (PA), Peloponnese coast bordering the Ionian Sea (IO), Zakynthos (ZA) and Kefallonia (KE) is shown in

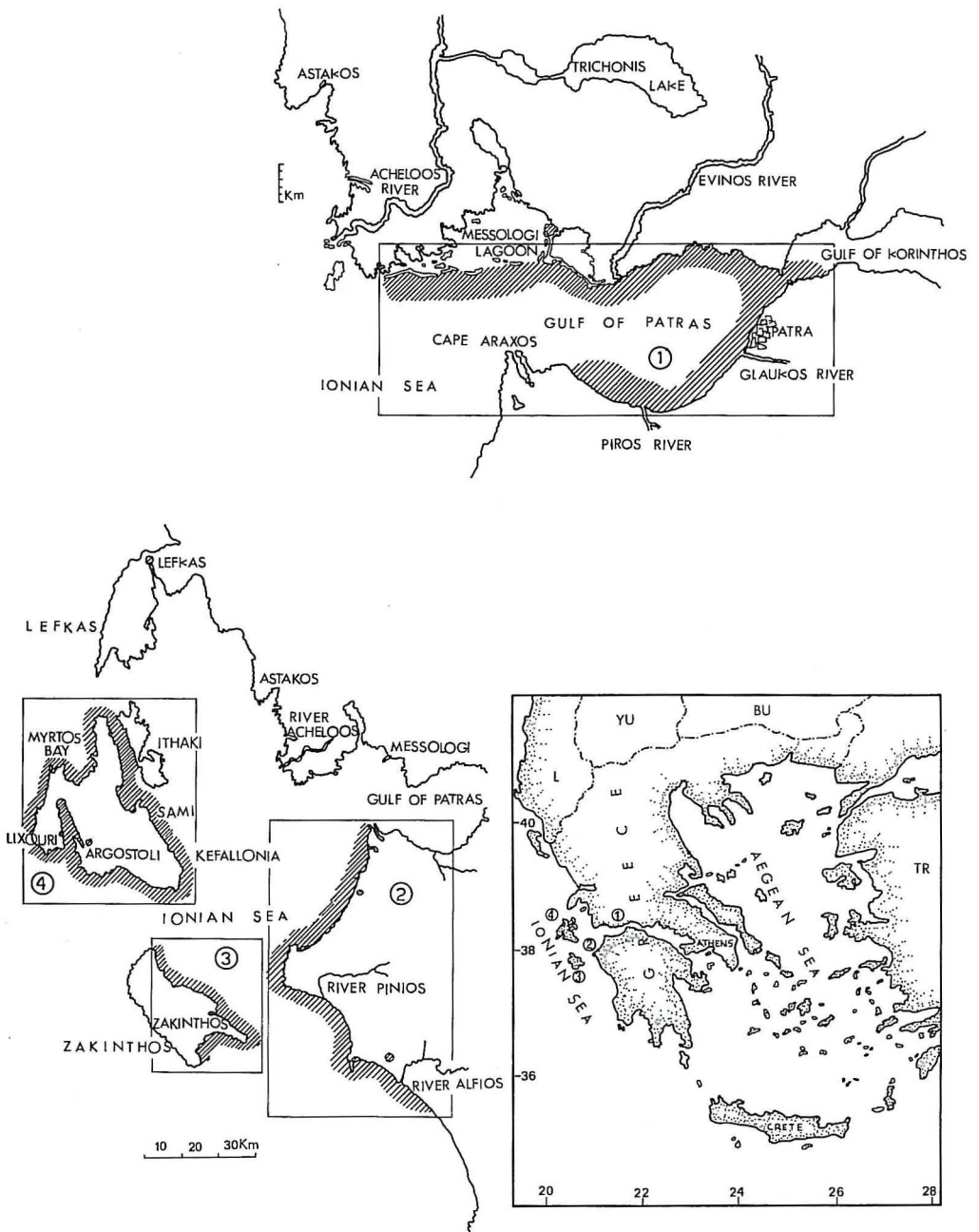


Figure 1 : Map showing the location of sampling stations :

- 1 : Gulf of Patras (PA)
- 2 : Coast of Peloponnese (IO)
- 3 : Island of Zakynthos (ZA)
- 4 : Island of Kephallonia (KE)

Table 1. It is clear from the table that the sheltered waters of the Gulf of Patras overlies the sediments containing the lowest proportion of sand, while in the other three sectors sand was the dominant type. This appears to correlate well with the known greater influence of sea water currents in the Ionian Sea with the consequent creation of high energy environments.

TABLE 1

Proportion of sediment type, range of mud content and mean grain size ( $x + SD$ ) in the different sectors of the study-area.

Sediment type	PA N=80			IO N=44		
	% of stations	% mud	Mean grain size (in $\emptyset$ )	% of stations	% mud	Mean grain size (in $\emptyset$ )
Coarse sand and gravel	—	—	—	4.54	—	<0
Sand	28.75	0-7	1.50±0.85	54.54	0-9	2.20±0.24
Muddy sand	10	10-22	3.33±0.78	9.09	12-14	3.22±0.09
Silty sand	11.25	17-45	3.68±0.60	15.90	10-42	3.52±0.27
Sandy silt	15	55-81	5.03±0.58	6.82	50-60	4.04±0.07
Sandy mud	10	64-88	6.09±0.71	2.27	88	8.16
Mud + Posidonia	25	>90	—	6.82	>90	—

Sediment type	ZA N=19			KE N=32		
	% of stations	% mud	Mean grain size (in $\emptyset$ )	% of stations	% mud	Mean grain size (in $\emptyset$ )
Coarse sand and gravel	36.84	0	—	21.87	0	—
Sand	57.89	0-4	2.57±0.48	46.87	0-8	2.20±0.88
Muddy sand	—	—	—	3.12	13	3.13
Silty sand	5.26	15	3.22	9.37	14-42	3.68±0.48
Sandy silt	—	—	—	3.12	53	4.03
Sandy mud	—	—	—	3.12	50	4.37
Mud + Posidonia	—	—	—	12.50	—	—

#### PREVALENCE OF ECHINODERMATA

Table 2 summarises the prevalence data derived from the dredged samples. The species are arranged in order of decreasing overall prevalence. The first two columns are derived from pooled data from the whole study area, but the remaining columns present separately data from the four sectors of the study area. These data show that the most common species in the study area as a whole were: *Echinocardium cordatum* (in 36 stations, 20,6 %),

TABLE 2

Prevalence of echinodera species in the benthos samples

	All data (175 st.)		PA (80 st.)		10 (44 st.)		ZA (19 st)		KE (32 st)	
	Total N° of st.	% preval.	Num. of stations	% preval	Num. of stations	% preval	Num. of stations	% preval	Num. of stations	% preval
<i>Echinocardium cordatum</i>	36	20.6	14	17.5	15	34.1	3	15.8	4	12.5
<i>Asterina gibbosa</i>	21	12	15	18.8	4	9.1	1	5.26	1	3.12
<i>Ophiura albida</i>	21	12	1	2.27	—	—	—	—	—	—
<i>Amphiura chiajei</i>	20	11.4	15	18.8	1	2.27	1	5.26	3	9.37
<i>Genocidaris maculata</i>	19	10.8	16	20	—	—	—	—	3	9.37
<i>Holothuria tubulosa</i>	19	10.8	12	15	1	2.27	3	15.8	3	9.37
<i>Amphiura brachiata</i>	17	9.71	8	10	4	9.1	3	15.8	2	6.25
<i>Amphipholis squamata</i>	17	9.71	5	6.25	3	6.81	3	15.8	6	18.8
<i>Astropecten jonstoni</i>	14	8	4	5	7	15.9	1	5.26	2	6.25
<i>Echinocyamus pusillus</i>	8	4.57	6	7.5	—	—	1	5.26	1	3.12
<i>Amphiura mediterranea</i>	7	4	6	7.5	—	—	1	5.26	—	—
<i>Astropecten spinulosus</i>	6	3.4	3	3.75	1	2.27	—	—	2	6.25
<i>Ophiomyxa pentagona</i>	5	2.85	3	3.75	—	—	1	5.26	1	3.12
<i>Ophiothrix fragilis</i>	5	2.85	4	5	—	—	—	—	1	3.12
<i>Holothuria mammata</i>	5	2.85	5	6.25	—	—	—	—	—	—
<i>Asterina pancerii</i>	4	2.28	3	3.75	—	—	—	—	1	3.12
<i>Echinocardium mediterraneum</i>	4	2.28	1	1.25	—	—	1	5.26	2	6.25
<i>Holothuria helleri</i>	4	2.28	2	2.5	—	—	1	5.26	1	3.12
<i>Astropecten bispinosus</i>	3	1.71	—	—	3	6.81	—	—	—	—
<i>Amphiura filiformis</i>	3	1.71	2	2.25	—	—	—	—	1	3.12
<i>Sphaerechinus granularis</i>	3	1.71	3	3.75	—	—	—	—	—	—
<i>Leptopentacta tergestina</i>	3	1.71	3	3.75	—	—	—	—	—	—
<i>Antedon mediterranea</i>	2	1.14	2	2.5	—	—	—	—	—	—
<i>Astropecten irregularis pentacanthus</i>	2	1.14	1	1.25	1	2.27	—	—	—	—
<i>Ophioderma longicaudum</i>	2	1.14	—	—	1	2.27	1	5.26	—	—
<i>Paracentrotus lividus</i>	2	1.14	2	2.25	—	—	—	—	—	—
<i>Leptopentacta elongata</i>	2	1.14	2	2.5	—	—	—	—	—	—
<i>Leptosynapta galliennei</i>	2	1.14	—	—	2	4.54	—	—	—	—
<i>Amphiura lacazei</i>	2	1.14	2	2.5	—	—	—	—	—	—
<i>Astropecten platyacanthus</i>	1	0.57	—	—	—	—	—	—	1	3.12
<i>Echinaster sepositus</i>	1	0.57	1	1.25	—	—	—	—	—	—
<i>Ophiura ophiura</i>	1	0.57	1	1.25	—	—	—	—	—	—
<i>Phylloporus granulatus</i>	1	0.57	1	1.25	—	—	—	—	—	—
<i>Holothuria (Thymiosycia) impatiens</i>	1	0.57	1	1.25	—	—	—	—	—	—
<i>Mesothuria intestinalis</i>	1	0.57	1	1.25	—	—	—	—	—	—
<i>Leptosynapta makrankyra</i>	1	0.57	—	—	1	2.27	—	—	—	—
<i>Schizaster canaliferus</i>	1	0.57	—	—	1	2.27	—	—	—	—

*Asterina gibbosa* and *Ophiura albida* (in 21 stations, 12 %), *Amphiura chiajei* (in 20 stations, 11,43 %), *Genocidaris maculata* and *Holothuria tubulosa* (in 19 stations, 10,8 %), *Amphiura brachiata* and *Amphipholis squamata* (in 17 stations, 9,71 %) and *Astropecten jonstoni* (in 14 stations, 8 %). The remaining species were found in less than 10 stations.

But *Echinocardium cordatum* was not the most common echinoderm in all the sectors. Some species were absent altogether from one or more of the sectors. For example 12 species : *Antedon mediterranea*, *Echinaster sepositus*, *Amphiura lacazei*, *Ophiura ophiura*, *Sphaerechinus granularis*, *Paracentrotus lividus*, *Holothuria mammata*, *Holothuria (Thymiosycia) impatiens*, *Phyllophorus granulatus*, *Leptopentacta elongata*, *Leptopentacta tergestina* and *Mesothuria intestinalis* were found only in the Patras Gulf ; 3 species : *Schizaster canaliferus*, *Leptosynapta galliennei* and *Leptosynapta makrankyra* were present in the Ionian Sea and *Astropecten platyacanthus* only in the Kefallonia samples.

#### BIOGEOGRAPHY

Table 3 summarises what is known about the recorded distribution of the echinoderm species sampled. The Mediterranean Sea is subdivided into eastern and western moieties, according to the division advocated by Pérès (1967).

It is clear from the Table that the study area contains species which are widespread in the western Mediterranean but not well established in the eastern Mediterranean.

16 species, namely : *Astropecten jonstoni*, *Astropecten bispinosus*, *Astropecten platyacanthus*, *Asterina pancerii*, *Amphiura brachiata*, *Amphiura mediterranea*, *Amphiura lacazei*, *Echinocyamus pusillus*, *Echinocardium mediterraneum*, *Holothuria helleri*, *Holothuria mammata*, *Holothuria impatiens*, *Phyllophorus granulatus*, *Mesothuria intestinalis*, *Leptosynapta galliennei* and *Leptosynapta makrankyra* are first records for the study area.

Of the above species, special attention must be given to the following :

- *Echinocardium mediterraneum* is reported here for the second time in the greek waters after its first recording by Forbes (1843) in the Aegean Sea.
- *Mesothuria intestinalis* so far has only been recorded by Marenzeller (1893) in the Aegean Sea.
- *Amphiura mediterranea* and *Asterina pancerii* are known only from the NE Aegean Sea (Kisseleva, 1963 ; Makkavieva, 1963).
- *Holothuria mammata*, *H. impatiens*, *Ph. granulatus* and *Leptosynapta makrankyra* are recorded here for the second time in the eastern Mediterranean, their first record being that of Koukouras and Sinis (1981).
- *Astropecten platyacanthus* is reported here for the first time in the greek waters.
- *Amphiura brachiata* is reported here for the second time in the greek waters.
- *Leptosynapta galliennei*, a Boreal-Atlantic species, has only been recorded in the Adriatic Sea and this is the second finding in the Mediterranean.

TABLE 3

Geographical distribution of echinoderm species identified in the survey samples

Species	E. Mediterranean					Geo.distr.
	(1) Aegan S.	(2) Bosp. & Marm	(3) Lev. S.	(4) Adr. S.	(5) W.Med.	
<i>Antedon mediterranea</i>	+	+	+	+	+	Medit.
<i>Astropecten jonstoni</i>	+	+	+	+	+	Medit.
<i>A. spinulosus</i>	+	+	+	+	+	Medit.
<i>A. irregularis pentacanthus</i>	+	+	+	+	+	Med., E.Atl.
<i>A. bispinosus</i>	+	+	+	+	+	Med., Atl.
<i>A. platyacanthus</i>	+	+	+	+	+	Medit.
<i>Asterina gibbosa</i>	+	+	+	+	+	Med., NE Atl.
<i>A. pancerii</i>	+	+		+	+	Medit.
<i>Echinaster sepositus</i>	+	+	+	+	+	Med., E Atl.
<i>Amphiura chiajei</i>	+	+	+	+	+	Med., E Atl.
<i>A. mediterranea</i>	+		+	+	+	Medit.
<i>A. filiformis</i>	+	+	+	+	+	Med., N Atl.
<i>A. brachiata</i>			+	+	+	Med., NE Atl.
<i>A. lacazei</i>					+	Spain
<i>Amphipholis squamata</i>	+	+	+	+	+	Cosmopolitan
<i>Ophiomyxa pentagona</i>	+	+	+	+	+	Med., NE Atl.
<i>Ophioderma longicaudum</i>	+	+	+	+	+	Med., E Atl.
<i>Ophiothryx fragilis</i>	+	+	+	+	+	Med., NE Atl.
<i>Ophiura albida</i>	+	+	+	+	+	Med., NE Atl.
<i>O. ophiura</i>	+	+	+	+	+	Med., NE Atl.
<i>Sphaerechinus granularis</i>	+	+	+	+	+	Med., NE Atl.
<i>Paracentrotus lividus</i>	+	+	+	+	+	Med., NE Atl.
<i>Genocidaris maculata</i>	+	+	+	+	+	Med., Atl.
<i>Echinocyamus pusillus</i>	+	+	+	+	+	Med., EAtl.
<i>Echinocardium cordatum</i>	+		+	+	+	Med., Atl. Pac.
<i>E. mediterraneum</i>	+	+	+	+	+	Med., NE Atl.
<i>Schizaster canaliferus</i>	+	+	+	+	+	Medit.
<i>Holothuria tubulosa</i>	+	+		+	+	Med., Atlan.
<i>H. helleri</i>	+			+	+	Medit.
<i>H. mammata</i>	+			+	+	Med., E Atl.
<i>H. (Thymiosycia) impatiens</i>	+		+	+	+	Med., Red S.
<i>Phyllophorus granulatus</i>	+				+	Medit.
<i>Leptopentacta elongata</i>	+			+	+	Med., NE Atl.
<i>L. tergestina</i>	+	+	+	+	+	Med., E Atl.
<i>Mesothuria intestinalis</i>	+			+	+	Med., Atlan.
<i>Leptosynapta galliennei</i>				+		Adr., Atlan.
<i>L. makrankyra</i>	+			+	+	Med., E Atl.

(1): Forbes (1843), Marenzeller (1893), Péres & Picard (1958), Koukouras & Sinis (1981), Vamvakas (1970), Kisseleva (1963).

(2): Caspers (1968), Tortonese & Demir (1960).

(3): Demetropoulos & Hadjichristophorou (1976), Tortonese (1953-54).

(4): Zavodnik (1972), Gamulin-Brida (1976), Bruno (1972), Vatova (1949).

(5): Tortonese (1965), Lopez-Ibor (1982), Cherbonnier & Guille (1967), Cherbonnier (1956), Guille (1970).

- *Amphiura lacazei*, finally, is recorded here for the first time after its description by Guille (1976) in the coasts of Spain.

## DISCUSSION

The information on Echinodermata in greek waters, as already mentioned, is very fragmentary and far from complete (Forbes, 1843 ; Tortonese, 1946 ; Koukouras & Sinis, 1981 ; Kaspiris & Tortonese, 1982). From previous studies in the same area (Pérès & Picard, 1958 ; Kilian & Strauss, 1981 ; Kaspiris & Tortonese, 1982 ; Bogdanos & Nicolaidou, 1985), 22 more species (Table 4) have been identified, so the number of echinoderm species in the Gulf of Patras and Eastern Ionian Sea mounts to 59.

The difference between our material and that of the above authors must be attributed to the different zones examined. That is, infralittoral in this study and medio and circalittoral by the other authors.

Generally, the specimens of the species do not show any deviation from the typical features. Notable was the small size of all species, smaller than anything mentioned in the bibliography so far. This phenomenon has already been observed in benthic populations of the eastern Mediterranean by Forbes (1843), Tortonese (1953-54), Pérès and Picard (1956, 1958) and is what it is called "dwarfism". The "dwarfism" of the Eastern Mediterranean can be attributed to either a general deficiency of the available nutrients or to the fact that the higher temperature results in more intense metabolism and thus in an earlier sexual maturity which delays the growth.

Many of the identified species must be considered as rare for the Eastern Mediterranean and generally for the whole Mediterranean Sea.

It is interesting to note the presence of *Amphiura lacazei*, first described by Guille (1976) in the coast of Spain, and not reported ever since.

According to the biogeographical distribution (Table 3) of our species, there appear to be 3 distributional categories :

- a) an indigenous mediterranean component, 9 species (24,3 %)
- b) an atlantic-mediterranean component, 24 species (64,8 %)
- c) an atlantic-cosmopolitan component, 4 species (10,8 %), of which 2 species (5,4 %) penetrate as far as the Black Sea.

In contrast to other Invertebrate groups, there is no evidence of Lessepsian migration (Por, 1978).

It is hoped that this work will fill in a gap towards the systematic study, distribution, ecology and zoogeography of the echinoderm-fauna in the Mediterranean.



TABLE 4

List of echinoderm species previously recorded in the study areas

Species	Peres & Picard (1958)	Kilian & Strauss (1981)	Kaspiris & Tortonese (1982)	Bogdanos & Nicolaidou (1985)
<i>Leptometra phalangium</i>			+	
<i>Astropecten aranciacus</i>			+	+
<i>Luidia ciliaris</i>			+	
<i>Tethyaster subinermis</i>			+	
<i>Chaetaster longipes</i>			+	
<i>Peltaster placenta</i>			+	
<i>Hacelia attenuata</i>			+	
<i>Anseropoda placenta</i>			+	
<i>Coscinasterias tenuispina</i>			+	
<i>Marthasterias glacialis</i>		+		
<i>Ophiacantha setosa</i>			+	
<i>Stylocidaris affinis</i>			+	
<i>Centrostephanus longispinus</i>			+	
<i>Arbacia lixula</i>		+	+	
<i>Echinus acutus</i>			+	
<i>Spatangus purpureus</i>			+	
<i>Brissopsis lyrifera</i>	+			+
<i>Brissus unicolor</i>			+	
<i>Holothuria forskali</i>		+		
<i>Stichopus regalis</i>			+	
<i>Thyone fusus</i>				+

## REFERENCES

- BOGDANOS, C. & A. NICOLAIDOU, 1985. The offshore benthic fauna of the Patraikos Gulf (Greece). *Biologia Gallo-Hellenica*, vol. X (1) : 31-41.
- BOWLES, J.E., 1978. *Engineering properties of soils and their measurements*. 2nd Ed. McGraw-Hill.
- BRUNO, C., 1972. Echinodermi di Bocche di Cattaro (Adriatico). *Thalassia Salentina*, 6 : 37-45.
- CARUS, J.V., 1885. *Prodromus Faunae Mediterraneae*. Vol. II, 854 pp., Stuttgart.
- CASPERS, H., 1968. La macrofaune benthique du Bosphore et les problèmes de l'infiltration des éléments méditerranéens dans la Mer Noire. *Rapports et Procès-Verbaux. Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée*, 19 (2) : 107-115.
- CHERBONNIER, G., 1956. Les Échinodermes de Tunisie. *Bulletin de la Station Océanographique de Salambo*, 53 : 1-23.
- CHERBONNIER, G. & A. GUILLE, 1967. Complément à la faune des Échinodermes de la Mer de Banyuls. *Vie et Milieu*, Ser. B, 18 (2-13) : 317-330.
- DEMETROPOULOS, A. & M. HADJICHRISTOPHOROU, 1976. Echinodermata of Cyprus. *Fisheries Bulletin*, N.4, 83 pp.
- FORBES, E., 1843. Report on Mollusca and Radiata of the Aegean Sea and on their distribution considered as bearing on geology. *British Association for the Advancement of Science*, 13 : 130-193.
- GAGE, J., 1972. A preliminary survey of the benthic macrofauna and sediments in Lochs Etive and Crenan, sea-lochs along the west coast of Scotland. *Journal of Marine Biological Association U.K.*, 52 : 237-276.
- GAMULIN-BRIDA, H., 1976. Espèces caractéristiques et dominantes des Echinodermes dans les biocénoses benthiques de la Mer Adriatique. *Thalassia Jugoslavica*, 12(1) : 145-152.
- GUILLE, A., 1970. Bionomie benthique du plateau continental de la côte catalane française. II. Les communautés de la macrofaune *Vie et Milieu*, 21 (1) : 149-280.

- GUILLE, A., 1976. Échinodermes de la côte catalane espagnole (Méditerranée). *A. lacazei* nov. sp., ophiure nouvelle de la famille Amphiruridae. *Thalassia Jugoslavica*, 12 (1) : 165-171.
- HOLME, N.A. & A.D. MCINTYRE, 1971. *Methods for the study of marine benthos*. Blackwell, Oxford., 334 pp.
- KASPIRIS, P. & E. TORTONESE, 1982. Echinoderms from the Western Seas of Greece. *Thalassographica*, 2(5) : 27-32.
- KILIAN, E.F. & R. STRAUSS, 1981. Tierische macrobenthos-Gesellschaften im eu-und oberen sublitoral von Kephallinia. *Bibliotheca Phycologica*, 51 : 153-179.
- KISSELEVA, M. 1963. La distribution du Benthos qualitative et quantitative dans la Mer Égée. *Trudy Sevastopolskoi biologicheskoi Stantsii*, 16 : 192-200.
- KOUKOURAS A. & A. SINIS, 1981. Benthic fauna of the North Aegean Sea. II. Crinoidea and Holothurioidea (Echinodermata). *Vie et Milieu*, 31 (3-4) : 271-281.
- LOPEZ-IBOR, A., C. GALAN & J. TEMPLADO, 1982. Echinodermes du Cap du Palos (Murcia, Espagne). *Biologie-Écologie Méditerranéenne*, IX (2) : 3-18.
- MAKKAVIEVA, E., 1963. Quelques peuplements des zones sableuses de la Mer Égée. *Trudy Sevastopolskoi Biologicheskoi Stantsii*, XIV : 211-214.
- MARENZELLER, E., 1893. Neue Echinodermen aus dem Mittelmeere. *Sitzungsberichte Kaiserlichen Akademie Wissenschaften. CII. Band. Abtheilung I.*, Heft I bis X : 65-70.
- PÉRÉS, J.M., 1967. The Mediterranean Benthos. *Oceanography and Marine Biology*, Annual Review, 5 : 449-533.
- PÉRÉS, J.M. & J. PICARD, 1956. Notes préliminaires sur les résultats de la campagne de recherches benthiques de la "Calypso" dans la Méditerranée Nord-Orientale. *Recherches et Travaux de la Station Marine d'Endoume*, 18(11) : 5-13.
- PÉRÉS, J.M. & J. PICARD, 1958. Recherches sur les peuplements benthiques de la Méditerranée Nord-Orientale. *Annales de l'Institut Océanographique*. Paris, 34 : 213-291.
- PIPER, D.J.W. & A.G. PANAGOS, 1979. Superficial sediments of the Gulf of Patras. *Thalassographica*, 1(3) : 5-20.
- POR, D.F., 1978. *Lessepsian Migration*. Springer-Verlag, Berlin., 228 pp.
- SOURI-KOIROUBALI, F., 1976. Surface temperatures of Greek seas. *Hydrographic Service*, Athens.
- TORTONESE, E., 1946. Echinoderms from the Eastern Mediterranean (Island of Rhodes). *Annales of the Magazine of Natural History*, 13 : 715-719.
- TORTONESE, E., 1953-54. Gli Echinodermi viventi presso le coste dello Stato di Israele (Mar di Levante, Golfo di Elath). *Bolletino Istituto e Museo di Zoologia dell'Università di Torino*, 4(4) : 39-72.
- TORTONESE, E., 1965. *Fauna d'Italia. Echinodermata*. VI, 422 pp., Ed. Calderini, Bologna.
- TORTONESE, E. & M. DEMIR, 1960. The Echinoderm fauna of the Sea of Marmara and the Bosphorus. *Hidrobiologi Istanbul*, S.B, V(1-2) : 1-16.
- VAMVAKAS, K. N., 1970. Peuplements benthiques des substrats meubles du Sud de la Mer Égée. *Tethys*, 2(1) : 89-130.
- VATOVA, A., 1949. La fauna bentonica dell'Alto e Medio Adriatico. *Nova Thalassia*, 1(3) : 1-110.
- ZAVODNIK, D., 1972. Peculiarities of geographical distribution of Adriatic Echinoderms. *Thalassia Jugoslavica*, 8(2) : 321-330.