

ASCIDIAN FAUNA OF THE AEGEAN SEA WITH A CHECK LIST OF THE EASTERN MEDITERRANEAN AND BLACK SEA SPECIES

Athanasios KOUKOURAS⁽¹⁾, Eleni VOULTSIADOU-KOUKOURA⁽¹⁾,
Theodoros KEVREKIDIS⁽²⁾ & Dimitris VAFIDIS⁽¹⁾

Abstract

Forty-two ascidian species were found during sampling carried out in the Aegean Sea. Twenty-four of these species are new records for the fauna of the Aegean, which numbers at present 67 species. A check list of the ascidian species known to date from the Eastern Mediterranean is given, including 21 new records added by the present study. From a zoogeographical point of view, the ascidian fauna of the Eastern Mediterranean showed that from the 7 species characterized as Lessepsian migrants only two are true ones; 14 species are cosmopolitan, 36 are Mediterranean endemics and 36 are Atlanto-Mediterranean.

Key words: Tunicata, Ascidiacea, Distribution, Aegean Sea, Eastern Mediterranean, Black Sea.

Résumé

Faune des Ascidies de la mer Égée.

Liste récapitulative des espèces de Méditerranée Orientale et de mer Noire

Quarante-deux espèces d'ascidies ont été observées lors d'échantillonnages en mer Égée. Vingt-quatre de ces espèces sont nouvelles pour la faune de la mer Égée, qui en recense maintenant 67. Une liste récapitulative des espèces d'ascidies connues à ce jour pour la Méditerranée Orientale est établie. Elle inclut 21 nouvelles citations, apportées par cette étude. Les considérations zoogéographiques sur la faune d'ascidies de Méditerranée Orientale montrent que des 7 espèces notées comme des migrants lessepsiens, seulement 2 le sont réellement ; 14 espèces sont cosmopolites ; 36 sont endémiques de la Méditerranée et 36 sont Atlanto-méditerranéennes.

Mots-clés : Tuniciers, Ascidies, Répartition, mer Égée, Méditerranée Orientale, mer Noire.

INTRODUCTION

The study of the ascidian fauna of the Mediterranean was started at the end of the 19th century. The sole list of the Mediterranean ascidian fauna was compiled by PÈRÈS (1958a) although many problems were left open concerning the validity of some species, or the geographical distribution of others. Since 1960, reviews of certain taxa such as Pyuridae (MONNIOT C., 1965; MONNIOT F., 1965), Molgulidae

(MONNIOT F., 1965; MONNIOT C., 1969a) and Didemnidae (LAFARGUE, 1974a, 1976, 1977; LAFARGUE & WAHL 1987), have changed this number, either due to synonymies or to the description of new species. However, there still exist several problematic taxa. According to FREDJ & LAUBIER (1985) of the 200 recorded species, probably no more than 160 correspond to true or valid taxa. A review of the relevant literature

(1) Department of Zoology, University of Thessaloniki, 54006 Thessaloniki, Greece

(2) Department of Education-Primary Level, University of Thrace, 68100 Alexandroupolis, Greece

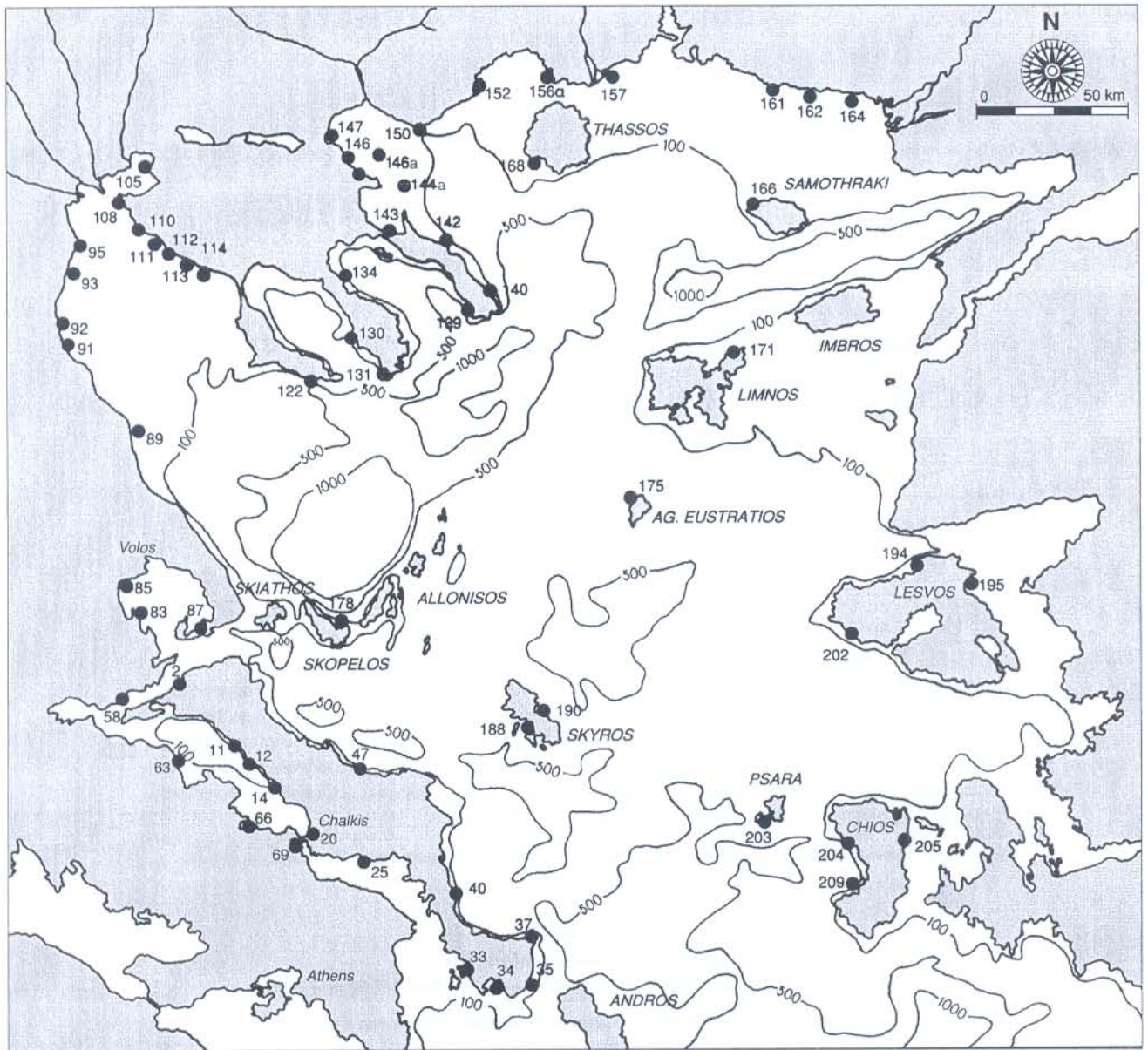


FIG. 1.— Map of the northern Aegean Sea showing the sampling stations.

FIG. 1.— Carte du nord de la mer Égée, avec les stations d'échantillonnage.

shows that the number of ascidian species now known from the Mediterranean, is about 190, including certain doubtful species.

The ascidian fauna of the Western Mediterranean, and to a lesser extent that of the Central Mediterranean and the Adriatic, has been studied fairly well, and a rich literature exists on it. Conversely, existing information on the ascidian fauna of the Levantine Basin, the Aegean Sea and the Black Sea is very restricted, resulting in a much lower species num-

ber compared with that of the remaining Mediterranean and especially with that of the western basin. The review of the literature shows that the publications concerning the ascidian fauna of the Levantine Basin do not exceed ten, recording the presence of 45 species in this area; those concerning the ascidian fauna of the Black Sea are about six, and those on the ascidians of the Aegean (Sea of Marmara included) are eleven recording the presence of 43 species. Among these eleven papers, only four are concerned ex-

clusively with ascidians; while the rest are either general faunistic or ecological papers. From the species reported from the Levantine Basin and the Aegean, 21 (about 50 %) were common among to both areas. So, the total number of species known from the Eastern Mediterranean has reached 65. Only 10 species are known from the Black Sea.

MATERIAL AND METHODS

The examined specimens were collected from 65 stations in the northern Aegean Sea (*Fig. 1*). Information for some of the sampling stations is given in the presentation of the species found.

Sampling was made by fishing nets, by free or scuba diving and by various types of trawls, dredges and grabs, at depths down to approximately 200 m (continental shelf) since 1970. All specimens have been deposited in the Museum of the Department of Zoology, University of Thessaloniki.

The treatment of the specimens before and after identification was similar to that proposed by MONNIOT & MON-

NIOT (1972). For the presentation of the species, the classification system of BERRILL (1950), MONNIOT & MONNIOT (1972) and LAFARGUE & WAHL (1987) was used.

In order to present the geographical distribution of the species in the Mediterranean, the main areas were delimited as shown in *figure 2*. This delimitation was made on the basis of the biogeographical status of this area (PÈRES & PICARD, 1964; POR & DIMENTMAN, 1989) and the needs of this particular study. The Korinthiakos Gulf and the Sea of Marmara were also included in the Aegean Sea. The Levantine Basin and the Aegean Sea were considered as Eastern Mediterranean.

RESULTS AND DISCUSSION

MATERIAL EXAMINED

The examined material from the northern Aegean Sea included 1220 specimens belonging to 42 ascidian species. Other specimens from the same area, belonging to the families Cionidae and Ascidiidae (9 species), have been presented by KOUKOURAS & SIAMIDOU-EFREMIDOU (1978-79)

and consequently are not included in the present paper. The 42 species found are presented in *Table I*. The 25 most interesting of them (of which 21 are reported for the first time from the Eastern Mediterranean) are detailed below, with new taxonomic, zoogeographical or habitat information.

TABLE I.— Check list of the Eastern Mediterranean and Black Sea ascidians with their distribution in the main Mediterranean geographical areas (WM = Western Mediterranean, CM = Central Mediterranean, AD = Adriatic Sea, AS = Aegean Sea, LB = Levantine Basin, BS = Black Sea). Zoogeographical classification (ZC): E = possibly Mediterranean endemic, AM = Atlanto-Mediterranean, LM = Lessepsian migrant, C = Cosmopolitan. Vertical distribution (VD): In this column, the depths at which the various species have been found in the eastern Mediterranean and the Black Sea are given, according to the data of the authors and the relevant literature. Species marked with *** are new records for the eastern Mediterranean, ** are new records for the Aegean Sea. Other species found by the authors in the N. Aegean Sea (and known previously from the Aegean) are marked with *. The question marks in front of some species names show doubtful taxonomic status.

TABLE I.— Liste des ascidies de la Méditerranée orientale et de la mer Noire, et leur répartition dans les principales zones géographiques de la Méditerranée (WM = Méditerranée Occidentale, CM = Méditerranée Centrale, AD = mer Adriatique, AS = mer Égée, LB = bassin Levantin, BS = mer Noire). Caractérisation zoogéographique (ZC) : E = Endémie méditerranéenne possible, AM = Atlanto-Méditerranéenne, LM = migrateur lessepsien, C = Cosmopolite. Répartition verticale (VD) : la profondeur à laquelle les différentes espèces ont été observées, en Méditerranée Occidentale et en mer Rouge, est donnée dans cette colonne, d'après les données des auteurs et de la littérature. Les espèces marquées avec *** sont nouvelles de la Méditerranée Orientale, et celles avec ** de la mer Égée. Les autres espèces observées par les auteurs dans le nord de la mer Égée (et connues auparavant de la mer Égée) sont notées avec *. Les points d'interrogation en face de quelques espèces soulignent un statut taxonomique douteux.

	EM						VD (m)	ZC
	WM	CM	AD	AS	LB	BS		
POLYCITORIDAE								
	+	+		+			30	E
***	+	+	+	+			2-18	AM
*	+	+	+	+	+		1-180	E
	+				+		?20	AM
	+	+	+	+			55-75	E
	+	+	+		+		50-60	E
	+	+		+	+		36	E
POLYCLINIDAE								
*				+			1-40	E
***	+	+	+	+			3-45	AM
***	+		+	+			3-6	E
*	+	+	+	+	+		5-50	E
	+			+	+		20-40	E
?	+				+		40	E
	+	+			+		50-70	AM
***	+			+			8	AM
***	+			+			2-20	AM
	+	+		+			36	E
***	+	+	+	+			30	E
	+	+		+			36	E
***	+		+	+			3-6	AM
DIDEMNIDAE								
***	+			+			30	E
	+	+	+		+		15-40	C
***	+	+	+	+			1-30	C
***	+		+	+			30	E
	+	+	+	+	+		25-100	AM
***	+	+	+	+			1-40	E
*	+	+	+	+	+		5-55	AM
***	+			+			35	E
	+	+	+		+	+	7-11	C
***	+	+	+	+			20-50	AM
	+	+	+		+		1-10	AM
***	+	+	+	+			20-35	AM
	+	+	+	+	+		7-65	AM
**	+	+	+	+	+		1-40	C
?	+				+		?1-20	AM
?	+				+		13	AM
***	+	+	+	+			4-6	E
CIONIDAE								
	+	+	+	+	+	+	5-250	C
DIAZONIDAE								
*	+		+	+			90-100	AM
*	+	+	+	+	+		2-150	E
?	+	+			+		4-10	E
?					+		?2-40	E
PEROPHORIDAE								
	+	+			+		7	C
**	+	+	+	+	+		2-35	AM

	WM	CM	AD	EM			VD (m)	ZC
				AS	LB	BS		
CORELLIDAE								
<i>Corella parallelogramma</i> (Müller, 1776)	+		+	+	+		68	AM
<i>Rhodosoma turcicum</i> (Savigny, 1816)	+	+		+			40-73	C
ASCIDIIDAE								
<i>Ascidia cannelata</i> Oken, 1820					+		720	LM
<i>Ascidia colleta</i> Monniot & Monniot, 1970	+		+	+			3-40	E
<i>Ascidia mentula</i> Müller, 1776	+	+	+	+	+		1-200	AM
<i>Ascidia muricata</i> Heller, 1874	+	+	+	+			3-80	E
<i>Ascidia salvatoris</i> (Traustedt, 1883)	+			+			4	E
<i>Ascidia virginea</i> Müller, 1776	+	+	+	+		+	5-410	AM
<i>Ascidiella aspersa</i> (Müller, 1776)	+	+	+	+	+	+	2-70	AM
<i>Ascidiella scabra</i> (Müller, 1776)	+	+	+	+	+		20-55	AM
<i>Phallusia fumigata</i> (Grübe, 1864)	+		+	+	+		0.5-63	E
<i>Phallusia mammillata</i> (Cuvier, 1815)	+	+	+	+	+		9-160	AM
<i>Phallusia nigra</i> Savigny, 1816					+		720	C
STYELIDAE								
** <i>Botryllus leachi</i> (Savigny, 1816)	+	+	+	+	+		0.5-4	AM
<i>Botryllus niger</i> (Herdman, 1886)	+	+			+		25	C
* <i>Botryllus schlosseri</i> (Pallas, 1766)	+	+	+	+	+	+	1-82	C
* <i>Distomus variolosus</i> Gaertner, 1774	+	+	+	+			4-104	AM
<i>Eusynstyela hartmeyer</i> Michaelsen, 1904					+		720	LM
<i>Polycarpa caudata</i> Monniot & Monniot, 1974	+			+			866	E
* <i>Polycarpa fibrosa</i> (Stimpson, 1852)	+	+		+	+		2-257	AM
*** <i>Polycarpa gracilis</i> Heller, 1877	+	+	+	+			2-40	AM
* <i>Polycarpa pomaria</i> (Savigny, 1816)	+	+	+	+	+		1-150	AM
* <i>Styela partita</i> (Stimpson, 1852)	+	+	+	+	+		3-80	C
* <i>Styela plicata</i> (Lesueur, 1823)	+	+	+	+	+		1-70	C
<i>Symplegma viride</i> Herdman, 1886					+		75	C
PYURIDAE								
* <i>Halocynthia papillosa</i> (Linnaeus, 1767)	+	+	+	+	+		1-100	E
<i>Herdmania momus</i> (Savigny, 1816)					+		0-1	C
* <i>Microcosmus claudicans</i> (Savigny, 1816)	+	+	+	+			2-75	AM
*** <i>Microcosmus nudistigma</i> Monniot C., 1962	+			+			2-30	AM
*** <i>Microcosmus polymorphus</i> Heller, 1877	+	+	+	+			2-90	E
*** <i>Microcosmus sabatieri</i> Roule, 1885	+		+	+			3-45	E
<i>Microcosmus savignyi</i> Monniot C., 1962	+	+	+	+			75	E
* <i>Microcosmus vulgaris</i> Heller, 1877	+	+	+	+	+		1-100	E
*** <i>Pyura dura</i> (Heller, 1877)	+	+	+	+			1-55	E
* <i>Pyura microcosmus</i> (Savigny, 1816)	+	+	+	+			1-90	AM
* <i>Pyura squamulosa</i> (Alder, 1863)	+	+	+	+			2-50	AM
*** <i>Pyura tessellata</i> (Forbes, 1848)	+			+			3-60	AM
MOLGULIDAE								
<i>Eugyra arenosa</i> (Alder & Hancock, 1848)	+	+	+	+		+	145-230	AM
<i>Molgula amesophleba</i> (Codreanu & Mack-Fira, 1956)	+					+	37-55	?E
<i>Molgula appendiculata</i> Heller, 1877	+	+	+	+		+	10-55	E
? <i>Molgula euprocta</i> (Von Drasche, 1884)			+			+	40-110	E
<i>Molgula helleri</i> Von Drasche, 1883			+		+		7-14	E
<i>Molgula manhattensis</i> (De Kay, 1841)	+	+	+	+		+	35-90	AM
* <i>Molgula occulta</i> Kupffer, 1875	+	+	+	+	+		2-50	AM

POLYCITORIDAE

Clavelina lepadiformis (Müller, 1776)

Clavelina lepadiformis, Berrill, 1950, p. 70, figs 14, 15.- Brunetti, 1979, p. 97; 1987, p. 102, pls II, VIb, b1, VIII.

10 colonies (stations: 20, 69, 105) were collected from depths of 2-18 m, on rocks and artificial hard substrates.

Distribution: First record from the Eastern Mediterranean. Adriatic Sea, Central and Western Mediterranean (PÉRÈS, 1956a; BRUNETTI, 1987; TURON, 1988b, etc.), Atlantic (BERRILL, 1950).

POLYCLINIDAE

Aplidium albicans (Milne-Edwards, 1841)

Amaroucium albicans, Harant & Vernières, 1933, p. 85, figs 86, 94.- Fiala-Médioni, 1970, p. 292, pl. II.

34 colonies (stations: 95, 108, 111, 144a, 146a, 156a) were collected from depths of 3-45 m, on rocks and calcareous algae.

Distribution: First record from the Eastern Mediterranean. Known from all the other parts of the Mediterranean and the Atlantic, mainly under the names *Amaroucium albicans* and *A. proliferum* (CARUS, 1889-93; FIALA-MÉDIONI, 1970; MILLAR, 1970; TURSI, 1976, etc.).

Aplidium asperum Von Drasche, 1883

Aplidium asperum, Harant & Vernières, 1933, p. 83.

21 colonies (stations: 14, 40, 110, 134, 146, 175) collected from depths of 3-6 m, on rocks, boulders and artificial substrata.

Distribution: The only Mediterranean areas in which this species has been found to date were Rovigno in the Adriatic Sea and Provence (CARUS 1889-93, SEELIGER & HARTMEYER 1906-11). HARANT & VERNIÈRES (1933) classified it as a rare Mediterranean species, while PÉRÈS (1958a) includes it in his list of the Western Mediterranean endemics. However, it was not known from the Eastern Mediterranean.

Remarks: Although our specimens agree with the description given by HARANT & VERNIÈRES (1933) and are not close to any other species of the genus, we have some reservations about their identity, since the description of the above authors is not sufficiently detailed.

Aplidium nordmanni (Milne-Edwards, 1841)

Aplidium (*Amaroucium*) *nordmanni*, Berrill, 1950, p. 105, figs 30, 31.

Amaroucium nordmanni, Fiala-Médioni, 1970, p. 294, pl. III.

One colony (station: 108) collected from a depth of 8 m, on an *Ostrea* sp. shell.

Distribution: First record from the Eastern Mediterranean. In the rest of the Mediterranean it is known from several localities in the western basin only (FIALA-MÉDIONI, 1970; TURON, 1987). Also known from the E. Atlantic (BERRILL, 1950).

Aplidium pallidum (Verrill, 1871)

Aplidium pallidum, Berrill, 1950, p. 97, fig. 26.- Fiala-Médioni, 1970, p. 288, pl. I.

7 colonies (stations: 12, 108) were found in depths of 2-20 m, on rocks and calcareous algae.

Distribution: First record from the Eastern Mediterranean. In the rest of the Mediterranean known only from the western basin (PÉRÈS, 1952; FIALA-MÉDIONI, 1970; TURON 1987, etc.). Also well known from the N. Atlantic (BERRILL, 1950).

Aplidium aegeansis (Hartmeyer, 1904) nom. nov.

Amaroucium vitreum, Hartmeyer, 1904, p. 325, figs 1, 2.

14 colonies (stations: 25, 33, 92, 131, 145, 146, 157) were collected from depths of 1-40 m, on rocks and calcareous algae.

Distribution: The type locality of this species is Aegina Islet, Saronikos Gulf, South Aegean Sea (HARTMEYER, 1904). It has not been reported elsewhere since then. PÉRÈS (1958a) classified this species as an Eastern Mediterranean endemic. Finding it in various localities of the northern Aegean considerably extends its distribution.

Remarks: The valid species *Aplidium vitreum* was named by LAHILE (1887) and later transferred to the genus *Aplidiopsis*, Toulouse 1890. HARTMEYER (1904) named *Amaroucium vitreum* which is also a valid species. Due to the usage of the genera *Aplidium* and *Amaroucium* as synonyms by various authors, the species *Amaroucium vitreum* Hartmeyer, 1904, should be transferred to the genus *Aplidium*. However, it cannot be given the name *Aplidium vitreum*. So we consider it necessary to change the species name to *aegeansis*, a name selected because this species has been reported to date only from the Aegean Sea.

Polyclinella azemai Harant, 1930

Polyclinella azemai, Monniot & Monniot, 1971, p. 1189, fig. 1A,B.

1 colony (station: 152) from a depth of 30 m, on a small stone.

Distribution: First record from the Eastern Mediterranean. It is known from the Adriatic (MONNIOT & MONNIOT, 1970), Central Mediterranean (PÉRÈS, 1956a), and Western Mediterranean (HARANT & VERNIÈRES, 1933; TURON, 1987).

***Sidnyum turbinatum* Savigny, 1816**

Sidnyum turbinatum, Berrill, 1950, p. 112, fig. 34.

3 colonies (station: 114) from a depth of 3-6 m, on stones and a polychaete (*Serpula* sp.) tube.

Distribution: First record from the Eastern Mediterranean. In the rest of the Mediterranean it was known from the Adriatic Sea (LAFARGUE, 1971) and its western basin (SALFI, 1931-32; RAMOS, 1984; TURON, 1987, 1988b). Known also from the eastern Atlantic coast (BERRILL, 1950, etc.).

DIDEMNIDAE

***Didemnum amourouxi* Lafargue, 1976**

Didemnum amourouxi, Lafargue, 1976, p. 268, fig. 4a, 5.

One colony (station: 152) from a depth of 30 m, on a stone.

Distribution: First record from the Eastern Mediterranean. In the Mediterranean it is known only from Banyuls and the Catalan and Balearic coasts (LAFARGUE, 1976; LAFARGUE *et al.*, 1986; TURON, 1988b).

***Didemnum coriaceum* (Von Drasche, 1883)**

Didemnum coriaceum, Lafargue, 1975a, p. 188, figs 11, 12.

Several colonies (stations: 12, 37, 85, 113, 140, 157, 168, 171, 175, 190, 195, 203, 205) from depths of 1-30 m on various types of substrata, such as *Cystoseira*, *Posidonia* rhizomes and the gorgonian *Eunicella singularis*.

Distribution: First record from the Eastern Mediterranean. Known all over the rest of the Mediterranean and the Atlantic (LAFARGUE & TURSI, 1975; LAFARGUE, 1981; TURON, 1986; LAFARGUE & WAHL, 1987).

***Didemnum drachi* Lafargue, 1975**

Didemnum drachi, Lafargue, 1975a, p. 179, figs 5, 6a.

One colony (station:145) from a depth of 30 m, on *Posidonia* rhizome.

Distribution: First record from the Eastern Mediterranean. It is known from the Adriatic (LAFARGUE, 1981) and the western basin of the Mediterranean (LAFARGUE, 1975a; TURON, 1986; LAFARGUE & WAHL, 1987).

***Didemnum granulosum* (Von Drasche, 1883)**

Didemnum granulosum, Lafargue, 1972, p. 15, figs 2-4.- Lafargue & Wahl, 1987, p. 14, fig. 5D-F., pl. IIID.

27 colonies (stations: 20, 95, 145, 147, 152) from depths of 1-40 m, on rocks, stones and polychaete tubes.

Distribution: First record from the Eastern Mediterranean. It is known from the Adriatic (LAFARGUE, 1971; BRUNETTI, 1979), Central Mediterranean (LAFARGUE & TURSI, 1975) and Western Mediterranean (*e.g.* LAFARGUE, 1972; TURON, 1986).

***Didemnum peyrefittense* Brément, 1913**

Didemnum [Leptoclinum] peyrefittense Brément, 1913, p. 1, figs 1-2.

Didemnum peyrefittense, Lafargue, 1975a, p. 183, figs 6b-c, 7, 8.

One colony (station: 145) from a depth of 35 m on calcareous algae.

Distribution: First record from the Eastern Mediterranean. It was known only from the Gulf of Lions (BRÉMENT, 1913) and Banyuls (LAFARGUE, 1975a; LAFARGUE & WAHL, 1987).

***Diplosoma spongiforme* (Giard, 1872)**

Diplosoma cupuliferum, Lafargue, 1968, p. 413, figs 11-12.

Diplosoma spongiforme, Lafargue, 1975c, p. 304, fig. 4d.

3 colonies (stations: 83, 122, 157) from depths of 20-50 m, on stones and shells.

Distribution: First record from the Eastern Mediterranean. It is known from the Adriatic (LAFARGUE & TURSI, 1975; LAFARGUE, 1981), Central Mediterranean (LAFARGUE & TURSI, 1975), Western Mediterranean (*e.g.* MÉDIONI, 1970; LAFARGUE & WAHL, 1987; TURON, 1988b) and also from the European Atlantic coasts (KOTT, 1952).

***Polysyncraton bilobatum* Lafargue, 1968**

Polysyncraton bilobatum Lafargue, 1968, p. 401, fig. 8.- Lafargue & Wahl, 1987, p. 11, fig. 3jJ, K, L, Pls XII above.

2 colonies (station:150) from depths of 20-35 m, on *Posidonia* rhizomes.

Distribution: First record from the Eastern Mediterranean. It is known from all other parts of the Mediterranean (LAFARGUE, 1971; LAFARGUE & TURSI, 1975; LAFARGUE & WAHL, 1987; TURON, 1988b, etc.) and the European Atlantic coasts (LAFARGUE, 1968).

***Trididemnum cereum* (Giard, 1872)**

Trididemnum cereum, Lafargue, 1968, p. 369, fig. 2.-Lafargue, 1974a, p. 176, figs 1, 2a,c.

8 colonies (stations: 157, 188) from depths of 1-40 m, on rocks and stones.

Distribution: First record from the Aegean Sea. In the Levantine Basin it is known only from the Mediterranean coast of Israel (PÉRÈS, 1958b,c; as *T. tenerum*). Known also from the Adriatic (LAFARGUE, 1981), Central Mediterranean (PÉRÈS, 1956a; LAFARGUE & TURSI, 1975), Western Mediterranean (SALFI, 1931-32; TURON, 1986, etc.) and the Atlantic (BERRILL, 1950; LAFARGUE & WAHL 1987).

***Trididemnum inarmatum* (Von Drasche, 1883)**

Trididemnum inarmatum, Lafargue, 1974b, p. 178, figs 2b, 3, 4.

2 colonies (station: 20) from depths of 4-6 m, on a stone and a shell of *Phyllonotus trunculus*.

Distribution: First record from the Eastern Mediterranean. It is known from all over the Mediterranean (PÉRÈS, 1956a; LAFARGUE, 1971; LAFARGUE & TURSI, 1975; LAFARGUE, 1977; TURON, 1986, etc.).

PEROPHORIDAE

***Perophora listeri* Wiegmann, 1835**

Perophora listeri, Berrill, 1950, p. 145, fig. 45.

2 colonies (station: 87) were collected from depths of 2-35 m, on stones.

Distribution: First record from the Aegean Sea. In the Levantine Basin it is known only from the Mediterranean coast of Israel (PÉRÈS, 1958b, 1958c). Its presence was known in the Adriatic (PÉRÈS, 1956b), Central Mediterranean (PÉRÈS, 1956a), Western Mediterranean (SALFI, 1931-32; CAPPOCACCIA, 1964; MÉDIONI 1970), and the Atlantic (BERRILL, 1950).

STYELIDAE

***Botryllus leachi* (Savigny, 1816)**

Botrylloides leachi, Berrill, 1950, p. 224, figs 77-79.

10 colonies (station: 20) from depths of 0.5-4 m, on an artificial substratum (cement).

Distribution: First record from the Aegean Sea. In the Levantine Basin it is known only from the Mediterranean coast of Egypt (HARANT, 1939). It is known from the Adriatic (PÉRÈS, 1956b; LAFARGUE, 1971, etc.), Central Mediterranean (TURSI *et al.*, 1974), Western Mediterranean

(SALFI, 1931-32; LAFARGUE *et al.*, 1986, etc.) and the Atlantic (BERRILL, 1950; MILLAR, 1970, etc.).

Remarks: MONNIOT & MONNIOT (1987a) argue convincingly that the characteristic used to distinguish the genus *Botrylloides* from *Botryllus* are too unreliable to maintain this separation and that the name of the older genus *Botryllus* should prevail in all cases.

***Polycarpa gracilis* Heller, 1877**

Polycarpa gracilis Heller, 1877, p. 262, Tab. V, figs 4-6.- Berrill, 1950, p. 191, figs 61I, J, 63.

2 specimens (stations: 83,87) were collected from depths of 2 and 40 m, on stones.

Distribution: First record from the Eastern Mediterranean. It is known from the Adriatic (HELLER, 1877; MONNIOT & MONNIOT, 1970), Central Mediterranean (PÉRÈS, 1956a; TURSI, 1976), western Mediterranean (SALFI, 1931-32; PÉRÈS, 1952; TURON, 1988a, etc.) and the Atlantic (BERRILL, 1950).

PYURIDAE

***Microcosmus nudistigma* Monniot C., 1962**

Microcosmus nudistigma, Monniot C., 1962, p. 413, figs 1, 5, 7d-f, 8a-b, 9.

52 specimens (stations: 139, 146, 157, 194, 203) were collected from depths of 2-30 m, on rocks and stones.

Distribution: First record from the Eastern Mediterranean. In the rest of the Mediterranean it is known from the French and Spanish coasts (MONNIOT C., 1962, 1965; MÉDIONI, 1970; RAMOS, 1984; TURON, 1988a; etc.). Known also from the coast of Portugal (SALDANHA 1974).

***Microcosmus polymorphus* Heller, 1877**

Microcosmus polymorphus Heller, 1877, p. 246, Tab. I, figs 9-11, Tab. II, figs 1-4.-Monniot C., 1962, p. 410, figs 1, 5, 6a-b, 7a-c.

65 specimens (stations: 20, 25, 35, 47, 58, 87, 93, 120, 140, 150, 152, 168, 161, 166, 171, 175, 178, 190, 194, 203, 204) from depths of 2-90 m, mainly on stones and shells.

Distribution: First record from the Eastern Mediterranean. It is known from all over the Mediterranean (e.g. HELLER, 1877; TRAUSTEDT, 1883; MÉDIONI, 1970; TURSI, 1976; RAMOS, 1984).

***Microcosmus sabatieri* Roule, 1885**

Microcosmus sabatieri, Monniot C., 1962, p. 400, figs 1, 2a-b, 3a-c, 5.

8 specimens (stations: 87, 91, 112, 122, 146, 188) from depths of 3-45 m, on rocks and stones.

Distribution: First record from the Eastern Mediterranean. In the rest of the Mediterranean it is known only from the Adriatic (LAFARGUE, 1971) and its Western basin (e.g. MONNIOT C., 1962, 1968; CAPPOCACCIA, 1964; TURON, 1988a).

***Pyura dura* (Heller, 1877)**

Cynthia dura Heller, 1877, p. 251, Tab. III, figs 1-5.

Pyura dura, Monniot C., 1965, p. 86, figs 26-27.

82 specimens (stations: 11, 34, 47, 66, 83, 89, 114, 131, 142, 157, 164, 165, 168, 171, 175, 188, 202, 203, 209) from depths of 1-55 m, on stones, shells and calcareous algae.

Distribution: First record from the Eastern Mediterranean. It is known from all over the Mediterranean (HELLER, 1877; TRAUSTEDT, 1883; MÉDIONI, 1970; TURON, 1988a, etc.).

***Pyura tessellata* (Forbes, 1848)**

Pyura tessellata, Monniot C., 1965, p. 93, figs 23C, 29. 17 specimens (stations: 63, 112, 130, 143, 150, 152, 162, 166, 203) from depths of 3-60 m, on rocks, stones, shells and calcareous algae.

Distribution: First record from the Eastern Mediterranean. It was known only from the French and Spanish coasts (HARANT & VERNIÈRES, 1933; MONNIOT C., 1965; MÉDIONI, 1970; TURON 1988a).

REMARKS ON THE ASCIDIAN FAUNA
OF THE MAIN MEDITERRANEAN AREAS AND THE BLACK SEA

PÉRÈS (1958a) listed 130 Mediterranean species. Since then, this number has changed remarkably. Many of the species included in his list have either been proved to be synonyms, or not distributed in the Mediterranean. On the other hand, an important number of new species have been described, and some species, mainly of Atlantic origin, were found to have extended their distribution into the Mediterranean. From a review of the relevant literature, we estimated that the number of Mediterranean species is 187, including 10 problematic species. This estimate was mainly based on the references below, which are listed separately for each of the mentioned Mediterranean areas.

Western Mediterranean

The ascidian fauna in the western Mediterranean has been studied in greater detail than that of any other Mediterranean area, and has been recorded in an important number of early and recent publications. On the basis of these publications, the number of ascidian species found to date in the western basin was estimated to be 165, corresponding to 88.2 % of the total Mediterranean ascidian species (Fig. 2). Only 37 of the Mediterranean species have not been found in this area. This estimate was based mainly on the following references: PÉRÈS (1958a, 1959a,b,c), MONNIOT C. (1962, 1963, 1965, 1969a, 1981), MONNIOT F. (1965), MONNIOT & MONNIOT (1961, 1983, 1990), FIALA-MÉDIONI (1970), GAILL

(1972), LAFARGUE (1972, 1974a,b, 1975a,b,c, 1976, 1977), BRUNETTI (1978-79, 1987), HOSHINO & NISHIKAWA (1985), LAFARGUE & WAHL (1987), TURON (1987, 1988c), TURON & MATEO (1987), RAMOS *et al.* (1988) and RAMOS *et al.* (1991).

Central Mediterranean

From the Central Mediterranean 93 species are known to date (49.7% of the Mediterranean species) (Fig. 2), according mainly to PÉRÈS (1954, 1956a), MONNIOT & MONNIOT (1975) and TURSÌ (1976). In this area, 28 species known from the Eastern Mediterranean and 2 species known from the Black Sea (*M. amesophleba* and *M. euprocta*) have not been found, as can be seen from Table I. The low number of ascidian species recorded in this area should be attributed mainly to the very restricted sampling which has taken place there.

Adriatic Sea

Eighty-five ascidian species are known in this area (45.5 % of the Mediterranean species) (Fig. 2). The above estimate is mainly based on the papers by: HELLER (1874, 1875, 1877), SEELIGER & HARTMEYER (1906-11), SALFI (1946), MONNIOT & MONNIOT (1970, 1975), LAFARGUE (1971, 1981), LAFARGUE & TURSÌ (1975), TURSÌ (1977) and BRUNETTI (1979). Twenty-nine of the species known from the Eastern Mediterranean and 1 from the Black Sea (*M. amesophleba*) have not been found in the Adriatic (see Table I).

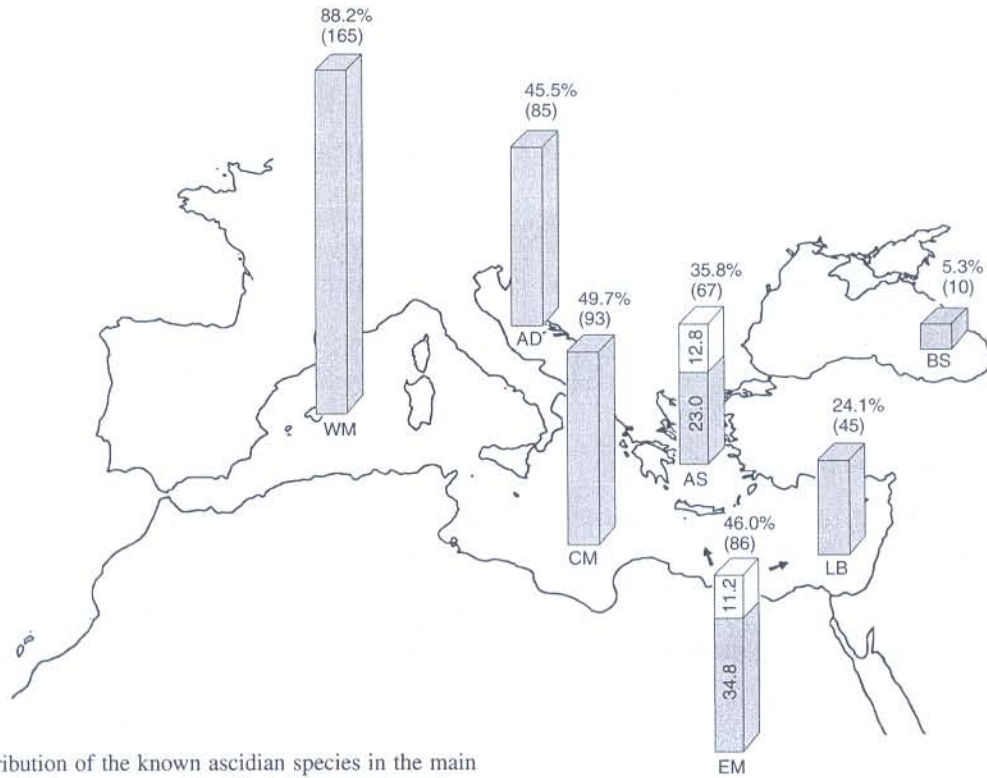


FIG. 2.— Distribution of the known ascidian species in the main areas of the Mediterranean and the Black Sea, as real numbers and percentages of the total Mediterranean species. The white part of the columns shows numbers and percentages added by the present study. WM = Western Mediterranean, CM = Central Mediterranean, AD = Adriatic, LB = Levantine Basin, AS = Aegean Sea, BS = Black Sea, EM = Eastern Mediterranean (Levantine Basin & Aegean).

FIG. 2.— Répartition des espèces connues d'ascidies dans les différentes zones de la Méditerranée et de la mer Noire, en nombre d'espèces et en pourcentage du nombre total d'espèces méditerranéennes. La partie supérieure des colonnes, en blanc, représente le nombre d'espèces et leur pourcentage, ajoutés par cette étude. WM = Méditerranée Occidentale, CM = Méditerranée Centrale, AD = Adriatique, LB = bassin Levantin, AS = mer Égée, BS = mer Noire, EM = Méditerranée orientale (bassin Levantin et mer Égée).

Aegean Sea (including the Sea of Marmara)

Forty-three ascidian species were known to date from this area, according to information given by: FORBES (1844), HARTMEYER (1904), ATHANASOPOULOS (1928), DEMIR (1952-54), PÉRÈS & PICARD (1958), KISELEVA (1961, 1963), JAQUOTTE (1962), MAKKAVIEVA (1963), GELDIAY & KOCATAS (1972), VAMVAKAS (1971), MONNIOT & MONNIOT (1974), UYSAL (1976) and KOUKOURAS & SIAMIDOU-EFREMIDOU (1978-79).

During the present study, 42 ascidian species were identified and are listed in *Table I*. Twenty-four of them are reported as new elements of the Aegean fauna, thus increasing the number of species known from this area to 67, corresponding to 35.8% of the total number of Mediterranean species. The 24 species new for the area correspond to a 12.8% increase (*Fig. 2*). It is worth mentioning that only *Aplidium aegeansis* has not been found in any other Mediterranean area, while 9 more species have been reported only from the western basin (*Table I*).

Levantine Basin

Only 45 species (24.1% of the total Mediterranean ascidians, *Fig. 2, Table I*) are known from this impoverished (POR & DIMENTMAN, 1989) basin according to: SEELIGER & HARTMEYER (1906-11), HARANT (1939), HARANT & VERNIÈRES (1933), PÉRÈS (1958a,b,c), MONNIOT C. (1965, 1969a), LAFARGUE (1974a) and POR (1978). All these species have been found only along the coasts of Egypt and Israel.

POR (1978) listed 7 species as Lessepsian migrants (*i.e.* having entered through the Suez Canal). Recently,

ZIBROWIUS (1991) noted that C. MONNIOT's opinion (personal communication) is that *Ascidia cannelata* may be the only true Lessepsian migrant in POR's list. Taking into account the information existing on the 7 species in POR's list we can make the following comments:

The highly probable Lessepsian migrant *Herdmania momus* which, according to POR (1978), was known from Alexandria, Haifa, all over the Suez canal, and Port Taufiq, Red Sea, has not only been found in Victoria, Australia (MILLAR, 1960), New Caledonia (MONNIOT C., 1989, 1992), but also in the Atlantic from the Antilles to Sao Paulo, Brasil (MONNIOT C., 1983c). MONNIOT C. (1965) thinks that perhaps a species group has been included under the name of this species, and that this Indo-Pacific species may have entered the Atlantic through Panama, as it entered the Mediterranean through Suez. The reports of the uncertain taxon *Pyura momus* var. *pontica* from the Black Sea, and other reports of *Pyura momus* from the Western Mediterranean and the Adriatic (SEELIGER & HARTMEYER, 1906-11) make this species even more problematic. However, until this confusion is clarified, it should be considered as a tropical cosmopolitan species.

Phallusia nigra, according to POR, is known from Caesarea, the Suez Canal and the Gulf of Suez; SEELIGER & HARTMEYER (1906-11), under the name *Phallusiopsis nigra*, give a much wider distribution (Bermuda and east coast of South America in the Atlantic and along the east coasts of Africa in the Indo-Pacific). Therefore it should also be classified as a tropical cosmopolitan.

Symplegma viride, known in the Eastern Mediterranean from Caesarea, the coast of Israel and also from the Suez Canal and the Red Sea (POR, 1978), is not a true Lessepsian migrant, as it is also known from Rio de Janeiro (RODRIGUES & ROCHA, 1993), Guadeloupe, the Antilles (MONNIOT C., 1983b), and the west coast of Africa, Senegal (PÉRÈS, 1951; MONNIOT C., 1969b). According to MONNIOT C. (1983b) other reports of this species from the Indo-Pacific should be attributed to another species of the genus. This species must also be considered to be cosmopolitan.

Ascidia cannelata, known from Haifa on the Mediterranean coast of Israel, and also from Lake Timsah, the Suez Canal, the Gulf of Suez and the Indo-Pacific (POR, 1978) could be considered as a true Lessepsian migrant.

Ecteinascidia turbinata (as *E. moorei*) is a cosmopolitan species and not a true Lessepsian migrant, as it is known not only from all over the Mediterranean (HARANT, 1939; PÉRÈS, 1954, 1956a; TURON, 1988b; etc.), but also from the Bahamas, Bermuda, Guyana, the coast of Brasil, the Canary

Islands, Cap Verde in the Atlantic and along the east coasts of Africa in the Indo-Pacific (SEELIGER & HARTMEYER, 1906-11; MONNIOT C., 1983a, etc.).

Botryllus niger (as *Metrocarpa nigrum*) should be considered as a cosmopolitan species and not as a true Lessepsian migrant, since it is known from all over the Mediterranean (PÉRÈS, 1954, 1958b,c, 1961), from the Atlantic: Bermuda, Florida, Venezuela, the coast of Brasil, Rabat, Morocco, and from the Indo-Pacific: east African coast (SEELIGER & HARTMEYER, 1906-11; MILLAR, 1967; MONNIOT C., 1983a; RODRIGUES & ROCHA, 1993).

Finally, *Eusynstyela hartmeyeri*, which according to POR (1978) is known not only from the harbour of Port Said in the Mediterranean but also from along the Suez Canal and the Gulf of Suez. It has been found in the Red Sea and along the east African coast by SEELIGER & HARTMEYER (1906-11) and could be considered as a true Lessepsian migrant.

Therefore only *Ascidia cannelata* and *Eusynstyela hartmeyeri* can, at present, be classified as true Lessepsian migrants.

Aplidium griseum, *Trididemnum fallax*, and *T. graphicum* are included among the species reported from the Levantine Basin, recorded in early publications (e.g. SEELIGER & HARTMEYER, 1906-11) from the western basin of the Mediterranean. Since these three species are still problematic, their presence in the Levantine Basin should be considered uncertain. *Rhopalopsis hartmeyeri*, known from the Gulf of Napoli (SALFI, 1931-32), the Central Mediterranean (PÉRÈS, 1954, 1956a) and Banyuls (PÉRÈS, 1959c), as well as *R. orientalis* described and reported only from Haifa on the Israeli coast (PÉRÈS, 1958b) should also be considered uncertain mainly due to their poor description. It is worth mentioning that *Distaplia magnilarva* recorded by HARANT (1939) from the coast of Alexandria is known in the Mediterranean only from its western basin (HARANT & VERNIÈRES, 1933; MONNIOT & MONNIOT, 1987b).

Eastern Mediterranean

Considering the Aegean and the Levantine Basin as part of the Eastern Mediterranean (in order to compare their fauna with those of other Mediterranean areas), although there are important differences between these two areas from the zoogeographical point of view (PÉRÈS & PICARD, 1964; POR & DIMENTMAN, 1989, etc), we can make the following remarks: 86 ascidian species are known from the Eastern Mediterranean, comprising 46.0 % of the total Mediterranean ascidians (Fig. 2). Of these, 21 species (11.2 %) have

been added by the present study, since the species found in the Aegean represent new records for the fauna of the Eastern Mediterranean (Fig. 2).

The number of species known from the Eastern Mediterranean is much lower than that from the Mediterranean as a whole and, more specifically, than that of its western basin. This difference should be attributed mainly to the fact that a large number of Atlanto-Mediterranean species have been found exclusively in the Western Mediterranean, obviously not having extended their distribution to the Eastern Mediterranean. This aspect of the distribution has been shown by many earlier and more recent authors studying the ascidian fauna (e.g. PÉRÈS, 1958a; MILLAR, 1971) and also by results of studies on other taxa in the Aegean (e.g. KOUKOURAS *et al.*, 1992; VOULTSIADOU-KOUKOURA & KOUKOURAS, 1993; VAFIDIS *et al.*, 1994). Two additional points should be seriously taken into consideration to explain this difference; in the Aegean, the sampling effort involving at least the ascidian fauna, is insufficient — as proved by the large number of species new for the area found during the present study. The finding of new species was expected as depths greater than 200 m as well as biotopes like the coralligenous bottoms were sampled. The Levantine Basin, where the sampling effort was restricted, has proved to be impoverished due to its oligotrophic character (POR & DIMENTMAN, 1989; KOUKOURAS & RUSSO, 1991, etc). We attribute the great difference between the number of species known from the Aegean Sea and the Levantine Basin (67 ascidian species from the Aegean versus 45 from the Levantine) to the latter. The difference between the two areas becomes more striking if

we take into account that only 26 of these species (Table 1) (making 30.2 % of the species found in the Eastern Mediterranean) are found in both areas.

Black Sea

Only 10 ascidian species are known from the Black Sea according to BORCEA (1928-29), CASPERS (1951, 1957), CODREANU & MACK-FIRA (1956) and BACESCU *et al.* (1971), shown in Table 1. Eight of them are common in the Mediterranean. From the remaining two, *Molgula amesophleba* described from this area (CODREANU & MACK-FIRA, 1956) has only been found since in Banyuls (MONNIOT C., 1969a), while the presence of *Molgula euprocta*, described from the Adriatic Sea (SEELIGER & HARTMEYER, 1906-11), in this area should be considered uncertain since it was not recorded by MONNIOT C. (1969a). The 10 species found in the Black Sea correspond to 5.3 % of the Mediterranean ascidian fauna. The impoverished fauna of the Black Sea is a result of the very peculiar oceanographic conditions prevailing in the area, especially the low temperature and salinity values (CASPERS, 1957, etc.)

Eighty-eight ascidian species are known to date from the Eastern Mediterranean and the Black Sea (Table 1). According to the above, only 2 of them (2.3 % of the total number) are Lessepsian migrants, thus having an Indo-Pacific origin (Fig. 3). Fourteen more species (15.9 %) must be considered cosmopolitan. The remaining species are either Atlanto-Mediterranean or endemics. From the 36 endemic spe-

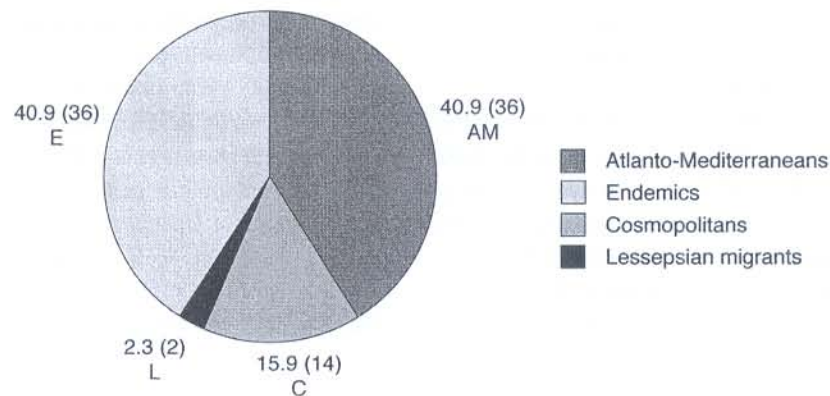


FIG. 3.— Composition of the ascidian species known in the eastern Mediterranean and the Black Sea showing their zoogeographical classification, as percentages and with real numbers (in parentheses).

FIG. 3.— Composition en espèces connues d'ascidies de la Méditerranée Orientale et de la mer Noire, sur le plan de leur caractérisation zoogéographique, pourcentages et nombres réels (entre parenthèses).

cies (40.9 %) found, only 2 (*Aplidium aegeansis* and *Rhopalopsis orientalis*) can possibly be classified as Eastern Mediterranean endemics, since they have not been found in other Mediterranean areas. This composition seems to be very close to that given by PÉRÈS (1958a) for the whole Mediterranean. This is more obvious for the endemic species; the above author has given 50 %, and later (PÉRÈS 1985) 40 %, explaining their great number as a result of the short pelagic life of the group. However, the distinction made by PÉRÈS (1958a) between the endemics of the Eastern and of the Western Mediterranean does not seem to be true, since several of the species he placed in the first category have been found in the Western Mediterranean and vice versa.

However, the ascidian fauna of the Mediterranean is considered particular, although its differentiation started

relatively recently, after the basin became isolated (MONNIOT & MONNIOT, 1978).

The depths at which the species in the list have been found are within the limits of their known vertical distribution. Since sampling in the Eastern Mediterranean was carried out in shallow depths (<200 m), the list does not include abyssal species — with the exception of *Polycarpa caudata*, found in the northern Aegean Sea at a depth of 866 m (MONNIOT & MONNIOT, 1974). It is expected that future samplings in this area, at depths greater than 200 m, will add species already known from the deep waters of the Mediterranean to the list.

Acknowledgements. We are grateful to Dr. C. Monniot for confirming the identification of some species and giving useful advice, and also to the two referees for their useful comments.

REFERENCES

- ATHANASSOPOULOS G.D., 1928.— Espèces planctoniques de la baie du Phalères. *Bull. comité Thalass. Hellenique*, Athens, **8** (1) : 33-87.
- BACESCU M., MÜLLER G., GOMOIU H.T., 1971.— *Ecologie Marina*. Vol. IV. Cercetari de ecologie bentala in Marea Neagra (Analiza cantitativa, calitativa si comparata a fannei bentale pontice). Bucuresti, ARSR, 357 p.
- BERRILL N.J., 1950.— *The Tunicata with an account of the British species*. London, Ray Society, 354 p.
- BORCEA I., 1928-29.— Nouvelles observations sur la faune côtière du littoral roumain de la Mer Noire. *Ann. Sci. Univ. Jassy*, **15** : 286-298.
- BRÉMENT E., 1913.— Sur deux nouveaux Didemnidés (Synascidies) du golfe du Lion (Note préliminaire). *Bulletin de l'Institut océanographique*, Monaco, **257** : 1-7.
- BRUNETTI R., 1978-79.— *Polyandrocarpa zorritensis* (Van Name, 1931) a colonial ascidian new to the Mediterranean record. *Vie et Milieu*, **28-29** : 647-652.
- BRUNETTI R., 1979.— Ascidiens of the Venice Lagoon. I. Annotated inventory of species. *Annales de l'Institut océanographique*, Paris, **55** : 95-109.
- BRUNETTI R., 1987.— Species of *Clavelina* in the Mediterranean Sea. *Annales de l'Institut océanographique*, Paris, **63** : 101-118.
- CAPPOCCIA L., 1964.— Gli Ascidiacei del golfo di Genova. Rassegna preliminare. *Ann. Mus. Stor. nat., Genova*, **75** : 1-19.
- CARUS J.V., 1889-93.— *Prodromus faunae Mediterraneae sive Descriptio Animalium Maris Mediterranei incolarum quam comparata silva rerum quatenus innotuit adiectis locis et nominibus Vulgaribus corumque auctoribus in commodum Zoologorum*. Vol. II. Brachiostomata. Mollusca. Tunicata. Vertebrata. Stuttgart, E. Schweizerbart'sche Verlagshandlung (E. Koch).
- CASPERS H., 1951.— Quantitative Untersuchungen über die Bodentierwelt des Schwarzen Meeres im bulgarischen Küstenbereich. *Archiv Hydrobiol.*, **45** : 1-192.
- CASPERS H., 1957.— Black Sea and Sea of Azov. *Geol. Soc. America Memoir*, **67** (1) : 801-890.
- CODREANU R., MACK-FIRA V., 1956.— Sur une Ascidie nouvelle de la Mer Noire, *Ctenicella amesophleha* n. sp. confondue avec la *Ct. appendiculata* (Heller 1877). *Comptes rendus de l'Académie des Sciences*, Paris, **242** : 2665-2668.
- DEMIR M., 1952-54.— The invertebrate benthos of the Bosphorus and of the littoral of the sea of Marmara closer to the Bosphorus. *Hidrobiol. arast. enst. yayinl.*, **3** : 1-615 (in Turkish).
- FIALA-MÉDIONI A., 1970.— Ascidiens du benthos rocheux de Banyuls-sur-Mer. Polyclinidae (Ascidiens composées). *Vie et Milieu*, **21** : 287-308.
- FORBES E., 1844.— Report on the Mollusca and Radiata of the Aegean Sea. *Rep. Br. Ass. Advmt. Sci.*, **13** : 130-193.
- FREDJ G., LAUBIER L., 1985.— The deep Mediterranean Benthos : 109-146. In : *Mediterranean marine ecosystems*. M. Moraitou-Apostolopoulou & V. Kiortsis (Eds). NATO Conf. series I. Ecology. London, Plenum Press.
- GAILL F., 1972.— Répartition du genre *Pseudodistoma* (Tuniciers); Description de deux espèces nouvelles. *Cahiers de biologie marine*, **13** : 37-47.
- GELDIAY R., KOCATAS A., 1972.— Note préliminaire sur les peuplements benthiques du golfe d'Izmir (in Turkish). *Sci. Monogr. Fac. Sci. Ege Univ.*, **12** : 1-34.
- HARANT H., 1939.— Les fonds de pêche près d'Alexandrie. *Notes et Mémoires*, Ministère du Commerce et de l'Industrie, Egypte, **28** : 1-12.
- HARANT H., VERNIÈRES P., 1933.— *Faune de France*. Tuniciers. I : Ascidiens. Paris, Lechevalier, 99 p.
- HARTMEYER R., 1904.— Tunicaten von Aegina. Ein Beitrag zur Kenntnis der Fauna des östlichen Mittelmeeres. *Zoologischer Anzeiger*, **27** : 321-327.

- HELLER C., 1874.— Untersuchungen über die Tunicaten des Adriatischen meeres. I. *Denkschr. K. Akad. Wien*, **34** : 1-31.
- HELLER C., 1875.— Untersuchungen über die Tunicaten des Adriatischen meeres. II. *Denkschr. K. Akad. Wien*, **34** : 107-131.
- HELLER C., 1877.— Untersuchungen über die Tunicaten des Adriatischen meeres. III (I). *Denkschr. K. Akad. Wien*, **37** : 241-282.
- HOSHINO Z., NISHIKAWA T., 1985.— Taxonomic Studies of *Ciona intestinalis* (L.) and its Allies. *Publications of the Seto Marine Biological Laboratory*, **30** : 61-79.
- JACQUOTTE R., 1962.— Étude des fonds de maërl de Méditerranée. *Recueil des travaux de la Station marine d'Endoume*, **26** (41) : 141-235.
- KISELEVA M.I., 1961.— Répartition qualitative et quantitative du benthos dans la région des Dardanelles en Mer Égée (in Russian). *Trudy Sevastopol' biol. Sta.*, **14** : 135-146.
- KISELEVA M.I., 1963.— Répartition qualitative du benthos de la Mer Égée (in Russian). *Trudy Sevastopol' biol. Sta.*, **14** : 192-200.
- KOTT P., 1952.— Observations on compound ascidians of the Plymouth area, with description of two new species. *Journal of the Marine Biological Association of the United Kingdom*, **31** : 65-83.
- KOUKOURAS A., DOUNAS C., TÜRKAY M., VOULTSIADOU-KOUKOURA E., 1992.— Decapod Crustacean Fauna of the Aegean Sea : New Information, Check List, Affinities. *Senckenbergiana marit.*, **22** : 217-244.
- KOUKOURAS A., RUSSO A., 1991.— Midlittoral soft substratum macrofaunal assemblages in the North Aegean Sea. *P.S.Z.N.J. Marine Ecology*, **12** : 293-316.
- KOUKOURAS A., SIAMIDOU-EFREMIIDOU O., 1978-79.— Benthic fauna of the North Aegean Sea. I. Cionidae and Ascidiidae (Tunicata, Ascidiacea). *Vie et Milieu*, **28-29** : 635-646.
- LAFARGUE F., 1968.— Les peuplements sessiles de l'Archipel de Glé-nan. II. Les Didemnidae - Systématique - Écologie. *Vie et Milieu*, **19** : 353-446.
- LAFARGUE F., 1971.— Note préliminaire concernant les Ascidies récoltées dans la région de Rovinj (Yougoslavie). *Thalassia jugoslavica*, **7** : 515-524.
- LAFARGUE F., 1972.— Didemnidae de Port-Cros (Ascidies composées). Deux espèces nouvelles pour les côtes de France. *Ann. Soc. Sci. nat. arch. Toulon, Var*, **24** : 120-140.
- LAFARGUE F., 1974a.— Révision taxonomique des Didemnidae des côtes de France (Ascidies composées). Description des espèces de Banyuls-sur-Mer. Généralités. Genre *Trididemnum*. *Annales de l'Institut océanographique*, Paris, **50** : 173-184.
- LAFARGUE F., 1974b.— Description d'un néotype de *Didemnum candidum* Savigny, 1816, espèce-type d'Ascidie composée de Mer Rouge. *Vie et Milieu*, **24** : 341-356.
- LAFARGUE F., 1975a.— Révision taxonomique des Didemnidae des côtes de France (Ascidies composées). Description des espèces de Banyuls-sur-Mer. Genre *Didemnum*, 1^{re} partie : larves à trois ventouses. *Annales de l'Institut océanographique*, Paris, **51** : 173-194.
- LAFARGUE F., 1975b.— Révision taxonomique des Didemnidae des côtes de France (Ascidies composées). Description des espèces de Banyuls-sur-Mer. Genre *Polysyncraton*. *Vie et Milieu*, **25** : 133-164.
- LAFARGUE F., 1975c.— Révision taxonomique des Didemnidae des côtes de France (Ascidies composées). Description des espèces de Banyuls-sur-Mer. Genre *Lissoclinum* et genre *Diplosoma*. *Vie et Milieu*, **25** : 289-309.
- LAFARGUE F., 1976.— Révision taxonomique des Didemnidae des côtes de France (Ascidies composées). Description des espèces de Banyuls-sur-Mer. Genre *Didemnum*, 2^e partie : larves à trois ventouses. *Annales de l'Institut océanographique*, Paris, **52** : 259-281.
- LAFARGUE F., 1977.— Révision taxonomique des Didemnidae des côtes de France (Ascidies composées). Synthèse des résultats principaux. *Annales de l'Institut océanographique*, Paris, **53** : 135-153.
- LAFARGUE F., 1981.— Les Didemnidae de Rovinj (Ascidies Aplousobranches). *Thalassia jugoslavica*, **17** : 83-87.
- LAFARGUE F., RAMOS A., TURON X., BANAIGS B., WAHL M., 1986.— The littoral ascidians of the Spanish Mediterranean. I. From Port Bou to the Islas Medas. *Vie et Milieu*, **36** : 133-139.
- LAFARGUE F., TURSÍ A., 1975.— Contribution à la connaissance des Didemnidae (Ascidies composées) des côtes des Pouilles (Mer Ionienne et Mer Adriatique). *Vie et Milieu*, **25** : 33-48.
- LAFARGUE F., WAHL M., 1987.— The Didemnid Ascidian fauna of France. *Annales de l'Institut océanographique*, Paris, **63** : 1-46.
- MAKKAVIEVA E.B., 1963.— Quelques peuplements des zones sableuses de la Mer Egée (in Russian). *Trudy Sevastopol' biol. Sta.*, **16** : 211-214.
- MÉDIONI A., 1970.— Les peuplements sessiles des fonds rocheux de la région de Banyuls-sur-Mer : Ascidies-Bryozoaires (Première partie). *Vie et Milieu*, **21** : 591-656.
- MILLAR R.H., 1960.— Ascidiacea. *Discovery Reports*, **30** : 1-160.
- MILLAR R.H., 1967.— Ascidians of Rabat, Morocco. *Bull. Soc. Sci. nat. Phys. Maroc*, **47** : 201-206.
- MILLAR R.H., 1970.— British Ascidiacea Tunicata : Ascidiacea. Keys and Notes for the Identification of the Species. In : *Synopses of the British Fauna N° 1 (New series)*. The Linnean Society of London. London, Academic Press, 88 p.
- MILLAR R.H., 1971.— The biology of Ascidiacea. *Advances in Marine Biology*, **9** : 1-100.
- MONNIOT C., 1962.— Les *Microcosmus* des côtes de France. *Vie et Milieu*, **13** : 397-432.
- MONNIOT C., 1963.— *Cratostigma regularis* n. sp. ascidie des gravelles de la région de Marseille. *Recueil des travaux de la Station marine d'Endoume*, **28** : 55-59.
- MONNIOT C., 1965.— Étude systématique et évolutive de la famille des Pyuridae (Ascidiacea). *Mémoires du Muséum national d'histoire naturelle*, Paris, A sér., **36** : 1-203.
- MONNIOT C., 1968.— Les Ascidies et la faune des zones chalutables du golfe du Lion. *Rapports de la Commission internationale pour l'exploration scientifique de la mer Méditerranée*, **19** : 187-188.
- MONNIOT C., 1969a.— Les Molgulidae des mers européennes. *Mémoires du Muséum national d'histoire naturelle*, Paris, A sér., **60** : 171-272.
- MONNIOT C., 1969b.— Sur une collection d'Ascidies de Dakar (Phlébobranches et Stolidobranches). *Mémoires du Muséum national d'histoire naturelle*, Paris, 2 sér., **41** : 622-654.
- MONNIOT C., 1981.— Apparition de l'Ascidie *Microcosmus exasperatus* dans les ports méditerranéens. *Téthys*, **10** : 59-62.

- MONNIOT C., 1983a.— Ascidies littorales de Guadeloupe. II. Phlébo-branches. *Bulletin du Muséum national d'histoire naturelle*, Paris, 4 sér., **5** : 51-71.
- MONNIOT C., 1983b.— Ascidies littorales de Guadeloupe. IV. Styeli-
dae. *Bulletin du Muséum national d'histoire naturelle*, Paris, 4
sér., **5** : 423-456.
- MONNIOT C., 1983c.— Ascidies littorales de Guadeloupe. VI. Pyuri-
dae et Molgulidae. *Bulletin du Muséum national d'histoire natu-
relle*, Paris, 4 sér., **5** : 1021-1044.
- MONNIOT C., 1989.— Ascidies de Nouvelle-Calédonie. VI. Pyuridae
et Molgulidae. *Bulletin du Muséum national d'histoire naturelle*,
Paris, 4 sér., **11** : 475-507.
- MONNIOT C., 1992.— Ascidies de Nouvelle-Calédonie. XI. Phlébo-
branches et Stolidobranches du plateau des Chesterfield. *Bulletin
du Muséum national d'histoire naturelle*, Paris, 4 sér., **14** : 3-22.
- MONNIOT F., 1965.— Ascidies interstitielles des côtes d'Europe. *Mé-
moires du Muséum national d'histoire naturelle*, Paris, A sér., **35** :
1-154.
- MONNIOT C., MONNIOT F., 1961.— Recherches sur les ascidies inter-
stitielles des gravelles à *Amphioxus* (2^e note). *Vie et Milieu*, **12** :
269-283.
- MONNIOT C., MONNIOT F., 1970.— Quelques ascidies de l'Adriatique.
Bulletin du Muséum national d'histoire naturelle, Paris, 2 sér.,
42 : 1189-1199.
- MONNIOT C., MONNIOT F., 1972.— Clé mondiale des genres d'Asci-
dies. *Archives de zoologie expérimentale et générale*, **113** :
311-367.
- MONNIOT C., MONNIOT F., 1974.— Ascidies abyssales de Méditerranée
récoltées par le «Jean Charcot» (campagnes Polymède).
Bulletin du Muséum national d'histoire naturelle, Paris, 3 sér.,
251 : 1353-1360.
- MONNIOT F., MONNIOT C., 1975.— Sept espèces d'Ascidies profondes
de Méditerranée. *Bulletin du Muséum national d'histoire natu-
relle*, Paris, 3 sér., **330** : 1117-1134.
- MONNIOT C., MONNIOT F., 1978.— Recent work on the deep-sea tuni-
cates. *Oceanography and Marine Biology. An Annual Review*,
16 : 181-228.
- MONNIOT C., MONNIOT F., 1983.— Ascidies des fonds meubles situés
autour de l'île de Port-Cros. *Trav. sci. Parc nation. Port-Cros, Fr.*,
9 : 97-105.
- MONNIOT C., MONNIOT F., 1987a.— Les ascidies de Polynésie fran-
çaise. *Mémoires du Muséum national d'histoire naturelle*, Paris,
A sér., **136** : 1-143.
- MONNIOT C., MONNIOT F., 1987b.— Ascidies (Ciones et Violets) :
743-760. In : *Fiches FAO d'identification des espèces pour les be-
soins de la pêche* (Révision 1).— Méditerranée et Mer Noire.
Zone de pêche 37. Volume I. Végétaux et Invertébrés.— Fischer
W. & Bouchot M.L. & Schneider M. (eds). Publication préparée
par la FAO, résultat d'un accord entre la FAO et la Commission
des Communautés européennes (Projet GCP/INT/422/EEC),
financée conjointement par ces deux organisations. Rome, FAO,
1, 760 p.
- MONNIOT C., MONNIOT F., 1990.— Relationships between deep-sea
tunicate populations west and east of the Straits of Gibraltar.
Progress in Oceanography, **24** : 289-296.
- PÈRES J.M., 1951.— Nouvelle contribution à l'étude des Ascidies de
la côte occidentale d'Afrique. *Bull. I.F.A.N.*, **13** : 1051-1071.
- PÈRES J.M., 1952.— Ascidies de la roche littorale corse. *Recueil des
travaux de la Station marine d'Endoume*, **6** : 35-44.
- PÈRES J.M., 1954.— Contribution à l'étude des Ascidies de Tunisie.
*Bulletin de l'Institut national scientifique et technique d'océano-
graphie et de pêche, Salammbô*, **45** : 3-21.
- PÈRES J.M., 1956a.— Ascidies : Résultats des campagnes scienti-
fiques de la «Calypso»; études sur le seuil Siculo-tunisien, Vol. II.
Annales de l'Institut océanographique, Paris, **32** : 265-304.
- PÈRES J.M., 1956b.— Note sommaire sur quelques ascidies récoltées
dans la Lagune de Venise par M. Giordani-Soika. *Boll. Mus. Civ.
Venezia*, **9** : 7-9.
- PÈRES J.M., 1958a.— Origine des affinités du peuplement en ascidies
de la Méditerranée. *Rapports et procès-verbaux des réunions.
Commission internationale pour l'exploration scientifique de la
mer Méditerranée*, **14** : 493-502.
- PÈRES J.M., 1958b.— Ascidies récoltées sur les côtes méditerra-
néennes d'Israël. *Bull. Res. Council. Israel*, **7B** : 143-150.
- PÈRES J.M., 1958c.— Ascidies de la baie de Haifa, collectées par
E. Gottlieb. *Bull. Res. Council. Israel*, **7B** : 151-164.
- PÈRES J.M., 1959a.— Note sur deux ascidies des côtes de Provence
dont une nouvelle pour la Méditerranée et la faune de France. *Re-
cueil des travaux de la Station marine d'Endoume*, **16** : 149-150.
- PÈRES J.M., 1959b.— Ascidies récoltés sur les côtes d'Algérie par
le « Professeur Lacaze-Duthiers » (1952). *Vie et Milieu*, **10** :
189-194.
- PÈRES J.M., 1959c.— Campagne de la Calypso en mer d'Alboran
et dans la baie Ibéro-Marocaine (1958). I. Ascidies. Résultats
scientifiques des campagnes de la «Calypso» XIII. *Annales de
l'Institut océanographique*, Paris, **37** : 295-313.
- PÈRES J.M., 1961.— Addendum à la liste des espèces méditerra-
néennes d'Ascidies d'Israël. *Bull. Res. Council. Israël*, **9** : 191 p.
- PÈRES J.M., 1985.— History of the Mediterranean Biota and the colo-
nization of the Depths : 198-232. In : *Key Environments. Western
Mediterranean*. R. Margalef (Ed.). Oxford, Pergamon Press.
- PÈRES J.M., PICARD J., 1958.— Recherches sur les peuplements ben-
thiques de la Méditerranée nord-orientale. Résultats scientifiques
des campagnes de la «Calypso». *Annales de l'Institut océano-
graphique*, Paris, **34** : 213-291.
- PÈRES J.M., PICARD J., 1964.— Nouveau manuel de bionomie ben-
thique de la mer Méditerranée. *Recueil des travaux de la Station
marine d'Endoume*, **31** : 1-137.
- POR F.D., 1978.— Lessepsian Migration. The influx of Red Sea Biota
into the Mediterranean by way of the Suez Canal. *Ecological Stu-
dies*, Berlin, **23** : 1-228.
- POR F.D., DIMENTMAN C., 1989.— The Legacy of Tethys. An Aquatic
Biogeography of the Levant. In : *Monographiae Biologicae*, **63** :
214 p. Dumont H.J. & Wergel M.J.A. (Eds.). Dordrecht, Kluwer
Academic Publishers.
- RAMOS A., 1984.— Els Ascidis de les illes Medes. In : *Els sistemes
naturals de les illes Medes*. J. Olivella & J. Gili (Eds.). *Arx. Sec.
Ciènc.*, **73** : 581-596.
- RAMOS A., TURON X., LAFARGUE F., 1988.— *Cratostigma campoyi*
n. sp. (Ascidacea, Pyuridae) en Méditerranée occidentale :

- observations sur le genre *Cratostigma* C. et F. Monniot, 1961. *Vie et Milieu*, **38** : 55-100.
- RODRIGUES S.A., ROCHA R.M., 1993.— Littoral compound ascidians (Tunicata) from Sao Sebastiao, Estado Sao Paulo, Brazil. *Proc. Biol. Soc. Wash.*, **106** : 728-739.
- SALDANHA L., 1974.— Estudo do povoamento dos horizontes superiores de rocha litoral da costa da Arrabida (Portugal). *Arqu. Mus. Bocage*, 2a ser., **5** : 1-382.
- SALFI M., 1931-32.— Gli Ascidiacei del Golfo di Napoli. *Pubblicazioni della Stazione zoologica di Napoli*, **11** : 293-366.
- SALFI M., 1946.— Ascidiacei della laguna Veneta. *Bollettino di pesca, piscicoltura e idrobiologia*, **1** : 5-7.
- SEELIGER O., HARTMEYER R., 1906-11.— Tunicata (Manteltiere). In : *Bronn's Tier-Reichs*, III Supl. Leipzig.
- TRAUSTEDT, 1883.— Die einfachen Ascidien (Ascidiae Similices) des Golfes von Neapel. *Mitteilungen aus der zoologischen Station zu Neapel*, **4** : 448-488.
- TURON X., 1986.— Morfologia de las espículas en las especies de la familia Didemnidae (Ascidacea) del litoral de cataluña e islas Baleares. *Misc. Zool.*, **10** : 213-222.
- TURON X., 1987.— Las ascidias de Tossa de Mar (Girona). I. Generalidades. Faunística y taxonomía. *Misc. Zool.*, **11** : 221-231.
- TURON X., 1988a.— Ascidias de los caladeros de arrastre de la costa catalana (Mediterráneo noroccidental). *Investigacion pesquera*, **52** : 467-481.
- TURON X., 1988b.— Distribucion ecologica de las ascidias en las costas de Cataluña e Islas Baleares (Mediterráneo Occidental). *Misc. Zool.*, **12** : 219-236.
- TURON X., 1988c.— *Cratostigma vestigialis* n. sp. (Tunicata), ascidie nouvelle de la Méditerranée occidentale. *Bulletin du Muséum national d'histoire naturelle*, Paris, 4 sér., **10** : 237-240.
- TURON X., MATEO B., 1987.— Presencia de *Diplosoma carnosum* Von Drasche, 1883, en el litoral balear. *P. Dept. Zool. Barcelona*, **13** : 99-102.
- TURSI A., 1976.— Ascidies de la Mer Ionienne des parages du nouveau port italsider (Taranto). Première note : Campagne 1975. *Oebalia*, **2** : 153-163.
- TURSI A., 1977.— Su alcuni Ascidiacei delle Bocche di Cattaro (Iugoslavia). *Thalassia Salent.*, **7** : 95-100.
- TURSI A., GHERARDI M., LEPORE E., 1974.— Andamento stagionale di alcuni Ascidiacei del Mar Piccolo di Taranto : Dati preliminari. *Mem. Biol. Marina e Oceanogr.*, **4** : 421-434.
- UYSAL A., 1976.— Ascidians in Turkish waters. *Publ. Hydroniol. Res. Inst. Fac. Sci. Univ. Istanbul*, **15** : 1-25.
- VAFIDIS D., KOUKOURAS A., VOULTSIADOU-KOUKOURA E., 1994.— Octocoral fauna of the Aegean Sea with a check list of the Mediterranean species : New information, faunal comparisons. *Annales de l'Institut océanographique*, Paris, **70** : 217-229.
- VAMVAKAS C., 1971.— Contribution to the study of soft substrata benthic biocoenoses of Greek seas area W. Saronikos Gulf. *Hellenic Oceanol. Limnol.*, **10** : 1-152.
- VOULTSIADOU-KOUKOURA E., KOUKOURAS A., 1993.— Contribution to the knowledge of Keratose Sponges (Dictyoceratida, Dendroceratida, Verongida : Demospongiae, Porifera) of the Aegean Sea. *Mitt. Zool. Mus. Berl.*, **69** : 57-72.
- ZIBROWIUS H., 1991.— Ongoing modification of the Mediterranean marine fauna and flora by the establishment of exotic species, *Mésogée*, **51** : 83-107.