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# Further additions to the knowledge of Indo-Pacific Mollusca in the Mediterranean Sea

## (Lessepsian migrants)

By **Al. Barash** and **Z. Danin**

### Summary [1])

A report on 29 Indo-Pacific species found in the Mediterranean is presented. These species have not been discussed in the general reports on the migrations of Indo-Pacific species published by G. Haas (1948), Ghisotti (1974), Barash and Danin (1973) and in various articles on the migrating species collected during 1971–1984.

The 29 species recorded in the present report belong to 19 Gastropoda (Prosobranchia – 10, Opisthobranchia – 9) and to 10 Bivalvia (Pteriomorphia – 3, Heterodonta – 7).

The majority of the presented species (22) have been collected only close to the Suez Canal, along the Mediterranean coasts of Israel and Sinai. 7 species are recorded only or also from sites outside of Israel and Sinai: Black Sea, Aegean Sea, Adriatic Sea, Ionian Sea, Tyrrhenian Sea.

The greatest part of the Indo-Pacific species in the Mediterranean (79 of 91) are from the Erythrean subregion. A smaller part (12 species) were not recorded from the Erythrean subregion, but from areas in the Indo-Pacific remote from the Mediterranean. It is unlikely that these species would be able to reach the Mediterranean in larval stage, since the life span of molluscan larvae is rather limited. It is assumed that certain migrants were transported in adult stage by carriers (ships, fishes etc).

Of the 91 Indo-Pacific species appearing in the Mediterranean, 44 species have been collected as one or a few shells. The shells may be brought occassionally into the Mediterranean and it is doubtful if we can consider these species as inhabitants of this sea. 47 species were found live or in great numbers of shells, they may be regarded as residents in the Mediterranean.

The following 13 species may be qualified as permanent inhabitants in the Mediterranean: *Diodora rueppelli, Minolia nedyma, Pirenella cailliaudi, Cerithium scabridum, Rhinoclavis kochi, Thais carinifera, Bursatella leachi savigniana, Hypselodoris infucata, Brachidontes variabilis, Pinctada radiata, Malleus regula, Paphia textile* and *Gastrochaena cymbium*.

Based on the data accumulated since the opening of the Suez Canal (1869) it may be stated: 1). The number of immigrating molluscan species has increased gradually during the past years. 2). The great majority of the Indo-Pacific immigrants are concentrated in the Eastern Mediterranean. A few penetrated the Western Mediterranean but did not surpass the Siculo Tunisian threshold.

## Introduction

Several summary reports devoted to the migration of Indo-Pacific mollusca into the Mediterranean have been published during this century by G. Haas (1948), Ghisotti (1974b) and Barash & Danin (1973, 1977). Numerous articles on separate Indo-Pacific species collected in the Mediterranean during 1971–1984 have been published by H. K. Mienis and by other authors.

[1]) The species *Melibe fimbriata,* recorded in the addendum, was not included in the lists of the paper.

Today we are able to present an additional report on 29 Indo-Pacific species in the Mediterranean which have not been discussed in the general reports of 1948–1977 mentioned above. Eight species are recorded for the first time; 3 species were mentioned by name only (but not discussed) in the article by Barash & Danin (1982: 107) and 18 species have been dealt with in articles on individual Indo-Pacific immigrants.

Along with the 29 species not yet discussed in earlier reports, 4 species, which have been treated previously are included in this paper for supplementary data (see general remarks, p. 130ff.).

This report is based on material obtained from various sources, as follows:

A great deal of dredging was carried out during 1974–1977 by the late Prof. Ch. Lewinsohn (Tel Aviv University) and his assistants M. Tom and B. Galil. They worked in the infralittoral zone in north and south Israel and opposite the Mediterranean coast of north Sinai. Among the material collected by them the nudibranch *Plocamopherus ocellatus* is noteworthy because of its power of luminescence (O'Donoghue 1929: 808).

Investigations of the benthic fauna in the Haifa area, concerned with pollution, were carried out by Dr. Ch. Hornung of the Israel Oceanographic Limnological Research Institute. The molluscs collected there, mainly by diving, were put at the authors' disposal for examination. Amongst this material were the rare species *Cerithiopsis pulvis* and *Cingulina isseli* figured by Savigny, 1817 (Bouchet & Danrigal 1982).

Some Indo-Pacific species new to the Mediterranean have been revealed in the malacological collections of Israel such as *Planaxis punctostriatus*, *Vasum turbinellus*, *Ventomnestia girardi* and *Soletellina rubra* in the Zoological Museum of the Hebrew University, Jerusalem, *Divaricella angulifera* and *Trapezium oblongum* in the Department of Zoology, Tel Aviv University and *Cerithium nesioticum* in the collection of Dr. Yaron, Ben Gurion University, Beer Sheva.

Among the new species obtained from shore collectors, the most interesting was *Sphenia rueppelli*, which compares remarkably with the holotype of this species in the British Museum.

The specimens of the species enumerated in the present report are kept for the most part (20 species) in the collections of Tel Aviv University (NS) and the Hebrew University, Jerusalem (HUJ). The remaining 9 species are deposited in the collections of the following scientific institutions abroad: Messina University, Civica Stazione Idrobiologica Milano; University of Ege, Izmir; British Museum, London, and in the private collections of Dr. J. J. van Aartsen (Holland), Mr. M. Bloecher (West Germany), Dr. F. Carrozza and Mr. Raybaudi Massilia (Italy).

The identification of 8 species reported for the first time in this paper was made by the following specialists: Gastropoda – Dr. J. J. van Aartsen, Dieren, Holland; Dr. F. Carrozza, Pisa, Italy; Dr. H. Gantes, University of Bordeaux, France; Dr. Mr. M. S. S. Lavaley, Rijksmuseum van Natuurlijke Historie, Leiden, Holland; Prof. T. E. Thompson, University of Bristol, England. Bivalvia – Prof. E. Fischer-Piette and Dr. P. Metivier of the Museum National d'Histoire Naturelle, Paris; Dr. R. N. Kilburn, Natal Museum, South Africa and Dr. Morris-Whybrow, British Museum, Natural History, London. The authors gratefully acknowledge their assistance.

## Notes on the species

Remarks

1. The term "specimens" has been used for molluscs collected alive. Others are indicated as shells or valves.
2. Species marked by asterisk have been recorded in the earlier reports on Indo-Pacific species in the Mediterranean and the data on them are supplementary.

## Gastropoda

Subclass Prosobranchia
Order Archaeogastropoda

**Trochidae**
Monodontinae

*Clelandella infuscata* (Gould, 1861)

Di Natale 1982: 573, fig. 2

syn.: *Ziziphinus infuscatus* Gould, 1861; Johnson, R. J. 1964: 92
*Cantharidus infuscatus* (Gould, 1861); Kira 1968: 10, fig. 5

Mediterranean record (Sicily): Di Natale 1982: 573

Material: One shell found in Ganzirri (Sicily, Straits of Messina), March 1972, 17 m depth, sand and small stones.

Distribution: Japanese Sea (Kira, 1968: 10).

Trochinae

*Trochus (Infundibulops) erythraeus* Brocchi, 1823*

Thiele 1931: 55

Mediterranean record: Israel – Barash & Danin 1973: 305

Material: 1. Live: Infralitoral zone, south of Netanya, 12.VII.1971, 2–2.5 m depth, on rocks, 1 specimen (NS 19721); 12.XII.1977, 2 m depth, 1 specimen juv. (NS 19722).

2. One shell: Shiqmona, south of Haifa, 2.XI.1968, on the beach (NS 8897).

Remark: For the distribution of this species, see Barash & Danin 1973: 305.

**Neritidae**

*Nerita sanguinolenta* Menke, 1829

Por 1978: 102

syn. *Nerita forskalii* Recluz, 1841
*Nerita crassilabrum* Smith, 1885
*Nerita albicilla* Auct. (non Linne, 1758); Mienis 1974: 45
*Neritina kinzelbachi* Nordsieck, 1973

Mediterranean record (Greece); Nordsieck 1973: 4

Material: One shell at Karpathos Is.

Distribution: Suez Canal (Moazzo 1939: 200); Gulf of Suez and Aqaba (Lamy 1938: 78). Red Sea, Perim Is. (Sturany 1903: 56). Aden (Smith 1891: 419).

Remark: Nordsieck (1973: 4) described one shell found at Karpathos Is. as a new species under the name *Neritina kinzelbachi* spec. nov. According to Mienis (1974: 45) the figure of *N. kinzelbachi* is identical with *Nerita sanguinolenta* (Menke, 1929), a common erythraean species.

Order Mesogastropoda

**Planaxidae**

*Planaxis punctostriatus* Smith, 1872

Mienis 1981: 361

syn. *Planaxis lineolatus* Gould, 1849 (not *Planaxis lineolatus* Risso, 1826); Lamy 1938: 70; Mienis 1980a

Mediterranean record (Israel): Mienis 1981: 361

Material: South of Dor, 1950, 3 shells, in the collection of Prof. G. Haas, Hebrew University, Jerusalem (HUJ 21, 385).

Distribution: Gulf of Aqaba (Safriel & Lipkin 1964: 189); Gulf of Suez (Lamy 1938: 70); Madagascar (Dautzenberg 1929: 493); Siam (P. H. Fischer 1970: 101); Solomon Is. (Abbott 1958: 204). Tuamotu and Manihiki Is. (Johnson 1964: 102).

*Cerithium nesioticum* Pilsbry and Vanatta, 1906

CERNOHORSKY 1972: 69, Plate 16, fig. 1

syn. *Semivertagus nesioticus* (Pilsbry & Vanatta, 1906); HABE 1970: 43, plate 13, fig. 2
*Cerithium lacteum* Kiener, 1841; TRYON 1887: 143, plate 27, figs. 29, 30, 33
*Liocerithium lacteum* (Kiener, 1841); SOLEM 1953: 220

Mediterranean record (Israel): MIENIS 1977a: 45

Material: Shiqmona (south of Haifa), January 1971, on the beach, one shell (MIENIS, 1977a: 45)

Distribution: Gulf of Suez and Aqaba (LAMY 1938: 66), Red Sea (STURANY 1903: 53, 70). Gulf of Aden, Perim, Djibouti, Obock (JOUSSEAUME 1930: 284). Madagascar (DAUTZENBERG 1929: 274 [480]). Mauritius (VIADER 1937: 42). East Africa – Zanzibar, Ceylon, Cocos Keeling Is. (ORR MAES 1967: 114). Indonesia (ADAM & LELOUP 1938: 106). Philippines (MCANDREW 1870: 441). Japan (HABE 1970: 43). Central Pacific Islands: New Caledonia, Palau Islands, Cook Islands (ORR MAES 1967: 114). Tahiti, Tuamotu Islands (DAUTZENBERG & BOUGE 1933: 308), Hawaii Islands (KAY 1979: 123).

Remark: The name *Cerithium lacteum* Kiener, 1841, has priority but was preoccupied by *Cerithium lacteum* Philippi, 1836.

## Cerithiopsidae

*Cerithiopsis pulvis* (Issel, 1869)

PALLARY 1926: 66, plate 4, fig. 5

syn. *Cerithium (Cerithiopsis?) pulvis* Issel, 1869: 150; BOUCHET & DANRIGAL 1982: 14, fig. 35

Mediterranean record (Israel): AARTSEN & CARROZZA 1983: 37

Material: Haifa, VII. 1980, 9 m depth, 2 shells and one fragment, 10. V. 1982, 12 m depth, 3 shells; Hadera, VII. 1982, 9 m depth, 3 fragments. All the material was obtained by diving. The largest specimen measures 4 × 1 mm and has 7.5 teleconch whorls (AARTSEN & CARROZZA 1983: 40).

Distribution: Gulf of Suez (ISSEL, 1869: 151).

## Hipponicidae

*Hipponix (Sabia) conicus* (Schumacher, 1817)

WENZ, 1960–1962 (1938–1944): 888, fig. 2612

syn. *Amalthea conica* Schuhmacher, 1817; KURODA, HABE & OYAMA 1971: 84
*Sabia conica* (Schumacher, 1817); KAY 1979: 179
*Hipponix australis* (Quoy and Gaimard, 1834); STURANY 1903: 49 (257); KURODA and al. 1971: 84

Record: New to the Mediterranean (Israel) (Det. Kilburn)

Material: Dor, 30. IX. 1980, by diving, 1–2 m depth, one shell with the rest of soft body (NS 19723).

Distribution: Gulf of Suez (MOAZZO 1939: 191); Gulf of Aqaba (LAMY 1938: 69). Red Sea (STURANY 1903: 49 (257); Aden (SMITH 1891: 418); South Africa-Natal (KILBURN & RIPPEY 1982: 56); Madagascar (DAUTZENBERG 1929: 300); Mauritius (VIADER 1937: 48); Indonesia (ADAM & LELOUP 1938: 108); Japan (KIRA 1968: 28); Australia (ALLAN 1950: 85); Central Pacific Is. (DAUTZENBERG & BOUGE 1933: 371); Hawaii Is. (KAY 1979: 179); East Pacific; British Columbia (COWAN 1974: 3).

Remark: The small limpet *Hipponix conicus* (Schumacher) is a very common Indo-Pacific species that lives epizootically on the shells of larger gastropods. Methods of feeding are described in YONGE 1953: 11; TINKER 1967: 44; CERNOHORSKY 1968: 275 and MASTALLER 1979: 58.

 

*Strombus decorus* (Roeding, 1798)

Abbott R. T., 1960: 137, 139, plate 14, figs. 13, 14

Mediterranean record (Turkey): L. R. Massilia, 1983: 20; M. Bloecher (in Nicolay, K. & E. R. Manoja) 1983: 17, 18

Israel: H. K. Mienis (pers. comm.)

Material: I. Turkey – 1) Bozborum, summer 1983, one shell and 2 live specimens between Gelibolu and Marmaris, 12 specimens, (Leg: L. R. Massilia)

2) Between Silifke and Mersin, autumn 1983, many specimens (Leg. M. Bloecher)

II. Israel – Shiqmona (south of Haifa), one shell in 1983, 3 shells, February-March, 1984 (Leg. B. Singer).

Distribution: 1) *Strombus decorus decorus* (Roeding, 1798) – Zanzibar, Mozambique, South Africa, Saudi Arabia, Madagascar, Indian Ocean Islands, Ceylon, Thailand, Indonesia, Burma (Abbott, T. 1960: 137, 138)

2) *Strombus decorus persicus* Swainson, 1821 – Persian Gulf (Abbott, T. 1960: 139); Gulf of Aden (Nicolay & Manoja 1983: 18)

3) *Strombus decorus raybaudi* n. ssp. – Turkey (Mediterranean) (Nicolay & Manoja 1983: 18).

Remarks: The specimens of *Strombus decorus* collected in Turkey and Israel have great similarity to *S. decorus persicus*

Some differences from *S. decorus persicus* are evident in the specimens of *Strombus* collected in Turkey, according to Nicolay & Manoja (1983). In their opinion a taxonomic separation from *S. decorus persicus* is necessary, and they established a new subspecies *S. decorus raybaudi.*

The existence of *Strombus* species in the Mediterranean was previously considered as doubtful. Only *Strombus lentiginosus* was recorded (Aharoni 1934: 476) but no information was available about the number of specimens collected, nor of the place of their deposition.

## Cypraeidae

*Erosaria turdus* (Lamarck, 1810)

Taylor & Walls 1975: 263

syn. *Cypraea turdus* Lamarck, 1810; Pallary 1926: 96, fig. 31;
Burgess 1970: 235, plate 22, fig. 8

Record: New to the Mediterranean (Israel) – (Det. Burgess)

Material: Dor, 6. VI. 1980, in shallow water, 1–1.5 m depth, one shell juv., lenght 37 mm, width 24 mm, height 19 mm.

Distribution: Suez Canal – Little Bitter Lake (Moazzo 1939: 166, 272); Gulfs of Suez and Aqaba, Red Sea (Sturany 1903: 47); Aden (Shopland 1902: 175); Kenya (Burgess 1970: 235); Madagascar (Dautzenberg 1929: 259); Arabian Sea – Karachi (Melvill & Standen 1901: 384); Gulf of Oman (Burgess 1970: 235); Persian Gulf (Biggs 1973: 365); Ceylon, Indonesia (Jickeli 1884: 197).

*Palmadusta gracilis* (Gascoin, 1849)

Taylor & Wells 1975: 262

syn. *Cypraea gracilis* Gascoin, 1849; Burgess 1970: 140, plate 9a, fig. A

Mediterranean records: 1) Turkey – Bloecher 1983: 26

2) Israel – Mienis & Singer 1983: 535

Material: 1) Mediterranean coast of east Anatolia (Turkey), between the small towns of Silifke and Mersin, rocky shore.

Live: Infralittoral, 3 m depth, autumn 1983, under stone, one specimen, shell measures: 16.4×10×7.9 mm (BLOECHER 1984).

One shell, near the shore, on a rock, 28.X.1982 (leg. BLOECHER).

2) Mediterranean coast of Israel

Live: Hadera, 25.VII.1981, 1 m depth, one specimen (NS 19724).

Shells: On beaches – Akhziv, 28.VII.1983, 4 shells, Nahariyya, 28.VII.1983, one shell, Akko, VIII, 1983, one shell, Netanya, 8.XI.1983, one shell, Palmahim, 3.VII.1983, 15.VII.1983, 5.VIII.1983, 3 shells.

Distribution: Gulf of Suez (STURANY 1903: 68), Gulf of Aqaba (MIENIS 1971: 30); Red Sea (MASTALLER 1978: 132); Kenya, Oman (BURGESS 1970: 140); Persian Gulf (SMYTHE 1979: 67); South India-Gulf of Manaar (SATYAMURTI 1952: 127); China, Japan (BURGESS 1970: 140); Indonesia-Java (REGTERN 1945: 146); Australia (CATE 1968: 291); Fiji Is. (CERNOHORSKY 1967: 95); Hawaii Is. (KAY 1979: 202).

Remarks: *Palmadusta gracilis notata* (GILL 1858) is the common subspecies in the Erythraean area – (MIENIS 1971: 29). In some publicaions *P. gracilis* has been reported as *Palmadusta fimbriata* (Gmelin) e. g. by MCANDREW 1870: 440, STURANY 1903: 276 and MOAZZO 1939: 164.

The recent findings of *P. gracilis* in 1982 and 1983 in two areas of the Mediterranean (Israel and South Turkey) are quite remarkable. The possibility of permanent settlement and colonisation of this Indo-Pacific species in the Mediterranean is most probable.

Order Neogastropoda

**Muricidae**

*Rapana venosa* (Valenciennes, 1846)

GHISOTTI 1974b: 12, fig. 38

syn. *Purpura venosa* Valenciennes, 1846
*Rapana bezoar* Reeve, 1847 (non Linnaeus, 1767), GHISOTTI 1974a: 125
*Rapana thomasiana* Crosse, 1861
*Rapana pontica* Nordsieck 1969; MIENIS 1976a: 39

Records: *Rapana venosa* is an introduction from the Far East, which reached the Black Sea before 1947. Since then it has also been reported from the Adriatic Sea (MIENIS 1976a: 41) and recently from the Tyrrhenian Sea – Elba Is. (TERRENI 1980: 11).

Material: Data on the collecting of *Rapana venosa* are presented in the following publications: in the Black Sea (GROSSU & LUPU 1964); in the Adriatic Sea (GHISOTTI 1971a, 1974a; MEL 1976) and in the Tyrrhenian-Elba Is. (TERRENI 1980). The live specimens collected in the areas indicated were obtained in the infralittoral zone, at depths of 12–90 m. The measurements of the specimens are various; generally large. The dimensions of a specimen collected from the Elba Is. are: height – 89 mm, width – 68 mm, and of a specimen taken from the Gulf of Trieste, height – 110 mm, width – 75 mm.

Distribution: Japan-Tartari Canal (GHISOTTI 1971a: 55), Yellow Sea and Pacific Ocean (GROSSU & LUPU 1964: 215).

Remarks: *Rapana venosa* obviously covered the long route from the Far East to the Mediterranean through human intervention (GHISOTTI 1974a: 125). The occurrence of *R. venosa* in the Black Sea was confirmed again recently by Prof. Grossu and in the Adriatic Sea by Dr. Ghisotti (in litt.).

*Rapana venosa* seems already to be past the phase of acclimatization in the Mediterranean and is able to reproduce in the new environment (GROSSU & LUPU 1964: 216).

*Vasum turbinellus* (Linnaeus, 1758)

CERNOHORSKY 1972: 164, plate 49, figs. 2, 2a

Mediterranean record (North Sinai): MIENIS 1973: 6

Material: North Sinai, near Bardawil Lagoon, XII. 1956, one shell.

Distribution: Gulf of Aqaba (LAMY 1938: 49); Gulf of Suez, Red Sea (STURANY 1903: 39); Aden (SHOPLAND 1902: 173); Obock (JOSSEAUME 1888: 182); East Africa-Dar es Salaam (SPRY 1961: 25); Madagascar (DAUTZENBERG 1929: 196); Ceylon (ROBERTSON 1969: 5); Cocos Keeling Is. (ABBOT 1950: 84); Indonesia, New Guinea (ADAM & LELOUP 1939: 114); Philippines, Marianos Is. (HIDALGO 1905: 6); Japan (KIRA 1968: 84); Solomon Is. (SOLEM 1953: 225); Australia (WILSON & GILLETT 1971: 112; RIPPINGALE & MCMICHAEL 1961: 126).

Subclass Opisthobranchia
Order Pyramidellomorpha

**Pyramidellidae**

*Chrysallida fischeri* (Hornung and Mermod, 1925)

AARTSEN & CARROZZA 1979: 29, figs. 1A, 1B

syn. *Pyrgulina fischeri* HORNUNG & MERMOD 1925: 27, fig. 1A

Mediterranean record (Israel): Aartsen & Carrozza 1979: 29

Material: Haifa Bay, 24. XII. 1974, 40–70 m depth, mud, several shells, average length 2.60 mm, width 0.80 mm (specimens kept in the collections of Aartsen & Carrozza).

Distribution: Gulf of Aqaba-Elat (Gittenberger by litt.); Red Sea-Massawa (Hornung & Mermod 1925: 27). This species has not been recorded from the Suez Canal.

Remark: In addition to *Chrysallida fischeri,* four other Indo-Pacific species of Pyramidellidae have been found in the Mediterranean: *Chrysallida maiae, Kleinella fulva,* ? *Monoptygma sinuata* and *Cingulina isseli.* The hosts of these ectoparasitic snails which feed upon invertebrates (as do Pyramidellidae in general) are as yet unknown.

*Kleinella fulva* (A. Adams, 1851)

LAVALEYE & BARASH 1981: 87, fig. 1

syn. *Monoptygma fulva* A. Adams, 1851
*Pyrammidella (Actaeopyramis) fulva* (A. Adams) LAVALEYE & BARASH 1981: 87

Mediterranean record: (Israel). LAVALEYE & BARASH 1981: 87

Material:

Live: Haifa Bay, 14. XI. 1982, 9 m depth, one specimen, measuring height – 11.5 mm, width – 3.1 mm, height of last whorl – 5.1 mm, height of aperture – 3.1 mm. (NS 19725).

Shell: Atlit-Dor, south of Haifa, 15. II. 1967, 22 m depth, one shell (SFRS[1] 1357), measuring, height – 8.9 mm, width – 2.7 mm, height of last whorl – 4.8 mm, height of aperture – 2.9 mm.

Distribution: Arabian Sea: Karachi, Bombay (MELVILL & STANDEN 1901: 392); Japan, Philippines (LAVALEYE & BARASH 1981: 88).

[1]) Sea Fisheries Research Station, Haifa

*? Monoptygma sinuata* Gould, 1861

JOHNSON, 1964: 150

A record new to the Mediterranean (Israel); determined tentatively by van Aartsen

Material:

Live: Haifa Bay, 14.XI.1982, 9 m depth, 4 specimens, average measurements, height – 6.4 mm, width – 2 mm, height of last whorl – 4 mm, height of aperture – 3 mm (NS 19726).

Shell: Haifa Bay, 16. II. 1975, 73 m depth, mud, one shell.

Distribution: China Seas (JOHNSON 1964: 150).

Remark: "This species belongs to Actaeopyramis/Kleinella group of Pyramidellidae. The only Actaeopyramis which looks reasonably close seems to be *Monoptygma sinuata* Gould, 1861. In my opinion it is not one of the better known species of Actaeopyramis: *fulva, amoena, casta, lauta* or *eximia*. I have not been successful in a certain identification up to now" (AARTSEN, in litt. 4.XI.1982).

*Cingulina isseli* (Tryon, 1886)

AARTSEN & CARROZZA 1983: 38, fig. 1

syn. *Eulimella cingulata* Issel, 1869; ISSEL 1869: 182, 332; BOUCHET & DANRIGAL 1982: 12, fig. 73
*Odetta cingulata* Issel; PALLARY 1926: 58, plate 3, fig. 25

Mediterranean record: (Israel). AARTSEN & CARROZZA 1983: 38

Material: Haifa Bay, VII.1980, 9 m depth, 8 shells; 10.V.1982, 12 m depth, one shell. Measurements of largest shell collected are, height – 3 mm, width – 1 mm.

Distribution: Gulf of Suez (Issel 1969: 182); Red Sea-Massawa (AARTSEN & CARROZZA 1983: 38).

Order Bullomorpha (Cephalaspidea)

**Bullidae**

*Bulla ampulla* Linnaeus, 1758

HABE 1970: 136, plate 42, fig. 17

syn. *Bullaria ampulla* (Linnaeus, 1758); THIELE 1931: 384, fig. 483

Mediterranean record (Israel): BARASH & DANIN 1982: 107

Material: Gaash (north of Tel Aviv), 20.IV.1978, on the beach, one shell (NS 19727).

Distribution: Gulf of Suez and Aqaba, Red Sea (STURANY 1903: 60, 74); Aden, Obock (JOUSSEAUME 1888: 170); East Africa-Dar es Salaam (SPRY 1961: 29); Madagascar (DAUTZENBERG 1929: 365); Mauritius (VIADER 1937: 3); Persian Gulf (MELVILL & STANDEN 1901: 456); East Indies-Gulf of Manaar (SATYAMURTI 1952: 218); Ceylon (STARMUEHLNER 1974: 63); Cocos Keeling Is. (ABBOTT 1950: 86); Indonesia (ADAM & LELOUP 1938: 198); Philippines (HIDALGO 1905: 14); Japan (HABE 1970: 136); New Guinea (Papua Is) (TAPPARONE CANEFRI, 1874: 14); Solomon Is. (SOLEM 1953: 217); Gambier (DAUTZENBERG & BOUGE 1933: 53).

Remark: *Bulla ampulla* has been found live in the waters of Alexandria, according to EHRENBERG (1831). ISSEL (1869) remarked with regard to this record: "We hardly believe that it has been collected there, since it was never encountered in the Mediterranean by any other conchologist".

**Retusidae**

*Ventomnestia girardi* (Audouin, 1827)

MIENIS 1976b, fig. 1

syn. *Cylichna girardi* (Audouin, 1827); PALLARY 1926: 74, plate 5, fig. 3; MOAZZO 1939: 135, fig. 10
*Bulla girardi* Audouin, 1827; BOUCHET & DANRIGAL 1982: 13, fig. 52
*Alicula girardi* (Audouin); ISSEL 1869: 341

Mediterranean record (Israel): Mienis 1976b: 209

Material: Bardawil Lagoon (North Sinai), 9. I. 1974, on the beach, 3 shells, height – 3.0–3.2 mm.

Distribution: Suez Canal, Gulf of Suez (Moazzo 1939: 135); Gulf of Aqaba (Lamy 1938: 86); Red Sea, China Sea, Ryu Kyu Is. (Japan) (Mienis 1976b: 210).

Order Aplysiomorpha (Anaspidea)

**Aplysiidae**

*Bursatella leachi* de Blainville, 1817; *subspec. savigniana* Audouin, 1826*

Barash & Danin, 1973: 329

Material:

Israel. Haifa Bay, 10. IV. 1979, 80 m depth, mud, 1 specimen (NS 16597); 22. VI. 1981, sea water pond (at Electricity Station, Haifa), 1–2 m depth, 1 sspecimen (NS 19010); Maayan Zvi, 28. VI. 1981, sea water pond, 1–2 m depth, 3 specimens juv., (NS 19011); Maagan Michael, 31. I. 1978, sea water pond, 1–2 m depth, 1 specimen (NS 16570); Off Bardawil, 1. IV. 1978, 14.5 m depth, 1 specimen juv. (NS 16398).

Greece: Salamis Is. – east coast, VIII–X. 1977, many specimens, in shallow water, among algae (Ulva) (Dr. Alice Panou, in litt.); Khios Is. 16. IV. 1975, 36 m depth, silt, collection of Thessaloniki University (75–$G_2$748). Lesbos Is.-Kalloni, 3 m depth, seagrass meadow (?Posidonia), collection of Thessaloniki University (116-$G_2$748).

Italy: Sicily-Syracuse, 37° N, Bay of Panagia, 10. VII. 1978, 22 m depth, mud, 1 specimen, 8 cm long (in the collection of the Hydrogiological Station of Milano) (cat. no. 1547M) (Piani 1980: 7). Gulf of Palermo, 38° N, 4–5 m depth, I. 1976, 1 specimen, III. 1976, 6 specimens, average length 7–13 cm, (Catalano, Parinello & De Leo 1978: 123, 124). Gulf of Taranto, salt lakes Mar Grande and Mar Piccolo, 1970–1973, 4–9 m depth, sandy detritic bottom, often among algae (Gracilaria), 49 specimens, average length 3–9 cm. Egg strings deposited on Gracilaria, March to May (Tortorici & Panetta 1977: 256 and pers. comm. with P. Panetta).

Remark: The sea water ponds along the shores of Israel seem to be favourable habitats for *Bursatella leachi savigniana*. Adults and juveniles are often found there and the deposition of egg strings has been observed. Some ecological data for these ponds are: depth 1–2 m, bottom – sand mixed with silt, yearly temperature 12–35° C, 4° C difference between day and night, salinity 30–38‰, pH 7.6–8.4.

Order Nudibranchia

Family **Triophidae** (Kaloplocamidae)

*Plocamopherus ocellatus* Rueppell and Leuckart, 1828

O'Donoghue, 1929: 735, 806

syn. *Plocamophorus ocellatus* F. S. Leuckart, 1828; Chenu 1859: 403, fig. 3043; Thiele 1931: 426

Mediterranean record: (Israel); Barash & Danin 1982: 107

Material: Nizanim, 12. IV. 1977, 50 m depth, 1 specimen (NS 19728)

Distribution: Suez Canal-Great Bitter Lake, Canal proper (O'Donoghue 1929: 806); Gulf of Suez (Issel 1869: 159); Red Sea (Pruvot-Fol 1933: 100).

**Chromodorididae**

*Hypselodoris infucata* (Rueppell and Leuckart, 1828)*

Bertsch & Johnson 1981: 62, 63, 2 figs.

syn. *Doris infucata* Rueppell and Leuckart, 1828; Issel 1869: 156

*Glossodoris infucata* (Rueppell and Leuckart, 1828); O'Donoghue 1929: 724

*Glossodoris runcinata* (Bergh, 1877); ENGEL & EEKEN 1962: 24
*Chromodoris runcinata* Bergh, 1877; RUDMAN 1971: 386

Mediterranean records (Israel): 1) Under the name *Glossodoris runcinata:* BARASH & DANIN 1974: 98; 2) Under the name *Hypselodoris infucata:* MIENIS & GAT 1981: 51

Material: Shiqmona, VI. 1983, 2–3 m depth, 1 specimen; Dor, 10. IX. 1974, 1 m depth, 1 specimen (NS 12914); 13. VIII. 1980, 1 m depth, 1 specimen (NS 981); Hadera, 25. I. 1971, 35 m depth, 1 specimen (NS 18944); Mikhmoret, 19. VI. 1978, 1 specimen; Ashdod, 8. II. 1968, 1 specimen (HUJ SLM 495); Ashkelon, 12 m depth, rocky ground, 7. IV. 1977, 1 specimen; 19. VI. 1978, 1 specimen; 20. VI. 1980, 3 specimens; 20. IX. 1980, 1 specimen; 27. IX. 1980, 1 specimen; 15. III. 1981, 1 specimen; 3. IV. 1981, 5 specimens; 11. IV. 1981, 15 specimens; 20. IV. 1981, 10 specimens; 7. V. 1981, 15 specimens (Data on Ashkelon given by G. Gat in litt.).

Distribution: Gulf of Suez-Tor (ISSEL 1869: 156); Gulf of Aqaba-Elat (ENGEL & EEKEN 1962: 24); Red Sea, East Africa-Zanzibar, Dar-es-Salaam, South Africa, Philippines Is., South Australia, New Caledonia, Fiji, Hawaii Is. (RUDMAN 1974: 387; BERTSCH & JOHNSON 1979: 42).

Remark: The numerous records of *H. infucata* from different localities along the Mediterranean coast of Israel and Sinai prove that this species has established itself permanently in this part of the eastern Mediterranean.

According to BERTSCH & JOHNSON (1981: 62) *H. infucata* feeds on the sponge *Dysidea fragilis.* In Ashkelon many specimens of *H. infucata* were observed on a bed of the sponge *Clathrina coreacea* (GAT & FAINZILBER 1983: 17).

**Dendrodorididae**

*Dendrodoris nigra* Stimpson, 1855

THOMPSON 1975: 504, fig. 5f, g

syn. *Doris nigra* Stimpson, 1855; O'DONOGHUE 1929: 730, 827

A record new to the Mediterranean (Det. J. Orr)

Material: North of Dor, 23. VII. 1980, 5 m depth, under stone, 1 specimen (NS 18713)

Distribution: Suez Canal-Little Bitter Lake, Kabret (O'DONOGHUE 1929: 827); Red Sea (PRUVOT-FOL 1933: 100); Madagascar (MARCUS & MARCUS 1970: 206); Persian Gulf (THORSON 1940: 221); India, Maldives Is. (SATYAMURTI 1952: 243); Hong Kong (ORR 1980: 112); Vietnam, Japan, Australia (THOMPSON 1975: 504); Central Pacific Is., Gilbert Is., New Caledonia (MARCUS & MARCUS 1970: 206); Hawaii Is., (KAY 1979: 473). *Dendrodoris nigra* is widely distributed in the Indian and Pacific Oceans.

## Bivalvia

Subclass Pteriomorphia
Order Arcoida

**Arcidae**
Arcinae

*Acar plicatum* (Dillwyn, 1817)

KURODA, HABE & OYAMA 1971: 330, plate 67, fig. 17

syn. *Arca plicata* (Chemnitz) Dillwyn, 1817; BARNARD 1964: 372, fig. 2a; SMYTHE 1972: 495
*Barbatia plicata* (Dillwyn); DIGERONIMO & ROBBA 1979: 177, plate 1, fig. 2

A record new to the Mediterranean (Israel) – (Det. S. Morris Whybrow)

Material: Netanya, 14. II. 1978, intertidal zone, under stone, 1 specimen with rest of soft body (NS 19729)

Distribution: Suez Canal-Bitter Lake, Port Taufiq (MOAZZO 1939: 55, 257); Gulf of Suez and Aqaba (STURANY 1899: 35, 41); Aden (SHOPLAND 1902: 178); Dijbouti, Obok (LAMY 1917: 7); Somalia (DIGERONIMO & ROBBA 1979: 177); South Africa, Madagascar (BARNARD 1964: 372); Seychelles, Oman (LAMY 1907: 87); Persian Gulf (SMYTHE 1972: 495); Japan (KIRA 1968: 121); Philippines, Indonesia, New Caledonia, Australia, New Zealand (PRASHAD 1932: 51, 52), Hawaii Is. (KAY 1979: 501).

Anadarinae

*Scapharca demiri* Piani, 1981

PIANI 1981: 284

syn. *Arca amygdalum* Philippi, 1847; DEMIR 1977: 197 figs. 1, 9

Mediterranean record (Turkey): DEMIR 1977: 197

Material: Izmir Harbor, in the spring, 1978, 5–15 m depth, sandy mud, mud, numerous specimens collected by Dr. A. Kocatas, University of Ege, Izmir.

Distribution: China Seas (LAMY 1907: 235). This species has not been recorded from the Suez Canal.

Remarks: Accordingto Dr. B. Metivier of the Museum National d'Histoire Naturelle, the species common in the Izmire harbour is *Arca amygdalum* Philippi (DEMIR 1977: 198)

A new name *Scapharca demiri* was proposed for *Arca amygdalum* Philippi, since Link 1807 described other species under the same name *Arca amygdalum* (PIANI 1981: 284).

*Scapharca inaequivalvis* (Bruguiere, 1789)

KURODA, HABE, OYAMA 1971: 333, plate 69, figs. 3, 4

syn. *Arca inaequivalvis* Bruguiere, 1789; LAMY 1907: 256

Mediterranean record: (Adriatic Sea): GHISOTTI 1974: 11, under the name of *Scapharca cf. cornea* (Reeve)

Material: A few small specimens of *Scapharca inaequivalvis* appeared for the first time in 1969 and 1971 in the littoral zone of Ravenna (northern Adriatic) (GHISOTTI 1972: 21). Through the years the number of specimens found in the Adriatic Sea multiplied and became distributed southwards. Specimens have been found in Ancona and in 1981 reached Manfredonia (S. Adriatic). The range of vertical distribution of specimens collected is from shallow water near the shore up to a depth of 10 m. The dimensions of the specimens of different ages are: from 1 mm length and 0.6 mm height, up to adults of 73.5 mm length and 61 mm height (RINALDI 1977: 199–201).

Distribution: Philippines (LAMY, 1907: 256); Japan (KURODA, HABE, OYAMA, 1971: 334).

Remark: This species was at first recorded under the name *Scapharca cornea* Reeve, 1844 (GHISOTTI, 1973: 68). GHISOTTI & RINALDI (1976: 13) later concluded that the correct name of this new Indo-Pacific species should be *Scapharca inaequivalvis* (BRUGUIERE, 1789).

Subclass Heterodonta
Order Veneroida

**Lucinidae**

*Divaricella angulifera* (von Martens, 1880)

DAUTZENBERG, 1929: 418; LAMY 1938: 31

syn. *Lucina angulifera* von Martens, 1880; LAMY 1916a: 15
? *Divaricella quadrisulcata* (D'ORBIGNY 1846); LAMY 1916a: 14; MOAZZO 1939: 114

Mediterranean record (Israel): MIENIS 1979: 200

Material: Netanya, 9. IV. 1976, 1 m depth, 1 valve, length and height 12.5 mm (NS 19730); off Bardawil, 7. XII. 1956, depth unknown, 1 valve, length and height 12 mm (NS 19731).

Distribution: Gulf of Suez (LAMY 1938: 31); Gulf of Aqaba and Red Sea (STURANY 1899: 285); Djibouti (MASTALLER 1979: 148); Madagascar (DAUTZENBERG 1929: 418 (624); Mauritius and Seychelles (BARNARD 1964: 479); Indonesia (PRASHAD 1932: 160).

Remark: There has been a great deal of confusion regarding the proper name of this species. VON MARTENS 1880 described under the name *Lucina angulifera* specimens collected in the Red Sea, Seychelles and Mauritius (LAMY 1920: 272). Some other authors (STURANY 1899; MOAZZO 1939) assigned specimens collected in the Red Sea to *Lucina quadrisulcata* d'Orbigny known to occur in the western Atlantic. Priority therefore goes to the latter species. However, *Divaricella quadrisulcata* is different from *D. angulifera* "the divaricate impressed lines are less angulated" (MIENIS 1979: 200) and these two species are not synonymous.

## Cardiidae

### *Laevicardium flavum* (Linnaeus, 1758)

FISCHER-PIETTE 1977: 29

syn. *Cardium flavum* Linnaeus 1758; SATYAMURTI 1956: 91, plate XIV, figs. a, c
*Vasticardium flavum* (Linnaeus); KIRA 1968: 156, plate 56, fig. 7
*Trachycardium flavum* (Linnaeus); SPRY 1964: 29, plate II
*Cardium pectiniforme* Born, 1780; PRASHAD 1932: 266
*Cardium rugosum* Lamarck, 1819; FISCHER-PIETTE 1977: 30
*Cardium orbita* Broderip & Sowerby, 1833; DAUTZENBERG & BOUGE 1933: 446
*Trachycardium hawaiiensis* Dall, Bartsch & Rehder, 1938; KAY 1979: 556

A record new to the Mediterranean – (Det. Fischer-Piette)

Material: Dor, 6. VI. 1980, intertidal zone, 1 valve, length 40 mm, height 48 mm (NS 19732)

Distribution: Gulfs of Suez and Aqaba, Red Sea proper (STURANY 1899: 39), Aden (SHOPLAND 1902: 178); East Africa-Dar es Salaam (SPRY 1964: 29); Seychelles (FISCHER-PIETTE 1977: 32); Madagascar (DAUTZENBERG 1929: 382 [588]); Mauritius (VIADER 1937: 68); Gulf of Oman, Persian Gulf (MELVILL & STANDEN 1906: 837); India, (Manaar) (STARMUHLNER 1974: 68); Indonesia (PRASHAD 1932: 266); Philippines, Jolo Archipelago and Marianas Is. (HIDALGO 1905: 15); Japan (KIRA 1968: 156); Tuamotu (LAMY 1906: 214); Australia, north and south (RIPPINGALE & MCMICHAEL 1961: 186); New Guinea (FISCHER-PIETTE 1977: 32); Hawaii Is., (KAY 1979: 556).

Remark: *Laevicardium flavum* is a wide ranging species in the Indo-West Pacific. It is extremely variable and thus also appears under numerous synonyms.

## Psammobiidae

### *Soletellina rubra* (Schroeter, 1788)

MIENIS 1980 b: 301

syn. *Solen ruber* Chemnitz, 1782; MASTALLER 1979: 165
*Soletellina rueppelliana* (Reeve, 1857); MIENIS 1980 b: 301
*Psammotella rueppelliana* Reeve, 1857; LAMY 1918: 244
*Solen roseus* Gmelin, 1791
*Soletellina rosea* (Gmelin, 1791); STURANY 1899: 277

Mediterranean record (Israel): MIENIS 1980 b: 301

Material: Off Bardawil, VII. 1967, by dredging, depth unknown, 1 shell, length 54 mm, height 26 mm, 1 damaged valve (NS 19734); on the beach at Bardawil Lagoon, 7. IV. 1968, 2 shells, length 54.4 mm, height 27.4 mm (MIENIS 1980 b: 301)

Distribution: Suez Canal: Lake Timsah, Great and Little Bitter Lakes, Canal proper (MOAZZO 1939: 97, 264); Gulf of Suez, Red Sea (STURANY 1899: 38 [292]); Aden, Djibouti (LAMY 1918: 245); Kenya, Persian Gulf (fide Fischer-Piette, by litt.).

Remark: This species from the Red Sea is today acclimatised in Port Said (PALLARY 1912: 175, plate XVII, figs. 3, 4).

*Soletellina subradiata* (Reeve, 1857)

Fischer-Piette (unpublished manuscript on Psammobiidae)

syn. *Psammotella subradiata* (Desh. m. s.) in Reeve, 1857, vol. X, plate I, fig. 6, fide Fischer-Piette, manuscript

Mediterranean record (Israel): Barash & Danin, 1982: 107

Material: Off Bardawil Lagoon, 1.IV.1974, on the beach, 1 damaged valve, length 30 mm, height 19 mm (NS 19735)

Distribution: Philippines, Nicobar Is., Japan, New Guinea (Fischer-Piette, Ms. on Psammobiidae).

## Trapeziidae

*Trapezium oblongum* (Linnaeus, 1758)

Kay 1979: 566, fig. 184E, F

syn. *Chama oblonga* Linnaeus, 1758; Dodge 1952: 137

Mediterranean record (Israel): Mienis 1980c: 313

Material: Rafah, IV.1980, on the beach, 1 valve, length 43 mm, height 25 mm (NS 19736)

Distribution: Gulf of Suez (Lamy 1938: 25); Gulf of Aqaba (Dafni, pers. comm.); Red Sea, Perim (Lamy 1916b: 315); Djibouti (Mastaller 1979: 152); Madagascar (Franc 1960: 2099); Seychelles, Reunion Is. (Lamy 1918–19: 271); Mauritius (Viader 1937: 64); Cocos Keeling Is. (Abbott 1950: 95); Japan (Kira 1968: 148); New Guinea-Aroe Is., Tahiti, Tuamotu (Lamy 1918–19: 271); Hawaii Is. (Kay 1979: 566).

## Veneridae

*Gafrarium callipygum* (Born, 1780)

Fischer-Piette & Vukadinovic 1975: 35

syn. *Cytherea callipyga* (Born, 1780) Issel 1869: 66
*Circe callipyga* (Born)
*Venus callipyga* Born, 1780
*Cytherea arabica* (Lamarck, 1818); Fischer-Piette & Vukadinovic 1975: 35, 36
*Lioconcha arabica* (Lamarck, 1818)
*Gafrarium arabicum* (Lamarck, 1818); Spry 1964: 32

A record new to the Mediterranean (Det. Metivier)

Material: Tel Aviv, 19.X.1980, on the beach, 1 valve, (NS 19733)

Distribution: Suez Canal, Lake Timsah, Great and Little Bitter Lakes (Moazzo 1939: 80); Gulfs of Suez and Aqaba, Red Sea proper (Sturany 1899: 26 [280], 39 [293]); Persian Gulf, Arabian Sea-Karachi (Melvill & Standen 1906: 830).

# Order Myoida

## Myidae

*Sphenia rueppelli* A. Adams, 1850

Moazzo 1939: 106, fig. 5

syn. *Cuspidaria adenensis* Jousseaume, 1888; Lamy 1926: 145

A record new to the Mediterranean (Israel) – (Det. Morris-Whybrow)

Material: Netanya, 14.II.1978, on the beach, under stone, 1 shell, length 10.90 mm, height 7.35 mm, width 6.25 mm. (Registration number of British Museum – BM/NH 1980 11/8)

Distribution: Suez Canal, Port Taufiq, Little Bitter Lake (Moazzo, 1939: 106, 265); Gulf of Suez (McAndrew 1870: 445); Red Sea, Aden, Perim, Djibouti (Lamy 1926: 145)

Remarks: Dr. Solene Morris-Whybrow, British Museum (Natural History) stated in a letter of 1. VII. 1980 "The specimen found in Israel was identified after comparison with the holotype of *Sphenia ruppelli* A. Adams, 1851, collected from the Red Sea (Proc. Zool. Soc. London, 1850: 89) Dr. Jousseaume described this species in 1888: 202 under the name *Cuspidaria adenensis.* In his notes in the manuscript he remarked: "This species lives within madreporic rocks and is subjected to numerous deformations... The posterior end es short and wide in most specimens, and is often rather long and narrow as in the *Cuspidaria,* therefore I considered it as a *Cuspidaria* (LAMY 1926: 146).

### Gastrochaenidae

*Gastrochaena cymbium* Spengler, 1783*

MOAZZO 1939: 107

Mediterranean records (Israel): BARASH & DANIN 1973: 342, fig. 24; 1977: 102

(Italy): ANONYMOUS 1980: 20

Material: 1) Israel – data on material collected, see BARASH & DANIN 1973: 342; 1977: 102

2) At Talamone (central Tyrhenian Sea), 1 dead specimen has been found, III. 1979, on the beach. Capsule was attached to the interior of a valve of *Venus verrucosa,* size of capsule: height 12 mm, width 6.5 mm (Dr. Nofroni, Roma, in litt.)

## General Remarks

The present report includes, as mentioned in the introduction, 29 Indo-Pacific species found in the Mediterranean, which were not discussed in the earlier reports of 1948–1977. The first records on the presence in the Mediterranean and on their distribution in this sea are indicated in Table I. Of these species 19 belong to Gastropoda (Prosobranchia – 11, Opisthobranchia – 8) and 10 to Bivalvia (Pteriomophia – 4, Heterodonta – 7). The majority of the species (23) have been collected only along the Mediterranean coasts of North Sinai and Israel, close to the Suez Canal.

The 4 following species are recorded only from Mediterranean sites outside of Israel and Sinai: *Clelandella infuscata* – Sicily; *Nerita sanguinolenta* and *Scapharca demiri* – Aegean Sea and *Rapana venosa* – Black Sea, Adriatic Sea, Tyrrhenian Sea. 2 species: *Stombus decorus* and *Palmadusta gracilis* were found both in Israel and in the Aegean Sea (Turkey).

With regard to the vertical distribution 14 species have been collected in the intertidal zone or washed ashore, and the equal number of species (14) in the infralittoral zone, in depths of 1.5–90 m.

Shells of one species *Soletellina rubra* were obtained both in the intertidal and the infralittoral zones. Live specimens were found of the following 10 species: *Strombus decorus, Palmadusta gracilis, Rapana venosa, Kleinella fulva, ?Monoptygma sinuata, Plocamopherus ocellatus, Dendrodoris nigra, Acar plicatum, Scapharca demiri* and *Scapharca inaequivalvis.* These species are obviously able to adapt themselves to the changed ecological conditions existing in the Mediterranean.

Supplementary data are presented in this report for 4 species already discussed in the former reports: *Trochus erythraeus, Bursatella leachi savigniana, Hypselodoris infucata (= Glossodoris runcinata)* and *Gastrochaena cymbium.*

Only one shell of *Trochus erythraeus* was found at first (BARASH & DANIN 1973: 305) but recently 2 live specimens of this species were reported. Thus, *T. erythraeus* may probably be considered as a rock dweller in the Mediterranean waters of Israel.

*Bursatella leachi savigniana* was distinguished as a successful immigrant distributed in the Eastern and Western Mediterranean (BARASH & DANIN 1982: 108). The present report offers additional data on the occurrence of this species in two islands of the Aegean Sea: Khios and Lesvos.

Table 1. List of Indo-Pacific Species of Mollusca in the Mediterranean not discussed in earlier report (1948–1977)

| Species | First record of presence in the Mediterranean | Distribution in the Mediterranean |
|---|---|---|
| Gastropoda | | |
| Prosobranchia | | |
| *Clelandella infuscata* (Gould, 1861) | Di Natale 1982: 573 | Sicily-Straits of Messina |
| *Nerita sanguinolenta* Menke, 1829 | Nordsieck 1973: 4 | Karpathos Is. (Aegean Sea) |
| *Planaxis punctostriatus* Smith, 1872 | Mienis 1981: 361 | Dor (Israel) |
| *Cerithium nesioticum* Pilsbry & Vanatta, 1906 | Mienis 1977a: 45 | Shiqmona (Israel) |
| *Cerithiopsis pulvis* (Issel, 1869) | Aartsen & Carrozza 1983: 37 | Haifa, Hadera (Israel) |
| *Hipponix conicus* (Schumacher, 1817) | Present paper | Dor (Israel) |
| *Strombus decorus* (Roeding, 1798) | Massilia 1983: 21 | Turkey, Rhodes, Cyprus, Israel |
| *Erosaria turdus* (Lamarck, 1810) | Present paper | Dor (Israel) |
| *Palmadusta gracilis* (Gascoin, 1849) | Bloecher 1983: 26 | Israel: Akhziv, Nahriyya, Akko, Hadera, Palmahim, Aegean Sea – Turkey: between Mersin and Silifk |
| *Rapana venosa* (Valenciennes, 1846) | Stark 1950 (fide Mienis 1976a: 39) | Black Sea, Adriatic Sea, Tyrrhenian Sea |
| *Vasum turbinellus* (Linnaeus, 1758) | Mienis 1973: 6 | North Sinai, near Bardawil Lagoon |
| Opisthobranchia | | |
| *Chrysallida fischeri* (Hornung & Mermod, 1925) | Aartsen & Carrozza 1979: 29 | Haifa Bay (Israel) |
| *Kleinella fulva* (A. Adams, 1851) | Lavaleye & Barash 1981: 87 | Israel: Haifa Bay, Atlit-Dor |
| *?Monoptygma sinuata* Gould, 1861 | Present paper | Haifa bay (Israel) |
| *Cingulina isseli* (Tryon, 1886) | Aartsen & Carrozza 1983: 38 | Haifa bay (Israel) |
| *Bulla ampulla* Linnaeus, 1758 | Barash & Danin 1982: 107 | Gaash – north of Tel Aviv (Israel) |
| *Ventomnestia girardi* (Audonin, 1827) | Mienis, 1976b: 209 | North Sinai, near Bardawil Lagoon |
| *Plocamopherus ocellatus* Rueppell & Leuckart, 1828 | Barash & Danin 1982a: 107 | Nizanim (Israel) |
| *Dendrodoris nigra* Stimpson, 1855 | Present paper | Israel: Dor, Caesarea |
| Bivalvia | | |
| Pteriomorphia | | |
| *Acar plicatum* (Dillwyn, 1871) | Present paper | Netanya (Israel) |
| *Scapharca demiri* Piani, 1981 | Demir, 1977: 197 | Aegean Sea – Turkey: Izmir |
| *Scapharca inaequivalis* (Bruguiere, 1789) | Ghisotti, 1973: 68 | Adriatic Sea |
| Heterodonta | | |
| *Divaricella angulifera* (von Martens, 1880) | Mienis, 1979: 200 | Israel: Netanya, off Bardawil (North Sinai) |
| *Laevicardium flavum* (Linnaeus, 1758) | Present paper | Dor (Israel) |
| *Soletellina rubra* (Schroeter, 1788) | Mienis, 1980b: 301 | Israel: North Sinai – Bardawil |
| *Soletellina subradiata* (Reeve, 1857) | Barash & Danin 1982a: 107 | North Sinai – Bardawil |
| *Trapezium oblongum* (Linnaeus, 1758) | Mienis, 1980c: 313 | Rafa (north of North Sinai) |
| *Gafrarium callipygum* (Born, 1780) | Present paper | Tel Aviv (Israel) |
| *Sphenia rueppelli* (A. Adams, 1850) | Present paper | Netanya (Israel) |

*Hypselodoris infucata* was first mentioned in the report of Barash & Danin 1977: 98 under the name *Glossodoris runcinata*. Then, only two specimens were found. Today this species is fairly common in some localities along the Mediterranean coast of Israel. The new records are given (Mienis & Gat 1981: 51, Gat & Fainzilber 1983: 17) under the name *Hypselodoris infucata*, which is synonymous with *Glossodoris runcinata*. This species has apparently established itself as a permanent settler in the South Eastern Mediterranean.

*Gastrochaena cymbium* was reported as an immigrant into the Mediterranean, but only from the coasts of North Sinai and Israel. Dr. Nafroni (Italy) acknowledged finding shells in Talamone (Central Tyrrhenian Sea). (Anonymous, 1980: 20, Table 15.) The distribution of *G. cymbium*, in the Mediterranean, outside of Israel, still needs further clarification.

In conclusion, it would be expedient to make some remarks on all of the Indo-Pacific immigrants (Lessepsian immigrants) into the Mediterranean. Altogether 91[2]) species of Mollusca from the Indo-West Pacific region are known to be found in the Mediterranean. They belong to 3 classes: Polyplacophora – 1 species, Gastropoda – 57, Bivalvia – 33 species. It seems that classes confined exclusively to marine environments are less capable (Polyplacophora) or incapable (Scaphopoda, Cephalopoda) of adapting themselves to the change of ecological conditions involved in the migration.

The provenance of the species that have immigrated into the Mediterranean is mostly designated in general terms: Red Sea, Indo-Pacific or Indo-West-Pacific spcies. An attempt should be made here to mark the subdivisions in the Indo-Pacific from which the immigrants arrived into the Mediterranean. The following subregions may be tentatively suggested: Erythraean, Western Indian Ocean (East Africa and the adjacent islands), Persian, Indian (South and East Indies), Indo-Malayan, West Pacific Is. (including Hawaii Is.) and North Australia. The subdivisions proposed are close to the schemes outlined by Schilder 1965; Ekman 1967 and Eales 1960.

Table 2. Distribution of the Lessepsian immigrants in the subregions of the Indo-Pacific

Abbreviations:

| | |
|---|---|
| SC | Suez Canal |
| Ery. | Erythraean subregion |
| WIO | Western Indian Ocean |
| Per. | Persian subregion |
| Ind. | Indian (South and East Indies) subregion |
| Mal. | Indo-Malayan subregion |
| WPI | Western Pacific Islands |
| Au | Australia |

| Species | SC | Ery. | WIO | Per. | Ind. | Mal. | WPI | Au |
|---|---|---|---|---|---|---|---|---|
| Polyplacophora | | | | | | | | |
| *Chiton platei* Thiele, 1910 | | + | + | | + | + | | |
| Gastropoda | | | | | | | | |
| *Haliotis pustulata cruenta* Reeve, 1846 | | + | + | | | | + | |
| *Diodora rueppelli* (Sowerby, 1834) | SC | + | + | + | | | + | |
| *Cellana radiata* (Born, 1778) | SC | + | + | + | + | + | + | |
| *Clelandella infuscata* (Gould, 1861) | | | | | | + | | |

[2]) 3 additional species have been recorded by Mienis (1984: 3): *Diloma atrovirens, Cypraea pantherina* (Lightfoot, 1786) and *Nassarius glans* (Linnaeus, 1758). The data are incomplete. These species are no doubt occasional migrants that arrived on Mediterranean beaches, probably mainly as ballast.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Trochus erythraeus* Brocchi, 1823 | SC | + | + | + | | | | |
| *Minolia nedyma* Melvill, 1897 | | + | | + | + | | | |
| *Umbonium vestiarium* (Linnaeus, 1758) | | + | | + | | + | | |
| *Nerita sanguinolenta* Menke, 1829 | SC | + | | | | | | |
| *Alvania dorbignyi* (Andouin, 1827) | SC | + | | | | | | |
| *Rissoina bertholleti* (Issel, 1869) | SC | + | + | + | | | | |
| *Planaxis punctostriatus* Smith, 1872 | | + | + | | | + | + | |
| = *Planaxis lineolatus* Gould, 1849 | | | | | | | | |
| *Pirenella cailliaudi* (Potiez & Michaud, 1838) | SC | + | + | | | | | |
| *Bittium proteum* (Jousseaume, 1930) | | + | | | | | | |
| = *Dahlakia* cf. *leilae* Biggs, 1971 | | | | | | | | |
| *Eufenella pupoides* (A. Adams, 1860) | SC | + | | + | + | + | | |
| *Clathrofenella reticulata* (A. Adams, 1860) | | + | | + | | + | | |
| *Scaliola* cf. *elata* Issel, 1869 | SC | + | + | + | | | | |
| *Diala varia* A. Adams, 1861 | SC | + | + | | + | + | + | |
| *Cerithium erythraeonense* Lamarck, 1822 | SC | + | + | | | | | |
| *Cerithium scabridum* Philippi, 1849 | SC | + | | + | + | | | |
| *Cerithium nesioticum* Pilsbry & Vanatta, 1906 | | + | + | | + | + | + | |
| *Rhinoclavis kochi* (Philippi, 1848) | SC | + | + | + | | + | | |
| *Cerithiopsis pulvis* (Issel, 1869) | | + | | | | | | |
| *Hipponix conicus* (Schumacher, 1817) | | + | + | | | + | + | |
| *Strombus lentiginosus* Linnaeus, 1758 | | | + | | + | + | + | |
| *Strombus decorus* (Roeding, 1798) | | | + | + | + | + | | |
| *Erosaria turdus* (Lamarck, 1810) | ?SC | + | + | + | + | + | | |
| *Erronea caurica* (Linnaeus, 1758) | | + | + | + | + | + | + | + |
| *Palmadusta gracilis* (Gascoin, 1849) | | + | + | + | + | + | + | + |
| *Monetaria moneta* Linnaeus, 1758 | | + | + | + | + | + | + | + |
| *Murex tribulus* (Linnaeus, 1758) | SC | + | + | | + | + | | |
| *Aspella anceps* (Lamarck, 1822) | | + | + | + | | + | + | + |
| *Rapana rapiformis* (Born, 1778) | | + | + | + | + | + | + | |
| *Rapana venosa* (Valenciennes, 1846) | | | | | | + | | |
| *Thais carinifera* (Lamarck, 1822) | SC | + | | + | + | + | | |
| *Quoyula madreporarum* (Sowerby, 1832) | | + | + | | + | + | + | |
| *Anachis savignyi* (Moazzo, 1939) | | + | | | | | | |
| *Nassarius arcularius plicatus* (Roeding, 1798) | | + | + | + | | | | |
| *Fusinus marmoratus* (Philippi, 1846) | SC | + | + | + | | | | |
| *Vasum turbinellus* (Linnaeus, 1758) | | + | + | | + | + | + | + |
| *Lophiotoma indica* (Roeding, 1798) | | | | | + | + | | + |
| *Conus arenatus* Hwass in Bruguiere, 1792 | SC | + | + | | + | + | + | |
| *Chrysallida fischeri* (Hornung & Mermod, 1925) | | + | | | | | | |
| *Chrysallida maiae* (Hornung & Mermod, 1924) | | + | | | | | | |
| *Kleinella fulva* (A. Adams, 1851) | | | | + | + | + | | |
| ?*Monoptygma sinuata* Gould, 1861 | | | | | | + | | |
| *Cingulina isseli* (Tryon, 1886) | | + | | | | | | |
| *Ventomnestia girardi* (Audouin, 1827) | SC | + | | | | + | | |
| *Bulla ampulla* Linnaeus, 1758 | | + | + | + | + | + | + | + |
| *Notarchus indicus* Schweigger, 1820 | ?SC | + | + | | + | + | + | + |
| *Bursatella leachi savigniana* Audouin, 1826 | SC | + | | | | | | |
| *Pleurobranchus forskali* Rueppell & Leuckart, 1828 | | + | + | | | | | |
| *Berthellina citrina* (Rueppell & Leuckart, 1828) | SC | + | + | | + | + | + | + |
| *Plocamopherus ocellatus* Rueppell & Leuckart, 1828 | SC | + | | | | | | |
| *Hypselodoris infucata* (Rueppell & Leuckart, 1828) | | + | | | | + | + | |
| = *Glossodoris runcinata* (Bergh, 1877) | | | | | | | | |
| *Discodoris concinna* (Alder & Hancock, 1864) | | + | + | | + | | | + |
| *Dendrodoris nigra* Stimpson, 1855 | SC | + | + | + | + | + | + | + |
| *Siphonaria kurracheensis* Reeve, 1856 | SC | + | | + | | | + | |

| Species | SC | Ery. | WIO | Per. | Ind. | Mal. | WPI | Au |
|---|---|---|---|---|---|---|---|---|
| Bivalvia | | | | | | | | |
| *Acar plicatum* (Dillwyn, 1817) | SC | + | + | + | | + | + | + |
| *Scapharca demiri* Piani, 1981 | | | | | | + | | |
| = *Arca amygdalum* Philippi, 1847 | | | | | | | | |
| *Scapharca inaequivalvis* (Bruguiere, 1789) | | | | | | + | | |
| *Scapharca natalensis* (Krauss, 1848) | SC | + | + | + | | + | | |
| *Limopsis multistriata* (Forskall, 1775) | | + | + | | + | | | |
| *Glycymeris* cf. *arabica* (H. Adams, 1870) | SC | + | | | | | | |
| *Modiolus auriculatus* Krauss, 1848 | SC | + | + | + | | + | + | + |
| *Modiolus arcuatulus* Hanley, 1843 | | + | + | + | | + | + | |
| *Modiolus glaberrimus* (Dunker, 1856) | SC | + | + | | | + | | + |
| *Brachidontes variabilis* (Krauss, 1848) | SC | + | + | | + | | + | + |
| *Pinctada radiata* (Leach, 1814) | SC | + | + | + | + | + | + | + |
| *Malleus regula* (Forskall, 1775) | SC | + | + | + | | + | + | + |
| *Spondylus spectrum* Reeve, 1856 | | + | + | | | + | | |
| *Crassostrea* cf. *gigas* (Thunberg, 1793) | | | | | | + | + | |
| *Divaricella angulifera* (von Martens, 1880) | SC | + | + | | | + | | |
| *Chama broderipi* Reeve, 1846 | SC | | + | | | + | | |
| *Pseudochama cornucopia* (Reeve, 1846) | SC | + | | | | | | |
| *Laevicardium flavum* (Linnaeus, 1758) | | + | + | + | + | + | + | + |
| *Papyridea australe* (Sowerby, 1834) | SC | + | + | + | | + | + | + |
| *Papyridea papyraceum* (Gmelin, 1791) | SC | + | + | + | + | + | + | + |
| *Hippopus hippopus* (Linnaeus, 1758) | | | | | | + | + | + |
| *Mactra olorina* Philippi, 1846 | SC | + | + | + | | + | | |
| *Atactodea striata* (Gmelin, 1791) | SC | + | + | | | + | + | |
| *Angulus valtonis* (Hanley, 1844) | SC | + | | | | | | |
| *Soletellina rubra* (Schroeter, 1788) | SC | + | + | + | | | | |
| *Soletellina subradiata* (Reeve, 1857) | | | | | | + | | |
| *Trapezium oblongum* (Linnaeus, 1758) | | + | + | | + | + | + | |
| *Gafrarium callipygum* (Born, 1780) | SC | + | + | + | | | | |
| *Garfarium pectinatum* (Linnaeus, 1758) | SC | + | + | + | + | + | + | |
| *Clementia papyracea* (Gmelin, 1791) | SC | + | | + | + | + | | + |
| *Paphia textile* (Gmelin, 1791) | SC | + | | + | + | + | | + |
| *Sphenia rueppelli* A. Adams, 1850 | SC | + | | | | | | |
| *Gastrochaena cymbium* Spengler, 1783 | SC | + | | | + | + | | |
| *Laternula subrostrata* (Lamarck, 1818) | SC | + | + | + | + | + | + | |

Table 3. Distribution of the Lessepsian immigrants in the subregions of the Indo-Pacific[3]) (91 species = 100 %)

| | | |
|---|---|---|
| Erythraean subregion | 79 species | 86.8 % |
| Western Indian Ocean | 56 species | 61.5 % |
| Persian subregion | 41 species | 45 % |
| Central Indian Ocean | 37 species | 40 % |
| Indo Malayan subregion | 60 species | 66 % |
| Pacific Is. | 36 species | 39 % |
| Australia | 23 species | 25.3 % |

Tables 2, 3, show that the greatest part of the Indo-Pacific species in the Mediterranean – 79 species – are from the Erythraean subregion: – 14 species, from the Erythraean subregion only, 65 species also from other subregions.

[3]) *Crassostrea* cf. *gigas* (Thunberg, 1793) was recorded as an Indo-Pacific immigrant into the Mediterranean (GHISOTTI 1974: 14). It proved to be an introduction of an edible claim and not taken into account in the percentages of the distribution in the subregions of the Indo-Pacific.

A relatively small part of migrants – 12 species – are not recorded from the Erythraean subregion, but from the areas more remote from the Mediterranean Sea (Tables 3, 4).

Table 4. Lessepsian migrants not recorded from the Erythraean subregion

| Species | Collected | Distribution outside the Mediterranean[4]) |
|---|---|---|
| *Clelandella infuscata* (Gould, 1861) | One shell | Japanese Sea |
| *Strombus lentiginosus* Linnaeus, 1758 | ?shells | East Africa, Madagascar, Ceylon, Indonesia, Western Pacific Is., Philippines |
| *Strombus decorus* (Roeding, 1798) | Live | Zanzibar, Mozambique, South Africa, Madagascar, Gulf of Aden, Persian Gulf, Saudi Arabia, Ceylon, Burma, Thailand, Indonesia |
| *Rapana venosa* (Valenciennes, 1846) | Live | Japan – Tartari Canal, Yellow Sea |
| *Lophiotoma indica* (Roeding, 1798) | ?Live | Ceylon, Thailand, Malacca, Indonesia, (Java, Celebes), Philippines, Japan, New Guinea, Australia |
| *Kleinella fulva* (A. Adams, 1851) | Live | Arabian Sea: Karachi, Bombay, Philippines, Japan |
| *?Monoptygma sinuata* Gould, 1861 | Live | China Seas |
| *Scapharca demiri* Piani, 1981 | Live | China Seas |
| *Scapharca inaequivalvis* Bruguière, 1789 | Live | Philippines, Japan |
| *Chama broderipi* (Reeve, 1846) | shells | Madagascar, New Guinea |
| *Hippopus hippopus* (Linnaeus, 1758) | One valve | Malaya, Indonesia, Philippines, Japan, Western Pacific Is., Australia |
| *Soletellina subradiata* (Reeve, 1857) | One valve | Nicobar Is., Philippines, Japan |

It may be surmised that the pelagic larvae of the benthic molluscan species living in the Erythraean subregion are brought into the Mediterranean by sea currents and settle there. It is very unlikely that the species from subregions that are remote from the Mediterranean should be able to migrate by means of the larval stage, since the life span of the larvae is rather limited (up to 9 weeks in Gastropoda and 5 weeks in Bivalvia). It is more reasonable to assume that the migrants from the distant subregions were transported in the adult stage by carriers (ships, fish, etc.) to the localities in which they were collected in the Mediterranean.

Many Indo-Pacific species, 43 of the 91, occurring in the Mediterranean have not been recorded from the Suez Canal (see Table 2). Presumably they did not find suitable environmental conditions for settling in the Suez Canal.

The inclusion of the following species in the list of the Lessepsian migrants into the Mediterranean is questionable: *Scaliola* cf. *elata, Strombus lentiginosus, Monetaria moneta, Aspella anceps, Spondylus spectrum, Crassostrea* cf. *gigas* and *Hippopus hippopus.*

*Scaliola* cf. *elata* is recorded by Barash & Danin, 1977: 91, fig. 6. According to Mienis (in litt.) there are "differences between true *Scaliola* and the figured shell. It is evident that the latter is not congeneric".

Shells of *Strombus lentiginosus* and *Spondylus spectrum* were collected on the Israeli Mediterranean coast by Aharoni (1934). No information was given about the number of specimens collected, nor about the site where they were deposited.

The appearance of *Monetaria moneta* and *Hippopus hippopus* in the Mediterranean seems to be adventitious. Their shells were most probably brought to the Israeli coast by man.

The identity of *Aspella anceps* is disputed by Vokes (in litt.): "I doubt that the species, you have, is really *anceps,* more likely it is *producta,* which does occur along the coast of eastern Africa and Mauritius. Another possibility is that the species is a native Mediterranean form that has just been overloo-

[4]) The geographical records according to Barash & Danin, 1973 and the present report.

ked." RADWIN & D'ATTILIO (1976: 21) also contest the identity of *Aspella anceps,* saying: "The name is probably best considered a 'nomen dubium'."

*Crassostrea* cf. *gigas* (Thunberg, 1793) was recorded as a species of Indo-Pacific origin, found in the Mediterranean (GHISOTTI 1971: 13; 1974b: 14). It seems, however, to be a case of introduction of edible clams for commercial reasons. For the past 5 years *C. gigas* has frequently been reported as being from Mediterranean and Black Sea localities.

The results of the observations made for about 40 years on the migration of Indo-Pacific Mollusca into the Mediterranean will be summarised below. The number of Indo-Pacific species reported to occur in the Mediterranean have increased fivefold (from 20 to 91) from 1948 to 1984 (Table 5).

Table 5.

| | Polyplacophora | Gastropoda | Bivalvia | Total |
|---|---|---|---|---|
| Report HAAS, 1948 | – | 8 | 10 | 18 |
| Present Report, 1984 | 1 | 57 | 33 | 91 |

Of the 91 species appearing in the Mediterranean, 44 species have been collected as one or a few shells, their being inhabitants of this sea is doubtful. The other 47 species were found live or in considerable numbers of shells. These species are considered as residents in the Mediterranean.

The following 13 species may safely be qualified as permanent inhabitants of the Mediterranean: *Diodora rueppelli, Minolia nedyma, Pirenella cailliaudi*[5]), *Cerithium scabridum, Rhinoclavis kochi, Thais carinifera, Bursatella leachi savigniana, Hypselodoris infucata, Brachidontes variabilis, Pinctada radiata, Malleus regula, Paphia textile* and *Gastrochaena cymbium.*

We have had the possibility of following the rate of colonization of 3 successful immigrants from the beginning of their penetration into the new area. *Minolia nedyma* was recorded first by BARASH & DANIN (1973: 305) under the name *Isanda* cf. *holdsworthiana* (NEVILL, 1871). The first two specimens were dredged in 1966 at Haifa Bay. This species is now common in various localities on the continental shelf of Israel. *Rhinoclavis kochi* was recorded for the first time in the Mediterranean in 1963. It is at present one of the most abundant species in the continental shelf of Israel. *Hypselodoris infucata* was first recorded from Israel in 1974 (BARASH & DANIN, 1977). Only 2 specimens were found. In the present report the number of specimens already observed amounts to 48.

In retrospect, on the data accumulated since the opening of the Suez Canal (1869) the following may be stated on the phenomenon of the Lessepsian migration of Mollusca:

1. The number of immigrating species has increased gradually during the past years.
2. The great majority of the Indo-Pacific immigrants are concentrated close to the Suez Canal. Their penetration into other parts of the Mediterranean is increasing, but at a very slow rate.

## Addendum

Further findings of *Strombus decorus* in additional localities reported by K. NICOLAY (La Conchiglia, 1986 No. 202, 203: 20): Cyprus-Aghia Napa, leg T. Zambakidis and Rhodes in Ixia by Dr. R. de Roover from Antwerpen.

Countless specimens of *Melibe fimbriata* Alder and Hancock, 1864 (Tethyidae) were observed in the Astacos inlet of the Ionian Sea coast of Greece on 22–24 September, 1982 (THOMPSON and CRAMPTON 1984: 114). This species is of Indo-Pacific origin and the number of Lessepsian immigrants of Mollusca in the Mediterranean amounts with it to 92.

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[5]) *Pirenella cailliaudi* considered as an Indo-Pacific species and *P. conica* – as a Mediterranean one, seem to belong to the same species.

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