# Stomatopod Crustacea from the Eastern Mediterranean

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*Ch. Lewinsohn*
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## ABSTRACT

Lewinsohn, Ch., and Raymond B. Manning. Stomatopod Crustacea from the Eastern Mediterranean. *Smithsonian Contributions to Zoology,* number 305, 22 pages, 7 figures, 1980.—Five species of stomatopod Crustacea are reported, three of which are based on new records for the Israeli coast. Four of the five species are indigenous to the eastern Atlantic. The fifth, *Oratosquilla massavensis* (Kossmann), is a Lessepsian immigrant into the Mediterranean from the Red Sea.



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# Contents

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## Introduction

Although nine species of stomatopods are known to occur in the Mediterranean Sea, only two species have been recorded so far from the Mediterranean coast of Israel. The most common Mediterranean species, *Squilla mantis* (Linnaeus, 1758), was first reported from Israel by Monod (1931). The second species, *Oratosquilla massavensis* (Kossmann, 1880), a Lessepsian immigrant (see Por, 1971, 1975) into the Mediterranean from the Red Sea via the Suez Canal, was first recorded from Israel by Steuer (1936). This latter species, now the most abundant stomatopod along the southeastern coast of the Mediterranean, apparently was not detected there until the 1930s; Gruvel (1936) and Steuer (1936) both provided the first records for the species from other localities in the southeastern Mediterranean.

A survey of the literature, which would have been much less complete without the assistance of L. B. Holthuis, revealed few records of stomatopods from the eastern Mediterranean before 1930. *Squilla mantis* was known to Aristotle, who called it squilla or crangon, from Greece (Thompson, 1910). Bodenheimer (1960) reported that a "sea locust," which he identified with *S. mantis,* was found on Assyrian tablets. Guérin (1832) reported three species from Greece: *Meiosquilla desmaresti* (Risso, 1816), *S. mantis,* and *Pseudosquillopsis cerisii* (Roux, 1828). The first two of these also are represented in our collections from Israel; *P. cerisii* has not been recorded again from the eastern Mediterranean. There are two additional records of *S. mantis* from Greece (Panagiatopoulos, 1916; Athanassopoulos, 1917), both recording the species from Athens.

The larger crustaceans of the Israeli coast had received little attention prior to the 1930s, probably a reflection of the relative late exploration of that coast. Holthuis and Gottlieb (1958), who summarized the decapod fauna of the eastern Mediterranean, also stated that the first decapod to be reported by the name from Israel, *Portunus pelagicus* (Linnaeus, 1758), was recorded as recently as 1924 by Fox. Like *O. massavensis, P. pelagicus* is an immigrant from the Red Sea. Insofar as the stomatopods are concerned, the fauna of the latter area has received far more attention than has the fauna of the eastern Mediterranean. There have been several recent accounts of the stomatopods of the Red Sea, including those by Ingle (1963) and Holthuis (1967b), who summarized the literature to that time, and Makarov (1971), who described a species of *Oratosquilla* and reported on several other species. The only paper that we have found dealing exclusively with stomatopods of the eastern part of the Mediterranean is that by Geldiay and Kocatas (1969), who reported *O. massavensis* and *S. mantis* from Turkey.

It is worthwhile to document the present distribution of the only Indo-West Pacific stomatopod in the Mediterranean fauna, *O. massavensis,* for we can foresee no barriers other than temperature,

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especially along the northern Mediterranean, which might keep it from spreading throughout the sea, and it will be interesting to follow the further spread of this species, if that occurs. Only one of the decapods that has entered the Mediterranean via the Suez Canal (for accounts of these species see Holthuis and Gottlieb, 1958; Lewinsohn and Holthuis, 1964; and Ramadam and Dowidar, 1976), *Portunus pelagicus,* is now known to occur in the western basin of the Mediterranean. This large portunid is well enough established in the harbor of Syracuse, Sicily, to support a commercial fishery there. A survey of the Tunisian fauna conducted by one of us (R.B.M.) from 1972 to 1974, including material from trawl samples in the southern Gulf of Gabès, near the Libyan border, yielded numerous *S. mantis* but no specimens of *O. massavensis.* As of 1974, it had not yet spread to the Tunisian coast from Egypt.

The Mediterranean stomatopod fauna comprises nine species representing three families: *Allosquilla adriatica* Manning and Froglia, 1979, *Nannosquilloides occulta,* and *Platysquilla eusebia* (Risso, 1816), family Lysiosquillidae; *Parasquilla ferussaci* (Roux, 1830) and *Pseudosquillopsis cerisii,* family Pseudosquillidae; and *Meiosquilla desmaresti, M. pallida, O. massavensis,* and *S. mantis,* family Squillidae. Five of these, *N. occulta, M. desmaresti, M. pallida, O. massavensis,* and *S. mantis,* are represented in our collections from Israel.

Accounts of eight of the Mediterranean species, including references to original descriptions and synonyms, were included in a recent report on the West African stomatopods (Manning, 1977a), for five of those species, *N. occulta, P. ferussaci, P. cerisii, M. pallida,* and *S. mantis,* also occur off tropical West Africa.

We give here a relatively complete account of *O. massavensis,* based on specimens from Mediterranean localities, as well as copies of good figures of the posterior part of the body of that species, and *S. mantis,* from the account of Dollfus (1938) (Figure 7), in the hope that this will facilitate recognition of these two species when they are taken in other areas. We hope that this will help to avoid the situation where two similar portunids, *Callinectes sapidus* Rathbun, 1897, and *Portunus pelagicus,* both introduced into the Mediterranean from different regions, were confused in the past by various authors (see references in Holthuis and Gottlieb, 1958, Holthuis, 1961, and Froglia, 1972). Apparently the two Mediterranean species of *Meiosquilla* have been confused in the past (see Manning and Froglia, 1979, and Manning, 1978b, for references), so we have also included expanded accounts of these species.

Although there have been several reports, some from before the opening of the Suez Canal in 1869, of the occurrence of one or more species of the tropical genus *Gonodactylus* from the Mediterranean (for references see Manning, 1977a:49), recent collections, including extensive surveys by the Department of Zoology, Tel Aviv University, as well as collections made by several organizations under the auspices of the Smithsonian Institution and Hebrew University, Jerusalem, have yielded no specimens of *Gonodactylus* from the Israeli coast. The species in question, *G. chiragra* (Fabricius, 1781) and *G. falcatus* (Forskål, 1775), are tropical Indo–West Pacific species that typically inhabit coral flats or coral rubble.

The genus *Gonodactylus* is not represented in the fauna of the tropical eastern Atlantic, although it comprises more than 30 species occurring in other tropical regions. In the eastern Atlantic it appears to have been replaced by two species of *Protosquilla* Brooks, 1886 (Manning, 1977a).

One stomatopod, *O. massavensis,* and more than 30 species of decapods (Holthuis and Gottlieb, 1958; Lewinsohn and Holthuis, 1964; Ramadan and Dowidar, 1976), including several shallow water species of alpheids and one xanthid crab, *Atergatis roseus* (Rüppell, 1830), are now well established in rocky shore habitats along the Israeli coast. The decapods that have entered the Mediterranean via the Suez now comprise about 10% of the entire Mediterranean decapod fauna. This clearly demonstrates that some kinds of littoral habitats for tropical species are available in the eastern Mediterranean. Level bottom, sublittoral habitats also have been colonized by numerous decapod immigrants off the Israeli coast (Gilat, 1974), as well as *O. massavensis.*

However, for inhabitants of shallow water coral rubble habitats like some species of *Gonodactylus,* as well as related genera in the Indo–West Pacific (see Dingle, Caldwell, and Manning, 1977), habitats

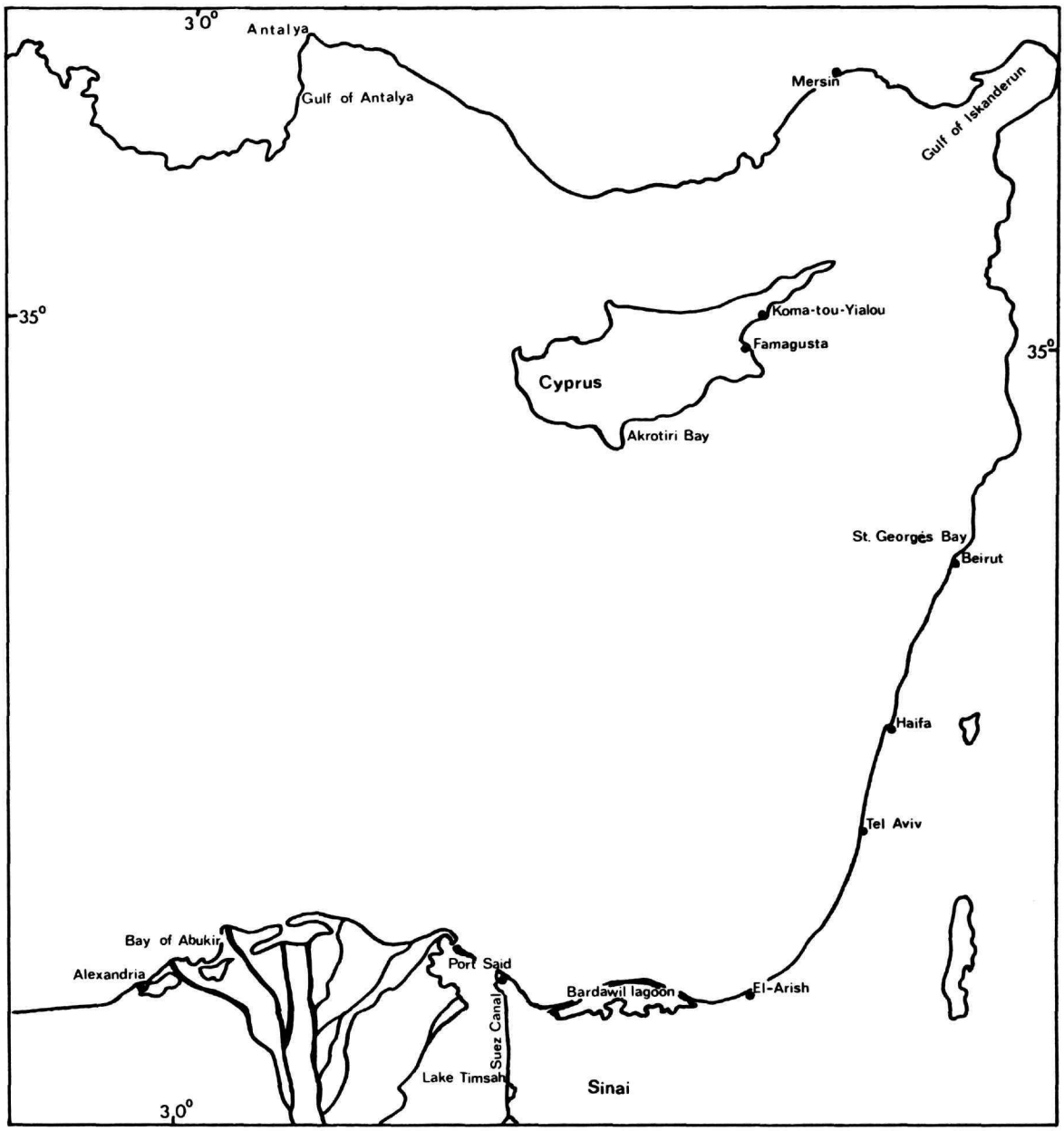


FIGURE 1.—Eastern Mediterranean localities from which Stomatopoda are known.

are restricted or unavailable in Mediterranean localities (Por, 1971:154).

Temperature might well be a limiting factor for tropical stomatopods and/or their larvae. The tropical western Atlantic species *Gondactylus oerstedii* Hansen, 1895, is quite common in shallow water habitats in the Caribbean, but it does not occur north of Miami on the east coast of Florida (Manning, 1969), the northern limit for many tropical species. The larvae of *G. oerstedii* did not

complete their larval development at 15°C and 20°C but did undergo metamorphosis to the postlarva at 25°C (Provenzano and Manning, 1978). Oren (1962:6) reported that the sea surface temperatures along the Mediterranean coast of Israel were equal to or higher than those recorded at Eylath in the Red Sea for five months of the year, from June through October. This undoubtedly is a contributing factor to the successful colonization of coastal habitats off Israel by decapod immigrants and could allow tropical stomatopod species to become established there if they do enter the Mediterranean. The fact that only one species has become established there suggests that the tropical stomatopods may be less tolerant of temperature changes than are some decapods or that suitable habitats are not available.

Bacescu and Mayer (1961:195) recorded a lysiosquillid larva from east of Crete and larvae, which they identified with *Gonodactylus falcatus* (as *G. glabosus*), from the Aegean Sea and commented that these larvae were immigrants from the Red Sea. There are no records of Red Sea species of lysiosquillids occurring in the Mediterranean, and Por (1971:154) pointed out that it is unlikely that transport through the Suez was made by larvae because of hydrographic conditions in the canal.

The basic work on larvae of Mediterranean stomatopods is that by Giesbrecht (1910), who identified larval stages of five species from the Gulf of Naples: *Nannosquilloides occulta, Parasquilla ferussaci, Pseudosquillopsis cerisii, Meiosquilla desmaresti,* and *S. mantis.* Most of his larval series were reconstructed from the plankton, and we are not aware that any of his stages have been verified by subsequent rearing experiments.

The basic work on stomatopod larvae from the Red Sea was carried out by Gurney (1937), who studied the development of *G. falcatus* (as *G. glabrous*) and an unidentified lysiosquillid, and by Gohar and Al-Kholy (1957), who identified larval stages with three species: *O. massavensis,* an unidentified squillid, and *G. falcatus* (as *G. glabrous*).

Environmental conditions along the Israeli coast, from where most of our specimens originate, have been studied in some detail in recent years. Oren (1970) reported on seasonal changes in physical and chemical characteristics of Mediterranean waters off Israel, and Gilat (1964, 1974) studied bottom types and invertebrate communities there. Emery and George (1963) described inshore conditions of Lebanon. Ben-Tuvia (1966) related ecological factors to the distribution of fishes, with particular reference to immigrant species in the Mediterranean from the Red Sea. Por (1971, 1975) discussed the implications of invasions from the Red Sea and provided historical background to present distributional patterns.

Most of the material reported here, and all of that from Israel, was collected by staff and students from the Department of Zoology, Tel Aviv University. Many of the specimens of *O. massavensis* and *S. mantis* are quite small, reflecting collecting methods used rather than a "dwarf" fauna. Most of the specimens were collected with a beam trawl with an opening of 1.20 meters, a net that large specimens can evade. Larger specimens of *O. massavensis* and *S. mantis* were taken with a commercial trawl; these two species are very common and can be collected with any commercial net.

In the synonymies given below, parenthetical comments on geography which follow page citations, such as "[Israel]" or "[Egypt]," show that that citation was based on material from the Mediterranean coast of Israel or Egypt.

Vertical distribution ranges of our material from the eastern Mediterranean, including available depth records from the literature, are summarized in tabular form below, under the account of *Squilla mantis.*

The size of our specimens indicated in the "Material" sections after the number of specimens is total length (in mm), measured from the anterior margin of the rostral plate to a line between the apices of the submedian marginal teeth of the telson.

Repositories are indicated in our "Material" sections under the following abbreviations:

| | |
|---|---|
| MCSN | Museo Civico di Storia Naturale, Milan |
| MNHN | Muséum National d'Histoire Naturelle, Paris |
| NS or SLM | Tel Aviv University |
| USNM | United States National Museum collections (in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.) |

In our sections on "Material" and Distribution," coordinates not given in original data as well as alternate spellings, both taken from gazeteers of the

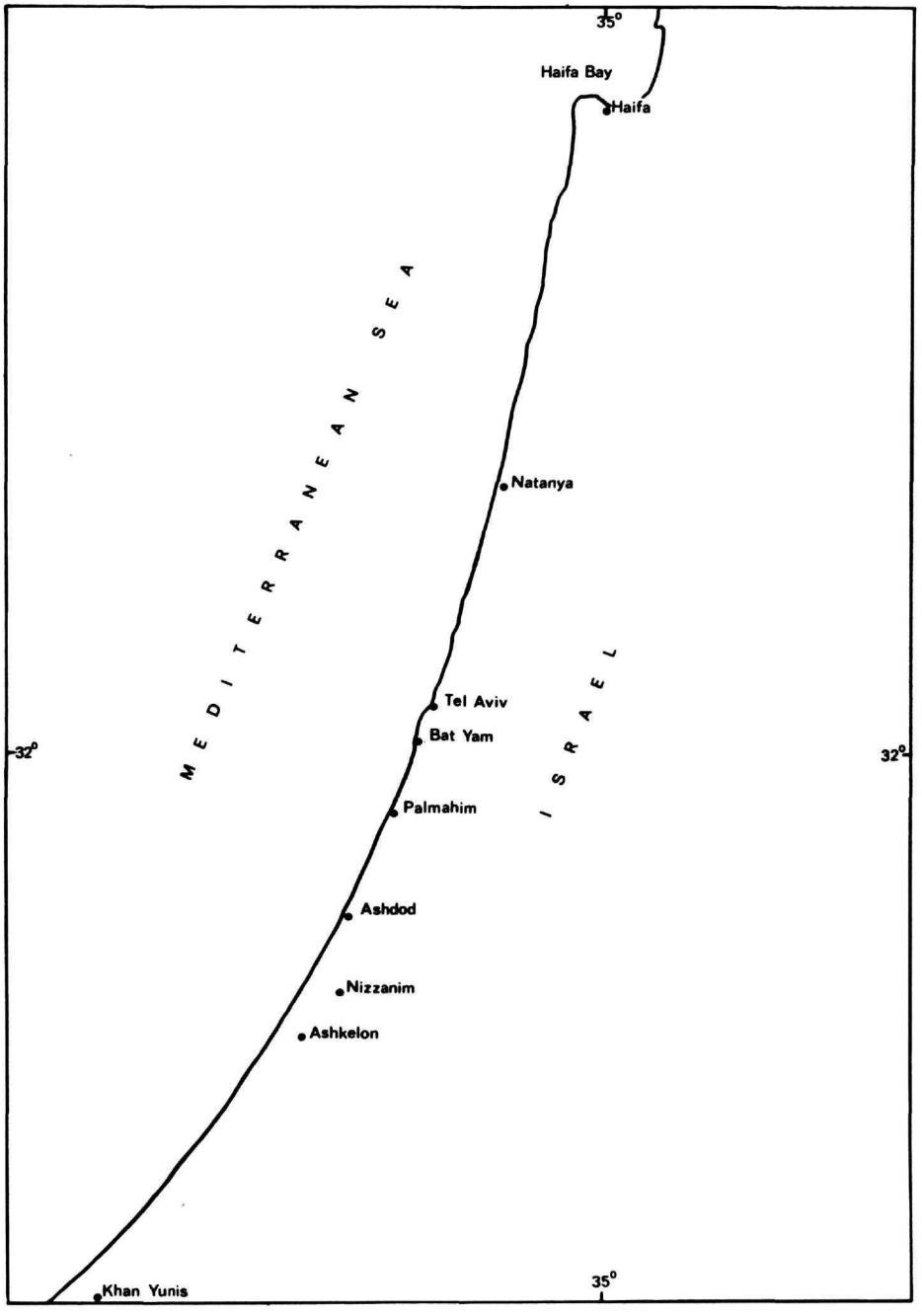


FIGURE 2.—Israeli localities mentioned in text.

United States Board on Geographic Names, are given in parentheses. Specimens from Israel are arranged from west to east off the Sinai and then from south to north. Most localities mentioned in the text are shown in Figures 1 and 2.

ACKNOWLEDGMENTS.—We thank F. D. Por, Department of Zoology, Hebrew University, Jerusalem, for three specimens from Cyprus and E. Gilat, Department of Fisheries, Ministry of Agriculture, for two of the specimens of *Nannosquilloides*. Most of the specimens from the Palmahim-Nizzanim areas and from Haifa Bay were collected by B. Galil and M. Tom during sampling programs that were part of their M. Sc. studies.

We also thank L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, Leiden, for his comments on the manuscript. Dr. Holthuis provided us with references to numerous older papers, which otherwise would have been overlooked.

All of the illustrations were prepared by Lilly King Manning.

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## Family LYSIOSQUILLIDAE Giesbrecht, 1910

### *Nannosquilloides occulta* (Giesbrecht, 1910)

FIGURE 3

*Nannosquilla occulta*.—Holthuis, 1967a:25 [references].

*Nannosquilloides occulta*.—Manning, 1977a:91, fig. 27 [West Africa].

MATERIAL.—ISRAEL: Off Khan Yunis, about 31°24'N, 34°15'E; 40 m; 5 Jan 1970; E. Gilat; USNM: 1♀, 17.5 mm. Off Nizzanim, 31°44'N, 34°28'E, 50 m; mud; 26 Jan 1977; Ch. Lewinsohn and B. Galil; NS 13623: 1♂, 25 mm; 1♀, 24 mm. Same, 31°44'N, 34°28'E; 50 m; mud; 1 Jul 1977; Ch. Lewinsohn and B. Galil; USNM: 1♀, 23 mm. Off Ashdod, 31°50'N, 34°30'E; 45 m; 8 Dec 1969; E. Gilat; USNM: 1♀, 21 mm.

DIAGNOSIS.—Size small, maximum length less than 50 mm. Rostral plate quadrangular, with anterior spine, lacking median carina. Cornea bilobed. Anterolateral angles of carapace unarmed. Carapace, thorax, and abdomen lacking longitudinal carinae. Mandibular palp absent, 5 epipods present. Dactylus of claw with 8-9 teeth. Lateral process of fifth thoracic somite low, inconspicuous. Telson margin (Figure 3) with movable submedian and 2 other pairs of fixed teeth, 4 intermediate denticles present.

SIZE.—Our specimens are 17.5-25 mm long. The specimens studied by Giesbrecht (1910) also were small, the largest, juveniles, apparently having total lengths of 22-23 mm. Steuer (1933) recorded a specimen 36 mm long from the Adriatic; that, apparently, is the largest specimen known to date.

REMARKS.—These specimens, the first to be collected east of the Adriatic Sea, suggest that this species, like *M. desmaresti* and *S. mantis*, can be expected to occur throughout the Mediterranean.

The material from Israel agrees well with the account of the species given by Manning (1977a)

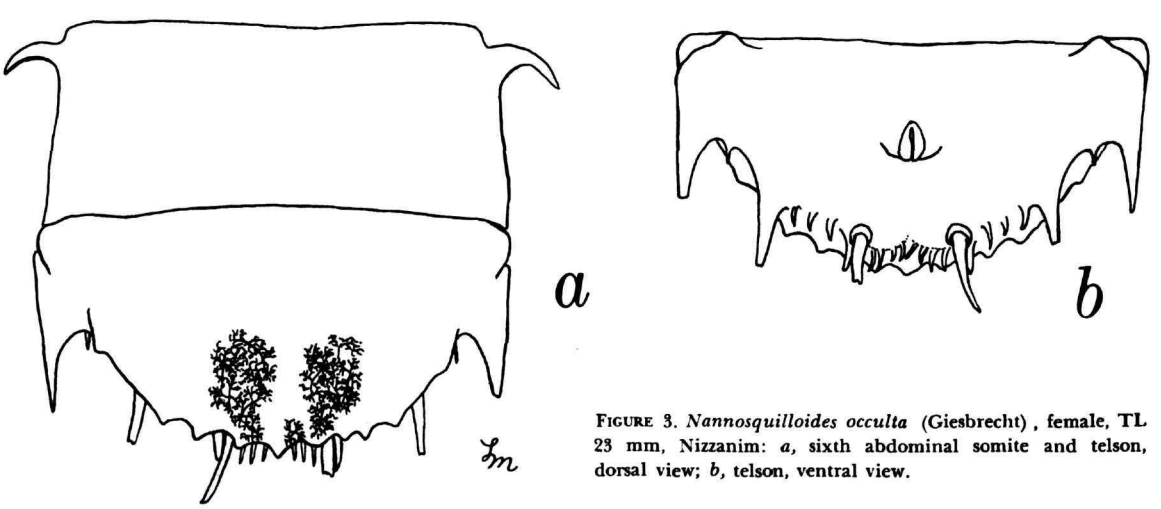


FIGURE 3. *Nannosquilloides occulta* (Giesbrecht), female, TL 23 mm, Nizzanim: *a*, sixth abdominal somite and telson, dorsal view; *b*, telson, ventral view.

based on collections from West Africa. As in those specimens there are four antennal papillae, two mesial and two ventral; there is a full complement of five epipods, and the mandibular palp has been suppressed. These features led one of us (R.B.M.) to establish the monotypic genus *Nannosquilloides* (Manning, 1977a:89) for this species, which had previously been assigned to *Nannosquilla*. In that genus there are no antennal papillae and there are four rather than five epipods.

In addition, these specimens from Israel have 9-10 teeth on the claw, two slender posterior spines on the basal joint of each walking leg, four slender outer spines on the uropod, and the following complement of denticles on the telson: three to four submedian, four intermediate (innermost much the largest), and one lateral. On the posterior margin of the telson there are, on each side, two fixed teeth, an intermediate and a lateral, lateral to the movable submedian tooth (Figure 3*a,b*). In *Platysquilla eusebia* there are four pairs of fixed marginal teeth on the telson, and in *Allosquilla adriatica* there are nine submedian denticles on each side and three or four spatulate rather than slender spines on the outer margin of the uropodal exopod.

The color pattern is well preserved in the single male examined. The background is cream or off-white, completely covered with scattered black chromatophores, which in some of the females are aggregated into irregularly shaped middorsal patches. There is a dark posterior line on the posterior margin of each of the thoracic and abdominal somites. On the telson there are traces of dark pigment laterally and a pair of large, prominent submedian black spots on the posterior dorsal surface above the marginal armature (Figure 3*a*). The female (23 mm long) from off Nizzanim was bright orange when caught.

*Nannosquilloides occulta* is a sublittoral species, occurring so far off Israel in depths between 40 and 50 m on mud.

DISTRIBUTION.—Eastern Atlantic, from the Mediterranean Sea, including Naples, Italy, off Rovinj, Yugloslavia, in the Adriatic, and now Israel, and from the West African coast at localities between Sénégal and Angola. Sublittoral, in depths between 30-35 and 200 m.

It has not been recorded previously from Israel.

## Family SQUILLIDAE Latreille, 1803

### *Meiosquilla desmaresti* (Risso, 1816)

FIGURE 4*a–g*

*Squilla desmaresti*.—Guérin, 1832:43 [Greece].

*?Squilla* sp.—Steuer, 1936:13, 17, fig. 9; 1938:9, 14 [both Egypt; second pelagic larval stage].

*Meiosquilla desmaresti*.—Manning, 1977a:124, figs. 40, 41 [description].

MATERIAL.—ISRAEL: Off Palmahim, 31°56′N, 34°35′E; 50 m; mud; 2 May 1977; Ch. Lewinsohn and B. Galil; USNM: 1♀, 37 mm. Same, 31°56′N, 34°35′E; 50 m; 23 Oct 1977; B. Galil; NS 13881: 1♂, 27 mm. Haifa Bay (32°49′N, 35°00′E); 57 m; 14 Jul 1969; Ch. Lewinsohn; USNM: 1♀, 26 mm. Same, 32°54′N, 34°56′E; 40 m; sand-silt-clay; 31 Aug 1974; Ch. Lewinsohn and M. Tom; NS 14345: 1♂, 31 mm.

CYPRUS: Famagusta (35°07′N, 33°57′E); 54 m; 21 May 1969; SLM 2017: 1♀, 52 mm. Akrotiri (34°36′N, 33°05′E); 36 m; 9 Nov 1969; USNM: 1♂, 52 mm.

DIAGNOSIS.—Size small to moderate, maximum length less than 90 mm. Rostral plate (Figure 4*a*) subtriangular, unarmed anteriorly, lacking median carina. Cornea bilobed. Carapace lacking median carina and anterolateral spines, thoracic and anterior 5 abdominal somites lacking submedian carinae. Mandibular palp absent, 4 epipods present. Dactylus of claw (Figure 4*f,g*) with 5 teeth. Lateral process of fifth thoracic somite (Figure 4*c,d*) an oblique, rounded lobe. Lateral carinae of fourth abdominal somite unarmed. Telson with movable apices on submedian teeth, 2 pairs of fixed teeth present laterally, prelateral lobes absent; postanal keel absent. Basal prolongation of uropod (Figure 4*e*) crenulate mesially.

SIZE.—Total lengths of our specimens range from 27 to 52 mm for males and 26 to 52 mm for females. Giesbrecht (1910) noted that maximum length was 7.5 cm for males, 8.5 cm for females.

REMARKS.—This is the first substantiated record for adults of *M. desmaresti* from the eastern border of the Mediterranean. The previous easternmost record for this species was from southern Greece (Guérin, 1832).

These specimens are of great interest in that they differ from all other specimens of *M. desmaresti* available to us and resemble material of *M. pallida* in having the antennular peduncle as long as or longer than the carapace and rostral plate combined and in having a much slenderer claw, with the

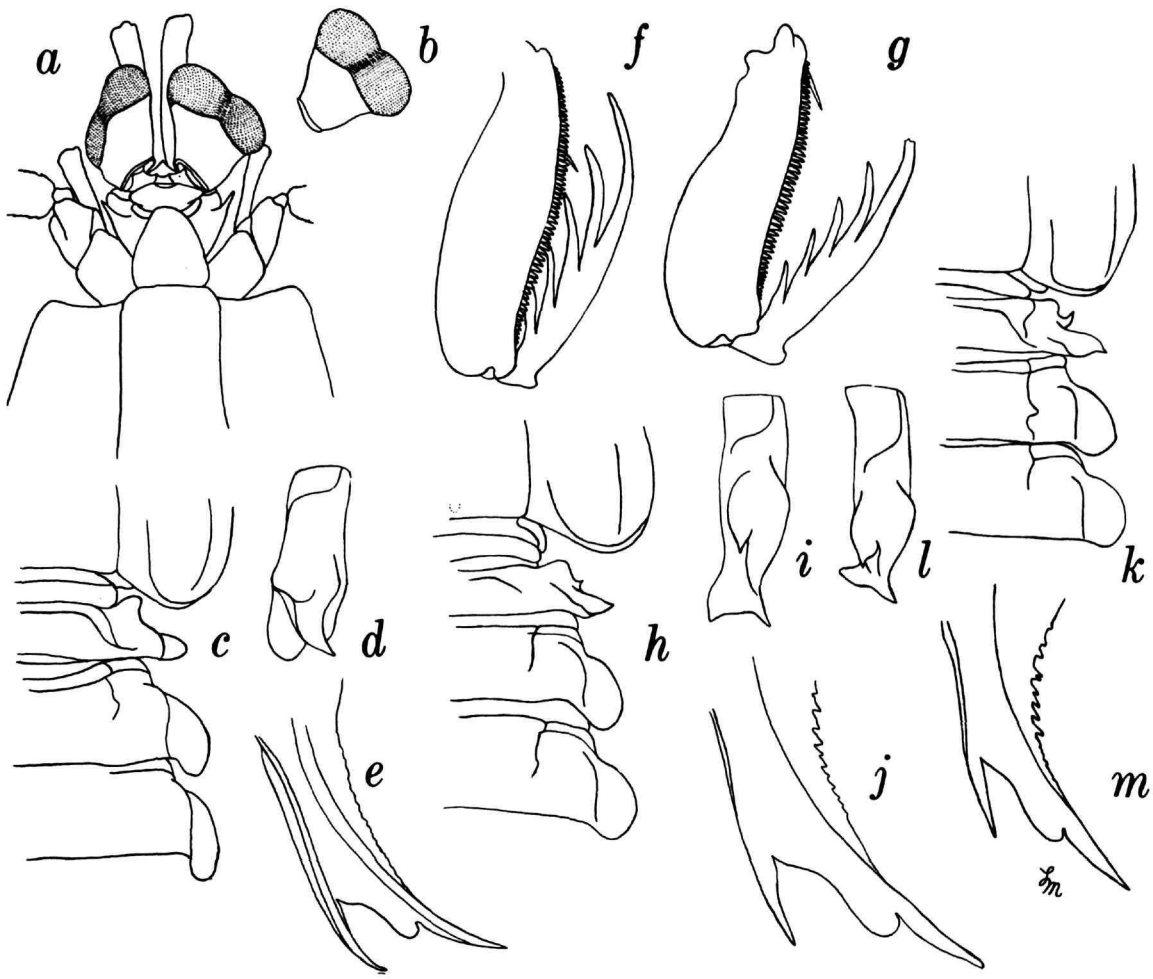


FIGURE 4.—*Meiosquilla desmaresti* (Risso), male, TL 52 mm, Akrotiri: *a*, anterior part of body; *b*, eye; *c*, lateral processes of exposed thoracic somites, dorsal view; *d*, lateral process of fifth somite, lateral view; *e*, basal prolongation of uropod; *f*, chela; *g*, male, TL 64 mm, Naples, chela. *Meiosquilla pallida* (Giesbrecht), female, TL 63 mm, Naples: *h*, lateral processes of exposed thoracic somites, dorsal view; *i*, lateral process of fifth somite, lateral view; *j*, basal prolongation of uropod. Male, TL 45 mm, off Palmahim: *k*, lateral processes of exposed thoracic somites, dorsal view; *l*, lateral process of fifth somite, lateral view; *m*, basal prolongation of uropod.

greatest depth of the propodus at midlength rather than distally. The claw in all of our specimens from Israel resembles that shown in Figure 4*f*, differing from the claw found in specimens from the western Mediterranean (Figure 4*g*). The same type of claw is found in a West African species, *M. calypso* Manning, 1974, which, like *M. pallida*, has an elongate antennular peduncle. *Meiosquilla calypso* also has the rounded lateral process on the fifth thoracic somite but differs from the other eastern Atlantic species of the genus in having eight rather than five or six movable spines on the outer margin of the uropodal exopod. The South African *Meiosquilla barnardi* Manning, 1975, has a rounded lateral process on the fifth thoracic somite, a relatively broad claw, and five movable uropod spines, but it, unlike *M. desmaresti*, has a distinct postanal keel.

The claw of *Meiosquilla barnardi*, characterized

by Manning (1975:366) as being broad, is similar to that of western Mediterranean specimens of *M. desmaresti* as well as that of *M. africana* from tropical West Africa (Manning, 1977a). The differences in claw shape in eastern Atlantic species of *Meiosquilla* are exceedingly subtle, as are most of the specific characters now used to distinguish species in the genus. Recognition of the species can be very difficult without comparative material. Manning (1975:366) was in error in characterizing the claw of *M. desmaresti* as slender. It is slender in specimens (at all sizes examined) from the eastern Mediterranean, but it is broad, apparently also at all sizes, in specimens from the western part of its range.

The corneal indices of our specimens from Israel, 360 at TL 26 mm (CL 5.4 mm), 355 at TL 37 mm (CL 7.7 mm), and 444 at TL 52 mm (CL 12.0 mm), are within the expected range of corneal indices as reported for *M. desmaresti* by Manning (1977a, table 3).

In other respects our specimens are typical of *M. desmaresti*, with a rounded, obliquely situated lateral process on the fifth thoracic somite (Figure 4*d*), which in *M. pallida* (Figure 4*h*) is flat dorsoventrally and sharp laterally, and a crenulate inner margin on the basal uropod (Figure 4*e*); that margin is distinctly spined or serrate in *M. pallida* (Figure 4*j,m*).

One of the larger specimens examined, the male, TL 52 mm from Cyprus, has slight swellings at the bases of the marginal teeth of the telson. These swellings are usually found in males larger than 48 mm.

These specimens shared the following morphological features. The abdominal carinae are unarmed anterior to the fifth somite and the following abdominal carinae end in spines: submedian 6, intermediate 5-6, lateral 5-6, marginal (4)-5. There were 5-6, 9-12, 1 denticles on the telson and 5-6 slender movable spines on the outer margin of the proximal segment of the uropodal exopod. In none of the specimens is there a distinct postanal keel.

The color pattern was well marked on the female from Palmahim. There are traces of a dark band across the posterior third of the carapace; the posterior 3 thoracic and anterior 5 abdominal somites each have 2 dark, rectangular, submedian patches middorsally, merging anteriorly on some somites, and irregular patches laterally, with dark pigment concentrated lateral to the intermediate carinae on the thoracic somites, more scattered on the abdomen; the posterolateral angles of the sixth abdominal somite are dark; on the telson dark pigment is concentrated in a black border, with some dark chromatophores scattered over the surface; there is a dark patch on the outer edge of the proximal segment of the uropod and a dark patch dorsally at each articulation.

Off Israel *M. desmaresti* was collected in 40 m on sand-silt-clay and in 50 m on mud, suggesting a preference for soft bottoms. Manning and Froglia (1979) showed that in the Adriatic, *M. desmaresti* occurred in shallower water than did *M. pallida*; the former was taken in depths between 30 and 75-80 m, whereas the latter occurred in 104–285 m in the Adriatic, with one lot having been taken in 500 m off Sicily. In the present collections from the eastern Mediterranean, *M. desmaresti* was taken in depths between 36 and 54 m; two specimens of *M. pallida* were taken in 80 and 91.5 m.

The records of larvae of this species from off Egypt given by Steuer (1936, 1938) should be accepted with caution. Steuer compared his specimen with the account of the second pelagic stage of *M. desmaresti* given by Giesbrecht (1910). Steuer (1938:14) also suggested that both of the larvae recorded in his account might be those of *O. massavensis*.

DISTRIBUTION.—Eastern Atlantic, from the Mediterranean Sea and adjacent Atlantic, north of the southern North Sea. Shallow water to a depth of at least 75-80 m (Manning and Froglia, 1979). There are few substantiated depth records in the literature.

The only eastern Mediterranean record in the literature is Gulf of Calamata, Greece (Messiniakós Kólpos, 36°45′N, 22°10′E) (Guérin, 1832).

This species has not been recorded previously from off Israel or Cyprus.

### *Meiosquilla pallida* (Giesbrecht, 1910)

FIGURE 4*h–m*

*Squilla desmaresti*.—Forest and Guinot, 1956:42 [Tunisia, 170–200 m]. [Not *Squilla desmaresti* Risso, 1816.]

*Meiosquilla pallida*.—Manning, 1977a:127, figs. 42, 43 [W Africa].

MATERIAL.—ISRAEL: Off Bardawil lagoon, opposite Mt. Cassius; 91.5 m (50 fm); 4 Feb. 1969; SLM 178: 1♀ 47 mm. Off Palmahim, 31°56'N, 34°34'E; 80 m; mud; 3 May 1977; Ch. Lewinsohn and B. Galil; NS 13626: 1♂, 45 mm.

DIAGNOSIS.—Size small to moderate, maximum length less than 90 mm. Rostral plate triangular, unarmed anteriorly, lacking median carina. Cornea bilobed. Carapace lacking median carina and anterolateral spines, thoracic and anterior 5 abdominal somites lacking submedian carinae. Mandibular palp absent, 4 epipods present. Dactylus of claw with 5 teeth. Lateral process of fifth thoracic somite (Figure 4*h,i,l*) a flattened lobe, usually sharp laterally. Lateral carinae of fourth abdonimal somite armed. Telson with movable apices on submedian teeth, 2 pairs of fixed teeth present laterally, prelateral lobes absent; postanal keel present ventrally. Basal prolongation of uropod (Figure 4*j,m*) serrate or denticulate mesially.

SIZE.—Our single male specimen has a total length of 45 mm; the female is 47 mm long. Giesbrecht (1910) reported that males attained a length of 6.5 cm, females 7.3 cm.

REMARKS.—*Meiosquilla pallida* is very similar to *M. desmaresti,* differing in having the lateral process of the fifth thoracic somite sharp laterally (Figure 4*h,k*) rather than rounded (Figure 4*c*), the lateral carinae of the fourth abdominal somite armed posteriorly, and the basal prolongation of the uropod spinulose or serrate mesially (Figure 4*j,m*) rather than crenulate (Figure 4*e*).

In our single male specimen the corneal index is 487, the antennular peduncle is as long as the carapace and rostral plate combined, and the propodus of the claw is relatively stout, measuring 10.2 mm long, 3.1 mm wide.

The color pattern of our specimens is similar to that of *M. desmaresti,* with pigment overall less well marked and noticeably less pigment laterally on the abdomen, between the intermediate and lateral carinae.

This is the first record for this species from the eastern part of the Mediterranean; the previous easternmost records there were Tunisia (Forest and Guinot, 1956, as *S. desmaresti*) and the Adriatic (Manning and Froglia, 1979). As noted above, these latter authors and Manning (1978b) pointed out that records of *M. desmaresti* from depths greater than 100 m or so are probably referable to *M. pallida,* the deeper dwelling of the two species.

Off Israel *Meiosquilla pallida* was collected with one other stomatopod, *S. mantis,* off Palmahim in 80 m on mud.

DISTRIBUTION.—Eastern Atlantic, from scattered localities in the Mediterranean and from several localities off West Africa between Morocco and Sénégal. Sublittoral, in depths between about 80 and 500 m.

This species has not been recorded previously from off Israel.

## *Oratosquilla massavensis* (Kossmann, 1880)

FIGURES 5, 6, 7*b*

*Squilla africana.*—Steuer, 1936: 13, figs. 9–15 [Egypt, Israel]; 1938:9, 10, figs. 9–15 [Egypt]. [Not *Squilla africana* Calman, 1917, preoccupied, = *Squilla aculeata calmani* Holthuis, 1959.]

*Squilla massavensis.*—Gruvel, 1936:177 [Egypt].—Monod, 1937:5 [Egypt], 18 [listed].—Steuer, 1937 [Nachtrag]: unnumbered page [Egypt].—Dollfus, 1938:186 [Egypt].—Tortonese, 1951:220, 240 [Egypt, Palestine].—Holthuis, 1961:63 [Turkey].—Ingle, 1963:15, figs. 3, 15, 32, 34 [all Israel], 62 [Red Sea] [Israel, Cyprus].—Gilat, 1964:16, 32, 37 [Israel].—Steinitz, 1967:167 [listed].—Geldiay and Kocatas, 1969:6, fig. 1a, c, figure on unnumbered plate [Turkey].—Gilat, 1974:B3, B4 [Israel].

*Squilla massauensis.*—Tortonese, 1952:5 [Lake Timsah, Egypt].

*Squilla ?massavensis.*—Williamson, 1967:61, fig. 18 [larvae; Israel].

*Squilla massawensis.*—Por, 1971:156, pl. 2: fig. 5.—Por, Steinits, Ferber, and Aron, 1972:470 [discussion].

*Oratoquilla massavensis.*—Manning, 1977a:130, fig. 44 [diagnosis].

MATERIAL.—EGYPT: Suez Canal, km 4–5; 27 Feb 1934; MNHN: 1♂, 140 mm, 1♀, 86 mm.

ISRAEL: Off N Sinai, 31°15'N, 32°41'E; 16 m; sand-stones; 31 Oct 1975; Ch. Lewinsohn; NS 13630: 2♂, 42–86 mm. Same, 31°23'N, 33°16'E; 30–32 m; 2 Nov 1975; Ch. Lewinsohn; NS 13631: 1♂, 137 mm. Same, 31°20'N, 33°22'E; 18 m; mud; 2 Nov 1975; Ch. Lewinsohn; NS 13629: 1♂, 88 mm, 1♀, 33 mm. Same, 31°22'N, 33°36'E; 36–56 m; 30 Oct 1975; Ch. Lewinsohn; USNM: 2♂, 115–125 mm, 1♀, 75 mm. Same, 31°26'N, 34°11'E; 36 m; mud; 30 Oct 1975; Ch. Lewinsohn; NS 13632: 4♂, 29–83 mm. Off Bardawil lagoon (Sirbonian lagoon, 31°10'N, 33°10'E), N Sinai; 9–18 m; 1–3 Jul 1977; M. Tom; NS 13583 (2♂, 2♀, USNM): 12♂, 77–113 mm, 10♀, 82–104 mm. Same; 14.5–27 m; 14–20 Nov 1977; M. Tom; NS 13880: 38♂, 60–151 mm (most ca. 120 mm), 81♀, 67–167 mm (most ca. 130 mm). Off Nizzanim, 31°44'N, 34°31'E; 35 m; 26 Jan 1977; B. Galil; NS 13662: 1♀, 54 mm. Off Palmahim, 31°55'N, 34°39'E; 35 m; 24 Jan 1977; B. Galil;

USNM: 2♂ (1 broken), 20 mm, 4♀, 19–56 mm, 4 postlarvae (2♂, 2♀), 17–18 mm. Same, 31°55′N, 34°39′E; 35 m; 24 Jan 1977; B. Galil; NS 13668: 3♀, 17–22 mm. Same, 31°56′N, 34°39′E; 35 m; 25 Jan 1977; B. Galil; NS 13666: 2♀, 20–31 mm. Same, 31°55′N, 34°39′E; 35 m; 25 Jan 1977; B. Galil; NS 13667: 2♂, 19–23 mm. Same, 31°35′N, 34°39′E; 35 m; 2 May 1977; B. Galil; NS 13664: 2♂, 35–53 mm, 2♀, 33–56 mm. Same, 31°56′N, 34°39′E; 35 m; 3 May 1977; B. Galil; NS 13663: 1♂, 57 mm, 4♀, 34–54 mm. Same, 31°35′N, 34°39′E; 35 m; 3 May 1977; B. Galil; USNM: 1♂, 40 mm, 1♀, 66 mm. Same, 31°55′N, 34°35′E; 50 m; 3 May 1977; B. Galil; NS 13665: 2♀, both 38 mm. Haifa Bay, 32°52′N, 34°58′E; 24 m; 25 Dec 1974; M. Tom; USNM: 1♂ postlarva, 15 mm. Same, 32°52′N, 34°58′E; 25 m; sand; 17 Sep 1975; M. Tom; USNM: 1♂ postlarva, 17 mm. Same, 32°52′N, 34°58′E; 25 m; sand; 17 Sep 1975; M. Tom; NS 13548: 2♂, 24–33 mm, 2♀, 23–53 mm. Same, 32°53′N, 34°59′E; 31 m; silt-sand; 13 Feb 1975; M. Tom; NS 15448: 3♂, 30–40 mm, 9♀, 23–47 mm. Same, 32°53′N, 34°59′E; 31 m; silt-sand; 13 Feb 1975; M. Tom; NS 15488: 1♂, 64 mm. Same, 32°53′N, 34°59′E; 31 m; sand-silt; 13 Feb 1975; M. Tom; USNM: 1 damaged ♂. Same, 32°53′N, 34°59′E; 31 m; silt-sand; 17 Sep 1975; M. Tom; USNM: 1♂, 17 mm. Same, 32°54′N, 34°56′E; 45 m; 25 Dec 1974; M. Tom; NS 15484: 1♀, 18 mm. Same, 32°54′N, 34°56′E; 46 m; 17 Sep 1975; M. Tom; NS 15220: 1♂, 30 mm. Same, 32°54′N, 34°54′E; 70 m; silt-clay; 17 Sep 1975; M. Tom; USNM: 1♂, 54 mm, 1♀ mm. Same, 32°54′N, 34°53′E; 75 m; silt-clay; 24 Dec 1974; M. Tom; NS 15438: 1♀, 37 mm. Same, 32°56′N, 34°55′E; 74 m; silt-clay; 24 Dec 1974; M. Tom; USNM: 7♂, 21–32 mm, 4♀, 24–33 mm.

LEBANON: St. George's Bay (33°54′N, 35°33′E); C. George; USNM: 39♂, 55–148.5 mm, 40♀, 52–119 mm (in 16 lots).

TURKEY: 1–2 km off S coast, between Lara and Zincir, 10–18 km S of Antalya (36°53′N, 30°42′E); 15–20 m; fine sand; Leiden University; 25 Apr 1959; USNM: 1♂, 116 mm.

CYPRUS: Famagusta (35°07′N, 33°57′E); 28 Sep 1956; USNM: 1♂, 69 mm. Koma-tou-Yialou (Komialik, 35°25′N, 34°08′E); 22 Oct 1968; SLM 902: 1♂, 132 mm.

DIAGNOSIS.—Size moderate to large, maximum length more than 200 mm. Rostral plate (Figure 5*a*) subtriangular, unarmed anteriorly, lacking median carina. Cornea (Figure 5*b*) bilobed. Carapace with median carina, anterior bifurcation reduced or absent, anterolateral spines present. Thoracic and abdominal somites with submedian carinae. Mandibular palp and 4 epipods present. Dactylus of claw with 6 teeth. Lateral process of fifth thoracic somite (Figure 5*d*) bilobed. Telson (Figure 5*e*) with fixed apices on submedian teeth, 2 pairs of fixed teeth present laterally, prelateral lobes present; dorsal surface of telson with rows of erect tubercles in adults.

SIZE.—Our specimens have total lengths ranging from 17 to 157 mm for males and 17 to 167 mm for females. The total lengths of postlarvae range from 15 to 18 mm, so that the sizes of postlarvae and juveniles overlap slightly. Our specimens are considerably smaller than specimens from Suez studied by Tattersall (1921:356), who saw material of both sexes with total lengths of 216 mm.

REMARKS.—*Oratosquilla massavensis,* the only Indo-West Pacific component of the Mediterranean stomatopod fauna, is now well established in the eastern Mediterranean, where it is known to occur between Alexandria, Egypt, and Turkey, including Cyprus. It apparently can occur together with *Squilla mantis,* the only other large Mediterranean stomatopod, although off Israel, at least, *O. massavensis* is found in shallower habitats. Our samples from Israel suggest that *O. massavensis* rather than the widely distributed *S. mantis* is the dominant stomatopod along the Sinai shore of the eastern Mediterranean, a status it has achieved since penetrating the Mediterranean after the opening of the Suez Canal in 1869. So far as we can determine, this species was not recognized in the Mediterranean prior to the 1930s. Its abundance, however, suggests that it has been established there for some time. Por (1971:148) characterized it as "a most successful Red Sea immigrant."

The two large squillids in the Mediterranean, *S. mantis* and *O. massavensis,* are quite easy to distinguish, even in preserved material. In freshly collected specimens the paired dark circles on the telson allow *S. mantis* to be recognized immediately. In preserved specimens *O. massavensis* differs from *S. mantis* as follows: The rostral plate lacks a median carina, the anterior bifurcation on the median carina of the carapace is poorly developed or absent, there are only four epipods, the lateral process of the fifth thoracic somite is bilobed, and there are two (three in very large specimens) rows of erect tubercles on the telson that converge under the apex of the median carina. The presence of only four epipods led A. Steuer (1936) to identify material of this species from Alexandria with the West African *Squilla africana* Calman; he corrected the name in an addendum (Nachtrag, dated 1937) to his 1936 paper. The name used by Calman for the West African species proved to be preoccupied; it is now known as *S. aculeata calmani* Holthuis, 1959 (see Manning, 1977a:133).

We have included a relatively complete account of this species, based on specimens from Israel, for

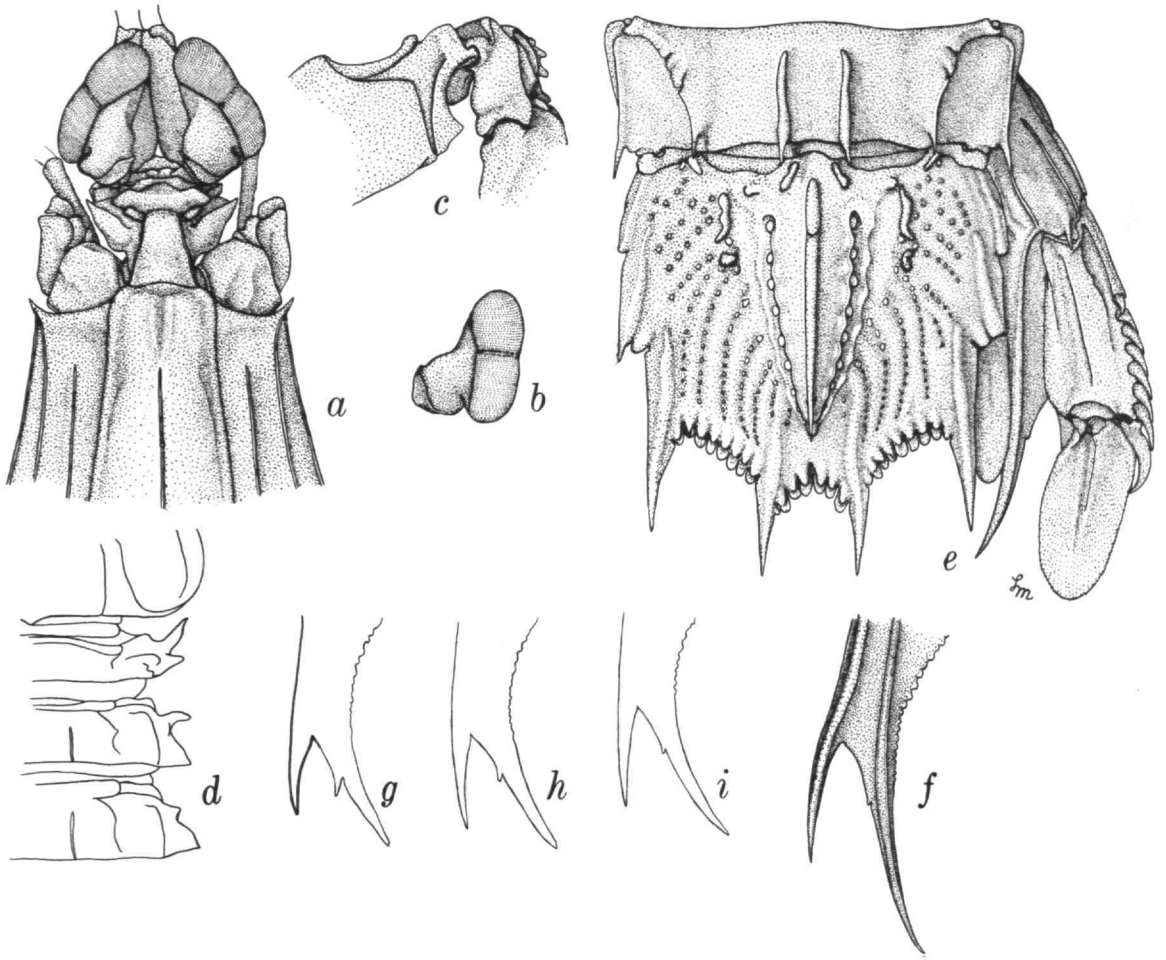


FIGURE 5.—*Oratosquilla massavensis* (Kossmann), male, TL 105 mm, off Bardawil lagoon: *a*, anterior part of body; *b*, eye; *c*, carpus of claw; *d*, lateral processes of exposed thoracic somites; *e*, sixth abdominal somite, telson, and uropod; *f*, basal prolongation of uropod. Basal prolongation of uropod of specimens from off Palmahim: *g*, TL 40 mm; *h*, TL 54 mm; *i*, TL 66 mm.

although the species has been well illustrated by earlier authors (Gravier, 1938; Dollfus, 1938, 1959), most of those accounts are based on specimens from the Red Sea; an exception is in the report by Ingle (1963), who based all but one of his figures of *O. massavensis* on specimens from the Mediterranean coast of Israel. In spite of the relatively large number of accounts of this species (Holthuis, 1967b:39, listed 16 citations in his synonymy), few authors have given any information on variability or growth changes, and, in the only account of the larval development of the species (Gohar and Al-Kholy, 1957), no information was given on the postlarva. Our material includes several postlarvae and young juvenile stages, allowing us to show differences between these stages.

Our material of *O. massavensis* from off Israel includes four male and two female postlarvae ranging in length from 15 to 18 mm; features of a female 18 mm long are shown in Figure 6*a-e*. Postlarvae typically differ from adults in that there is a reduction of numbers of spines on the abdomen, the body carination is less developed, and, in species in which the submedian teeth of the telson have

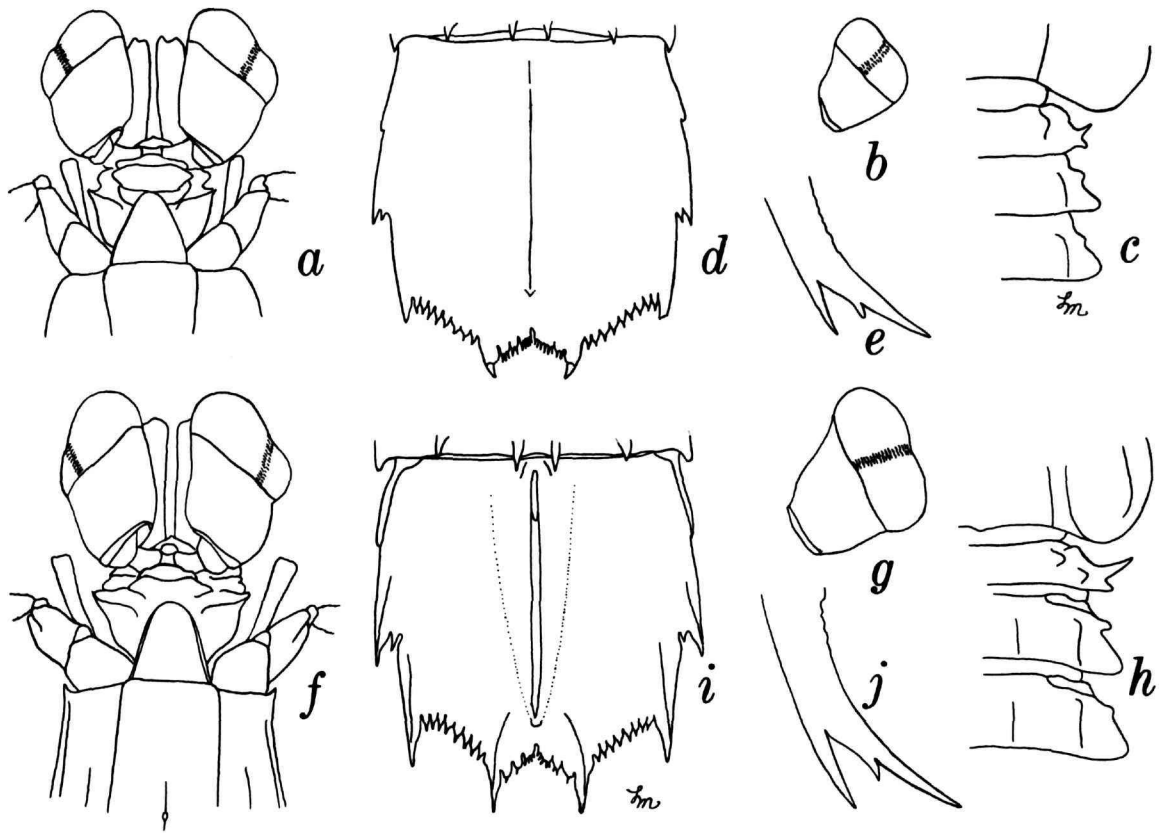


FIGURE 6.—*Oratosquilla massavensis* (Kossmann), female postlarva, TL 18 mm, off Palmahim: *a*, anterior part of body; *b*, eye; *c*, lateral processes of exposed thoracic somites; *d*, telson; *e*, basal prolongation of uropod. Juvenile female, TL 19 mm, off Palmahim: *f*, anterior part of body; *g*, eye; *h*, lateral processes of exposed thoracic somites; *i*, telson; *j*, basal prolongation of uropod.

fixed apices in the adult, the apices are clearly movable in the postlarvae. The postlarvae of *O. massavensis* have relatively large eyes and lack anterolateral spines on the carapace (Figure 6*a*), have relatively low carinae on the body, have poorly developed lateral processes on the exposed thoracic somites (Figure 6*c*), and have distinct movable apices on the submedian teeth of the telson (Figure 6*d*). In postlarvae as well as in juveniles (see below) the lobe between the spines of the basal prolongation of the uropod is a sharp spine (Figure 6*e,j*). The spine formula for the abdomen in our larvae is: submedian 6, intermediate 5-6, lateral (3) 4-6, and marginal 2-5. Only one specimen has the lateral carinae of the third abdominal somite armed, and, in that specimen, which may represent a second stage postlarva, there are anterolateral spines on the carapace and the lateral processes of the thoracic somites are better developed, but the movable apices of the submedian teeth have been retained.

The pigment pattern of preserved postlarvae also is reduced. There are a few dark spots on the carapace, the most prominent on the middle of the posterior margin. On the abdomen the dark color is reduced to a short line on the posterior margin near the lateral carina and a second short line on the anterior margin, accompanied by a diffuse spot in some specimens, near the intermediate carina. On the telson there are three dark spots anteriorly and one dark spot posteriorly on the median carina

and there are several curved rows of dark spots on the surface.

The postlarvae of *O. massavensis,* and very likely those of *S. mantis* as well, superficially resemble *Meiosquilla* spp., particularly in lacking anterolateral spines on the carapace and in having movable apices on the submedian teeth of the telson. However, the postlarvae of *O. massavensis* can readily be distinguished from species of *Meiosquilla* by the presence of the mandibular palp and six teeth on the dactylus of the claw; a further distinguishing feature is the sharp lobe between the spines of the basal prolongation of the uropod (Figure 6*e*).

In juvenile specimens, 17 to 26 mm long (Figure 6*f-j*), the anterolateral angles of the carapace are distinctly spined, the lateral processes of the thoracic somites are better developed, and the carination of the abdomen and telson are much better developed than in the postlarva. The apices of the submedian teeth of the telson are clearly fixed in specimens this size. The abdominal spine formula in these juveniles is: submedian 6, intermediate (4) 5-6, lateral (3) 4-6, and marginal 1-5. Smaller specimens lack the spines on the intermediate carinae of the fourth somite and the lateral carinae of the third. These specimens still have a prominent spine between the spines of the basal prolongation of the uropod (Figure 6*j*). The color pattern is better developed in these specimens, with each somite now having the entire posterior margin dark.

At about 30 mm, specimens begin to exhibit an abdominal spine formula similar to that of adults: submedian 5-6, intermediate (3) 4-6, lateral (2) 3-6, marginal 1-5. This formula can be found in specimens ranging in length from 30 to 148.5 mm, but generally, in larger specimens (total length greater than 100 mm), the formula is: submedian 4-5, intermediate (2) 3-6, lateral 1-6, marginal 1-5.

The spined lobe between the spines of the basal prolongation of the uropod is retained by smaller specimens but diminishes in size and sharpness with increasing size of specimens (Figure 5*f-i*). At a size of 80 mm or so and larger the lobe is very low and indistinct (Figure 5*i*).

The spined lobe between the spines of the basal prolongation of the uropod also appears to be characteristic of two other species of the Woodmasoni group of *Oratosquilla* (Manning, 1971, 1978a), *O. hesperia* (Manning, 1968), and *O. woodmasoni* (Kemp, 1911). Tirmizi and Manning (1968, fig. 17*c-e*) showed that in *O. hesperia,* which apparently replaces *O. massavensis* in western Indian Ocean localities outside of the Red Sea, this spine was present in small specimens (TL 52 mm), but was replaced by a low, inconspicuous lobe in larger specimens. *Oratosquilla tweediei* Manning, 1971, characterized in part by the presence of this spine, was shown by Manning (1978a:36) to be a synonym of *O. woodmasoni.* In that species the spine also is distinctive at small sizes, but in larger specimens it is replaced by a larger lobe, which may be scarcely discernible in very large adults.

Adults of *O. massavensis* generally have three lines of raised tubercles on each side of the midline of the telson (Figure 5*e*); these are characteristic for the species. Two of these lines of tubercles flank the median carina; there is one line on each side of the curved row of pits lateral to that carina. The inner row of tubercles may be detected in specimens as small as 22 mm, but they are very well developed in specimens 50 mm long. At a size of 75-90 mm, both rows of tubercles are generally developed. The third row, shorter than and situated lateral to the other rows, toward the anterior margin of the telson, is generally developed in larger specimens (total length more than 110 mm or so).

The following color notes were made on freshly collected specimens of *O. massavensis.* The basic body color is ochre (beige) to yellow-brown-gray, with lighter and darker variations occurring together. The antennules and antennae are similar to this, but the antennal scale differs in having a darkly pigmented margin and being orange brown proximally near the articulation. The raptorial claw is whitish, with the outer margin of the propodus and merus usually yellow, the inner margin of the carpus and its articulation to the merus also yellow. The rostral plate has an orange margin laterally. On the carapace the median carina, the gastric grooves, the posterior reflected part of the marginal carina, and the posterior margin are orange red; the other carinae show hardly any orange color. The submedian carinae and lateral and posterior margins of the exposed thoracic somites are red; the intermediate carinae are pale red. On the abdomen the submedian and intermediate carinae and the posterior margin of the

anterior four somites are red, the posterior margins of the last two somites are paler orange, and the lateral and marginal carinae are pale orange yellow. Parallel and anterior to the red margin there is a black line on each somite. The second to fifth somites each have two pin-sized red spots, in a line, on the midline; the first and last somites lack these spots. The median carina and the carinate bases of the marginal teeth, except for the greenish prelateral lobe of the telson, are red, the distal parts of the marginal teeth are whitish, and the denticles yellow. The rows of tubercles next to the median carina are marked here and there with yellow. The proximal segment of the uropod is beige, lacking dark pigment, with the inner half of the distal margin, including the distal spine, red. The proximal segment of the exopod is beige yellow proximally, blue black distally, bluer near the bases of the outer spines, which are whitish pink. The distal segment of the exopod is dark gray black, with the outer third yellow gray. The distal third of the endopod is dark, the remainder beige. The outer spine of the basal prolongation is whitish, the inner orange, with an orange carina proximally. The ventral surface of the uropod is darkly pigmented.

The color pattern in preservative of large specimens of *O. massavensis* is not particularly distinctive. The entire body appears dusky, with small, black chromatophores scattered over the lighter surface. The carinae, grooves, and margins of the carapace are outlined in dark pigment. Some specimens have a dark, U-shaped patch, open anteriorly, on the middle of the carapace anterior to the cervical groove. The carinae and posterior margins of the thoracic and abdominal somites are outlined by dark pigment. There is usually a dark, rectangular bar middorsally on the second abdominal somite. The posterior part of the abdomen and the telson appear darker than the remainder of the body. The telson lacks the large, black circles anteriorly, which are characteristic of *S. mantis,* but is usually ornamented with a dark patch posteriorly on the median carina and with a dark spot at the base of each of the marginal teeth. Most of the uropod is black; on the exopod, the proximal third of the proximal segment and the outer fourth of the distal segment is light, and the proximal part of the endopod and the basal prolongation are light. Some specimens show traces of green pigment on the carinae of the marginal teeth of the telson, with the spines of the telson and basal prolongation of the uropod and some of the posterior carinae of the abdomen orange.

Occurrences of *O. massavensis* together with *S. mantis* are discussed below under the account of the latter species.

Williamson (1967:61, fig. 18) tentatively identified 17 larvae taken off Natanya [32°20'N, 34°51'E], Israel, with *O. massavensis* but pointed out some differences between Israeli specimens and larvae of that species from the Red Sea as described by Gohar and Al-Kholy (1957). Specimens that Williamson believed to be in the last larval stage were 19-22 mm long, somewhat larger than the postlarvae we examined, which are 15-18 mm long. It is not unusual for postlarvae to be smaller than the last pelagic larva (Alikunhi, 1967).

Gruvel (1936:177) reported this species for the first time from localities within the Suez Canal and noted that it was common in the markets of Suez and Ismailia, whereas *S. mantis* was found in the markets of Port Said and Alexandria. Dollfus (1938) reported that both species were found together at km 4-5 in the canal.

The largest lot we examined, comprising 119 specimens, from off the Bardawil lagoon in November 1977, was taken during a cruise on a commercial vessel. Not one specimen of *S. mantis* was taken on the cruise.

Off Israel this species was taken on bottoms of mud, sand-stones, silt-sand, and silt-clay. Gilat (1964) found it on sand in 9-18 m and on sand-mud in 35-42 m off southern Israel. Steuer (1936, 1938) reported that off Alexandria it occurred on fine sand with little mud, *Amphioxus*-ground bottom with few algae, in 15 fms (27 m). Holthuis (1961) reported it from 10 m on sand and 15-20 m on fine sand off Turkey. The majority of our specimens from Israel were taken in depths of less than 50 m.

Gilat (1964, 1974), in his study of the benthic animal communities on the Israeli continental shelf, noted that the substratum varied with depth, with sandy bottoms predominating inshore, where *O. massavensis* is most abundant, silt and clay offshore, where *S. mantis* is common. In depths of 5-10 fms (9-18 m) sand constituted 93%-99% of the soil particles, but at depths of 75-100 fms (137-183 m) sand reached a minimum of 2%-4% of the

soil. At depths of 5-10 fms the percentage of silt and clay in the substrate was less than 5% each. Silt reached a maximum concentration of 49%-56% at 40 fms (73 m), whereas the maximum concentration of clay, 54%-56%, was found in slightly deeper water, 79-100 fms (146-183 m).

Although stomatopods are not fished commercially off Israel, *Squilla mantis* is a relatively important commercial species in the western part of the Mediterranean (Forest, 1973); judging from its abundance in our samples, *O. massavensis* may well have fishery potential off Israel.

DISTRIBUTION.—Red Sea and eastern basin of the Mediterranean between Egypt and Turkey (Holthuis, 1967b). The following eastern Mediterranean records are in the literature:

EGYPT: Alexandria (31°12′N, 29°54′E) (Gruvel, 1936; Tortonese, 1951). Off Alexandria, 15 fms (27 m) (Steuer, 1936, 1938). Suez Canal (Gruvel, 1936; Monod, 1937); at km 4–5 (Dollfus, 1938). Port Said (Gruvel, 1936). Lake Timsah (Tortonese, 1952).

ISRAEL: Palestine (Tortonese, 1951). Mediterranean coast of Israel (Ingle, 1963). El-Arish (31°08′N, 33°48′E), 9–15 m and 18 m (Gilat, 1974). Khan Yunis (31°21′N, 34°19′E), 5 m (Steuer, 1936). Between Ashdod (31°49′N, 34°39′E) and Bat-Yam (32°01′N, 34°45′E), 9, 9–18, 35–40, and 36–42 m (Gilat, 1964).

LEBANON: No specific locality (Manning, 1977a). Beirut (33°53′N, 35°30′E) (Holthuis, 1961).

TURKEY: Iskenderun Körfezi (Gulf of Iskanderun, 36°30′N, 36°08′E), 18–20 m; Antalya Körfezi (Gulf of Antalya, 36°30′N, 31°00′E), 55–60 m (Geldiay and Kocatas, 1969). 5 km off SE coast near Mersin (36°48′N, 34°38′E), 10 m; 1–2 km off S coast, between Lara and Zincir, 10–18 km S of Antalya (36°53′N, 30°42′E), 15–20 m (Holthuis, 1961).

CYPRUS: Famagusta (35°07′N, 33°57′E) (Ingle, 1963).

## *Squilla mantis* (Linnaeus, 1758)

FIGURE 7*a*

*Squilla mantis*.—Guérin, 1832:43 [Greece].—Thompson, 1910: 525b, 22, fig. [Greece].—Panagiatopoulos, 1916:581 [Greece].—Athanassopoulos, 1917:32 [Greece].—Fox, 1929:857 [footnote; Egypt].—Monod, 1931:430 ([Egypt, Israel, Syria].—Bodenheimer, 1935:468, pl. 68: fig. 2 [Palestine].—Gruvel, 1936:177 [Egypt].—Steuer, 1936:13, 17, figs. 9, 16 [Egypt].—Bodenheimer, 1937:281 [listed; Palestine].—Monod, 1937:5, 18 [listed; Egypt].—Maldura, 1938:465 [Rhodes].—Steuer, 1938:8, 9, 13, figs. 9, 16 [Egypt].—Dollfus, 1938:186, fig. 1 [Egypt].—Parisi, 1940:3 [Egypt].—Tortonese, 1947a:888 [Rhodes]; 1947b:18 [Rhodes]; 1951:220, 240 [Egypt, Palestine].—Demir, 1954:444, pl. 9 fig. 6 [?Turkey].—Holthuis, 1961:63 [Greece].—Bacescu and Mayer, 1961:195 [larvae; S of Cretel].—Ingle, 1963:15, figs. 4, 13 [Israel].—Gilat, 1964: 34, 37 [Israel].—Williamson, 1967:60 [larvae; Israel]. Holthuis, 1969:222.—Geldiay and Kocatas, 1969:4, fig. 1b,d, figure on unnumbered plate; 1972:22 [both Turkey].—Por, Steinitz, Ferber, and Aron, 1972:470 [discussion].—Manning, 1977a: 146, fig. 48 [West Africa].

*Squilla* sp.—Steuer, 1936:13, 17, fig. 9; 1938:9, 13, fig. 9 [both larvae; Egypt].

"Sea locust" Bodenheimer, 1960:114 [identified with *S. mantis*: from Assyrian tablets].

MATERIAL.—EGYPT: Port Said; 5 Jun 1924; MCSN: 3♀, 130–147 mm. Same; no other data; MCSN: 3♂, 101–130 mm; 1♀, 138 mm. Suez Canal, km 4–5; 27 Feb 1934; MNHN: 1♂, 138 mm.

ISRAEL: Off N Sinai, 31°22′N, 33°36′E; 36–56 m; 2 Nov 1975; Ch. Lewinsohn; NS 13634 (2♂, 2♀ USNM): 11♂, 85–165 mm, 12♀, 66–165 mm. Off Bardawil lagoon (Sirbonian lagoon, 31°10′N, 33°10′E), N Sinai; 9–18 m; 1-3 Jul 1977; M. Tom; USNM: 1♂, 139 mm. Off Palmahim, 31°55′N, 34°35′E; 50 m; mud; 24 Jan 1977; B. Galil; NS 13635: 1♂, 40 mm. Same, 31°56′N, 34°36′E; 63 m; mud; 25 Jan 1977; B. Galil; USNM: 1♀, 41 mm. Same; 31°55′N, 34°33′E; 80 m; mud; 3 May 1977; B. Galil; NS 13637: 1♀, 110 mm. Off Tel Aviv (32°04′N, 34°46′E); 106–112 m; 3 Nov 1977; O. Karman; NS 13882: 5♀, 155–165 mm. Haifa Bay, 32°54′N, 34°56′E; 47 m; sand-silt-clay; 26 Dec 1974; M. Tom; NS 14781: 1♂, 55 mm. Same, 32°54′N, 34°53′E; 75 m; silt-clay; 24 Dec 1974; M. Tom; NS 14758: 1♀, 37 mm. Same; 32°54′N, 34°54′E; 70 m; silt-clay-stones; 17 Sep 1975; M. Tom; NS 15257: 1♀, 89 mm. Same, 32°56′N, 34°55′E; 74 m; deep, viscous silt-clay; 24 Dec 1974; M. Tom; USNM: 1 juvenile ♂, 35 mm. Same; 32°58′N, 34°56′E; 71 m; deep, viscous silt-clay; 17 Sep 1975; M. Tom; NS 15312: 1♂, 64 mm, 1♀, 134 mm.

TURKEY: Izmir; channel markers of polluted inner harbor (= Izmir Limani, 38°26′N, 27°07′E); mud; 19 Jun 1973; M. J. Sweeney; USNM: 1♂, 142 mm, 1♀, 142 mm.

DIAGNOSIS.—Size moderate to large, maximum length less than about 200 mm. Rostral plate subtriangular, unarmed anteriorly, with median carina. Cornea bilobed. Carapace with anterior bifurcation on median carina, anterolateral spines present. Thoracic and abdominal somites with submedian carinae. Mandibular palp and 5 epipods present. Dactylus of claw with 6 teeth. Lateral process of fifth thoracic somite a slender, single spine. Telson with fixed apices on submedian teeth, 2 pairs of fixed teeth present laterally, prelateral lobes present; dorsal surface of telson (Figure 7*a*) lacking rows of erect tubercles.

SIZE.—The total lengths of our males range from 35 to 165 mm, of females 37 to 165 mm. Giesbrecht (1910) recorded males as long as 20 cm and females as long as 19 cm.

REMARKS.—Although *Squilla mantis* appears to

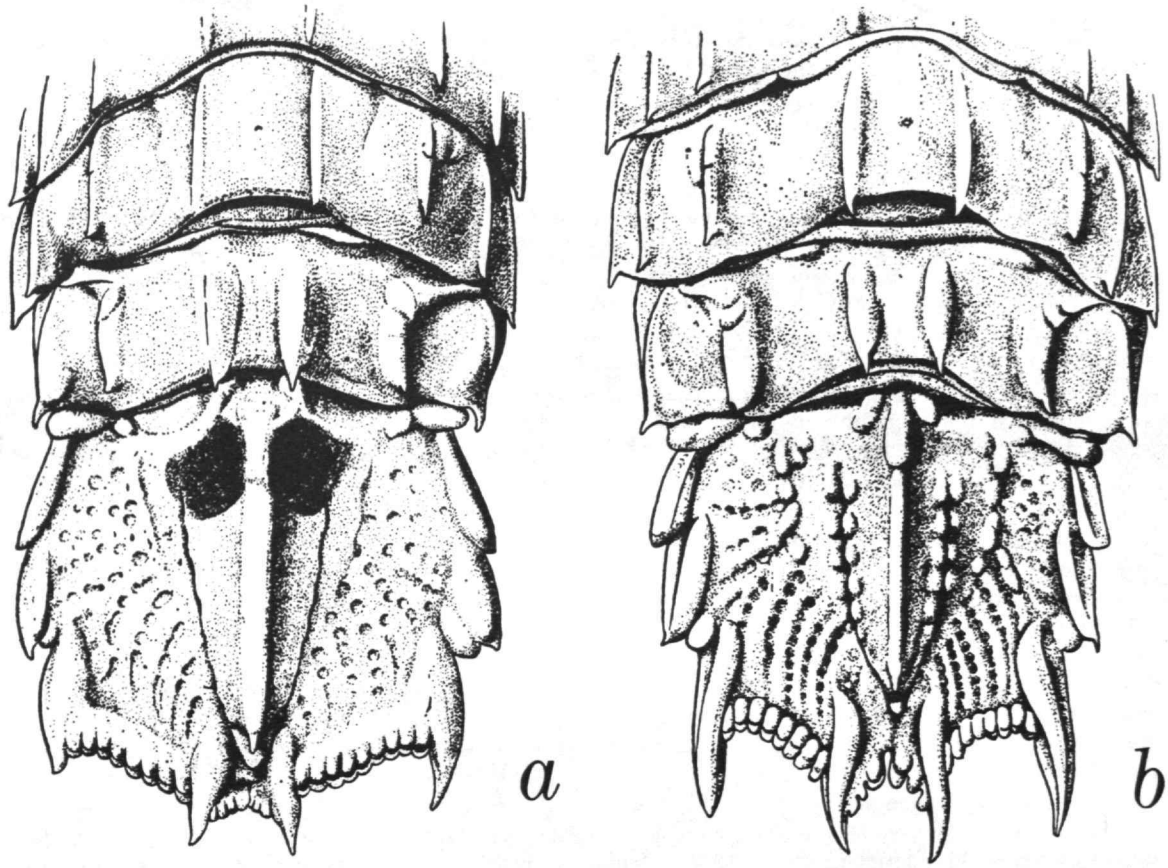


FIGURE 7.—Posterior somites of abdomen and telsons: *a*, *Squilla mantis* (Linnaeus); *b*, *Oratosquilla massavensis* (Kossmann). (From Dollfus, 1938, figs. 1, 3.)

be relatively common in sublittoral habitats off Israel, it is not nearly so abundant there as *O. massavensis*. Like *M. desmaresti*, *S. mantis* usually is found on soft, level bottoms. Off Israel it has been collected on bottoms of mud and silt-clay, including sand-silt-clay and silt-clay-stones, in depths ranging from 9-18 to 112 m. With one exception (9-18 m), our specimens were collected in depths of 47 m or more. In the Bardawil lagoon in areas of irregular sedimentation, sandy or muddy areas may be found in depths of 9-27 m. This could explain the shallower occurrence of *S. mantis* there.

*Squilla mantis* generally occurs in deeper waters off Israel than does *O. massavensis*, as shown below, although both species were taken together off Bardawill lagoon, N Sinai, in 9-18 m and at three stations in Haifa Bay, in depths of 70, 74, and 75 m. *Squilla mantis* also was taken at one station with *M. desmaresti*, as noted above.

TABLE 1.—Records of stomatopods at different depths from the eastern Mediterranean

| Depth (m) | *N.o.* | *M.d.* | *M.p.* | *O.m.* | *S.m.* |
|---|---|---|---|---|---|
| 0–10 | | | | 3 | 1 |
| 11–20 | | | | 8 | 3 |
| 21–30 | | | | 5 | |
| 31–40 | 1 | 2 | | 16 | 2 |
| 41–50 | 3 | 2 | | 4 | 5 |
| 51–60 | | 2 | | 1 | 1 |
| 61–70 | | | | 1 | 2 |
| 71–80 | | | 1 | 2 | 4 |
| 81–90 | | | 1 | | |
| 91–100 | | | | | 1 |
| 101–110 | | | | | 1 |

*Squilla mantis* and *O. massavensis* have been collected together several times in the past. The most interesting of these occurrences is that from between kilometer markers 4 and 5 in the Suez Canal proper at Port Said (Dollfus, 1938), indicating, as predicted by Monod (1937:5), that the species could be encountered together. The species also have been taken off Israel in 35-40 m and 26-42 m (Gilat, 1964) and off Turkey, in the Gulf of Iskanderum, 18-20 m, and Gulf of Antalya, 55-60 m (Geldiay and Kocatas, 1969).

Fox (1929:857, footnote) had noted that *S. mantis* was "very common in the Port Said Market, but was not taken in the canal" [by the 1924 Cambridge Expedition].

In the Golfe du Lion, northwestern Mediterranean, *S. mantis* is fished commercially on sand and sandy mud bottoms in 10-25 m; there the temperature ranges from 11° to 22°C, with the minimum in February, maximum in August and September (Do Chi, 1973, 1975). Do Chi also noted (1978:5) that Maurin (1962, 1968) had found *S. mantis* in deeper waters on detritic coastal bottoms of sand or sandy mud in two other areas, off Algeria in 80 to 280 m and in the Atlantic off NW Africa in 40-50 m; it may not be fished commercially in either of those areas. The fishing grounds in the Adriatic, however, like those studied by Do Chi, appear to be in shallower water. Piccineti and Piccinetti Manfrin (1970, 1971) studied *S. mantis* from depths of 6, 10, 13, and 16 m in the Adriatic, off Fano, Italy, and found that abundance fluctuated with temperature and depth. There the temperature at a depth of 16 m ranged from 8.6°C in February to 22.4°C in August; the temperature at 6 m in August reached 26.8°C.

According to Oren (1970) surface temperatures off Israel reach a maximum of about 28°C in August, about 17°C in February, and the water is almost homothermous, the surface and bottom at 200 m differing rarely by more than 0.5°C.

Thus off Israel, water temperature, although somewhat higher, is within the general range of temperatures encountered by *S. mantis* in other areas within the Mediterranean, but here it is abundant in somewhat deeper waters than in the Golfe du Lion or the Adriatic off Fano and apparently lives on softer sediments.

Whether temperature, bottom type, or pressure from *O. massavensis,* or a combination of these is responsible for its depth distribution off Israel remains to be determined.

Manning (1977b:291, fig. 1) has suggested that *S. mantis* may be represented by two distinct forms in the Mediterranean, one with a relatively long rostral plate, in which the submedian carinae of the fifth abdominal somite are unarmed, and one with a short, blunt rostral plate, which also has spines on the submedian carinae of the fourth abdominal somite. Both forms were found in material from Naples in the collection of the Muséum d'Histoire Naturelle, Geneva. All of our specimens are the form with the long rostral plate.

Even the smallest specimens examined can be distinguished readily from *O. massavensis* by the presence of five rather than four epipods and the characteristic pair of dark circles on the telson. Numerous features distinguish adults of the two species, even when the spots on the telson have faded. In *S. mantis* there is a carina on the rostral plate, the anterior bifurcation of the median carina of the carapace is always present, five epipods are present, the lateral process of the fifth thoracic somite is single, and the dorsal surface of the telson lacks erect tubercles.

The larger specimens of *S. mantis* that were examined showed the following color pattern in preservative. The carinae and grooves of the carapace are outlined by dark pigment. There is a broad, oblique submedian patch of dark pigment on the carapace anterior to the cervical groove. The posterior margin of the carapace, the posterior three thoracic somites, and all abdominal somites each have a dark posterior line. There is a dark, rectangular bar middorsally on the second abdominal somite; these may also be present, but less well developed, on the following somites. Some specimens show traces of dark pigment anteriorly on each somite between the intermediate and lateral carinae. The telson is ornamented with a prominent pair of dark black circles anteriorly, often edged in white or lighter pigment, and the posterior margin of the telson is darker than its dorsal surface. Most of the distal segment of the uropodal exopod is black.

The large male from off Bardawil lagoon, TL 139 mm, has the bases of the marginal teeth slightly swollen, a secondary sexual character.

Larvae identified with this species have been re-

corded from off the eastern harbor, Alexandria, Egypt by Steuer (1936, 1938), who studied two specimens corresponding to the 10th pelagic stage; from off Ashkelon [31°40′N, 34°35′E], Israel, by Williamson (1967), who had material representing pelagic stages 7–10; and by Bacescu and Mayer (1961), who reported two larvae, 4 and 15 mm long, from off Crete at 34°17′N, 27°33.5–35.5′E.

DISTRIBUTION.—Mediterranean Sea and adjacent Atlantic coast of southern Europe, Canary Islands, and West Africa from Morocco to southern Angola; shore to a depth of more than 200 m (186–247 m), generally in 120 m or less (Manning, 1977a). Makarov (1977:15) recently reported one lot of this species taken off Morocco, 34°07′N, 07°46′W, in 370–378 m. Eastern Mediterranean records are as follows:

EGYPT: No specific locality (Tortonese, 1951). Bay of Abukir (31°30′N, 30°15′E), near Alexandria, in 10, 23, and 25 fms (18, 41, and 45 m) (Steuer, 1936, 1938). Suez Canal (Monod, 1937); km 4–5 (Dollfus, 1938). Port Said (31°16′N, 32°18′E) (in market, Fox 1929; Monod, 1931; Gruvel, 1936; Parisi, 1940).

ISRAEL: No specific locality (Monod, 1931; Ingle, 1963). Palestine (Bodenheimer, 1935, 1937; Tortonese, 1951). Between Ashdod (31°49′N, 34°39′E) and Bat Yam (32°01′N, 34°45′E), 35–40 to 91 m (Gilat, 1964).

SYRIA: No specific locality (Monod, 1931).

TURKEY: No specific locality (?) (Demir, 1954). Iskenderum Körfezi (Gulf of Iskenderum, 36°30′N, 36°08′E), 18–20 m; Antalya Körfezi (Gulf of Antalya, 36°30′N, 31°00′E, 55–60 m (Geldiay and Kocatas, 1969). Hekim Adasi Aciklari (38°26′N, 26°46′E), 40–50 m (Geldiay and Kocatas, 1972).

GREECE: No specific locality (Thompson, 1910). Rhodes (Nísos Ródhos, 36°10′N, 28°00′E) (Maldura, 1938; Tortonese, 1947a, b). Napoli (Nauplion or Návplion, 37°34′N, 22°48′E) "et dans les iles" (of Greece) (Guérin, 1832). Near Athens (Athínai, 37°59′N, 23°44′E) (Pangiatopoulos, 1916). Athens, market (Athanassopoulos, 1917). Aegean coast, near harbor of Porto Lago (41°01′N, 25°07′E), Thraki, in 0–2 m (Holthuis, 1961).

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