Notes on Some Stomatopod Crustacea from the Sinai Peninsula, Red Sea

RAYMOND B. MANNING
and
CH. LEWINSOHN

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 433

SERIES PUBLICATIONS OF THE SMITHSONIAN INSTITUTION

Emphasis upon publication as a means of "diffusing knowledge" was expressed by the first Secretary of the Smithsonian. In his formal plan for the Institution, Joseph Henry outlined a program that included the following statement: "It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge." This theme of basic research has been adhered to through the years by thousands of titles issued in series publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

Smithsonian Contributions to Anthropology
Smithsonian Contributions to Astrophysics
Smithsonian Contributions to Botany
Smithsonian Contributions to the Earth Sciences
Smithsonian Contributions to the Marine Sciences
Smithsonian Contributions to Paleobiology
Smithsonian Contributions to Zoology
Smithsonian Folklife Studies
Smithsonian Studies in Air and Space
Smithsonian Studies in History and Technology

In these series, the Institution publishes small papers and full-scale monographs that report the research and collections of its various museums and bureaux or of professional colleagues in the world of science and scholarship. The publications are distributed by mailing lists to libraries, universities, and similar institutions throughout the world.

Papers or monographs submitted for series publication are received by the Smithsonian Institution Press, subject to its own review for format and style, only through departments of the various Smithsonian museums or bureaux, where the manuscripts are given substantive review. Press requirements for manuscript and art preparation are outlined on the inside back cover.

Robert McC. Adams
Secretary
Smithsonian Institution

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 433

Notes on Some Stomatopod Crustacea from the Sinai Peninsula, Red Sea

Raymond B. Manning
and Ch. Lewinsohn

SMITHSONIAN INSTITUTION PRESS
City of Washington
1986

Notes on Some Stomatopod Crustacea from the Sinai Peninsula, Red Sea

Raymond B. Manning and Ch. Lewinsohn†

Introduction

An expedition to the southern tip of the Sinai Peninsula, sponsored by the Department of Zoology, Tel-Aviv University, in October 1979, yielded several species of stomatopods and provided an opportunity to make observations on color in life of *Gonodactylus falcatus* (Forskål, 1775). The type-locality of *G. falcatus* is at Djeddah (21°30′N, 39°12′E), Saudi Arabia, in the Red Sea (see Manning and Lewinsohn, 1981). Until recently, that species was considered to be widely distributed throughout the Indo-West Pacific region, but recent field and behavioral studies (Caldwell and Dingle, 1975, 1976; Reaka and Manning, 1981) have demonstrated that *G. falcatus* is not a single, widespread species but a complex of species that are very similar morphologically but are different in color in life and in behavior as well. Six additional species have been recognized in the complex to date (see Dingle, Caldwell, and Manning, 1977; Manning, 1978a; Manning and Reaka, 1981a,b, 1982). Several of these species, such as *G. ternatensis* De Man, 1902, can be recognized on morphological differences, and all of these species can be differentiated on the basis of color in life. Until now there has been no detailed account of the color in life of *G. falcatus* sensu stricto from the Red Sea. Although Holthuis (1967:31, 32) provided some observations on color, his account did not include the color of the display spot on the merus of the claw; at that time it was not known to be a diagnostic character.

Material of five of the species reported herein was collected during the trip to the Sinai in 1979; additional material from the collections of the Department of Zoology, Tel-Aviv University, also is reported herein.

Holthuis (1967:38–42) provided a complete list of the stomatopods then known from the Red Sea. Since 1967 many of the generic names then in use have been changed and several additional families have been recognized within the Stomatopoda (Manning, 1980a). We provide below an updated list of Red Sea stomatopods, based on Holthuis' list, supplemented with references published since 1967.

Localities on the Sinai Peninsula mentioned in the text are shown in Figure 1. For additional information on Red Sea localities, see Lewinsohn

Raymond B. Manning, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560. Ch. Lewinsohn, Department of Zoology, Tel-Aviv University, Ramat-Aviv, Tel-Aviv, Israel.

† Dr. Lewinsohn passed away before this account could be completed; for an obituary, see Holthuis (1983:297).

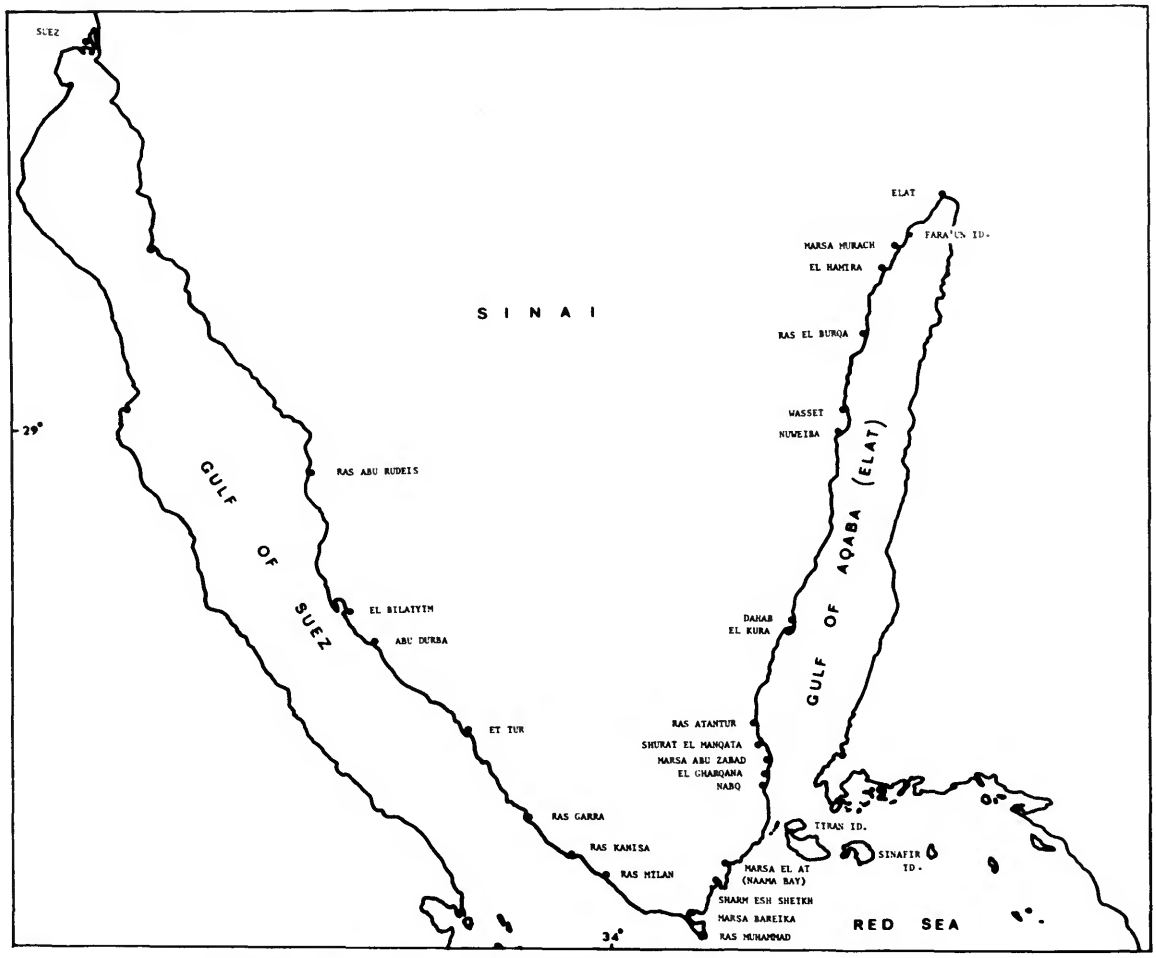

FIGURE 1.—Map showing localities in the Sinai Peninsula mentioned in the text.

(1969:194–198, pls.1–3). Localities outside of the Sinai Peninsula that are referred to in the text are accompanied by coordinates, in brackets, taken from gazetteers published by the U.S. Board on Geographic Names.

Abbreviations used in the "Material" sections are as follows:

NS	inventory number of Tel-Aviv University
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands
SLR	inventory number of joint program of Smithsonian Institution, Washington-Hebrew University, Jerusalem, "Biota of the Red Sea and the Eastern Mediterranean"
TAU	Zoological Museum, Tel-Aviv University
USNM	collections of the former United States National Museum, now deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

ACKNOWLEDGMENTS.—We thank L.B. Holthuis for the identifications of the material collected by the Smithsonian Institution—Hebrew University joint program, "Biota of the Red Sea and the Eastern Mediterranean," for providing us with the account of *Alima neptuni,* for allowing us to examine the specimen of that species taken in the Red Sea, and for his comments on the

manuscript. F.D. Por, Hebrew University, gave permission for us to publish the records of stomatopods taken by the Smithsonian Institution—Hebrew University joint program. Several colleagues from the Department of Zoology, University of Tel-Aviv, especially Lev Fishelson and Bella Galil, collected materials for us. We also thank Marjorie L. Reaka, University of Maryland, and C.W. Hart, Jr., Smithsonian Institution, for their comments on the manuscript.

Participation of one of us (R.B.M.) in the expedition to the southern Sinai in October 1979 was made possible by a grant from S. Dillon Ripley, then Secretary of the Smithsonian Institution, through his Fluid Research Fund; that support is gratefully acknowledged.

The figures were prepared by Lilly King Manning.

Stomatopoda Collected from the Sinai Peninsula, 1967–1981

Superfamily GONODACTYLOIDEA Giesbrecht, 1910

Family EURYSQUILLIDAE Manning, 1977

1. *Manningia amabilis* Holthuis, 1967

Manningia amabilis Holthuis, 1967:16, 40, figs. 4, 5.

MATERIAL.—*Gulf of Aqaba*. Marsa Abu Zabad: 15 Sep 1967, Fishelson, leg., 1♀ 41 mm, NS 5171 (TAU); 16 Sep 1967, Fishelson, leg., 1♀ 54 mm, NS 5172 (TAU); 16 Sep 1967, 1♀ 27 mm, SLR 616 (TAU). *Gulf of Suez*. Et Tur: 10 Sep 1968, 1♂, SLR 2008 (RMNH).

SIZE.—Total lengths of females 27–54 mm.

COLOR.–Not observed.

Family GONODACTYLIDAE Giesbrecht, 1910

2. *Gonodactylus acutirostris* De Man, 1898

FIGURE 2*a–c*

Gonodactylus chiragra acutirostris De Man, 1898:695, pl. 38: fig. 77b,c [♀ 56 mm, Mergui Archipelago].

Gonodactylus chiragra chiragra.—Ingle, 1963:27, figs. 27, 47, 63 [?part, ♀ 50 mm, Elat] [not *G. chiragra* (Fabricius, 1787)].

Gonodactylus smithii.—Holthuis, 1967:28, 41, fig. 7b [not *G. smithii* Pocock, 1890].

MATERIAL.—*Gulf of Aqaba*. El Hamira: 14 Dec 1967, 1♂, 1♀, SLR 1034 (RMNH). 5 km N of Dahab: reef flat, from dead coral, about 1 m deep, 5 Nov 1981, Lewinsohn, leg., 1♀ 43 mm, NS 19021 (TAU); reef flat, from dead coral, about 1 m deep, 5 Nov 1981, Lewinsohn, leg., 1♂ 18 mm, 1♀ 22 mm, NS 19022 (TAU). 1 km S of Shurat el Manqata: from dead coral, 1 m deep, 17 Oct 1979, Manning and Lewinsohn, leg., 1♂ 37 mm (USNM). *Southern tip of Sinai Peninsula*. 3 km S of Sharm esh Sheikh ("small Marsa"): 0–3 m deep, 15 Oct 1979, Manning and Lewinsohn, leg., 1♂ 42.5 mm (USNM).

SIZE.—Total lengths of males 18–42.5 mm, of females 22–43 mm.

COLOR.—Body dull green, with faint magenta line posteriorly on segments and on gastric grooves. Antennules golden yellow. Antennal scales golden yellow, setae purple. Meral spot of claw dark purple, outlined proximally and externally by almost iridescent ice-blue line; carpus with red spot proximally on inner margin; expanded part of propodus/dactylus purple red, distal part of dactylus pinkish. Walking legs with proximal segment purple, distal segment yellow. Uropods red proximally, most of remainder as in body, distal segment of exopod and all of endopod golden yellow, with purple setae.

REMARKS.—Holthuis (1967:28) noted that "The rostrum in my Red Sea specimens [of *G. smithii*] (Figure 7b) agrees perfectly with De Man's (1898, pl. 38: fig. 77) figure of that organ in his *Gonodactylus chiragra acutirostris*," and followed that with comments on the shape of the rostral plate in the types of *G. smithii*, in which the anterolateral angles of the plate are also acute, but not spiniform as in *G. acutirostris* sensu stricto and in material from the Red Sea. We agree with Holthuis that these differences are significant and identify our material with *G. acutirostris* rather than with *G. smithii*, realizing that

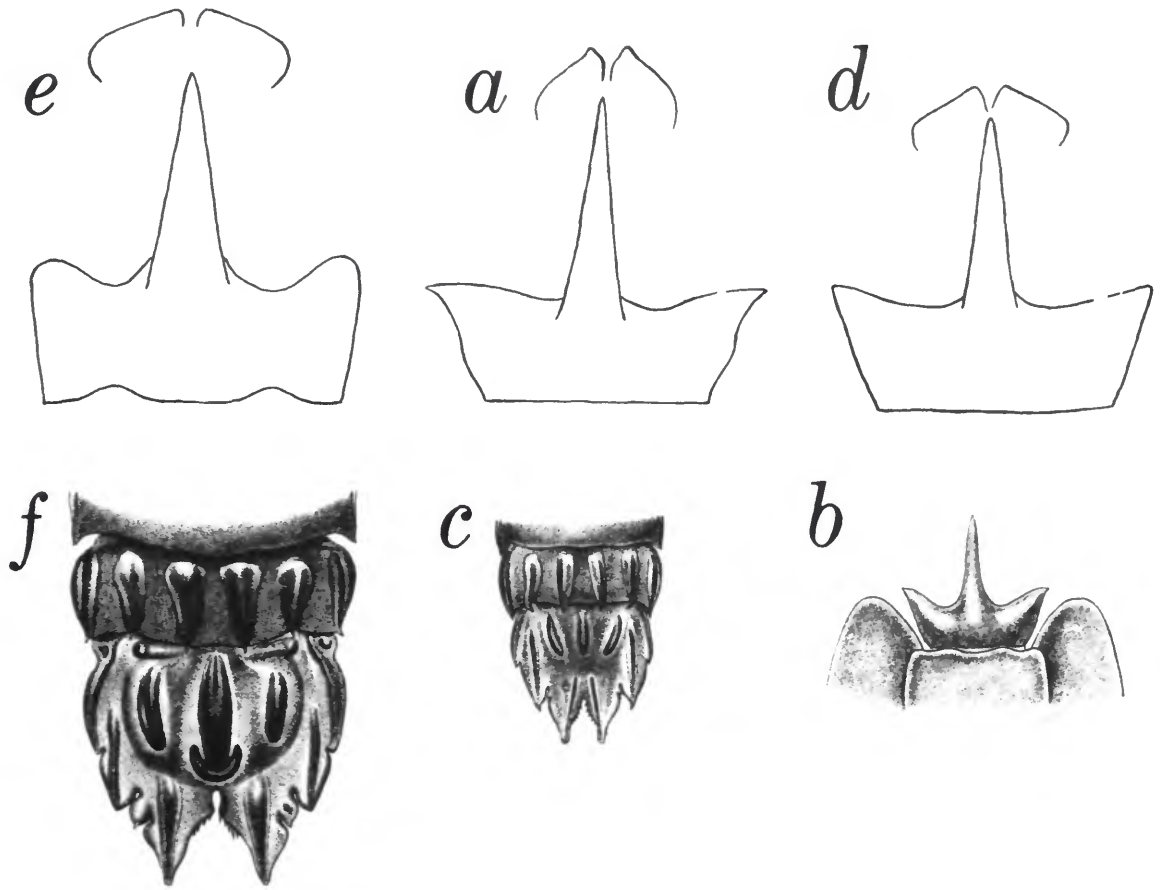

FIGURE 2.—*Gonodactylus acutirostris* De Man: *a*, ocular scales and rostral plate of ♂, 37 mm, Dahlak Archipelago, Red Sea; *b*, rostral plate; *c*, sixth abdominal somite and telson. *Gonodactylus smithii* Pocock: *d*, ocular scales and rostral plate of ♀, 48 mm, Tulear. *Gonodactylus chiragra* (Fabricius): *e*, ocular scales and rostral plate of ♂, 50 mm, Phuket; *f*, sixth abdominal somite and telson. (*b*, *c*, *f* from De Man, 1898, pl. 38: fig. 77.)

a re-examination of the type of *G. acutirostris* from the Mergui Archipelago might show that the population there is distinct from that in the Red Sea.

We reproduce here De Man's original figure of *G. acutirostris* (Figure 2*b*,*c*), a figure of the rostral plate of *G. smithii* from Madagascar (Figure 2*d*), and a figure of the rostral plate of a specimen of *G. acutirostris* from the Red Sea (Figure 2*a*). The rostral plate of the Red Sea specimen is clearly more like that of *G. acutirostris* than that of *G. smithii*.

We also reproduce here De Man's figure of the telson of his *G. acutirostris* (Figure 2*c*), the structure of which has been discussed several times in the literature (see Holthuis, 1967:29–30). The shortened median carina and lack of a knob clearly suggest that the telson surface has been damaged. The slenderness of the dorsal carinae and marginal teeth resembles our material from the Red Sea.

The account of the color of *G. smithii* given by Serène (1947:383, as *G. acutirostris*) also suggests that two different species are involved. Although

the basis color pattern appears to be very similar, he noted that "des appendices de l'uropode bleu outremer clair." The distal segments of the uropod in our specimens were golden yellow with purple setae. Both species share the prominent dark blue or purple meral spot.

3. *Gonodactylus botti* Manning, 1975

FIGURE 3

Gonodactylus chiragra.—Holthuis, 1967:26, 41, fig. 7a.—Hughes, 1977:90. [Not *G. chiragra* (Fabricius, 1787).]
Gonodactylus botti Manning, 1975:289, fig. 1 [♂ 48 mm, ♀ 51 mm, Indonesia].

MATERIAL.—*Gulf of Aqaba*. Ras el Burqa: 5 Oct 1968, Fishelson, leg., 10♂ 23–55 mm, 9♀ 20–52 mm, 2 juv. 10, 12 mm, NS 3510 (TAU); 5 Nov 1968, Fishelson, leg., 4♂ 38–59 mm, 6♀ 41–55 mm, 2 juv. 15, 19 mm, NS 4018 (TAU). Wasset: 7 Oct 1968, Fishelson, leg., 6♂ 19–61 mm, 4♀ 41–48 mm, NS 5162, NS 5163, NS 5165 (TAU). Nuweiba: 26 Jun 1972, 8♂ 26.5–58 mm, 7♀ 23–42 mm, NS 12542 (TAU). Dahab: 9 Oct 1968, Fishelson, leg., 3♀ 21–36 mm, NS 5161 (TAU). Ras Atantur: poisoning, 2 Jul 1969, Fishelson, leg., 3♂ 30.5–57 mm, 3♀ 33.5–46.5 mm (USNM). Shurat el Manqata: dead reef flat with algae, intertidal to 0.5 m, poisoning, 9 Nov 1981, Lewinsohn, leg., 1♂ 31 mm, 4♀ 32–45 mm, NS 19015 (RMNH). Marsa Abu Zabad: 15–16 Sep 1967, 6♀ 30–56 mm, SLR 564, SLR 616 (TAU). El Gharqana: 10–11 May 1968, 1♂, 45 mm, 1♀ 21 mm, SLR 1513, SLR 1542 (TAU); same date, 3♂, 2♀, SLR 1480, SLR 1626 (RMNH); 2 Jun 1969, 1♂ 50 mm, 1♀ 53 mm, SLR 2316 (TAU). 3 km S of Nabq: sandy reef flat with algae, intertidal to 0.5 m deep, poisoning, 8 Nov 1981, Holthuis and Lewinsohn, leg., 17♂ 16–53 mm, 10♀ 21–47 mm, NS 19014 (TAU). Sinafir Island, entrance to the Gulf of Aqaba: 19 Jul 1971, 3♂, 2♀, SLR 3229 (RMNH). *Southern tip of Sinai Peninsula*. Marsa Bareika: 7 Jun 1968, 6♂ 33–50 mm, 4♀ 33–42 mm, SLR 1892a (TAU). Ras Muhammad: 17 Sep 1967, 1♀, SLR 688 (RMNH). *Gulf of Suez*. Et Tur: 10–11 Sep 1968, 3♂, 2♀, SLR 2008, SLR 2066 (RMNH). Ras Abu Rudeis: 13 Jun 1968, 1♂, 1♀, SLR 1869 (RMNH).

SIZE.—Total lengths of males 19–61 mm, of females 20–56 mm.

COLOR.—Not observed.

REMARKS.—In his account of *Gonodactylus chiragra* from the Red Sea, Holthuis (1967:26) commented on the shape of the rostral plate, with the anterolateral angle comparatively broadly rounded, as well as the inflated carinae of the telson. In 1975 one of us (R.B.M.) described a species of *Gonodactylus, G. botti,* from Indonesia, which resembled *G. chiragra* in general facies, but differed in characteristics of the rostral plate, overall size, and in relative inflation of the carinae of the telson. These features are shown here for two different specimens in our collection (Figure 3), and the rostral plate and telson of what we consider to be *G. chiragra* sensu stricto is shown in Figure 2*e,f*. We identify our material with *G. botti* rather than *G. chiragra*.

Gonodactylus botti is a smaller species than *G. chiragra;* in the latter species total lengths of up to 100 mm or more have been recorded (Kemp, 1913; Dingle, Caldwell, and Manning, 1977). The largest known specimen of *G. botti,* recorded by Holthuis (1967:26), is 79 mm. The rostral plate in *G. botti* has a shorter median spine and a more rectangular basal part (compare Figure 3*a,d, G. botti,* with Figure 2*e, G. chiragra*). In *G. botti* the telson carinae are more inflated and the marginal teeth less distinct (compare Figure 3*b,e, G. botti,* with Figure 2*f, G. chiragra*). Both species share the relatively large ocular scales as shown in Figures 2*e* and 3*a,b*.

Our specimens have abdominal width/carapace length indices as indicated in Table 1.

Dingle, Caldwell, and Manning (1977:17) noted that in specimens of *G. chiragra* from Thailand this index ranged from 780–870, with a mean of 820. The relative width of the abdomen thus is similar in these two species.

We suspect that most, if not all, Red Sea records of *G. chiragra* will be referable to *G. botti.*

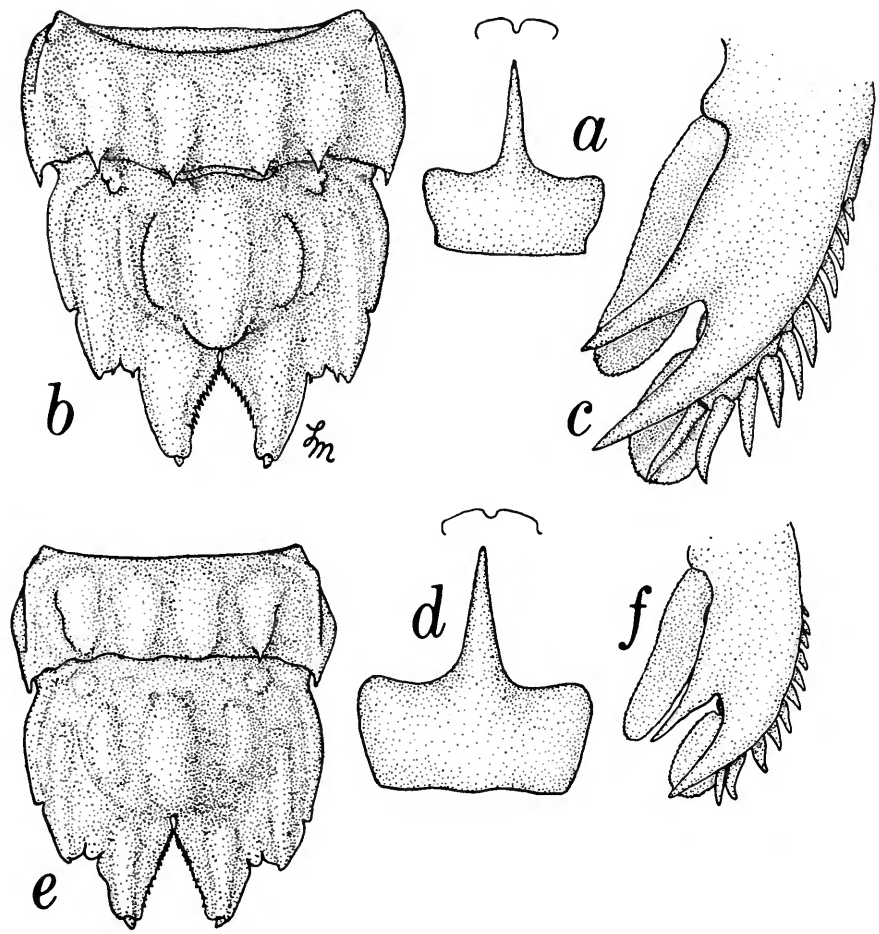

FIGURE 3.—*Gonodactylus botti* Manning, Ras Atantur: *a*, ocular scales and rostral plate; *b*, sixth abdominal somite and telson; *c*, uropod, ventral view; *d*, ocular scales and rostral plate; *e*, sixth abdominal somite and telson; *f*, uropod, ventral view. (*a–c*, ♂, 57 mm; *d–f*, ♀, 46.5 mm.)

4. *Gonodactylus demanii* Henderson, 1893

Gonodactylus demanii Henderson, 1893:455, pl. 40: figs. 23, 24.—Manning, 1967:8, fig. 3.—Holthuis, 1967:32, 41.
Gonodactylus demani.—Hughes, 1977:90.

MATERIAL.—*Gulf of Aqaba*. N of Marsa Murach: 19 Feb 1968, 1♀ 36 mm, SLR 1328 (TAU). El Hamira: 14 Dec 1967, 1♀ 20 mm, SLR 1051 (TAU). Ras el Burqa: poisoning, 5 Oct 1968, Fishelson, leg., 16♂ 16–34 mm, 9♀ 17–34 mm, NS 5168, NS 5169 (TAU); 0–1 m deep, poisoning, 24 Jun 1969, 1♂ 24 mm, NS 19043. Wasset: poisoning, 7 Oct 1968, Fishelson, leg., 2♂ 33, 34 mm, 6♀ 25–42 mm, NS 3723, NS 5164 (TAU); 8 Oct 1968, Fishelson, leg., 10♂ 24–31 mm, 2♀ 26, 28 mm, NS 3984 (TAU). Nuweiba: 26 Jun 1972, 1♂ 32.5 mm, NS 12542 (TAU). Dahab: beach poisoning, 9 Oct 1968, Fishelson, leg., 3♂ 14–25 mm, 2♀ 20–25 mm, NS 4399 (TAU). Ras Atantur: poisoning, 2 Jul 1969, Fishelson, leg., 10♂ 17–33 mm, 11♀ 17–34.5 mm, NS 5805 (7♂, 8♀ TAU, 3♂, 3♀ USNM). Shurat el Manqata: dead reef flat with algae, intertidal to 0.5 m deep, poisoning, 9 Nov 1981, Lewinsohn, leg., 9♂ 13–

TABLE 1.—Abdominal width/carapace length indices (AWCLI) of *Gonodactylus botti* Manning (numbers of specimens in parentheses; * = holotype, ** = paratype).

Carapace length (mm)	♂ AWCLI	♀ AWCLI	Mean AWCLI
5	–	857–865 (2)	861 (2)
6	831–879 (4)	–	860 (4)
7	855–873 (2)	863 (1)	863 (3)
8	880 (1)	846–867 (2)	864 (3)
9	824–851 (2)	839–882 (4)	847 (6)
10	806 (1*)	–	806 (1)
11	–	813 (1**)	813 (1)
12	782 (1)	–	782 (1)
13	767 (1)	–	767 (1)

32 mm, 7♀ 30–34 mm, NS 19038 (TAU). 1 km S of Shurat el Manqata: from dead coral, 1 m deep, 17 Oct 1979, Manning and Lewinsohn, leg., 1♂ 32 mm (USNM). 2 km S of Shurat el Manqata: reef flat, 0–1 m deep, 17 Oct 1979, Manning and Lewinsohn, leg., 1♀ 10.5 mm (USNM). Marsa Abu Zabad: 15–16 Sep 1967, 2♂ 32, 37 mm, 2♀ 23, 26 mm, SLR 564, SLR 616 (TAU). El Gharqana: 9, 11 May 1968, 6♂, 9♀, SLR 1480, SLR 1626 (RMNH). S of El Gharqana: 2 Jun 1969, 1♀ 31 mm, SLR 2316 (TAU). 3 km S of Nabq: reef flat, from black sponge, about 0.5 m deep, 8 Nov 1981, Holthuis and Lewinsohn, leg., 1♂ 17 mm, 2♀ 38, 40 mm, NS 19040 (USNM); same data, sandy reef flat with algae, intertidal to 0.5 m deep, poisoning, Holthuis and Lewinsohn, leg., 7♂ 27–40 mm, 5♀ 25–35 mm, NS 19037 (RMNH). Tiran Island, entrance to the Gulf of Aqaba: 1 m deep, 24 Sep 1981, Kerman, leg., 2♂ 22, 25 mm, 4♀ 17–34 mm, NS 19039 (TAU); same date, southern shore of Foul Bay, 1 m deep, Kerman, leg., 2♀ 23, 30 mm, NS 19041 (TAU).

Southern tip of Sinai Peninsula. Ras Muhammad: 17 Sep 1967, 1♀, SLR 688 (RMNH). 3 km NW of Ras Muhammad: 0–1 m deep, 18 Oct 1979, Manning and Lewinsohn, leg., 1♀ 42 mm (USNM). *Gulf of Suez.* Ras Garra: 9 Nov 1977, Goren, leg., 1♂ 24 mm, 1♀ 30 mm, NS 19042 (TAU). Et Tur: 10–11 Sep 1968, 16♂, 16♀, SLR 2008, SLR 2066 (RMNH). Abu Durba: 24 Sep 1974, 1♀ 28 mm, NS 19044 (TAU).

SIZE.—Total lengths of males 13–40 mm, of females 10.5–42 mm.

COLOR.—Not observed.

5. *Gonodactylus falcatus* (Forskål, 1775)

Cancer falcatus Forskål, 1775:96.—Manning and Lewinsohn, 1981:314, fig. 1.

Gonodactylus falcatus.—Holthuis, 1967:31, 41.—Manning, 1978a:4, figs. 1, 2*a*, 9.

MATERIAL.—*Gulf of Aqaba.* Elat: from *Stylophora*, 26 Nov 1971, Dafni, leg., 1♂ 18 mm, NS 8965 (TAU). Wasset: beach poisoning, 7 Oct 1968, Fishelson, leg., 2♂ 37, 42 mm, 2♀ 30, 35 mm, NS 3563, NS 3724 (TAU). 5 km S of Dahab: reef flat, from dead coral, about 1 m deep, 4 Nov 1981, Lewinsohn, leg., 2♂ 16, 30 mm, NS 19057 (USNM). Shurat el Manqata: dead reef flat with algae, intertidal to 0.5 m, poisoning, Lewinsohn, leg., 1♂ 30 mm, 1♀ 36 mm, NS 19047 (RMNH). 1 km S of Shurat el Manqata: from dead coral, 1 m deep, 17 Oct 1979, Manning and Lewinsohn, leg., 2♂ 17, 43.5 mm, 4♀ 31–36 mm (USNM). 2 km S of Shurat el Manqata: reef flat, 0–1 m deep, 17 Oct 1979, Manning and Lewinsohn, leg., 2♂ 29.5, 35.5 mm, 7♀ 14–37 mm (USNM). Marsa Abu Zabad: 16 Sep 1967, 1♀, SLR 616 (RMNH). El Gharqana: 9 May 1968, 1♂ 22 mm, SLR 1497 (TAU); 10–11 May 1968, 15♂, 16♀, SLR 1555, SLR 1626 (RMNH); 3 Jun 1969, 1♂ 21 mm, 4 juv. 11–12 mm, SLR 2391 (TAU). S of El Gharqana: 2 Jun 1969, 3♂ 27–36 mm, 5♀ 31–39 mm, SLR 2316 (TAU). 3 km S of Nabq: sandy reef flat with algae, 100 m offshore, 0.5 m deep, Lewinsohn, leg., 1♂ 52 mm, 2♀ 48, 50 mm, NS 19051 (TAU). Tiran Island, entrance to the Gulf of Aqaba, entrance to Foul Bay: 4 Jun 1981, Kerman, leg., 1♂ 41 mm, 1♀ 41 mm, NS 19053 (TAU); 10 m deep, 22 Sep 1981, Goren, leg., 1♂ 36 mm, 1♀ 22 mm, NS 19054 (TAU); 1 m deep, 24 Sep 1981, Kerman, leg., 4♂ 35–47 mm, 2♀ 35, 44 mm, NS 19045 (TAU). *Southern tip of Sinai Pen-*

insula. Ras Muhammad: 17 Sep 1967, 4♂, 1♀, SLR 688 (RMNH).

Gulf of Suez. N of Ras Milan: 3 m deep, 20 Apr 1979, Galil, leg., 15♂ 26–52 mm, 11♀ 38.5–56 mm, NS 16760 (9♂, 7♀ TAU; 6♂, 4♀ USNM). Ras Kanisa: about 1 km offshore, coral reef, from dead coral, 1–2 m deep, 17 Oct 1972, Lewinsohn, leg., 2♂ 14, 16 mm, 3♀ 15–36 mm, NS 19049 (TAU). Ras Garra: from dead coral covered with algae, 1 m deep, 16 Oct 1972, Lewinsohn, leg., 1♂ 21 mm, NS 19055 (TAU); 27 Sep 1974, 1♂ 38 mm, 4♀ 32–48 mm, NS 19046 (TAU); 19 Nov 1977, Goren, leg., 8♂ 20–45 mm, 6♀ 26–51 mm, NS 19048 (TAU); Apr 1979, Galil, leg., 1♂ 19 mm, NS 16765 (TAU). Et Tur: 20 Sep 1967, 1♀ 40 mm, SLR 770 (TAU); 10 Sep 1968, 4♂, 6♀, SLR 2008 (RMNH); 11 Sep 1968, 1♂, 1 juv., SLR 2093, SLR 2117 (RMNH); coral reef near beacon, from dead coral, 1–2 m deep, 18 Oct 1972, Lewinsohn, leg., 1♂ 22 mm, 4♀ 18–47 mm, NS 19052 (TAU); 5 Apr 1979, Galil, leg., 2♂ 41, 46 mm, 2♀ 33, 43 mm, NS 16763, NS 16764 (TAU). Abu Durba: 24 Sep 1974, 1♂ 42 mm, 3♀ 32–46 mm, NS 19050 (TAU). 3 km N of Abu Durba: from dead coral, 1 m deep, 19 Oct 1972, Lewinsohn, leg., 1♂ 13 mm, NS 19056 (TAU). El Bilaiyim: from dead coral, 23 Sep 1974, Fishelson, leg., 1♂ 56 mm, NS 12539 (TAU).

SIZE.—Total lengths of males 13–56 mm, of females 14–56 mm.

COLOR.—*Male*: Body a variable green, usually darker than females. Antennules with reddish flagella. Antennal scales with proximal third crimson, distal third light blue, setae blue proximally, crimson distally. Meral spot light yellow, with brownish infusion distally, grayish infusion proximally. Dactylus with enlarged part whitish, distal part pinkish. Walking legs uniformly pink to crimson. Body segments lined posteriorly with crimson. Sixth abdominal somite and telson each with 1 pair of small but prominent black spots, carinae green, surface between carinae pink. Uropods blue, suffused with crimson or pink; endopod pink.

Female: Overall lighter green than male. Antennal scales maroon or orange proximally, yellow distally. Meral spot and dactylus color as in male. Walking legs with proximal segment bright yellow, first of distal segments orange or yellow, distalmost segment yellow. Body segments with posterior line of small red spots. Sixth abdominal somite and telson each with 1 pair of small but prominent black spots and with slight infusion of pink on surface between carinae. Uropod proximal segment as in body, distal segment of exopod and endopod yellow with red setae.

Pleopods green in both sexes.

REMARKS.—The 1979 expedition provided the first opportunity to give an account of the color in life of the meral spot of this species, one of the diagnostic features of species of *Gonodactylus*. Holthuis (1967:32) already had noted that "females can immediately be recognized by their plan colour and yellow legs, the males by the transverse rows of dark spots on the dorsal surface of the body and by having the legs greenish or greyish but not yellow." In our material the dark spots were not particularly distinctive in live specimens but showed up vividly in freshly preserved material. Under magnification, the sexual differences in color, especially of the antennal scales and uropodal segments, were particularly striking.

Dollfus (1938, fig. 20) illustrated the telson of a specimen of *G. falcatus* (as *G. glaber*) from Ras Muhammad, in which the dorsal carinae were very inflated. Manning (1978a:8) noted that Dollfus's specimen might be referable to the smaller *G. mutatus* Lanchester, a species in which the telson carinae were very inflated, thus providing the first record of the second species of the *G. falcatus* complex in the Red Sea. At that time no specimens of *G. falcatus* sensu stricto on which the telson carinae were that inflated had been observed. Among the specimens reported here, the larger male from Et Tur (NS 16763, TL 46 mm) and two males from north of Ras Milan (NS 16760, TL 48, 52 mm), resemble the specimen, 47 mm long, figured by Dollfus. Large males of *G. falcatus* can be expected to show highly inflated dorsal carinae on the telson.

Nine species are now recognized in the *falcatus* Group; these are listed in Table 2, with appro-

TABLE 2.—Composition of the *falcatus* Group, with appropriate literature references.

Gonodactylus aloha Manning and Reaka, 1981	Manning and Reaka, 1981a
Gonodactylus falcatus (Forskål, 1775)	Manning, 1978a; Manning and Lewinsohn, 1981
Gonodactylus glabrous Brooks, 1886	Manning, 1978a
Gonodactylus graphurus Miers, 1875	Ingle, 1971; Manning, 1978a, fig. 2*b*
Gonodactylus insularis Manning and Reaka, 1982	Manning and Reaka, 1982
Gonodactylus mutatus Lanchester, 1903	Dingle, Caldwell, and Manning, 1977; Manning, 1978a
Gonodactylus randalli Manning, 1978	Manning, 1978a
Gonodactylus siamensis Manning and Reaka, 1981	Manning and Reaka, 1981b
Gonodactylus ternatensis De Man, 1902	Dingle, Caldwell, and Manning, 1977; Manning, 1978a

TABLE 3.—Morphological characteristics of *falcatus* Group species other than *Gonodactylus graphurus.*

Species	Maximum length (mm)	Knob single (–) or bilobed (+)	Sixth abdominal somite with (+) or lacking (–) median carinule	Median carina of telson slender, sharp (+), inflated (–), or both (±)
G. aloha	65	+	–	–
G. falcatus	70	+	+	±
G. glabrous	51	+	–	+
G. insularis	31.5	+	–	–
G. mutatus	57	+	–	–
G. randalli	51	+	+	+
G. siamensis	39.5	+	–	–
G. ternatensis	87	–	–	+

priate literature references.

As has been pointed out by several authors, *G. graphurus* differs from the remainder of the species in that the abdomen is ornamented by a series of fine, transverse grooves; these were contrasted with the condition of the surface of the abdomen in *G. falcatus* in figure 2 in Manning, 1978a.

Some morphological characteristics of these species, other than *G. graphurus,* are summarized in Table 3 as an aid to their identification.

Thus some of these species can be distinguished on the basis of morphological features alone. *Gonodactylus ternatensis* and *G. randalli* can be recognized immediately by their morphological features, even in preserved material lacking any clue to color in life. Further, these species can be recognized in the field by their color patterns, summarized in Table 4.

With the exception of *G. randalli,* which apparently lives at greater depths (6–8 to 21 meters) than the other species, all of these species appear to frequent shallow-water coral-rubble habitats, often in areas exposed at low tide. At least some of the species also may be found in slightly deeper habitats; *G. insularis,* for example, has been taken in very shallow water, 0–1 meter, as well as down to about 23 meters.

Finally, these species appear to have very limited geographical ranges. Whereas *G. falcatus* until very recently (Holthuis, 1967:32) was believed to occur from the Red Sea and SE Africa to Japan and Polynesia, it is now known that it does not. So far as we can tell, *G. falcatus* is endemic to the Red Sea.

Within the *falcatus* Group, the most widely distributed species appears to be *G. mutatus,* which has been recorded from localities in the

TABLE 4.—Color patterns of *falcatus* Group species other than *Gonodactylus graphurus* (+ = with, – = without, ± = modified).

Species	Display spot	Abdominal somites with posterior red line	Paired black spots on 6th somite and telson
G. aloha	yellow, with brown anterior infusion	♂ + ♀ –	+
G. falcatus	yellow, with brown anterior infusion	♂ + ♀ ± (line of dots)	+
G. glabrous	unknown	unknown	–
G. insularis	yellow, with reddish anterior infusion	♂ – ♀ –	+
G. mutatus	yellow, with brown anterior infusion	♂ – ♀ –	+
G. randalli	unknown	unknown	±?
G. siamensis	yellow, with brown anterior infusion	♂ + ♀ –	+
G. ternatensis	orange	♂ + ♀ +	+

western Indian Ocean, Phuket Island [7°49′N, 98°24′W], Thailand, in the Andaman Sea, and from the southern Baie de Nhatrang [12°15′N, 109°12′E], Vietnam, in the South China Sea (Manning, 1978a). Observations of living populations of *G. mutatus* throughout its range are needed to confirm this distribution pattern.

Gonodactylus ternatensis, a species that can be identified from preserved material without difficulty, also is fairly widely distributed. So far it has been recorded from localities between Apia, Samoa [13°48′S, 171°44′W], and Phuket Island, Thailand (Manning, 1978a).

The remainder of the species in the *falcatus* Group, including *G. graphurus,* have even more restricted ranges. *Gonodactylus aloha* is known only from the islands of Oahu [21°30′N, 158°00′W] and Maui [20°45′N, 156°20′W], Hawaiian Islands (Manning and Reaka, 1981a); *G. glabrous* is known from two localities, Samboang [Samboang Point, 09°02′N, 117°37′E], Philippines, and Ternate [0°50′N, 127°19′E], Molucca Islands, Indonesia (Manning, 1978a); *G. graphurus* is known only from Australasian waters (Manning, 1966, 1978a); *G. insularis* from Enewetak Atoll [11°30′N, 162°15′E] and possibly Onotoa, Gilbert Islands [01°52′S, 175°34′E] (Manning and Reaka, 1982); *G. randalli* from Arno Atoll [7°02′N, 171°40′E], Marshall Islands, Canton Island [2°50′S, 171° 40′W], Phoenix Islands, and Moorea [17°32′S, 149°50′W], Tahiti, Society Islands (Manning, 1978a); and *G. siamensis* is known only from Sattahip Island [12°40′N, 100°52′E], Thailand, in the Gulf of Thailand.

Additional field studies should help us gain a much better understanding of the distribution patterns of species in this group and could uncover additional species with limited distributions.

6. *Gonodactylus lanchesteri* Manning, 1967

Gonodactylus lanchesteri Manning, 1967:11, fig. 4.
Gonodactylus spinosus.—Holthuis, 1967:34, 42.—Makarov, 1971:149.—Hughes, 1977:90. [Not *G. spinosus* Bigelow, 1893.]

MATERIAL.—*Gulf of Aqaba.* Elat: from dead coral, Jun 1971, Fishelson, leg., 1♂ 16 mm, NS 7952 (TAU). Opposite Fara'un Island: 18 Dec 1967, 4♀, 2 juv., SLR 1120, SLR 1128 (RMNH). N of Marsa Murach: 19 Feb 1968, 1♀ (dry), SLR 1389 (TAU), 3 specimens (dry), SLR 1336 (RMNH). Fara'un Island: 7 Jan 1968, 1 juv. 8

mm, SLR 1219 (TAU). Marsa Murach: 24 Jun 1969, 2♀ 14, 16 mm, NS 7329 (TAU); 9 Feb 1971, Fishelson, leg., 1♂ 16 mm, NS 7387 (TAU). Ras el Burqa: 5 Oct 1968, poisoning, Fishelson, leg., 8♂ 18–25 mm, 3♀ 14–21 mm, NS 5167 (TAU); 5 Oct 1968, poisoning, Fishelson, leg., 4♂ 22–26 mm, 6♀ 23–26 mm, NS 5170 (TAU). Wasset: 7 Oct 1968, beach poisoning, Fishelson, leg., 2♀ 21, 25 mm, NS 3725, NS 5166 (TAU); 7 Oct 1968, beach poisoning, Fishelson, leg., 7♂ 17–25 mm, 4♀ 20–25 mm, NS 3726 (TAU). Nuweiba: 26 Jun 1972, 1♂ 18 mm (TAU). 5 km N of Dahab: reef flat from dead coral, about 1 m deep, 5 Nov 1981, Lewinsohn, leg., 1♀ 13 mm, NS 19036 (TAU). 2 km N of Dahab: from dead coral, about 1 m deep, 5 Nov 1981, Lewinsohn, leg., 3♂ 15–21 mm, 3♀ 15–21 mm, NS 19030 (RMNH). Dahab: 9 Oct 1968, poisoning, Fishelson, leg., 1♀ 17 mm, NS 5160 (TAU). 5 km S of Dahab: reef flat, from dead coral, about 1 m deep, 4 Nov 1981, Lewinsohn, leg., 1♂ 15 mm, 2♀ 13, 19 mm, NS 19035, NS 19036 (USNM). Ras Atantur: poisoning, 2 Jul 1969, Fishelson, leg., 4♂ 15–24 mm, 11♀ 19–25 mm, NS 5805 (TAU, 3♀ USNM). Shurat el Manqata: dead reef flat with algae, intertidal to 0.5 m deep, poisoning, 9 Nov 1981, Lewinsohn, leg., 5♂ 19–26 mm, 9♀ 20–29 mm, NS 19032 (TAU). 2 km S of Shurat el Manqata: reef flat, 0–1 m deep; 17 Oct 1979, Manning and Lewinsohn, leg., 3♂ 17–22 mm, 3♀ 16–20 mm (USNM). Marsa Abu Zabad: 16 Sep 1967, 1♀, SLR 616 (RMNH). El Gharqana: 10–11 May 1968, 6♂, 9♀, SLR 1555, SLR 1626 (RMNH); 2 Jun 1969, 1♂ 23 mm, SLR 2355 (TAU). S of El Gharqana: 2 Jun 1969, 2♂ 20, 25 mm, 1♀ 28 mm, SLR 2316 (TAU).

Southern tip of Sinai Peninsula. Marsa el At: 4 Jun 1969, 1 juv., SLR 2415 (RMNH). 1 km N of Nama Bay: reef flat, from dead coral about 1 m deep, 6 Nov 1981, Holthuis and Lewinsohn, leg., 1♂ 20 mm, NS 19033 (RMNH). 3 km S of Sharm esh Sheikh: 0–3 m, 15 Oct 1979, Manning and Lewinsohn, leg., 1♂ 20 mm (W); 15 Oct 1979, 0–3 m deep, Manning and Lewinsohn, leg., 1♀ 15 mm (USNM). Marsa Bareika: 7 Jun 1968, 2♀ 21, 23 mm, SLR 1892a (TAU). *Gulf of Suez.* Ras Garra: 19 Nov 1977, Goren, leg., 1♂ 16 mm, 1♀ 20 mm, NS 19031 (TAU). Et Tur: coral reef near beacon, from dead coral, 1–2 m deep, 18 Oct 1972, Lewinsohn, leg., 1♂ 17 mm, NS 19032 (TAU).

SIZE.—Total lengths of males 15–26 mm, of females 13–29 mm.

COLOR.—Uniform light green, including meral spot, which was indistinguishable from the body in color.

REMARKS.—Our meager notes on color in life in this species, diminished because of the small size of the specimens we collected and the lack of a microscope in the field, provide the first account of its color. Most noteworthy is that the meral spot was indistinguishable from the overall color of the body.

7. *Mesacturoides brevisquamatus* (Paulson, 1875)

Gonodactylus brevisquamatus Paulson, 1875:126, pl. 21: fig. 3.

Mesacturus brevisquamatus.—Holthuis, 1967:38, 42.—Makarov, 1971:150.—Hughes, 1977:90.

MATERIAL.—*Gulf of Aqaba.* 5 km N of Dahab: reef flat, from dead coral, about 1 m deep, 5 Nov 1981, Lewinsohn and Holthuis, leg., 4♂ 14–21 mm, 7♀ 15–20 mm, NS 19025 (RMNH). 2 km N of Dahab: from dead coral, 0–2 m deep, 5 Nov 1981, Lewinsohn, leg., 11♂ 19–28 mm, 8♀ 19–28 mm, 5 juv. 8–11 mm, NS 19024 (TAU). 5 km S of Dahab: reef flat, from dead coral, about 1 m deep, 4 Nov 1981, Lewinsohn and Holthuis, leg., 2♂ 16, 20 mm, 2♀ 16, 20 mm, 1 juv. 9 mm, NS 19027 (USNM). Ras Atantur: 15 Oct 1968, from corals, 2♂ 28, 30 mm, 1♀ 32 mm, NS 3765 (TAU). 1 km N of Nama Bay: reef flat, from dead coral, 1 m deep, 6 Nov 1981, Lewinsohn, leg., 1♂ 11 mm, NS 19028 (RMNH). 3 km S of Nama Bay: from dead coral, 1 m deep, 7 Nov 1981, Lewinsohn and Holthuis, leg., 1♂ 18 mm, 2♀ 19, 31 mm, NS 19026 (RMNH).

SIZE.—Total lengths of males 11–30 mm, of females 15–32 mm.

COLOR.—Not noted.

Family PSEUDOSQUILLIDAE Manning, 1977

8. *Pseudosquilla ciliata* (Fabricius, 1787)

Squilla ciliata Fabricius, 1787:333.
Pseudosquilla ciliata.—Holthuis, 1967:15, 40.

MATERIAL.—*Gulf of Aqaba*. Wasset: from corals, 15 Oct 1968, 2♀ 48, 53 mm, NS 4093 (TAU). Dahab: poisoning, 9 Oct 1968, Fishelson, leg., 1 juv. 15 mm, NS 5159 (TAU). Ras Atantur: poisoning, 2 Jul 1969, Fishelson, leg., 3♂ 32–47 mm, 2♀ 54, 60 mm, NS 5806 (2♂, 1♀ TAU; 1♂, 1♀ USNM). Shurat el Manqata: dead reef flat with algae, intertidal to 0.5 m deep, poisoning, Lewinsohn, leg., 1♀ 22 mm, NS 19017 (RMNH). Marsa Abu Zabad: 15–16 Sep 1967, 3♂ 41–48 mm, 2♀ 42, 47 mm, SLR 564, SLR 612 (TAU), SLR 616 (RMNH); 16 Sep 1967, 3♀ 55–60 mm, NS 5173 (TAU). El Gharqana: 9 May 1968, 3♂, SLR 1513 (RMNH). 3 km S of Nabq: reef flat with sand and algae, intertidal to 0.5 m deep, poisoning, 8 Nov 1981, Holthuis and Lewinsohn, leg., 1♀ 74 mm, NS 19016 (TAU). Tiran Island, entrance to the Gulf of Aqaba, entrance to Foul Bay: 10 m deep, 22 Sep 1981, Goren, leg., 1 juv. 15 mm, NS 19018 (USNM).

SIZE.—Total lengths of males 32–48 mm, of females 22–74 mm.

COLOR.—Not noted.

9. *Pseudosquilla megalophthalma* Bigelow, 1893

FIGURE 4

Pseudosquilla megalophthalma Bigelow, 1893a:101.—Holthuis, 1967:40.

MATERIAL.—*Southern tip of Sinai Peninsula*. 3 km S of Sharm esh Sheikh ("small Marsa"): 0–3 m deep, 15 Oct 1979, Manning and Lewinsohn, leg., 3♂ 16–26 mm, 1♀ 16.5 mm (USNM). Ras Muhammad: 7 Apr 1979, Galil, leg., 2♂ 27, 28 mm, NS 16766 (TAU). *Red Sea*. Mersa Haleib [Halaib, 22°13′N, 36°38′E], Sudan: Nov 1895, *Pola* Expedition, leg., 1♀ 17.5 mm (Zoologische Staatssammlung, Munich). Djeddah, Saudi Arabia: 1885, 1♀ 39 mm (Naturhistorisches Museum, Vienna). Habban [26°44′N, 36°32′E], Saudi Arabia: *Pola* Expedition, leg., 1♀ 19 mm (Zoologische Staatssammlung, Munich).

SIZE.—Total lengths of males 16–28 mm, of females 16.5–39 mm.

COLOR.—Not noted.

REMARKS.—Although this species has long been considered part of the Red Sea stomatopod fauna, so far as we can determine the only previous record of its occurrence there is that of Tattersall (1921:357), who recorded it from Tella Tella Kebira, Suakin Archipelago [18°42′N, 38°30′E], Sudan, at 18°48′N. His material consisted of a single young female, 30 mm long. Tattersall pointed out numerous differences between his specimen and Bigelow's holotype, a male, 68 mm long, from Mauritius. We believe that most of these differences can be attributed to age (size); none of our specimens is larger than 39 mm. We illustrate here (Figure 4) the telsons of one of the largest (26 mm) and the smallest (16 mm) males examined by us; both are clearly referable to *P. megalophthalma*, but in the smaller specimens the accessory median carinae of the telson are absent, whereas in the larger they are present but poorly developed. They are even more strongly developed in the specimen (30 mm long) figured by Tattersall (1921, pl. 27: fig. 3).

In addition to the material from the Sinai, we report here specimens studied by one of us (R.B.M.) in museums in Munich and Vienna. Those collected by the *Pola* in the Red Sea were not included by Balss (1910) in his report of the stomatopods taken by that expedition.

Superfamily LYSIOSQUILLOIDEA Giesbrecht, 1910

Family NANNOSQUILLIDAE Manning, 1980

10. *Keppelius hystricotelson* (Barnard, 1958)

Lysiosquilla hystricotelson Barnard, 1958:20, fig. 7.
Nannosquilla hystricotelson.—Holthuis, 1967:25, 40.
Keppelius hystricotelson.—Manning, 1978b:10, fig. 5.

MATERIAL.—*Gulf of Aqaba*. 3 km S of Nabq: sandy reef flat with algae, intertidal to 0.5 m

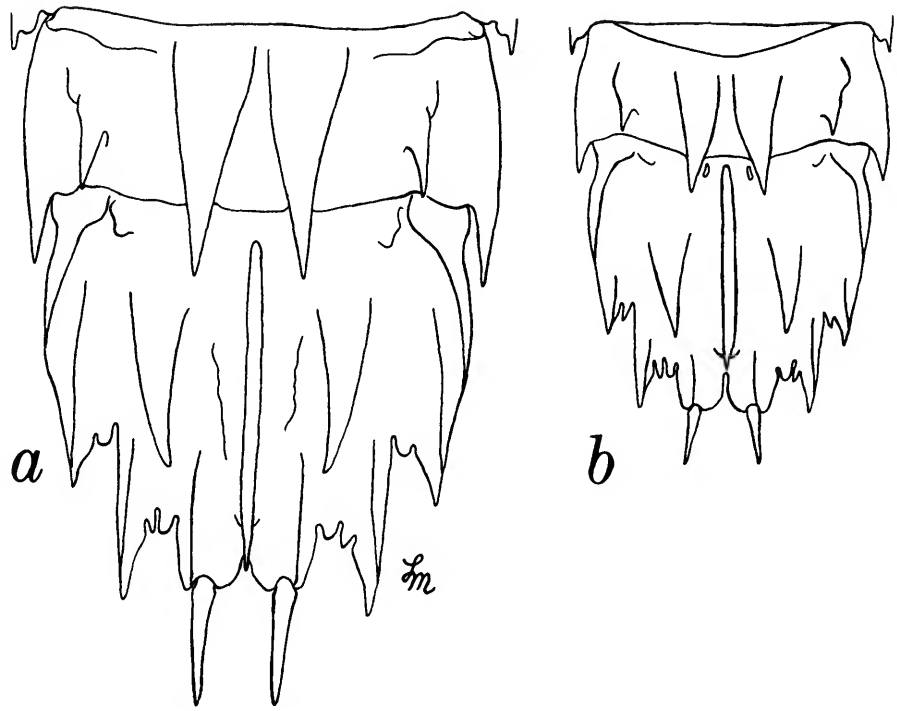

FIGURE 4.—*Pseudosquilla megalophthalma* Bigelow, Sharm esh Sheikh, sixth abdominal somite and telson of ♂: *a*, 26 mm; *b*, 16 mm.

deep, poisoning, 8 Nov 1981, Holthuis and Lewinsohn, leg., 1♂ 25 mm, NS 19020 (TAU).

SIZE.—Total length of male 25 mm.

COLOR.—Not noted.

Superfamily SQUILLOIDEA Latreille, 1802

Family SQUILLIDAE Latreille, 1802

11. *Alima neptuni* (Linnaeus, 1768), new combination

Cancer Neptuni Linnaeus, 1768:226.—Sparrman, 1769:506.
(Cancer) Astacus neptuni.—Herbst, 1793:91.
Alima hyalina Leach, 1817 [figure on unnumbered plate].
Erichthus hyalinus.—Schinz, 1823:64.
Squilla (Alima) hyalina.—Voigt, 1836:195.
Alima angusta Dana, 1852:631.
Hyalopelta gracilis Guérin-Méneville, 1857:lxvi.
Alima gracilis.—Claus, 1871:45, pl. 8: fig. 35.
Squilla alba Bigelow, 1893b:103.
Alima angustata Manning, 1962:507.
Alima alba.—Manning and Serène, 1968:116.

MATERIAL.—*Gulf of Aqaba.* El Kura (S of Dahab): 13 Sep 1967, 1♀ 39 mm, SLR 445 (RMNH).

SIZE.—Total length of female 39 mm.

COLOR.—Not noted.

REMARKS.—On page 226 of volume 3 of the 12th edition of *Systema Naturae,* in the Appendix Tomi I (= Appendix Animalium), Linnaeus (1768) mentioned *Cancer Neptuni* and gave the following description:

Cancer macrourus, thorace antice posticeque trispinoso. *Habitat in* Pelagi *Fuco natante. Sparman.* Corpus *magnitudine Tipulae. Locandus post C. Homarum.*

This description is so short and incomplete that the species cannot be recognized from it. However, a far more extensive description of the species is provided by Andreas Sparrman (1769) in his thesis "Iter in Chinam," published in the seventh volume of Linnaeus's *Amoenitates Aca-*

demicae. Sparrman's description is as follows:

Cancer Neptuni (macrourus) thorace antice posticeque trispinoso. (post Homarum 74. locandus).

Corpus magnitudine Tipulae. *Testa* figura fructus Bursae pastoris, oblonga; antice carinata & angustata spinis tribus porrectis, quarum media longior, supra caput extensa; Postice testa emarginata margine deflexo, armato spinis tribus, quarum laterales rectae, media vero brevior, erectior. *Corpus* pone testam lineare, longitudine ipsius testae, terminatum *Cauda* latiore, obovata, serrata mucronibus VI, parvis. *Oculi* pedunculati.

This description fits the larval stage of *Alima hyalina* extremely well, as is shown by a comparison of Sparrman's account with Manning's (1962) description of the larvae and postlarvae. The size as indicated by Sparrman (as large as a cranefly, *Tipula*) is of rather little help, as no indication is given how either species is measured, nor which species of *Tipula* is meant; the largest European *Tipula, T. maxima,* has a wingspread of up to 60 mm and a length of up to 35 mm, whereas in the common *T. oleracea* L. the wingspread is about 40 mm and the length about 25 mm. The total length of the larva of *Alima hyalina* is about 40 mm, that of the postlarva about 20 mm. One might therefore say that *Alima hyalina* and *Tipula* sp. are in about the same size range. Sparrman's description of the carapace as being elongate and having the shape of the fruit of the Sheperd's Purse, *Capsella bursa-pastoris* L., excellently characterizes the carapace, which is elongate and widens posteriorly, having the posterior margin emarginate in the middle. The three slender spines on the anterior margin of the carapace, of which the median is longest and reaches distinctly beyond the end of the body; the emarginate posterior margin likewise with three spines of which the outer are straight; and the median short and directed upward—all are found in *Alima hyalina.* The same is true for the very narrow (linear) abdomen, which is about as long as the carapace and ends in a broader, but elongate telson, which bears 6 small denticles on the margin. Also the pedunculated eyes are very conspicuous in *Alima hyalina.* There can be little doubt therefore that *Cancer neptuni* is based on a specimen of *Alima hyalina* or a very closely related species.

The locality where Sparrman collected the specimen of *Cancer neptuni* removes the last doubt as to the identity of that species. The entry for 27 May 1767 in Sparrman's narrative (1769:506) is as follows: "Maji. 27. hinc postquam nave in altum mare devecti, maximam FUCI *natantis* (Sargazo) copiam and is agi vidimus. In hoc SCYLLAEAM *pelagicam* & CANCRUM *Neptunni* cepi." On the 25th of May the ship had arrived at Ascension, and presumably left the 26th or 27th. *Cancer neptunus* thus must have been taken just north of Ascension, considering that the ship needed 55 days (26 May to 21 July) to cover the distance from Ascension to Fayal (Azores). Like the type-localities of *Alima hyalina,* the type-locality of *Cancer neptuni* lies in the central Atlantic [about 7°57'S, 14°22'W, the coordinates of Ascension]. Leach (1818:416) reported *Alima hyalina* from "Porto Praya [= Porto do Praia, Cape Verde Islands, 14°54'N, 23°31'W], and in 7,37,0 N. lat. 17,34,15 W. long." Gurney (1946:141) remarked that "In its [the larva] later stages this species is very conspicuous, and has, in consequence, been frequently noticed and figured," which explains why it was taken as early as 1767 by Sparrman on his home voyage from China.

In the literature the species has been reported under a great number of different names, and only recently the name *Alima hyalina* was adopted for the adult specimens (Manning, 1962). A change to the name *Alima neptuni* (Linnaeus, 1768), therefore, will not cause any nomenclatural upset.

This is the first record for this species from the Red Sea.

The synonymy given above includes only different name combinations used for larvae and adults of this species and references for citations in the text. The synonymy is not intended to be complete for the species.

12. *Kempina zanzibarica* (Chopra, 1939)

Squilla zanzibarica Chopra, 1939:143, figs. 2, 4.
Kempina zanzibarica.—Manning, 1981:298, fig. 1.

MATERIAL.—*Gulf of Aqaba.* Nuweiba: 270–280 m deep, Oct 1981, fishermen, leg., 1♂ (dry) 95 mm, NS 19058 (TAU).

SIZE.—Total length of only male examined 95 mm.

COLOR.—Not noted.

13. *Leptosquilla schmeltzii* (A. Milne Edwards, 1873)

Squilla Schmeltzii A. Milne Edwards, 1873:87, pl. 2: fig. 7.
Leptosquilla schmeltzii.—Holthuis, 1967:13, 40.

MATERIAL.—*Gulf of Aqaba.* Tiran Island, entrance to the Gulf of Aqaba, Foul Bay: 24 Sep 1981, Kerman, leg., 1♂ 20 mm, NS 19019 (TAU).

SIZE.—Total length of only male examined 20 mm.

COLOR.—Not noted.

14. *Oratosquilla massavensis* (Kossmann, 1880)

Squilla massavensis Kossmann, 1880:99.—Holthuis, 1967:13, 39.
Oratosquilla massavensis.—Makarov, 1971:146.—Lewinsohn and Manning, 1980:20, figs. 5, 6, 7*b* [Mediterranean records].

MATERIAL.—*Gulf of Suez.* Trawl net from 28°47′N, 33°09′E to 28°41′N, 33°08′30″E, 36–38 m, 12 Nov 1972, Lewinsohn, leg., 1♀ 86 mm, NS 19023 (TAU).

SIZE.—Total length of only female examined 86 mm.

COLOR.—Not noted.

List of Adult Stomatopoda Known from the Red Sea

Adults of 33 species of stomatopods are now known from localities within the Red Sea, and these are listed below. Reference numbers of those species described in this study are in parentheses. Larval forms are not included in the list; accounts of larvae of Red Sea species have been provided by Gurney (1937), Gohar and Al-Kholy (1957), and Williamson (1970). Our listing of adults, based on the complete list of Red Sea stomatopods compiled by L.B. Holthuis in 1967, includes references published since then, but does not duplicate the detailed synonymies he provided. Synonyms are indented under the applicable species entries.

Superfamily GONODACTYLOIDEA
- Family EURYSQUILLIDAE
  - *Manningia amabilis* Holthuis, 1967 (1)
- Family GONODACTYLIDAE
  - *Gonodactylus acutirostris* De Man, 1898 (2)
  - *Gonodactylus botti* Manning, 1975 (3)
  - *Gonodactylus choprai* Manning, 1967
    - *Gonodactylus demanii espinosus.*—Holthuis, 1967:41
  - *Gonodactylus demanii* Henderson, 1893 (4)
  - *Gonodactylus falcatus* (Forskål, 1775) (5)
  - *Gonodactylus lanchesteri* Manning, 1967 (6)
  - *Mesacturoides brevisquamatus* (Paulson, 1875) (7)
- Family PROTOSQUILLIDAE
  - *Chorisquilla spinosissima* (Pfeffer, 1881)
    - *Protosquilla spinosissima.*—Holthuis, 1967:42
  - *Haptosquilla lenzi* (Holthuis, 1941).—Hughes, 1977:90
    - *Protosquilla lenzi.*—Holthuis, 1967:36, 42
  - *Haptosquilla pulchella* (Miers, 1880)
    - *Protosquilla pulchella.*—Holthuis, 1967:42
- Family PSEUDOSQUILLIDAE
  - *Pseudosquilla ciliata* (Fabricius, 1787) (8)
  - *Pseudosquilla megalophthalma* Bigelow, 1893 (9)

Superfamily LYSIOSQUILLOIDEA
- Family CORONIDIDAE
  - *Neocoronida trachurus* (von Martens, 1881).—Manning, 1978b:13, fig. 7
    - *Coronida trachurus.*—Holthuis, 1967:40
- Family LYSIOSQUILLIDAE
  - *Lysiosquilla maculata* (Fabricius, 1793).—Holthuis, 1967:40
- Family NANNOSQUILLIDAE
  - *Acanthosquilla derijardi* Manning, 1970.—Holthuis, 1975:309
  - *Acanthosquilla multifasciata* (Wood-Mason, 1895).—Holthuis, 1967:22, 40
  - *Acanthosquilla vicina* (Nobili, 1904).—Holthuis, 1967:23, 40
  - *Keppelius hystricotelson* (Barnard, 1958) (10)
  - *Pullosquilla thomassini* Manning, 1978.—Manning, 1980b:269

Superfamily SQUILLOIDEA
- Family HARPIOSQUILLIDAE
  - *Harpiosquilla harpax* (De Haan, 1844).—Holthuis, 1967:15, 40
- Family SQUILLIDAE
  - *Alima neptuni* (Linnaeus, 1768) (11)
  - *Anchisquilla fasciata* (De Haan, 1844).—Makarov, 1971:143
    - *Squilla fasciata.*—Holthuis, 1967:2, 39

Carinosquilla carinata (Serène, 1950)
Squilla carinata.—Holthuis, 1967:39
Clorida fallax (Bouvier, 1914)
Squilla fallax.—Holthuis, 1967:5, 39, fig. 2
Clorida latreillei Eydoux and Souleyet, 1842.—Holthuis, 1967:39.—Makarov, 1971:143
Kempina zanzibarica (Chopra, 1939) (12)
Lenisquilla gilesi (Kemp, 1911).—Manning, 1981:300, fig. 2
Squilla gilesi.—Holthuis, 1967:3, 39, fig. 1
Squilloides gilesi.—Makarov, 1971:143, fig. 61
Leptosquilla schmeltzii (A. Milne Edwards, 1873) (13)
Oratosquilla birsteini Makarov, 1971:146, fig. 62.
Oratosquilla massavensis (Kossmann, 1880) (14)
Oratosquilla nepa (Latreille, 1825)
Squilla nepa.—Holthuis, 1967:7, 39
Oratosquilla simulans (Holthuis, 1967)
Squilla simulans Holthuis, 1967:7, 39, fig. 3
Squilla gonypetes.—Holthuis, 1967:39 (references)

Zoogeographical Notes

Our knowledge of the stomatopod fauna of the Red Sea has increased dramatically in the last two decades. In 1906, Nobili recorded a total of 15 species from the area, although only nine of these were from the Red Sea proper, the remainder having been taken in the Gulf of Aden. By 1938 only 15 species had been recorded from the Red Sea (Dollfus, 1938), and Ingle (1963) included accounts of only 18 species. In 1967 Holthuis updated the literature records and added several new ones, bringing the total to 28 species then known. Thirty-three species are recorded herein.

Of these 33 species, five (15%) are so far known only from the Red Sea proper. These are *Gonodactylus falcatus* (Forskål), *Mesacturoides brevisquamatus* (Paulson), *Oratosquilla birsteini* Makarov, *O. massavensis* (Kossmann), and *O. simulans* (Holthuis). Although *O. massavensis* has colonized the Mediterranean through the Suez Canal, within the Indo-West Pacific region proper it has not been taken outside of the Red Sea.

Eight species (24% of the Red Sea stomatopods) are otherwise known only in the Indian Ocean, and five of these (marked with an asterisk) occur only in the western part of the Indian Ocean. These eight species are **Gonodactylus choprai* Manning, *G. demanii* Henderson, *G. lanchesteri* Manning, **Kempina zanzibarica* (Chopra), **Keppelius hystricotelson* (Barnard), *Lenisquilla gilesi* (Kemp), **Manningia amabilis* Holthuis, and **Neocoronida trachurus* (von Martens).

The remaining 19 species (57% of the stomatopods found in the Red Sea) are more or less widely distributed in the Indo-West Pacific region, the ranges of some (*Alima neptuni* (Linnaeus) and *Pseudosquilla megalophthalma* Bigelow) extending to the central Pacific, others (*Harpiosquilla harpax* (De Haan), *Lysiosquilla maculata* (Fabricius), and *Anchisquilla fasciata* (De Haan)) extending from the Red Sea and western Indian Ocean to Japan.

Thus the Red Sea stomatopod fauna forms a small extension of the Indo-West Pacific stomatopod fauna. Even the endemic species are representatives of genera composed of many other Indo-West Pacific species: *Gonodactylus,* with eight other species in the *falcatus* Group alone; *Mesacturoides,* with four other species, three of which occur only in the northwestern Indian Ocean; and *Oratosquilla,* with more than 25 other species.

Literature Cited

Balss, H.

1910. Über Stomatopoden des Roten Meeres. *In* Expeditionen S.M. Schiff "Pola" in das Rote Meer, nördliche und südliche Hälfte, 1895/96–1897/98: Zoologische Ergebnisse XXVIII. *Denkschriften der Mathematisch-Naturwissenschaftlichen Klasse der Kaiserlichen Akademie der Wissenschaften,* 87 (supplement):29–32, figures 1–5.

Barnard, K.H.

1958. Further Additions to the Crustacean Fauna-List of Portuguese East Africa. *Memórias do Museu Dr. Álvaro de Castro,* 4:3–23, figures 1–7.

Bigelow, R.P.

1893a. Preliminary Notes on the Stomatopoda of the Albatross Collections and on Other Specimens in the National Museum. *Johns Hopkins University Circulars,* 12(106):100–102.

1893b. The Stomatopoda of Bimini. *Johns Hopkins University Circulars,* 12(106):102–103.

Caldwell, Roy L., and Hugh Dingle

1975. Ecology and Evolution of Agonistic Behavior in Stomatopods. *Die Naturwissenschaften,* 62:214–222, figures 1–4.

1976. Stomatopods. *Scientific American,* 234(1):80–89, 12 figures.

Chopra, B.

1939. Stomatopoda. *Scientific Reports, The John Murray Expedition, 1933–34,* 6(3):137–181, figures 1–13.

Claus, C.

1871. Die Metamorphose der Squilliden. *Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen,* 16:111–163, plates 1–8 [pages 1–55 on separate; separate only seen].

Dana, J.D.

1852. Crustacea, Part 1. In *United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842 under the Command of Charles Wilkes, U.S.N.,* 13:1–685. [Atlas, 1855:1–27, plates 1–96.] Philadelphia.

Dingle, Hugh, Roy L. Caldwell, and Raymond B. Manning

1977. Stomatopods of Phuket Island, Thailand. *Phuket Marine Biological Center, Research Bulletin,* 20:1–20, figures 1–11.

Dollfus, R.Ph.

1938. Stomatopoda (II): Catalogue synonymique des espèces jusqu'à présent récoltées dans la Mer Rouge, y compris la partie sud du Canal de Suez et le Golfe d'Aden. *In* Mission Robert Ph. Dollfus en Égypte, X. *Mémoires de l'Institut d'Égypte,* 37:185–236, figures 1–8, 10, 11, 13–23.

Fabricius, J.C.

1787. *Mantissa insectorum sistens eorum species nuper detectas adjectis characteribus genericis, differentiis specificis, emendationibus, observationibus.* Volume 1, xx + 348 pages. Copenhagen.

Forskål, P.

1775. *Descriptiones Animalium, Avium, Amphibiorum, Piscium, Insectorum, Vermium.* 19 + xxxii + 164 pages. Copenhagen.

Gohar, H.A.F., and A.A. Al-Kholy

1957. The Larval Stages of Three Stomatopod Crustacea. *Publications of the Marine Biological Station, Al-Ghardaqa, Red Sea,* 9:85–130, plates 1–23.

Guérin-Méneville, F.E.

1857. Crustacés. *In* R. de la Sagra, *Histoire physique, politique et naturelle de l'île de Cuba,* pages xiii–lxxxvii, plates 1–3. Paris.

Gurney, R.

1937. The Larvae of *Gonodactylus glabrous* Brooks and Other Stomatopoda, III: Notes on Some Decapod and Stomatopod Crustacea from the Red Sea, III–IV. *Proceedings of the Zoological Society of London,* series B, 1937(3):319–336, plates 1–8.

1946. Notes on Stomatopod Larvae. *Proceedings of the Zoological Society of London,* 116:133–175, figures 1–14.

Henderson, J.R.

1893. A Contribution to Indian Carcinology. *The Transactions of the Linnean Society of London,* series 2, *Zoology,* 5(10):325–458, plates 36–40.

Herbst, J.F.W.

1782–1804. *Versuch einer Naturgeschichte der Krabben und Krebse, nebst einer systematischen Beschreibung ihrer verschiedenen Arten.* Volumes 1–3, 515 pages, 62 plates. Berlin and Stralsund.

Holthuis, L.B.

1967. The Stomatopod Crustacea Collected by the 1962 and 1965 Israel South Red Sea Expeditions. *In* The Second Israel South Red Sea Expedition, Report No. 1. *Israel Journal of Zoology,* 16:1–45, figures 1–7.

1975. *Acanthosquilla derijardi* Manning, 1970, a Stomatopod New to the Fauna of the Red Sea. *Crustaceana,* 29(3):309–310.

1983. Prof. Dr. Chanan Lewinsohn, 26 February 1927–25 May 1983. *Crustaceana,* 45(3):297–302.

Hughes, Roger N.
1977. The Biota of Reef-Flats and Limestone Cliffs near Jeddah, Saudi Arabia. *Journal of Natural History,* 11:77–96, figures 1–3.

Ingle, R.W.
1963. Crustacea Stomatopoda from the Red Sea and Gulf of Aden (Contributions to the Knowledge of the Red Sea, Number 26). *Bulletin, Sea Fisheries Research Station* (Haifa), 33:1–69, figures 1–73.
1971. On the Nomenclature of *Gonodactylus graphurus* White, 1847 (Nomen Nudum), Miers, 1875 (Stomatopoda, Gonodactylidae). *Crustaceana,* 21(2):220–221.

Kemp, S.
1913. An Account of the Crustacea Stomatopoda of the Indo-Pacific Region, Based on the Collection in the Indian Museum. *Memoirs of the Indian Museum,* 4:1–217, 10 figures, plates 1–10.

Kossmann, R.
1880. Malacostraca. In *Zoologische Ergebnisse einer im Auftrage der königlichen Academie der Wissenschaften zu Berlin ausgeführten Reise in die Küstengebiete des Rothen Meeres,* 2(1):67–140, plates 4–15.

Leach, W.E.
1817–1818. A General Notice of the Animals Taken by Mr. John Cranch, during the Expedition to Explore the Source of the River Zaire. *In* Tuckey, *Narrative of an Expedition to Explore the River Zaire, Usually Called the Congo, in South Africa, in 1816, under the Direction of Captain J.K. Tuckey, R.N., to Which is Added the Journal of Professor Smith; Some General Observations on the Country and Its Inhabitants; and an Appendix Containing the Natural History of That Part of the Kingdom of Congo through Which the Zaire Flows,* pages 407–419 (1818), 1 plate (1817). London.

Lewinsohn, Ch.
1969. Die Anomuren des Roten Meeres (Crustacea Decapoda: Paguridea, Galatheidea, Hippidea). *Zoologische Verhandelingen, Uitgegeven door het Rijksmuseum van Natuurlijke Historie te Leiden,* 104:1–213, figures 1–37, maps 1–3, plates 1, 2.

Lewinsohn, Ch., and Raymond B. Manning
1980. Stomatopod Crustacea from the Eastern Mediterranean. *Smithsonian Contributions to Zoology,* 305: iii + 22 pages, 7 figures.

Linnaeus, C.
1768. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis locis.* Edition 12, 3:1–236. Stockholm.

Makarov, R.R.
1971. Fauna and Distribution of Red Sea Stomatopods. *In* V.A. Vodianitsky, editor, *Benthos shel'fa Krasnogo moria* [Benthos of the Shelf of the Red Sea], pages 141–155. Kiev: Akademia Nauk SSSR. [In Russian.]

De Man, J.G.
1898. Bericht über die von Herrn Schiffscapitän Storm zu Atjeh, an den westlichen Küsten von Malakka, Borneo und Celebes sowie in der Java-See gesammelten Decapoden und Stomatopoden, sechster (schluss-) Theil. In *Zoologische Jahrbücher, Abtheilung für Systematik, Geographie und Biologie der Thiere,* 10:677–708, plates 28–38.

Manning, Raymond B.
1962. *Alima hyalina* Leach, the Pelagic Larva of the Stomatopod Crustacean *Squilla alba* Bigelow. *Bulletin of Marine Science of the Gulf and Caribbean,* 12(3):496–507, figures 1–4.
1966. Notes on Some Australian and New Zealand Stomatopod Crustacea, with an Account of the Species Collected by the Fisheries Investigation Ship *Endeavour. Records of the Australian Museum,* 27(4):79–137, figures 1–10.
1967. Notes on the *demanii* Section of Genus *Gonodactylus* Berthold with Descriptions of Three New Species (Crustacea: Stomatopoda). *Proceedings of the United States National Museum,* 123(3618):1–27, figures 1–8.
1975. *Gonodactylus botti,* a New Stomatopod Crustacean from Indonesia. *Senckenbergiana Biologica,* 56(4/6):289–291, figure 1.
1978a. Notes on Some Species of the *Falcatus* Group of *Gonodactylus* (Crustacea: Stomatopoda: Gonodactylidae). *Smithsonian Contributions to Zoology,* 258: iii + 15 pages, 13 figures.
1978b. New and Rare Stomatopod Crustacea from the Indo-West-Pacific Region. *Smithsonian Contributions to Zoology,* 264: iii + 36 pages, 16 figures.
1980a. The Superfamilies, Families, and Genera of Recent Stomatopod Crustacea, with Diagnoses of Six New Families. *Proceedings of the Biological Society of Washington,* 93(2):362–372.
1980b. *Pullosquilla thomassini* Manning 1978 New to the Red Sea. *Senckenbergiana Biologica,* 60(3/4) [1979]:269–270.
1981. First Record of *Kempina zanzibarica* (Chopra 1939) from the Red Sea, with Notes on *Lenisquilla gilesi* (Kemp 1911) (Crustacea: Stomatopoda). *Senckenbergiana Biologica,* 61(3/4)[1980]:297–303, figures 1, 2.

Manning, Raymond B., and Ch. Lewinsohn
1981. Selection of a Neotype for *Cancer falcatus* Forskål, 1775 (Stomatopoda). *Crustaceana,* 41(3):314–316, figure 1.

Manning, Raymond B., and Marjorie L. Reaka
1981a. *Gonodactylus aloha,* a New Stomatopod Crustacean from the Hawaiian Islands. *Journal of Crustacean Biology,* 1(2):190–200, figures 1–3.

1981b. *Gonodactylus siamensis*, a New Stomatopod Crustacean from Thailand. *Proceedings of the Biological Society of Washington*, 94(2):479–482, figure 1.

1982. *Gonodactylus insularis*, a New Stomatopod Crustacean from Enewetak Atoll, Pacific Ocean. *Proceedings of the Biological Society of Washington*, 95(2):347–351, figures 1, 2.

Manning, Raymond B., and R. Serène

1968. Stomatopoda. *In* R. Serène, Prodromus for a Check List of the non-Planctonic Marine Fauna of South East Asia. *Singapore National Academy of Science, Special Publication*, 1:113–118.

Milne Edwards, A.

1873. Descriptions des quelques Crustacés nouveaux ou peu connus provenant du Musée de M.C. Godeffroy. *Journal des Museum Godeffroy*, 1(4):77–88, plates 12, 13. [Pages 1–12 on separate.]

Nobili, G.

1906. Faune carcinologique de la Mer Rouge, Décapodes et Stomatopodes. *Annales des Sciences Naturelles, Zoologie et Paléontologie*, series 9, 4:1–347, figures 1–12, plates 1–11.

Paulson, O.

1875. *Podophthalmata and Edriophthalmata (Cumacea): Studies on Crustacea of the Red Sea with Notes Regarding Other Seas, Part I.* xiv + 144 pages, plates 1–21. Kiev. [Original in Russian. Reprinted in English in 1961, with different pagination, by The Israel Program for Scientific Translations, Jerusalem.]

Reaka, Marjorie L., and Raymond B. Manning

1981. The Behavior of Stomatopod Crustacea, and its Relationship to Rates of Evolution. *Journal of Crustacean Biology*, 1(3):309–327.

Schinz, H.R.

1823. Krebse, Spinnen, Insekten. *In* G.L.C.F.D. Cuvier, *Das Thierreich eingetheilt nach dem Bau der Thiere als Grundlage ihrer Naturgeschichte und der vergleichenden Anatomie*, 3:i–xviii, 1–932. Stuttgart and Tubingen.

Serène, R.

1947. Sur des Stomatopodes rares trouvés en Indochine et n'existant pas dans les collections du Muséum. *Bulletin du Muséum National d'Histoire Naturelle* (Paris), (2)19(5):381–389, figures 1, 2, plates 1–4.

Sparrman, Andreas

1769. Iter in Chinam. *In* C. Linnaeus, *Amoenitates Academicae*, 7:1–506. Stockholm.

Tattersall, W.M.

1921. Report on the Stomatopoda and Macrurous Decapoda Collected by Mr. Cyril Crossland in the Sudanese Red Sea. *Journal of the Linnean Society* (London) *Zoology*, 34:345–398, plates 27, 28.

Voigt, F.S.

1836. Anneliden, Crustaceen, Arachniden, und die ungefluegelten Insekten. In G.L.C.F.D. Cuvier, *Das Thierreich, geordnet nach seiner Organisation*, edition 2, 4: xiv + 516 pages, Leipzig.

Williamson, D.E.

1970. On a Collection of Planktonic Decapoda and Stomatopoda (Crustacea) from the East Coast of the Sinai Peninsula, Northern Red Sea (Contributions to the Knowledge of the Red Sea, No. 45). *Bulletin, Sea Fisheries Research Station* (Haifa), 56:1–48, figures 1–31.

REQUIREMENTS FOR SMITHSONIAN SERIES PUBLICATION

Manuscripts intended for series publication receive substantive review (conducted by their originating Smithsonian museums or offices) and are submitted to the Smithsonian Institution Press with Form SI-36, which must show the approval of the appropriate authority designated by the sponsoring organizational unit. Requests for special treatment—use of color, foldouts, case-bound covers, etc.—require, on the same form, the added approval of the sponsoring authority.

Review of manuscripts and art by the Press for requirements of series format and style, completeness and clarity of copy, and arrangement of all material, as outlined below, will govern, within the judgment of the Press, acceptance or rejection of manuscripts and art.

Copy must be prepared on typewriter or word processor, double-spaced, on one side of standard white bond paper (not erasable), with 1¼″ margins, submitted as ribbon copy (not carbon or xerox), in loose sheets (not stapled or bound), and accompanied by original art. Minimum acceptable length is 30 pages.

Front matter (preceding the text) should include: **title page** with only title and author and no other information, **abstract** page with author, title, series, etc., following the established format; table of **contents** with indents reflecting the hierarchy of heads in the paper; also, **foreword** and/or **preface**, if appropriate.

First page of text should carry the title and author at the top of the page; **second page** should have only the author's name and professional mailing address, to be used as an unnumbered footnote on the first page of printed text.

Center heads of whatever level should be typed with initial caps of major words, with extra space above and below the head, but no other preparation (such as all caps or underline, except for the underline necessary for generic and specific epithets). Run-in paragraph heads should use period/dashes or colons as necessary.

Tabulations within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or numbered table captions.

Formal tables (numbered, with captions, boxheads, stubs, rules) should be submitted as carefully typed, double-spaced copy separate from the text; they will be typeset unless otherwise requested. If camera-copy use is anticipated, do not draw rules on manuscript copy.

Taxonomic keys in natural history papers should use the aligned-couplet form for zoology and may use the multi-level indent form for botany. If cross referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa, using the same numbers with their corresponding heads in the text.

Synonymy in zoology must use the short form (taxon, author, year:page), with full reference at the end of the paper under "Literature Cited." For botany, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in "Literature Cited") is optional.

Text-reference system (author, year:page used within the text, with full citation in "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all Contributions Series and is strongly recommended in the Studies Series: "(Jones, 1910:122)" or ". . . Jones (1910:122)." If bibliographic footnotes are required, use the short form (author, brief title, page) with the full citation in the bibliography.

Footnotes, when few in number, whether annotative or bibliographic, should be typed on separate sheets and inserted immediately after the text pages on which the references occur. Extensive notes must be gathered together and placed at the end of the text in a notes section.

Bibliography, depending upon use, is termed "Literature Cited," "References," or "Bibliography." Spell out titles of books, articles, journals, and monographic series. For book and article titles use sentence-style capitalization according to the rules of the language employed (exception: capitalize all major words in English). For journal and series titles, capitalize the initial word and all subsequent words except articles, conjunctions, and prepositions. Transliterate languages that use a non-Roman alphabet according to the Library of Congress system. Underline (for italics) titles of journals and series and titles of books that are not part of a series. Use the parentheses/colon system for volume (number): pagination: "10(2):5–9." For alignment and arrangement of elements, follow the format of recent publications in the series for which the manuscript is intended. Guidelines for preparing bibliography may be secured from Series Section, SI Press.

Legends for illustrations must be submitted at the end of the manuscript, with as many legends typed, double-spaced, to a page as convenient.

Illustrations must be submitted as original art (not copies) accompanying, but separate from, the manuscript. Guidelines for preparing art may be secured from Series Section, SI Press. All types of illustrations (photographs, line drawings, maps, etc.) may be intermixed throughout the printed text. They should be termed **Figures** and should be numbered consecutively as they will appear in the monograph. If several illustrations are treated as components of a single composite figure, they should be designated by lowercase italic letters on the illustration; also, in the legend and in text references the italic letters (underlined in copy) should be used: "Figure 9b." Illustrations that are intended to follow the printed text may be termed **Plates**, and any components should be similarly lettered and referenced: "Plate 9b." Keys to any symbols within an illustration should appear on the art rather than in the legend.

Some points of style: Do not use periods after such abbreviations as "mm, ft, USNM, NNE." Spell out numbers "one" through "nine" in expository text, but use digits in all other cases if possible. Use of the metric system of measurement is preferable; where use of the English system is unavoidable, supply metric equivalents in parentheses. Use the decimal system for precise measurements and relationships, common fractions for approximations. Use day/month/year sequence for dates: "9 April 1976." For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc. Omit space between initials of a personal name: "J.B. Jones."

Arrange and paginate sequentially every sheet of manuscript in the following order: (1) title page, (2) abstract, (3) contents, (4) foreword and/or preface, (5) text, (6) appendixes, (7) notes section, (8) glossary, (9) bibliography, (10) legends, (11) tables. Index copy may be submitted at page proof stage, but plans for an index should be indicated when manuscript is submitted.