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ON THE LABORATORY HATCHED SIX PHYLLOSOMA STAGES OF *SCYLLARUS SORDIDUS* (STIMPSON)*

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ABSTRACT

Of the two species of squat lobsters (*Thenus orientalis* and *Scyllarus sordidus*) ailable in the inshore waters off Bombay, six phyllosoma stages of *S. sordidus* (Stimpson) ve been reared in the laboratory. There are possibly 2-3 more stages before completion metamorphosis which, however, could not be completed in the course of the present ork. Necessary comparisons are made with the larvae of *S. americanus*, the only laboratory reared species.

INTRODUCTION

SPINY lobsters and sand lobsters (Palinuridae and Scyllaridae) constitute an important group of higher Crustaceans of great economic value and as such, have received attention of several scientists the world over on various aspects of their biology and ecology. Yet comparatively little is known about the life history of the species of these groups. Recently, Robertson (1968) and Provenzano (1968) have reviewed in detail the hitherto available information on the larvae, their rearing techniques, and other aspects. Hence in this paper, dealing with the larval stages of *Scyllarus sordidus*, reference is made to mainly the Indian works, particularly on Scyllarid larvae.

Prasad and Tampi (1957, 1960 a, 1968), tentatively identified and described various Scyllarid larvae collected mainly from plankton. They (1960 b) succeeded in getting the 1st phyllosoma from the eggs of *Scyllarus sordidus* hatched in the Laboratory, but did not succeed in rearing them. The only species in which the entire metamorphosis has been studied in the laboratory is *Scyllarus americanus* (Smith), described by Robertson (1968).

The family Scyllaridae is represented in Bombay waters by only two species —*Thenus orientalis* and *Scyllarus sordidus* — the former taken in good number both in trawl catches and intertidal collections; the latter, though not as abundant, is caught occasionally in the littoral zone, especially on muddy shores. Winter seems to be the breeding season of these animals (Chhapgar and Deshmukh, 1964).

On the 21st October, 1968, a berried female of *Scyllarus sordidus* (Stimpson) —the dwarf squat lobster—was collected off Danda island (Bombay) which gets exposed mainly during the minus low tides. The eggs were in an advanced state of embryonic development and hatched in the laboratory on the very next day of collection. The larvae thus obtained could be reared through six phyllosoma

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stages in the laboratory, beyond which the rearing experiments had to be discontinued. The present paper embodies detailed descriptions of these six phyllosoma stages reared in the laboratory.

The phyllosomae were reared individually in finger bowls of 250 cc capacity and mass culture was held in a 3-litre glass trough, in filtered sea water, without aeration. During the course of the rearing experiments, the temperature ranged between 26°C and 28°C and salinity 35.5‰ and 36.5‰. The larvae were fed on freshly hatched *Artemia* nauplii, for the early stages and bigger nauplii for the later stages. Each phyllosoma stage took, on an average, five days to moult to the next.

We are grateful to Dr. C. V. Kulkarni, the then Director of Fisheries, Maharashtra State, for the kind facilities and to Dr. H. G. Kewalramani for his encouragement and interest throughout the course of the study. Our sincere thanks are also due to Shri A. R. Naik for collection of the berried female during his shore collection trip.

DESCRIPTION OF LARVAL STAGES

1st Phyllosoma (Fig. 1,a)

Total length 1.3 mm; forebody wider than long as in other scyllarid phyllosomae; hind body 2/3 width of forebody; abdomen 1/3 length of hind body, narrow, almost parallel sided, its postero-lateral angles ending in sharp spines with 3 unequal setae; eyes not stalked, although with long base reaching tip of antennule.

Antennule (A 1) (Fig. 8, b_1) Uniramous, unsegmented, terminally with 3 aesthetascs and a small seta, and ventrally median seta slightly beyond middle of its length. *Antenna* (A2) (Fig. 8 b_1) Uniramous pointed terminally and about 1/5 length of A1; distally a pair of setae present on either side. Incisor part of *Mandible* (Md) (Fig. 9, c_1) armed with 3 long and a row of short strong teeth; remaining part of cutting edge with several fine teeth and a blunt projection. *First maxilla* (Mx 1) (Fig. 9, d_1) biramous without palp; basal endite with 2 large serrated teeth and a thin seta; coxal endite with 3 setae. *Second maxilla* (Mx 2) (Fig. 9, e_1) Uniramous as in other scyllarid larvae, with an elongated basal segment and a small apical segment bearing 2 long, plumose setae; two small setae also present on inner margin of basal segment. *Maxillipeds :* The first maxilliped (Mxp 1) not yet developed; *Second maxipllied* (Mxp, 2) (Fig. 9, f_1) Uniramous, with a 5-segmented endopod but no exopod; merus longest segment, almost 3-times length of rest; penultimate segment with a group of 3 bristle-like setae on inner distal angle and 2 similar setae—one median and one outer distal; dactylus terminates in a claw with 3 bristle-like apical setae. *Third maxilliped* (Mxp) (Fig. 9, g_1) without exopod; long, slender endopod more than twice length of second maxilliped; terminal segment with 8 distal setae; sub-terminal segment with 2 setae on inner distal angle having hook-like spinules distally. *Pereipods* (Per) (Fig. 1, a) four pairs, fourth pair present as minute buds at base of abdomen; first two pairs biramous; exopod of Per 1 with 7 pairs of plumose setae, whereas that of Per 2 with 8 pairs; Per 3 with a bud-like exopod. Dactylus of each pereiopod claw-like, terminating in a long spine (Fig. 1, h), groups of bristle-like setae present on all pereiopods; coxal spine with accessory seta also present as in *S. americanus* on Mxp 3 and pereiopods. *Abdomen* (Ab) (Fig. 7, i_1) as described earlier, ending in two sharp spines on postero-lateral angles; no traces of uropods or pleopods.

Chromatophores : Dark orange red or dark pinkish, mostly stellate, distributed as shown in the Fig. 1a.

Remarks: The larvae agree with the Ist phyllosoma described by Prasad and Tampi (1960 b) but for the following differences:

1. The size of the larva—in Prasad and Tampi's material, larvae are 1.03 mm whereas in the present material, they are larger, being 1.3 mm.

2. Chromatophores : Besides those described by Prasad and Tampi, the larvae have chromatophores below the antennae and a pair following these.

3. The apical segment of the Mx 2 bears only two instead of four setae as observed by Prasad and Tampi.

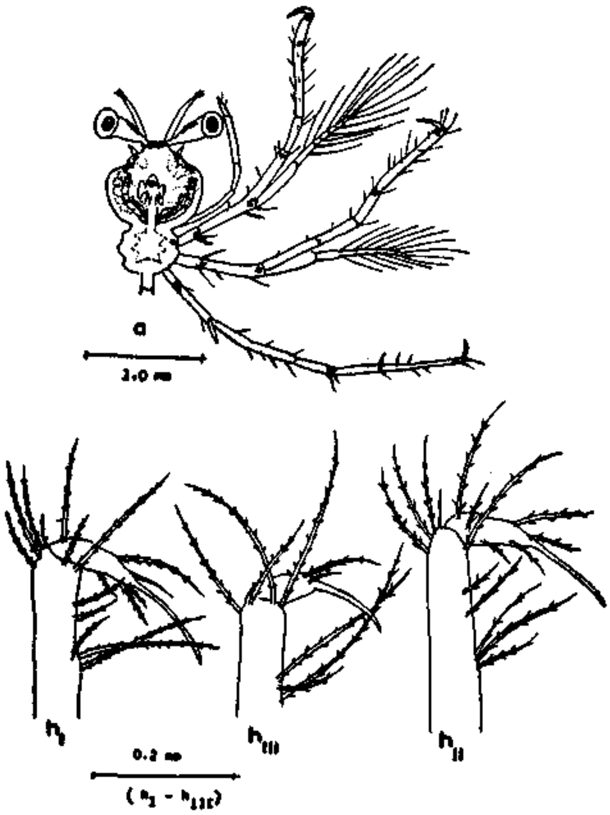

Fig. 1. *Scyllarus sordidus* (Stimpson) - Ist phyllosoma + pereiopods (Only dactylus show) (a-entire phyllosoma; b-antennule + antenna; c-mandible; d-First maxilla; e-second maxilla; f-second maxilliped; g-third maxilliped; h-pereiopods (only dactylus shown); and i-abdomen enlarged (Roman suffixes indicate the stage number).

IInd Phyllosoma (Fig. 2, a)

Total length 1.7 mm; eyes now distinctly stalked, slightly shorter than A 1; inner ramus of A 1 represented by a small protuberance; exopod of the Per 1 & 2 with 9 + 9 plumose setae, that of Per 3 still bud-like; Per 5 appearing as a small bud at base of Ab.

Inner ramus of A1 (Fig. 8, b II) represented by a small protuberance with a single hair-like seta; a group of 4 aesthetascs + 2 setae present terminally and 2 aesthetascs subterminally. A2 (Fig. 8, b II) showing no appreciable change; Md, Mx1 and Mxp 2 and 3 do not undergo any change except increase in size; Mx 2 (Fig. 9, e II) with a reduced apical segment and 4 apical setae instead of 2 of previous stage, this number continuing throughout subsequent stages; no change in Per 1 & 2 (Fig. 2, a) except for number of exopod setae increasing to 9 + 9. Exopod of Per 3 still not functional, but elongated, showing traces of segmentation; Per 4 bud-like, but as long as, or slightly longer than Ab (in *americanus*, this is twice length of abdomen); per 5 developed as minute buds at base of abdomen (Fig. 7, c II); phyllosomae of *S. americanus* at this stage differs from present material mainly in size, being 2.2—2.4 mm.

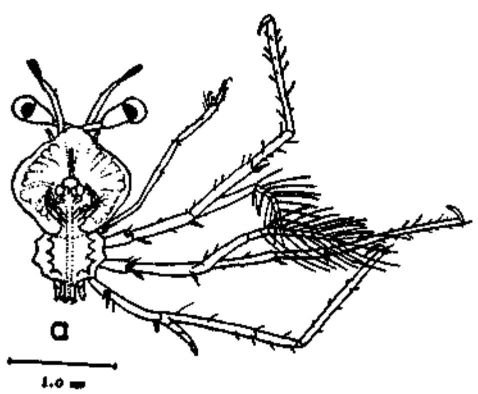

Fig. 2. *Scyllarus sordidus* (Stimpson)-IInd phyllosoma (For details see explanation under Fig. 1).

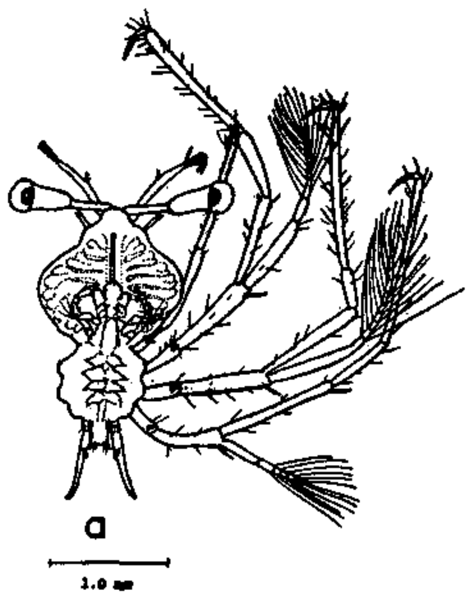

Fig. 3. *Scyllarus sordidus* (Stimpson)-IIIrd phyllosoma (For details see explanation under Fig. 1).

IIIrd phyllosoma (Fig.3, a)

Total length 2.2 mm; eye-stalks as long as corneal portion; a pair of minute setae at base of each eye; A1 biramous; Per 4 & 5 more developed, Per 3 being fully formed; A1 with a small inner ramus separated out (Fig. 8, b III) with 2 terminal tooth-like structures and a small seta; outer ramus with 4 aesthetascs + 2 setae, along with a slender tooth, terminally; also two groups of aesthetascs distally an outer ramus; A2 (Fig. 8, b III) as in the previous stage; appendages, Md onwards to Mxp 3,do not show much change over previous stage; Per 1 & 2 with no structural change (Fig. 3, a) but for increase in number of exopod setae, which become 9 to 10 pairs; Per 3 with well developed exopod bearing 6 + 6 plumose setae; Per 4 indistinctly segmented, a small dorsal fold indicating exopod; coxal spine with accessory seta present on this pereiopod also;Per 5 present as small buds at base of Ab; no changes in Ab (Fig. 7, i III). In corresponding stage of *americanus*, larvae are much bigger — 2.9 to 3.4 mm in size and also show uropods developing as swellings on each side of abdomen.

IVth Phyllosoma (Fig. 4, 1)

Total length 3.0 mm; antennular peduncle segmented with its rami distinctly separated; traces of uropods present; exopod setae on pereiopods more in number. A1 (Fig. 8, b IV) peduncle 2 — segmented; outer ramus distinctly separated from peduncle, bearing a slender tooth, 4 aesthetascs + 2 setae terminally; also four groups of aesthetascs of 2, 3, 1 and 2 each subterminally; inner ramus as in previous stage; a small tooth at distal end of A2 (Fig. 8, b IV)present in addition to setae of previous stage; lateral process observed in *americanus,* not yet developed; Md show increase in number of teeth, whereas Mx 1 & 2 and Mxps remain almost unchanged; exopods of the Per 1 + 2 (Fig. 4, a) with 11—12 pairs of plumose setae, and those of Per 3 with 8—9 pairs; Per 4 about half length of Per 3 and with well formed endopod and elongated bud-like exopod; Per 5 as bud with a papilla-like tip; in *americanus,* this appendage becomes at least half length of abdomen in corresponding stage.

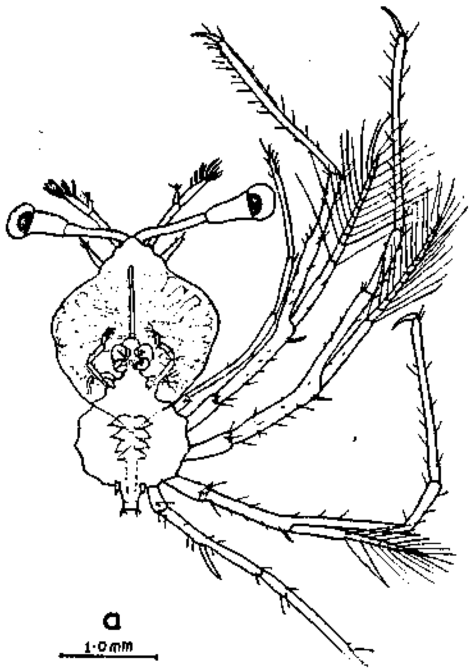

Fig. 4. *Scyllarus sordidus* (Stimpson)-IVth phyllosoma (For details see explanation under Fig. 1).

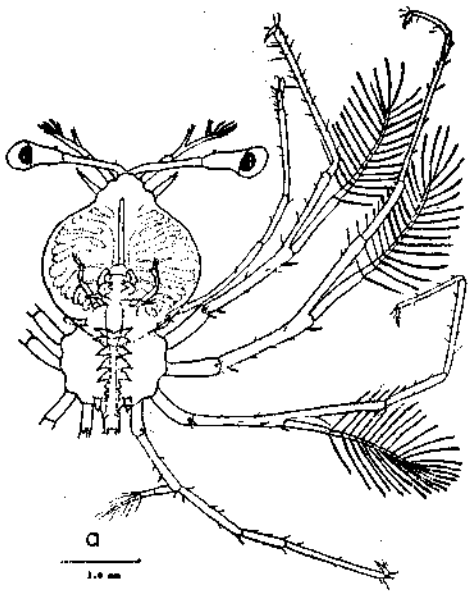

Fig. 5. *Scyllarus sordidus* (Stimpson)-Vth phyllosoma (For details see explanation under Fig. 1).

Ab (Fig. 7, i IV) with traces of uprods present; in *americanus,* uropods are already present and show shallow clefts indicating further segmentation.

Vth Phyllosoma (Fig. 5, a)

Total length 3.6 mm; Per 4 with functional exopod; Per 5 buds more elongated; Uropods presents, but no pleopods; A1 (Fig. 8, b V) peduncle 2—segmented with

3 seate on basal segment; inner ramus half length of outer with 2 terminal teeth and a seta; outer ramus with tufts of 2, 2, 2-3 and 2 aesthetascs distalwards on inner median line; no other change; A2 (Fig. 8, b V) reaches upto base of antennular peduncle; ventrally, a minute tooth present in basal half; basal protuberance, which is present in *americanus*, not developed as yet; Md no change; apical segment of Mx 2 considerably reduced, terminating into 4 plumose setae; Mx 1 and Mxp 1-3 without much change; exopods of Per 1 + 2 (Fig. 5, a) with 13+13 and those of third with 11 + 11 plumose setae; exopod of Per 4 well developed but half length of endopod and provided with 5 to 7 pairs of setae; Buds of Per 5 reach less than half length of Ab, whereas, in *americanus*, it reaches beyond abdomen; *Uropods* (Fig.7, i V) present as uniramous buds; in *americanus*, these are biramous; pleopods not developed as yet, unlike in *americanus*, where they are not only present but also show traces of bifurcation in advanced larvae; also, Mxp 1 starts developing in this stage in *americanus* but in *sordidus* no indication is seen; larvae show difference in size too—in present species, it is 3.6 mm whereas in *americanus*, it is 4.9 to 6.6 mm.

VIth Phyllosoma (Fig. 6, a)

Total length 5.0 mm; antenna with a basal knob which developes in IVth stage in *americanus*, Per 5 still rudimentary; inner ramus of A1 with 2 setae on the inner and 2 on the outer margins (Fig. 8, bVI); terminally, 2 teeth and a seta present; number of aesthetascs increased on outer ramus; a basal knob present on outer

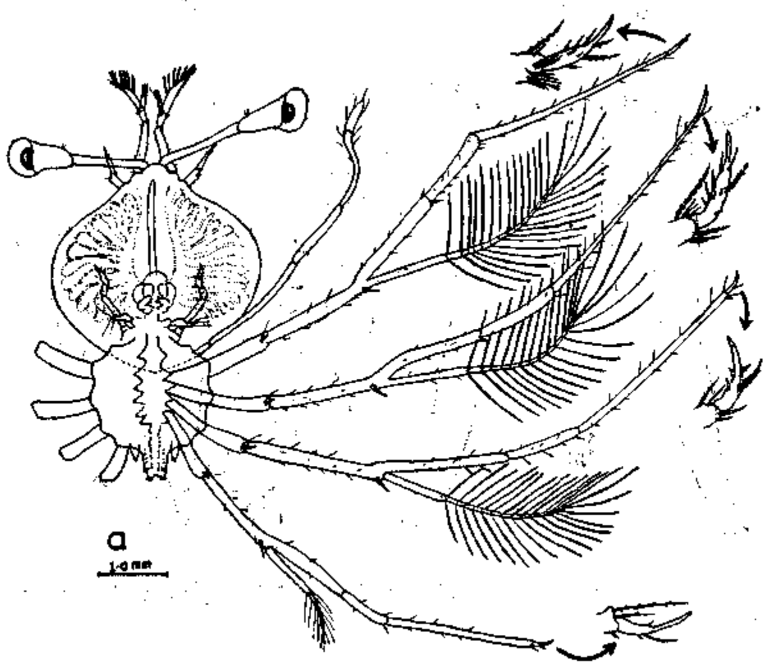

Fig. 6. *Scyllarus sordidus* (Stimpson)-VIth phyllosoma (For details see explanation under Fig. 1).

margin of A2 (Fig. 8, b VI); a few more setae present than in previous stage; Md showing increase in number of teeth; coxal endite of Mx1 (Fig. 9, d VI) with 3 serrated teeth and 4 setae as in *americanus*; apical segment of Mx 2 (Fig. 9, e VI) gets lost as in *americanus*, but 4 apical setae still persist; no rudiments of Mxp 1 as yet developed unlike in *americanus*; no major change in Mxp 2 and 3 except that setation becomes denser on dactylus of Mxp 3 (Fig. 9, g VI); Per 1-4 (Fig. 6, a) functional; exopods of first three pairs with 14 to 15 pairs of setae, whereas those of fouth with

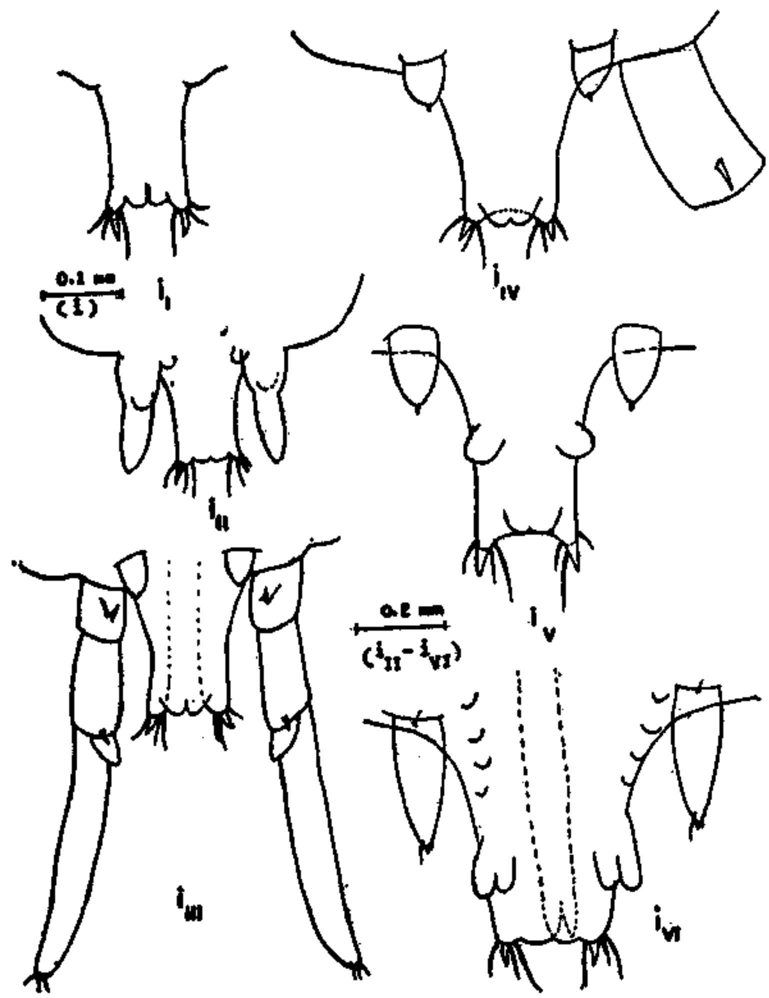

Fig. 7. *Scyllarus sordidus* (Stimpson)-abdomen of Ist to VIth stages (For details see explanation under Fig. 1).

9 to 10 pairs only. Fifth pair still not reaching entire length of abdomen and now armed with coxal spine and accessory seta; Uropods (Fig. 7, i VI) biramous; *Pleopods:* Present as four pairs of minute buds (Fig. 7, i VI). Gill buds are present in corresponding stage of *americanus* but these are absent in present material.

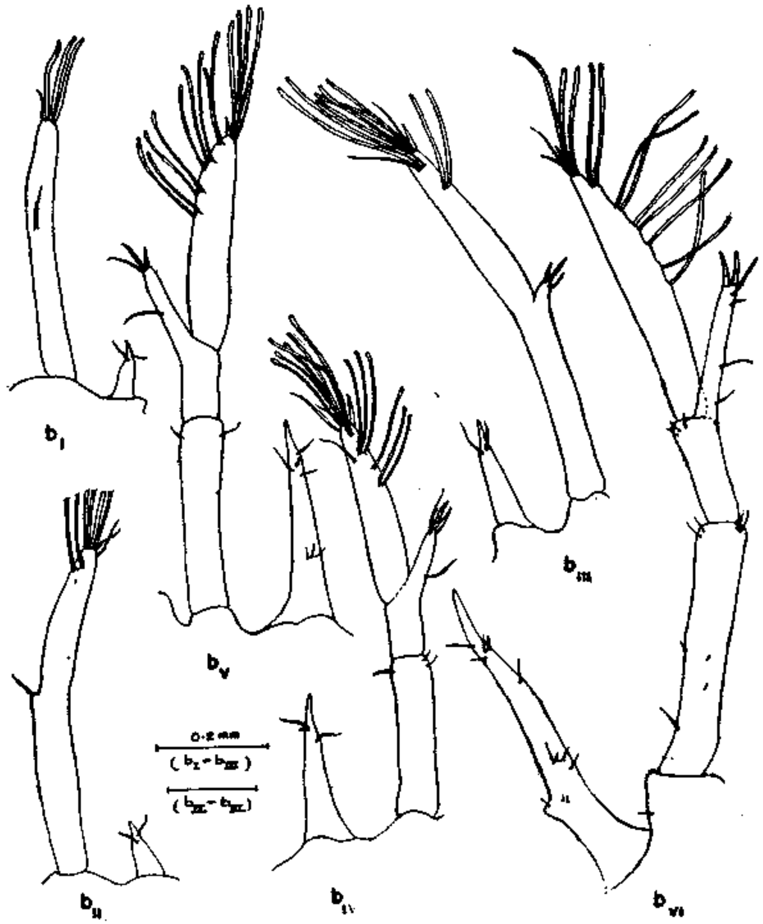

Fig. 8. *Scyllarus sordidus* (Stimpson)-antennule + antenna of Ist to VIth stages (For details see explanation under Fig. 1).

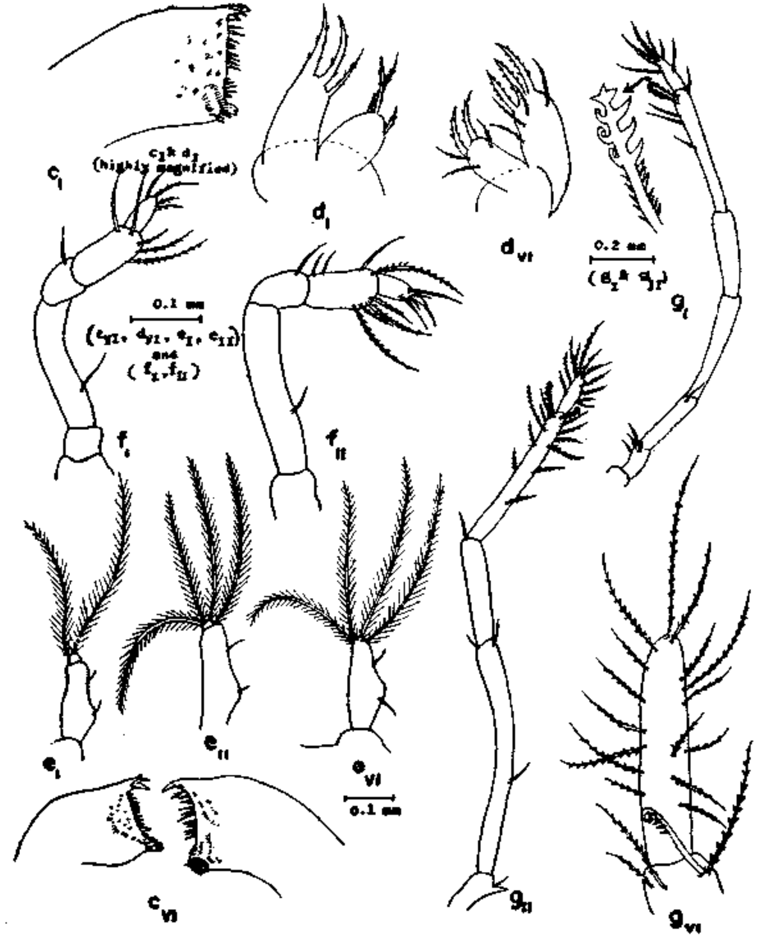

Fig. 9. *Scyllarus sordidus* (Stimpson)-mandible to third maxilliped of Ist to VIth stages (all stages not shown) (For details see explanation under Fig. 1).

DISCUSSION

It appears that there are at least two more stages after the VIth phyllosoma, before the completion of metamorphosis in *S. sordidus*, since pleopods are still in the form of uniramous rudiments; Mxp 1 undeveloped as yet; Per 5 not yet functional, and gill buds not developed.

As compared to the larvae of *S. americanus* which were also reared on diet of *Artemia* nauplii only, it is observed that the first 4 phyllosma stages of *S. sordidus* compare well with those of *americanus*, the Vth and VIth phyllosomae, however, are less developed in morphological features in *sordidus*.

Nothing is known as yet about the natural food of phyllosoma larvae. Also, practically no studies have so far been made on the nature of food or feeding habits and rate of growth of these larvae. The differential development mentioned above may, thus, have been caused due to improper food since *Artemia* nauplii may not be suitable food for the later stages of *sordidus*. Besides, the rate of growth or the pattern of development of morphological features in *sordidus* may be specific to the species.

REFERENCES

CHHAPGAR, B. F. AND S. K. DESHMUKH 1964. Further records of lobsters from Bombay. *J. Bombay Nat. Hist. Soc.*, **61**(1): 203-107.

PRASAD, R. R. AND P. R. S. TAMPI 1957. On the phyllosoma of Mandapam. *Proc. Nat. Inst. Sci. India*, Ser. B, **23** (1-2): 48-64.

——— 1960a. Phyllosomas of scyllarid lobsters from the Arabian Sea. *J. mar. biol. Ass. India*, **2**(2): 241-249.

——— 1960b. On the newly hatched phyllosoma of *Scyllarus sordidus* (Stimpson). *Ibid.*, **2**(2): 250-252.

———1967. Nistos of two species of *Scyllarus*. *Ibid.*, **9**(1): 116-120.

PROVENZANO, A. J. FR., 1968. Recent Experiments on the Laboratory Rearing of Tropical Lobster Larvae. *Proc. Gulf and Garibbean Fish. Inst.*, **21**: 152-157.

ROBERTSON, P. B., 1968. The complete larval development of the sand lobster, *Scyllarus americanus* (Smith), (Decapoda, Scyllaridae) in the laboratory, with notes on larvae from the plankton. *Bull. Mar. Sci.*, **18**(2): 294-342.

DISCUSSION

K. H. Mohamed : Could you please give some more details of the rearing?

K. N. Sankolli : Please see the main paper.

K. H. Mohamed : Is there any naupliosoma stage in *S. sordidus* ?

K. N. Sankolli : No, we have not observed such a stage. We feel this stage may be sometimes seen depending upon the hatchability in varying environments.