SOUTHERN AFRICAN CUMACEA

VOLUME 2

by

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SOUTHERN AFRICAN CUMACEA

PART 4

FAMILIES GYNODIASTYLIDAE AND DIASTYLIDAE

by

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(With 30 figures and 3 tables)

CONTENTS

ABSTRACT

The genera Gynodiastylis, Dicoides, Allodiastylis, Sheardia, Zimmeriana, and Haliana gen. nov. are removed from the Diastylidae and placed in the reinstated family Gynodiastylidae Stebbing, 1912. The family is confined to shallow waters of the Indo-west-Pacific Region.

In southern Africa the Gynodiastylidae are represented by seven species in three genera. One of the genera (Haliana) is new, and so are all of the species, Haliana eckloniae, Dicoides siphonatus, Gynodiastylis sulcatus, G. curvirostris, G. profundus, G. lineatus and G. fulgidus. All are described and figured.

The southern African Diastylidae are represented by seventeen species in six genera. Two further species are known from the Cape Basin. Sixteen species are described and figured. Vemakylindrus is raised from subgeneric to generic status and the genus Adiastylis is reinstated to accommodate many species intermediate between Makrokylindrus and Diastylis. Twelve species are new, namely Dic formosae, D. platytelson, Vemakylindrus stebbingi, Makrokylindrus spinifer, M. deinotelson, M. mundus, M. bicornis, Adiastylis aculeatus, Diastylis namibiae, Leptostylis gilli, L. attenuatus and L. faurei.

Keys are given to the southern African Gynodiastylidae and Diastylidae, the genera of the two families, Dicoides, the species of Gynodiastylis described since 1946, Dic, Vemakylindrus, Makrokylindrus, Adiastylis and the species of Diastylis and Leptostylis from the southern hemisphere.

The distribution of the Diastylidae is discussed; the family appears to predominate in temperate latitudes and occurs widely at all depths below the intertidal zone. Although the southern African Diastylidae are mainly deep-water forms, there are a few very successful shallow-water species, including Diastylis algoae, which is the most abundant of all local cumaceans, as well as accounting for more than 75% of the individuals of diastylid from

southern Africa. The species diversity is low and the rate of endemism appears to be 100%.

INTRODUCTION

This is the fourth in a series of papers on the systematics and distribution of the Cumacea of Africa south of 20^{o}S. The first three papers dealt with the Vaunthompsoniinae (Day 1975), the Bodotriinae (Day 1978a) and the Lampropidae and Ceratocumatidae (Day 1978b). A brief discussion of the structure and terminology of the group is included in the first paper.

References to diastylids in these waters are scanty. Three species, *Diastylis algoae* Zimmer, 1908, *Diastylis rufescens* Jones, 1955 and *Dic calmani* Stebbing, 1910 have been described from depths of less than 100 m, four from depths between 500 and 800 m, namely *Diastylis hexaceros* Zimmer, 1908, *Adiastylis acanthodes* Stebbing, 1912, *Leptostylis macruroides* Stebbing, 1912 and *Makrokylindrus fragilis* Stebbing, 1912, and two from 4 885 m off the south western Cape, namely *Makrokylindrus wolffi* Bacescu, 1962 and *Adiastylis lomakinae* Bacescu, 1962. No gynodiastylids have previously been recorded in the area.

MATERIAL AND STATION DATA

Most of the shallow-water material used in this study was obtained by the Zoology Department of the University of Cape Town (UCT) during a survey of the benthic fauna around the South African coast, the programme being funded by the Oceanographic Research Institute of the University and the Council for Scientific and Industrial Research (CSIR). Almost all of the deep-water material was loaned by the South African Museum (SAM), mostly collected by the S.S. *Pieter Faure* between 1898 and 1907 and the R.V. *Meiring*

Institute	Area	Explanation	Geographical position
UCT	SWD	University of Cape Town	
	SWD	South West Africa benthic survey	Cape Cross (21°S 13°E) to Orange River Mouth (28°S 16°E)
	WCD	West coast benthic survey	Orange River Mouth (28°S 16°E) to Cape Point (34°S 18°E)
	LBT	Lambert's Bay benthic transect	Lambert's Bay, shore - 800 m (32°S 18°E - 32°S 17°E)
	SB	Saldanha Bay benthic survey	Saldanha Bay (33°S 17°E)
	FAL	False Bay benthic survey	False Bay (34°S 18°E)
	FBY	False Bay benthic transect	False Bay, shore - 100 m
	CP	Cape Peninsula - intertidal	33-34°S 18°E
	SST	Still Bay benthic transect	Still Bay, shore - 200 m (34°S 21°E - 35°S 22°E)
	SCD	South coast benthic survey	Cape Point (34°S 18°E) to Umtamvuna River Mouth (31°S 30°E)
NIWR		National Institute for Water Research	
NIWR		Natal coast benthic survey	Umtamvuna River Mouth (31°S 30°E) to Kosi Bay (26°S 32°E)
SAM		South African Museum	Various (see records of individual species for details)
FISH		Sea Fisheries Branch	South West Africa: plankton

Table 1. Code letters of the survey programmes and their geographical ranges.

Naude in 1976 to 1977. Valuable additional material from Natal was loaned by the National Institute for Water Research (NIWR) of the CSIR in Durban. Material from South West Africa was loaned by the Sea Fisheries Branch, Cape Town.

Because of the very large number of samples, exact station data are provided only for holotype material; in all other cases only extremities of range and depth are given for each area and/or source of material. Both the areas and the sources of material are designated by code letters which are shown, together with their geographic limits, in Table 1 and Figure 1.

METHODS

Collecting The majority of material came from benthic sampling programmes using dredges (SAM, UCT, NIWR), grabs (UCT, NIWR) or a diver-operated suction-sampling device (a few shallow-water UCT samples). All material provided by the Sea Fisheries Branch was collected by plankton nets of varying mesh-size.

Length measurements were made from the anterior tip of the carapace to the posterior tip of the telson, the uropods being excluded in all cases.

KEY TO THE SOUTHERN AFRICAN GYNODIASTYLIDAE AND DIASTYLIDAE

This key is designed for the identification of immature and damaged animals of both sexes. It is therefore based on the more robust parts of animals and is not as rigorous as the keys to individual genera and species, which should be consulted for final identification. The key does not distinguish between local species and those from other parts of the world.

1 Carapace with one or two sharp transverse ridges anteriorly, evident on sides of carapace in female (Fig. 10A, B), sometimes only defined across frontal lobe in male (Fig. 11A, B) 2

\- Carapace without transverse ridges (there may be several very shallow depressions laterally - Fig. 27A) 6

2 Transverse ridge(s) (Fig. 17A) bearing spines or evidence of their insertion 3

\- Carapace entirely devoid of spines 4

3 One transverse ridge on carapace; telsonic somite hardly produced between uropods . . . . . <u>Makrokylindrus fragilis</u> (Fig. 16)

\- Two transverse ridges on carapace; telsonic somite produced between uropods for nearly half its length . . . . <u>Makrokylindrus deinotelson</u> (Fig. 17)

4 Transverse ridges on carapace entire in dorsal view, one on posterior half of carapace; at least a third of telson post-anal . . . . <u>Dic platytelson</u> (Fig. 14)

\- Transverse ridge(s) on carapace interrupted by eyelobe in dorsal view, none situated on posterior half; an insignificant part of telson post-anal 5

5 Carapace finely hairy; telson sloping terminally; last pedigerous somite rounded posteriorly in male; telson shorter than uropods in female . . . . <u>Dic calmani</u> (Figs 10 & 11)

\- Carapace not hairy; telson truncate posteriorly; last pedigerous somite pointed posteriorly in male; telson longer than uropods in female . . . . <u>Dic formosae</u> (Figs 12 & 13)

6 Integument smooth with no trace of spines, spinules, denticles or tubercles, even at anterolateral edge of carapace (which may be minutely scalloped - Fig. 9A) 7

\- Integument tuberculate or with spines at least at anterolateral edge of carapace (Fig. 16A), usually with spines or denticles elsewhere . 14

7 Carapace longitudinally concave middorsally (Fig. 4A, B) 8

\- Carapace flat or convex middorsally 9

8 Female without exopods on thoracic limbs; dorsolateral edge of middorsal concavity interrupted at level of eyelobe (male unknown) . . . . <u>Haliana eckloniae</u> (Fig. 9)

\- Female with exopods on pereiopods 1 and 2; dorsolateral edge of middorsal concavity uninterrupted in both sexes . . . . <u>Gynodiastylis sulcatus</u> (Figs 3 & 4)

9 Carapace with three or more pairs of longitudinal grooves or ridges (may be difficult to distinguish in newly-moulted individuals) . 10

\- Carapace with no trace of longitudinal grooves or ridges . . . 11

10 Three or four pairs of longitudinal grooves on carapace; siphon more than half as long as carapace (but may be damaged or missing); telson twice as long as wide . . <u>Dicoides siphonatus</u> (Fig. 2)

\- Ten to twelve pairs of longitudinal grooves on carapace; siphon less than a quarter as long as carapace; telson no longer than wide . . . . <u>Gynodiastylis lineatus</u> (Fig. 7)

11 Pedigerous somites 3 and 4 coalesced dorsally; telson tubular, more than twice length of telsonic somite. <u>Makrokylindrus mundus</u> (Fig. 18)

\- Pedigerous somites 3 and 4 not coalesced; telson flattened and shorter than telsonic somite (Fig. 5G) 12

12 Pseudorostral lobes flanged dorsolaterally from anterior tip to eyelobe; integument of carapace usually finely striate . . . . <u>Gynodiastylis profundus</u> (Fig. 6)

\- Pseudorostrum not flanged; integument of carapace not striate . 13

13 Pseudorostrum curving strongly downwards; setae of propodus of pereiopod 1 much longer than basis . <u>Gynodiastylis curvirostris</u> (Fig. 5)

\- Pseudorostrum roundly truncate anteriorly, not curving downwards; setae of propodus of pereiopod 1 much shorter than basis . . . . <u>Gynodiastylis fulgidus</u> (Fig. 8)

14 Pseudorostrum strongly upturned and more than half as long as rest of carapace . . . . <u>Vemakylindrus stebbingi</u> (Fig. 15)

\- Pseudorostrum hardly or not upturned and less than a third as long as rest of carapace 15

15 Pre-anal part of telson longer than telsonic somite; tubercles or large spines present dorsally on pedigerous somites (Fig. 21A) and/or carapace 16

\- Pre-anal part of telson shorter than or subequal to telsonic somite (if subequal, then post-anal part much longer than pre-anal); large spines absent or only one or two rows present at anterolateral edge of carapace (small denticles may be present) 22

16 Telson longer than last three abdominal somites together, tubular, with very short post-anal part; entire body densely covered with long spines . . . . . <u>Makrokylindrus spinifer</u> (Figs 19 & 20)

\- Telson subequal in length to last two or two and a half abdominal somites together, with a fifth or more of its length post-anal (Fig. 21A); spines or tubercles on body short, scattered or very sparse 17

17 Carapace with one or more pairs of large anterolateral horns (Fig. 21B); few other spines on body, all confined to dorsal region of pedigerous and abdominal somites 18

\- Carapace without anterolateral horns; many spines or tubercles on body (many may be damaged or lost - Fig. 22A) 19

18 Carapace with three pairs of large anterolateral horns; half of telson post-anal . . . . <u>Diastylis hexaceros</u>

\- Carapace with one pair of large anterolateral horns; less than a quarter of telson post-anal . <u>Makrokylindrus bicornis</u> (Fig. 21)

19 Carapace unevenly contoured with each major spine on an individual protuberance; telson distinctly shorter than peduncle of uropods in both sexes . . . . . . <u>Adiastylis acanthodes</u> (Fig. 22)

- Carapace evenly contoured with many short spines (Fig. 23A) or blunt tubercles; telson of female longer than peduncle of uropod; telson of male (where known) very slightly shorter 20

20 Pereion somites together about a third length of carapace; last three segments of pereiopod 2 subequal in length . Makrokylindrus lomakinae

- Pereion somites together about half length of carapace; carpus of pereiopod 2 longer than next two segments together 21

21 Telson longer than last two abdominal somites together, with no lateral spines; first segment of antenna 1 about half as long again as next two together . . . . Makrokylindrus wolffi

- Telson shorter than last two abdominal somites together, with at least three pairs of lateral spines; first segment of antenna 1 hardly longer than next two together, or slightly shorter . . . . Adiastylis aculeatus (Fig. 23)

22 Telson subequal in length to peduncle of uropod and twice length of telsonic somite, with seven or more pairs of lateral spines; carapace about twice as long as deep . . . . . Diastylis algoae (Figs 24 & 25)

- Telson distinctly shorter than peduncle of uropod and much less than twice length of telsonic somite (Fig. 26K), with no more than six pairs of lateral spines; carapace usually much less than twice as long as deep 23

23 Telson slightly longer than telsonic somite and only a little shorter than peduncle of uropod; about six pairs of lateral spines in female and two in male . . . . Diastylis namibiae (Fig. 26)

- Telson subequal in length to, or shorter than, telsonic somite and about half length of peduncle of uropod with no more than three pairs of lateral spines in male or four in female 24

24 Antenna 1 at least half as long as carapace . Leptostylis attenuatus (Fig. 30)

- Antenna 1 much less than half length of carapace 25

25 Serrated ventrolateral carina present above ventrolateral edge of carapace . . . . *Leptostylis macruroides*

- No ventrolateral carina present on carapace 26

26 First segment of endopod of uropod nearly twice length of next two together; carapace often with several shallow, transverse depressions laterally . . . . *Leptostylis gilli* (Figs 27 & 28)

- First segment of endopod of uropod subequal in length to next two together; carapace with no transverse depressions . . . . *Leptostylis faurei* (Fig. 29)

THE FAMILIES GYNODIASTYLIDAE AND DIASTYLIDAE

The first attempt to group genera of Cumacea into families was by Sars (1879), who arranged the eighteen known genera into eight families. Three more families were added by 1912 (one each by Sars in 1900, Calman in 1905 and one by Stebbing in 1910), by which time the number of genera had risen to 51. In 1912, in a paper on South African Cumacea, Stebbing added eleven new genera, six of which still stand, and thirteen new families. In his monograph on the world Cumacea in 1913 he added another family, bringing the total to 26. Due to the fact that seventeen of these contained only one genus (and some a single species at that) and because of the artificial separation of closely-related genera, Zimmer (1941) reduced the number of families to seven, including four of those originally proposed by Sars. This system has been generally accepted by most workers ever since.

Without wishing to advocate for one moment the return to a system as complicated and artificial as Stebbing's, it seems appropriate at this stage to reconsider the familial position of the Diastylidae in the presence of a large and diverse collection of material.

The family as it stands is far more variable than any except perhaps the Lampropidae, where at least the telson is quite distinctive, and the Nannastacidae (which will be considered in a later paper). There is no distinctive character or group of characters or even a "diastylid facies" by which a member of the family may be recognised. However, within the Diastylidae there is a group of six genera which are very closely related to each other, since they have a characteristic form and are quite unlike most of the other Diastylidae. They are: Gynodiastylis Calman, 1911, Allodiastylis Hale, 1936, Sheardia Hale, 1946, Dicoides Hale, 1946, Zimmeriana Hale, 1946 and Haliana gen. nov. It is proposed that these genera be removed from the Diastylidae and Stebbing's (1912) family Gynodiastylidae be reinstated to accommodate them. It should be pointed out that when Zimmer revised the families of Cumacea in 1941, there were only ten species in two genera, which would hardly have justified the maintainance of a separate family. The six genera now known contain 53 species, which makes the family larger than either the Pseudocumatidae or the Ceratocumatidae. A further justification is that familial boundaries are arbitrary for the most part, and reduction of the diagnostic characters of the diastylids should assist in placing animals in the correct family at least, which is often the most difficult step in identification. Furthermore, the gynodiastylids appear to be a phylogenetically distinct group with no very obvious affinities with the diastylids.

The majority of the other genera of diastylid do resemble each other, and can now be seen to show a "diastylid facies". They are active, rather delicate, not strongly calcified animals with a rather large cephalothorax clearly divided from the abdomen, and generally with long, slender uropods. There are exceptions, but the family becomes much more uniform on the removal of the gynodiastylids. Although still variable, the restricted family no longer has vastly aberrant genera. Variations within the family are discussed in the remarks on pages 39 - 43.

Family Gynodiastylidae Stebbing, 1912 (n. comb.)

Diagnosis

Antenna 1 of male without numerous sensory setae. Flagellum of antenna 2 of male very short, not reaching posterior edge of carapace; segments short and usually less than fifteen in number. Mandibles of normal boat-shape. Branchial filaments undivided. Exopod present on maxilliped 3 of male, absent in female. Exopods present on first two, three or (usually) four pereiopods in male; absent, or present only on first two pereiopods in female, or present on first two and rudimentary on next two. Male without pleopods. Telson shorter than telsonic somite with less than half length post-anal, or longer than telsonic somite and an insignificant portion post-anal; usually unarmed, sometimes with one pair of terminal spines and never more than two pairs of small lateral spines. Endopod of uropod 1-, 2- or 3-segmented.

Type genus

Gynodiastylis Calman, 1911

Remarks

The family consists of six genera. Three are known only from Australia, namely Allodiastylis Hale, 1936, Sheardia Hale, 1946 and Zimmeriana Hale, 1946. Gynodiastylis Calman, 1911 is widely known from the Indo-west-Pacific, Dicoides Hale, 1946 from Australia and South Africa and Haliana gen. nov. from South Africa.

The genera are morphologically similar, the main distinguishing features being the number of exopods on the thoracic limbs of the female, and the nature of pereiopod 1. Allodiastylis (with four species) and Sheardia (with one) are very similar in the nature of the large first antennae, but the former lacks exopods on all the thoracic limbs in the female and the pseudorostrum is bent upwards in the female and downwards in the male. Pereiopods 1 and 2 of the females of Sheardia possess exopods and the pseudorostrum is straight. No males of this genus were previously available, but the author has recently received some Australian material from the Great Barrier Reef including two adult males which appear to belong to this genus, and probably to Hale's species. They are typical of the family, with no pleopods and five pairs of exopods on thoracic limbs. The pseudorostral lobes are very short and the exhalent siphon is strongly directed dorsally. Zimmeriana (with three species) and Dicoides (with five) are also very similar to each other in the enormous development of the first pereiopod, but the former lacks exopods in the female and the dactyl bears a number of long setae, while in Dicoides exopods are present on the first four pairs of pereiopods in the female and the dactyl of the first pereiopod lacks long setae. Gynodiastylis is by far the largest, the most variable and the most widespread genus with 42 species. It is characteriesd by exopods on pereiopods 1 and 2 of the female while the propodus of pereiopod 1 is relatively short and usually bears a number of very long setae.

One new genus is erected here for four individuals of a species which, although very similar to a local species of Gynodiastylis, lacks exopods on all thoracic limbs in the female; the male is unknown. It is close to Zimmeriana, but the propodus and not the dactyl of pereiopod 1 bears long setae. Since the two genera are clearly mutually exclusive, the species, which bears features characteristic of both, has to be accommodated in yet another genus to avoid a complicated overlapping of generic characters. The new genus is named Haliana after H.M. Hale, the Australian carcinologist who has contributed by far the most to our knowledge of this family.

Adaptive features

Most members of the family are small, compact, usually well chitinised animals, often with bizarrely developed first pereiopods. There are a number of interesting and unusual features about the group which suggest functional adaptations. In most there is sufficient reduction of appendages to suggest that they are more sedentary than the majority of cumaceans. It is usual in this order that when pleopods are reduced in number or absent, the thoracic exopods are particularly well developed to facilitate swimming in the male. But in the gynodiastylids the thoracic exopods are not particularly well-developed in the male and are sometimes even reduced in number. Exopods when present in the female are also very small. This together with the often enormous size of the first pereiopods makes it difficult to visualise many of these animals ever being able to leave the substrate. (There are, however, several records of plankton samples, although in all cases the depths were not very great (Hale 1946)). Associated with this apparently reduced mobility, the respiratory surfaces are small, since the branchial filaments are not at all divided. This in turn suggests a rather low respiratory rate and a consequent reduction in activity. The majority of animals are small, the average length being about 3 mm: only three species are longer than 6 mm. It does not seem possible on the available evidence to say whether the small size is the cause or the effect of a small respiratory surface, or indeed whether the two factors are directly linked; but the coincidence suggests that they may be.

One would expect the disadvantages of possessing extraordinarily large first pereiopods to outweigh the advantages. They must therefore be of particular functional significance, although what their function might be is not readily apparent. In some, such as Dicoides areolata, these appendages appear to be far too cumbersome to be manipulative in function, while in many species of Gynodiastylis the setae of the propodus could either function as a sieve or as a brush. Now in filter-feeding types such as Diastylis, the substrate is stirred up by means of the exopods of the third maxillipeds. But the females of Zimmeriana, Allodiastylis and Haliana have no thoracic exopods, although the first pereiopods are large. It is therefore suggested that some of these animals at least use the first pereiopods to stir up the mud and to push it towards the mouthparts where it can be filtered or scraped clean. Haliana, living in the holdfasts of kelp, may in fact employ some rather unusual form of feeding, since the amount of sand and detritus in the holdfasts is not great.

Hale (1946) further mentions that a specimen of Zimmeriana longirostris was found in which the last two segments of the first pereiopod were reflected backwards, forming a shield covering the mouthparts.

The uropods and telson are relatively small, robust and sparsely setose, and the post-anal part of the telson is relatively short. Thus they would appear not to be of great value in cleaning, and indeed there are few setose regions requiring this; their robustness perhaps assists in anchorage in the substrate. Generally those without any spines on the telson have at least some well developed on the uropods - perhaps for cleaning purposes.

The adult males generally display few of the secondary sexual characters which usually distinguish such individuals from immature males or from females. For example, the first antenna does not bear a brush of sensory setae, the flagellum of the second antenna is very short (although setose), the exopods of the thoracic limbs are often reduced in size or number and the pleopods are absent. It almost appears that the males are neotenic.

KEY TO THE GENERA OF THE GYNODIASTYLIDAE

The following key is adequate for adults and most juveniles. Since the major distinction between several of the genera depends on characters of the first pereiopod, when this is absent or damaged it may not be possible to determine the genus.

1 Antenna 1 large, third segment subequal in length to, or longer than, first two together 2

\- Antenna 1 of small or moderate size, third segment shorter than first two together 3

2 Female with exopods on pereiopods 1 and 2; endopod of uropod of female 3-segmented and of male 2-segmented; pseudorostrum of female straight with exhalant siphon anteriorly directed, of male very short with exhalant siphon dorsally directed . . . . Sheardia Hale, 1946

- Female with exopods absent from pereiopods 1 and 2; endopod of uropod 2-segmented in both sexes; pseudorostrum bent upwards in female and downwards in male . . . . Allodiastylis Hale, 1936

3 Pereiopod 1 very large, propodus much more than half length of basis and never with a brush of long setae 4

- Pereiopod 1 of moderate size, propodus small, about half length of basis or less and frequently with a brush of long setae masking the small dactyl 5

4 Exopods absent from thoracic limbs of female; dactyl of pereiopod 1 distally bearing numerous setae longer than itself . . . . Zimmeriana Hale, 1946

- Exopods present on pereiopods 1 - 4 of female (rudimentary on 3 and 4); dactyl of pereiopod 1 distally bearing few setae not longer than itself . . . . Dicoides Hale, 1946

5 Exopods absent from all thoracic limbs of female (male unknown) . . . . Haliana gen. nov.

- Exopods present on pereiopods 1 and 2 of female, and on at least pereiopods 1 and 2 of male (usually 1 - 4) . Gynodiastylis Calman, 1911

Dicoides Hale, 1946

Generic diagnosis

Antenna 1 small or moderate in size. Pereiopods 1 to 4 with exopods in both sexes. Propodus of pereiopod 1 longer than basis in female, more than half length of basis in male; carpus no shorter than propodus. Telson subcylindrical with no distinct post-anal part or lateral spines; terminal spines short or absent. Endopod of uropod 3-segmented.

Type species

Dicoides brevidactylus (Hale, 1937) (as Dic brevidactylum)

Remarks

The genus is rather uniform apart from the rather variable nature of the first pereiopods, which are nonetheless always very large. The relatively small propodus of the first pereiopod in D. siphonatus sp. nov. has required a slight alteration in the generic diagnosis.

Distribution of Dicoides

Four species are known from Australia at depths between 70 and 87 m and one from South Africa at depths between 18 and 80 m.

KEY TO THE SPECIES OF DICOIDES

1 Telson longer than peduncle of uropod 2

\- Telson no more than two-thirds length of peduncle of uropod . . . 3

2 Carpus, propodus and dactyl of pereiopod 1 all areolate, massive; dactyl longest; pseudorostrum horizontal and siphon much shorter than carapace . . . . D. areolatus Hale, 1946 - Australia

\- Pereiopod 1 not areolate or massive; carpus and propodus subequal in length and each longer than dactyl; pseudorostrum slightly upturned and siphon more than half length of carapace . . . . D. brevidactylus (Hale, 1937) - Australia

3 Telson more than half length of peduncle of uropod; siphon at least half length of carapace (may be broken); sides of carapace with three to four shallow longitudinal grooves . . . . D. siphonatus sp. nov.

\- Telson less than half as long as peduncle of uropod; siphon much less than half length of carapace; sides of carapace with one shallow longitudinal groove or none 4

4 Pereiopod 1 twice length of carapace in male and even longer in female, with carpus and propodus highly setose; exopod of uropod shorter than endopod; carapace without shallow lateral depression . . . . D. fletti Hale, 1946 - Australia

\- Pereiopod 1 of male about one and a half times length of carapace (female unknown), with carpus and propodus not setose; rami of uropod subequal in length; carapace with a shallow midlateral depression . . . . D. occidentalis Hale, 1951 - Australia

Dicoides siphonatus sp. nov.

Fig. 2

Records

		adult ♂	♂	ovig. ♀	juv & manca	total	no. of records
FAL 34^oS 18^oE	18-54 m	1		3	1	5	2
SST 34^oS 21^oE	80 m	7		9		16	1
NIWR 30^oS 30^oE-33^oS 25^oE	20-102 m	2	3	3	6	14	7

Holotype

Ovigerous female, in the South African Museum, SAM-A15723, collected by the University of Cape Town, 21 June 1972. Type locality: 80 m, off Still Bay ($34^o40'S$ $21^o39'E$). UCT station number SST 26H.

Description

Ovigerous female, holotype, length 3,4 mm. Integument calcified, translucent, and with fine, elongate reticulations, appearing crystalline in intermoult individuals. Carapace (Fig. 2A) slightly longer than deep with three shallow longitudinal grooves on either side. Pseudorostrum slightly produced, moulded around extremely long, upturned siphon almost as long as carapace (this may be damaged, as in the holotype, and is sometimes entirely missing). Antennal notch a slight excavation. Carapace in dorsal view (Fig. 2B) with very indistinct middorsal carina. Eyelobe small, eyeless, wider than long. Second pedigerous somite wide and separating last three pairs of legs from first two. Fifth pedigerous somite dorsally situated. Abdominal somites cylindrical, together no longer than cephalothorax. Marsupium large and well-developed.

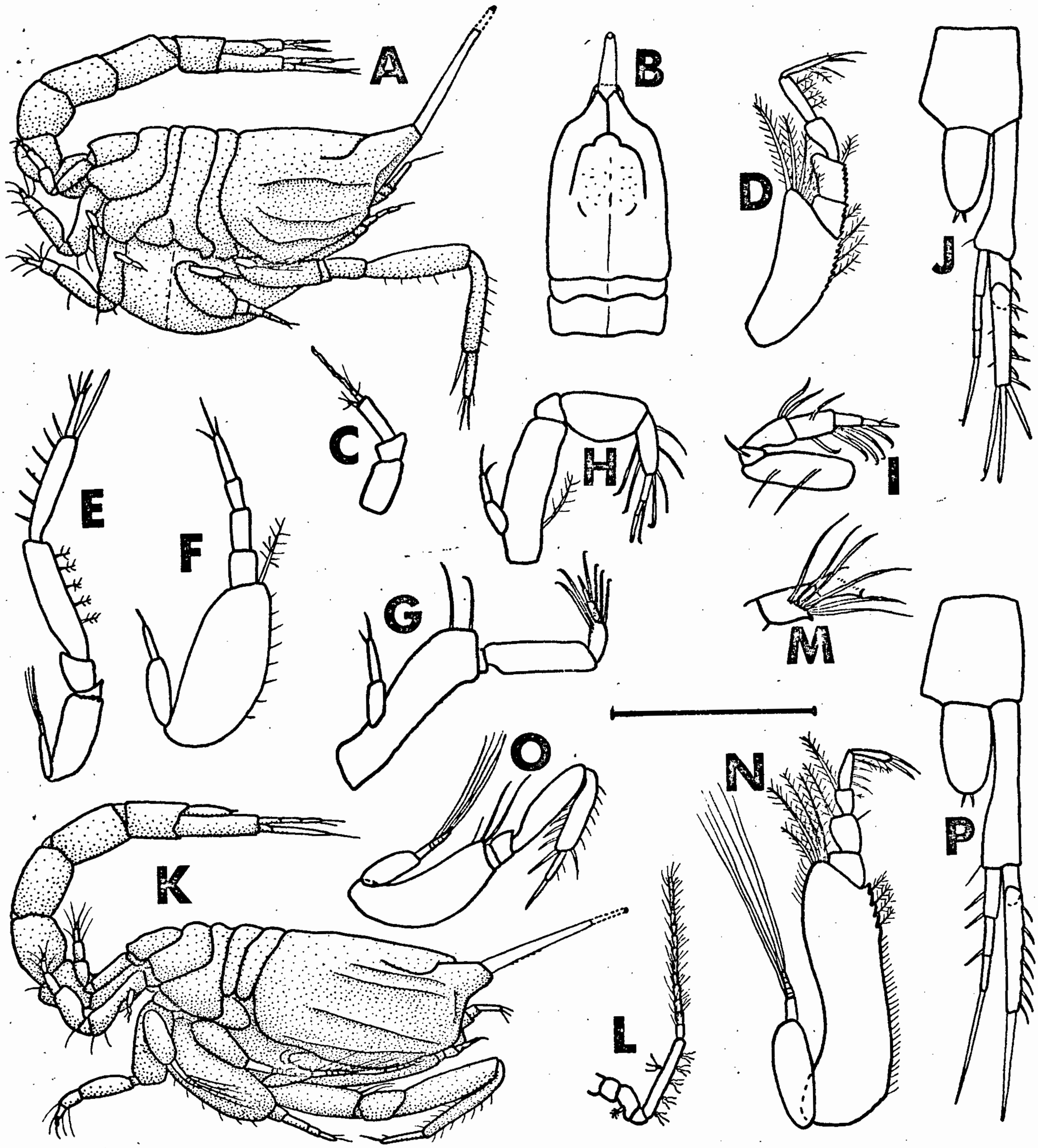

Fig. 2. Dicoides siphonatus sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Pereiopod 4. I. Pereiopod 5. J. Uropod and telson.

Adult male. K. Lateral view. L. Antenna 2. M. Detail of flagellum of antenna 2. N. Maxilliped 3. O. Pereiopod 1. P. Uropod and telson.

Scale line = 1 mm for A, B, K; 0,1 mm for M; 0,5 mm for C-J, L, N-P.

Antenna 1 (Fig. 2C) short, first and third segments subequal in length, second shorter. Both flagella very short, 2-segmented; main flagellum with one short aesthetasc.

Basis of maxilliped 3 (Fig. 2D) expanded distally, nearly half as wide as long. Ischium and merus subequal in length, as are carpus and propodus. Dactyl long and slender.

Basis of pereiopod 1 (Fig. 2E) less than a quarter total length of limb; exopod small with few setae. Ischium much wider than long; carpus longer than three preceding segments together, slightly flattened; propodus slightly shorter than carpus; dactyl long and slender. Pereiopod 2 (Fig. 2F) 6-segmented. Basis large and wide, longer than rest of limb. Next three segments subequal in length, dactyl slightly longer. Exopod with a single terminal seta. Pereiopod 3 (Fig. 2G) stout, basis longer than rest of limb. Ischium extremely small. Merus long and parallel-sided, last three segments small. Pereiopod 4 (Fig. 2H) similar to pereiopod 3 but basis shorter than rest of limb, ischium larger, merus much wider and carpus slightly longer. Exopod short and 2-segmented. Pereiopod 5 short, reflexed dorsally. Merus and carpus (Fig. 2I) stout, subequal in length.

Telsonic somite (Fig. 2J) slightly longer than wide, subequal in length to telson. Telson elongate-oval, about twice as long as wide with two small terminal spines. Peduncle of uropod about a third as long again as telson, wider distally and unarmed. Exopod subequal in length to peduncle with several small spines on outer edge and three long ones terminally. Endopod about three-quarters length of exopod, segments subequal in length.

Adult male, paratype, length 3,3 mm. As female, except as follows: siphon longer, less upturned, with a few minute denticles below (Fig. 2K). Pseudorostrum shorter and carapace longer with four shallow longitudinal grooves. Pereion shorter, abdomen slightly stouter.

Antenna 2 (Fig. 2L) reaching to end of carapace with 13 fairly short segments (Fig. 2M). Basis of maxilliped 3 (Fig. 2N) enormous in comparison with that of female. Basis of pereiopod 1 (Fig. 2 O) longer than next three segments together, carpus shorter. Basis of pereiopod 2 rectangular, merus shorter. Basis of pereiopod 3 very wide, merus more slender. Exopods of maxilliped 3 and pereiopods 1 - 3 very well-developed. Basis and merus of pereiopod 4 less stout, exopod much smaller.

Telson (Fig. 2P) slightly longer, peduncle of uropod distinctly so. Endopod more nearly equal in length to exopod.

A single adult male from Natal has the second antenna developed to the same extent as that described above but the exopod of pereiopod 4 is as large as that of pereiopod 3.

Three mancas, also from Natal, have the first pereiopods relatively very much larger than in the adults, although the proportions of the limbs are the same as those of the adult female described above. In all other respects these mancas agree with the adults.

In newly-moulted individuals the exhalant siphon is usually much better preserved but the longitudinal grooves on the carapace are difficult to detect.

Length

Adult male 3,1 - 3,3 mm

Ovigerous female 2,5 - 3,4 mm

Remarks

This species clearly belongs to *Dicoides*, which was previously known only from Australia. It is closest to *D. brevidactylus* (Hale, 1937), in which the dactyl of the first pereiopod is very short and the siphon long. The two are easily distinguished, however, by the longitudinal grooves on the carapace, the shorter telson and pseudorostrum and the much shorter stouter second pereiopod in *D. siphonatus*.

Distribution

From False Bay to Durban at depths from 18 to 102 m.

Gynodiastylis Calman, 1911

Generic diagnosis

Antenna 1 small or moderate in size. Exopods present on pereiopods 1 and 2 in both sexes; always absent from pereiopods 3 and 4 of female, but usually present in male. Propodus of pereiopod 1 short, often with a brush of long, stiff setae. Telson seldom longer than telsonic somite, post-anal part no more than a third of total length; not more than two pairs of articulated lateral spines on telson although lateral edges may be incised; terminal spines 0 or 2. Endopod of uropod 1-, 2- or 3-segmented.

Type species

Gynodiastylis carinatus Calman, 1911

Remarks

Calman erected the genus for four species, two from New Zealand and two from Malaya. 42 species are now known, 30 from Australia, seven from Malaya and Japan and five new ones from South Africa. Although morphologically variable in detail, the genus, which is the largest in the family, is quite a distinctive one. In more than half the species, the propodus of the first pereiopod bears a very characteristic brush of long, stiff setae on the expanded distal edge, while in the rest this segment is not expanded distally and bears a few short setae. There appear to be no other accompanying features which would satisfactorily separate the species into two genera, particularly as the telson is very variable (Hale 1946), but not uniformly so in the species possessing or lacking long setae on the first pereiopod.

Distribution of Gynodiastylis

Until the discovery of the five local species described here, it seemed that the genus was confined to a narrow band of the Indo-west-Pacific from Japan through south-eastern Asia to Australia and New Zealand. All of the species from that area are shallow-water inhabitants occurring at depths from 0 to 120 m. Four of the South African species fall within that depth-range, but one, G. profundus, is known from 80 to 680 m, an enormous increase in the known depth-range of the genus and the family.

KEY TO THE SPECIES OF GYNODIASTYLIS DESCRIBED SINCE 1946

In 1946, Hale produced a useful key to all the species known in the genus at the time. His key has not been superceded in any way, but the fourteen species described since 1946 are included in the key below. Consultation of this and Hale's key should allow identifiaction of all known species.

1 Carapace quite smooth with no longitudinal ridges, carinae or depressions, even on pseudorostral lobes 2

\- Carapace with one or more pairs of ridges, carinae or depressions on pseudorostrum or elsewhere 6

2 Endopod of uropod 3-segmented in female (male unknown) . . . . G. platycarpus Gâmo, 1961 - Japan

\- Endopod of uropod (where known) 1-segmented in both sexes . . . 3

3 Telson longer than peduncle of uropod . G. rotundicaudatus Gâmo, 1961 - Japan

\- Telson shorter than peduncle of uropod 4

4 Basis of pereiopod 2 shorter than rest of limb . . . . G. nitidus Harada, 1962 - Japan

\- Basis of pereiopod 2 longer than rest of limb 5

5 Basis of pereiopod 1 longer than rest of limb, propodus with 5-6 setae much shorter than basis . . . . G. fulgidus sp. nov.

- Basis of pereiopod 1 shorter than rest of limb, propodus with 12-18 setae much longer than basis . . . . . . G. curvirostris sp. nov.

6 Irregularities of carapace confined to a single pair of carinae submedially on pseudorostrum; endopod of uropod 1-segmented in both sexes . . . . G. profundus sp. nov.

- Carapace with carinae, ridges or depressions other than those on pseudorostrum; endopod of uropod 2-segmented in male (where known) and usually 2-segmented in female 7

7 Carapace with at least five pairs of well-defined longitudinal ridges or carinae, some of which may be short 8

- Carapace with no more than three pairs of often ill-defined longitudinal ridges or carinae 11

8 Carapace deeply concave middorsally between a pair of sharp, raised dorsolateral carinae . . . . G. sulcatus sp. nov.

- Carapace convex middorsally, with or without a pair of sharp dorsolateral carinae 9

9 Endopod of uropod 2-segmented in both sexes; anterolateral part of carapace with a depressed area, quite devoid of ridges, running back from antennal notch for more than half length of carapace . . . 10

- Endopod of uropod 1-segmented in female, 2-segmented in male; anterolateral part of carapace not depressed but with several ridges in male, slightly depressed but with a single, short dorsoventral ridge in female . . . . G. lineatus sp. nov.

10 Carpus of pereiopod 1 longer than basis; telson as wide as long; peduncle of uropod very stout . G. anguicephalus Harada, 1962 - Japan

- Carpus of pereiopod 1 shorter than basis; telson one and a half times as long as wide; peduncle of uropod slender . . . . G. tubicolus Harada, 1962 - Japan

11 Telson about one and a half times as long as wide, subequal in length to telsonic somite 12

- Telson hardly longer than wide, shorter than telsonic somite . . 13

12 Telson less than half length of peduncle of uropod; basis of pereiopod 1 as long as next four segments together; basis of pereiopod 2 of adult male nearly as wide as long . G. ineptus Hale, 1951 - Australia

- Telson more than half length of peduncle of uropod; basis of pereiopod 1 as long as next three segments together; basis of pereiopod 2 of adult male more than twice as long as wide . . . . G. vicarius Hale, 1951 - Australia

13 Propodus of pereiopod 1 with a brush of long, stiff setae; first segment of endopod of uropod twice as long as second . . . . G. milleri Jones, 196 - New Zealand

- Propodus of pereiopod 1 with one short seta; segments of endopod of uropod subequal in length . . . G. mundus Hale, 1951 - Australia

Gynodiastylis sulcatus sp. nov.

Figs 3 - 4

Records

NIWR 30°S 30°E 60-86 m 1 adult ♂, 1 ♂, 2 ovig. ♀♀, 4 ♀♀, 1 juv. (4 records)

Holotype

Ovigerous female, in the South African Museum, SAM-A15724, collected by the NIWR, 24 May 1973. Type locality: 74 m, off Hibberdene, near Durban (30°37'S 30°40'E). NIWR station number "Coast 6/P3".

Description

Ovigerous female, holotype, length 2,7 mm. Integument translucent with small, slightly crystalline reticulations. Carapace (Fig. 3A) not much longer than deep, concave middorsally between a pair of sharp dorso-

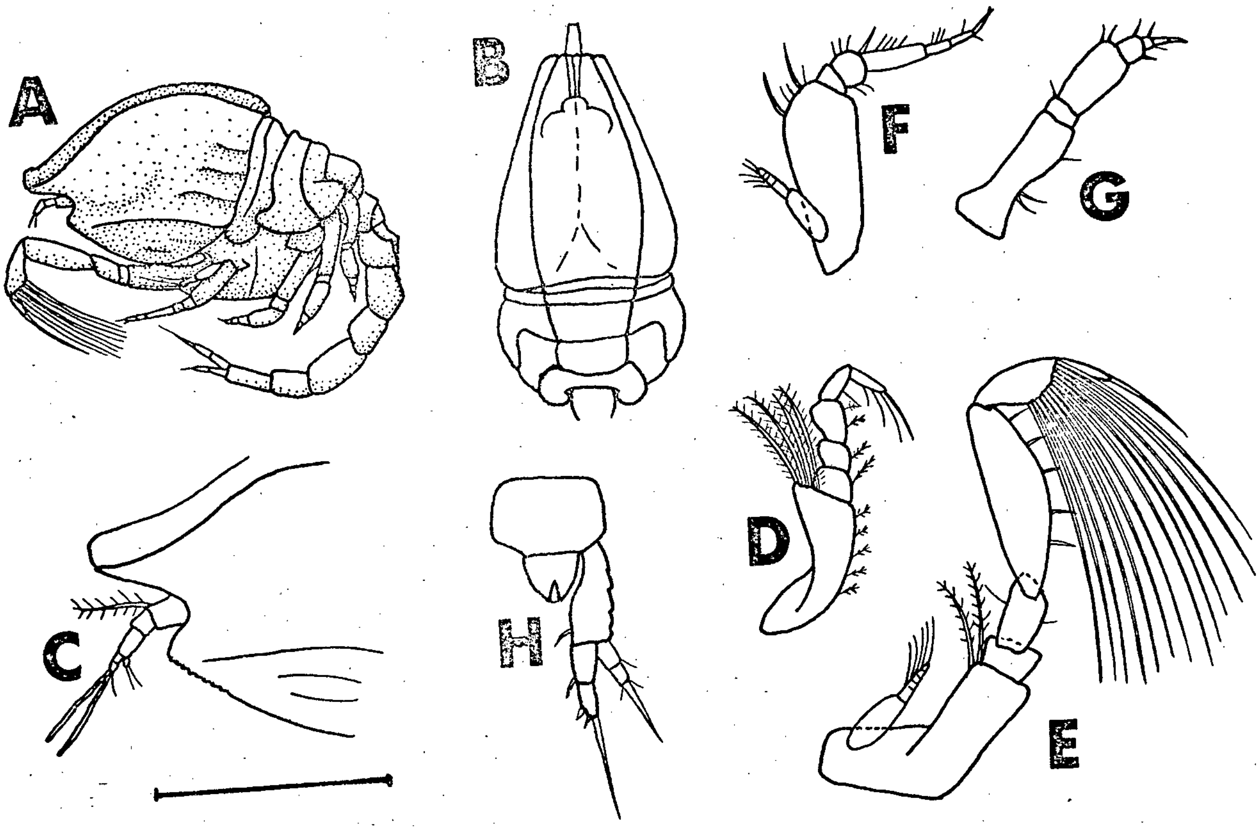

Fig. 3. Gynodiastylis sulcatus sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view of carapace. C. Detail of anterior tip of carapace. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 4. H. Uropod and telson.

Scale line = 1 mm for A, B; 0,5 mm for C-H.

lateral carinae. Sides of carapace slightly convex with three short longitudinal ridges on posterior third; below these a long, sharp ventro-lateral carina extending almost entire length of carapace. Antennal notch distinct, minutely serrated behind obtuse anterolateral angle. Carapace in dorsal view (Fig. 3B) about one and a third times as long as wide. Eye-lobe small, eyeless. Pseudorostral lobes with a pair of short, sharp carinae running from anterior edge to eyelobe.

First two pedigerous somites narrow, third very wide. Cephalothorax slightly longer than abdomen. First three abdominal somites slightly excavate dorsally, the rest cylindrical. Marsupium bearing one very large egg.

Antenna 1 (Fig. 3C) fairly small, basal segment largest. Flagellum 2-segmented, accessory flagellum minute and 1-segmented.

Basis of maxilliped 3 (Fig. 3D) widened distally, shorter than remaining segments together.

Basis of pereiopod 1 (Fig. 3E) angled, about half as long as remaining segments together. Ischium wider than long; carpus very large, subequal in length to basis and slightly flattened; propodus less than half length of carpus with 13 long, stout curved setae on widened distal edge; dactyl small. Exopod small with short flagellum. Basis of pereiopod 2 (Fig. 3F) large and stout, subequal in length to rest of limb. Exopod small. Pereiopods 3, 4 (Fig. 3G) and 5 similar; basis stout, subequal in length to rest of limb; merus very large; last three segments very short.

Telsonic somite (Fig. 3H) wider than long, telson semicircular. Peduncle of uropod about twice length of telson, serrated on outer edge. Exopod two-thirds length of endopod, both with two subequal segments and one long terminal spine.

Adult male, length 2,7 mm, from Natal. As female, except as follows: carapace (Fig. 4A) longer and shallower, anterolateral angle better developed. Sides of carapace parallel in dorsal view, pseudorostrum protruding slightly anteriorly (Fig. 4B). First pedigerous somite hardly

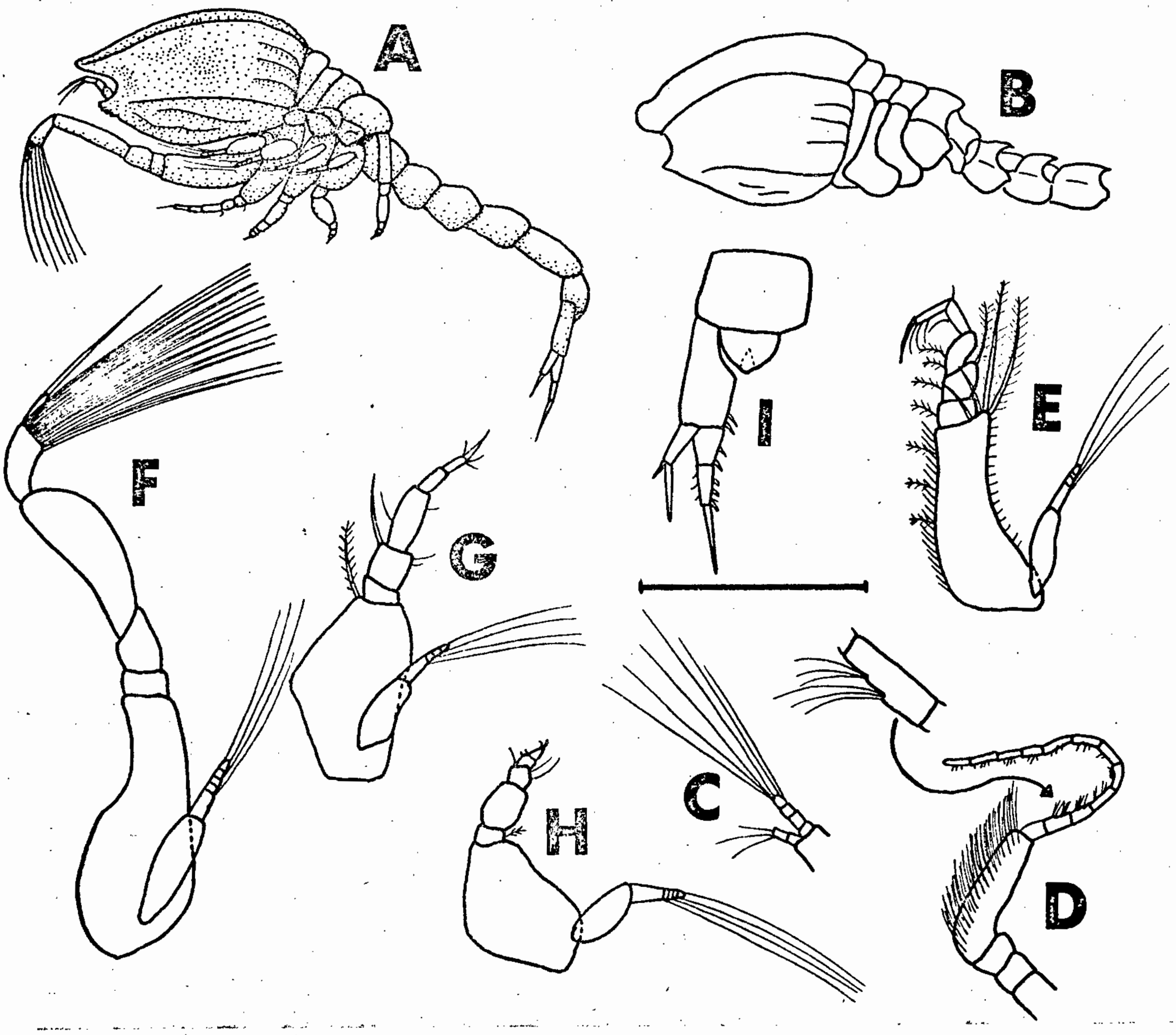

Fig. 4. Gynodiastylis sulcatus sp. nov.

Adult male. A. Lateral view. B. Dorso-lateral view. C. Detail of tip of antenna 1. D. Antenna 2. E. Maxilliped 3. F. Pereiopod 1. G. Pereiopod 2. H. Pereiopod 4. I. Uropod and telson.

Scale line = 1 mm for A, B; 0,5 mm for C-I.

visible, rest narrower and carinate dorsolaterally.

Second segment of antenna 1 slightly longer, flagellum (Fig. 4C) 4-segmented and accessory flagellum 2-segmented. Antenna 2 (Fig. 4D) with short, 12-segmented flagellum. Basis of maxilliped 3 (Fig. 4E) longer, stouter and not angled. Bases and exopods of pereiopods 2 (Fig. 4G) to 4 (Fig. 4H) much wider, merus of pereiopods 3 and 4 smaller. Basis and carpus of pereiopod 4 slightly smaller than that of pereiopod 3, merus slightly stouter.

Peduncle of uropod (Fig. 4I) not serrated. Exopod shorter and 1-segmented.

Length

Adult male 2,7 mm

Ovigerous female 2,7 mm

Remarks

The only other species in the genus having a distinct middorsal concavity on the carapace is G. bicristatus Calman, 1911 from Siam and Japan. G. sulcatus has three minor and one major longitudinal ridges on the carapace below the dorsolateral carina whereas the sides of the carapace are quite smooth in G. bicristatus. The uropods also differ: in G. bicristatus the exopod is 2-segmented in both sexes and the first segment is much shorter than the second. In G. sulcatus the exopod is 1-segmented in the male and the segments in the female are subequal in length.

Distribution

Known from the Natal between Port Shepstone and Hibberdene at depths from 60 to 86 m.

Gynodiastylis curvirostris sp. nov.

Fig. 5

Records

NIWR 31°S 30°E-30°S 30°E 37-75 m 1 adult ♂, 3 ovig. ♀♀, 2 ♀♀, 1 juv. (4 records)

Holotype

Adult male, in the South African Museum, SAM-A15725, collected by the NIWR, 19 July 1972. Type locality: 72 m, south of Durban (31°04'S 30°19'E). NIWR station number 2/36.

Description

Adult male, holotype, length 2,6 mm. Integument smooth, translucent, with fairly large reticulations (a patch illustrated in Fig. 5H). Carapace (Fig. 5A) more than twice as long as deep; pseudorostrum curved strongly downwards in a smooth arch. Anterolateral angle and antennal notch wanting. As female (Fig. 5I) in dorsal view. Carapace distinctly longer than free pedigerous somites together. Abdominal somites subcylindrical, cephalothorax and abdominal subequal in length.

Antenna 1 (Fig. 5B) small, first segment shorter than next two together; flagellum 3-segmented and accessory flagellum 1-segmented. Segments of antenna 2 rather long, each with two sets of long setae.

Basis of maxilliped 3 (Fig. 5C) wider proximally than distally, longer than rest of limb. Ischium short and wide, remaining segments slender.

Basis of pereiopod 1 (Fig. 5D) longer than next three segments together; exopod large. Ischium and merus subequal in length; carpus elongate, more than one and a half times length of ischium and merus together with three fine spines on lower edge; propodus half length of carpus with twelve very long serrate setae. Pereiopod 2 (Fig. 5E) relatively large, basis stout. Ischium very short, merus and carpus each longer than preceding segment. Propodus and dactyl subequal in length, dactyl with a row of

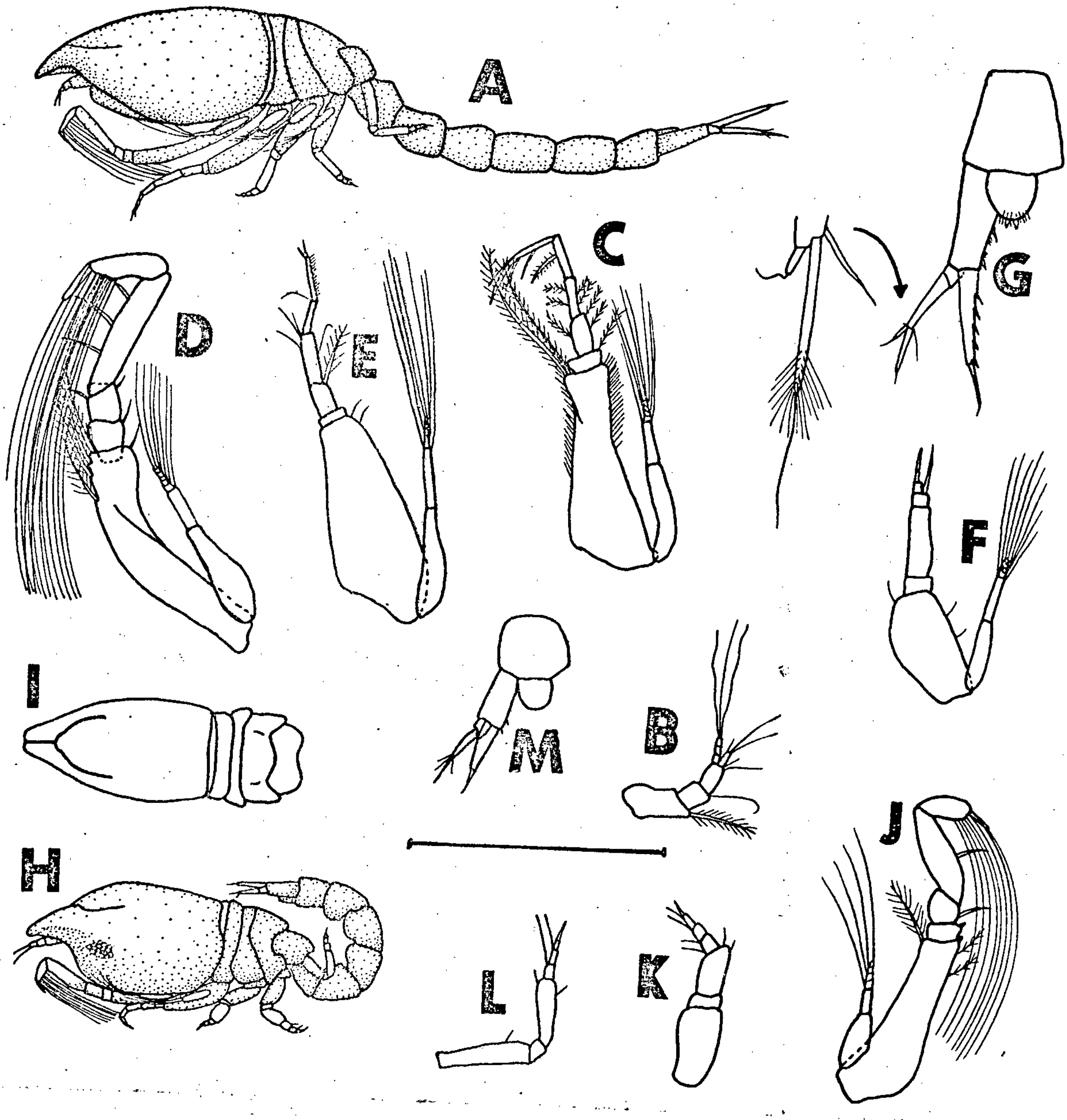

Fig. 5. Gynodiastylis curvirostris sp. nov.

Adult male. A. Lateral view. B. Antenna 1. C. Maxilliped 3. D. Pereiopod 1. E. Pereiopod 2. F. Pereiopod 3. G. Uropod and telson.

Ovigerous female. H. Lateral view. I. Dorsal view of carapace. J. Pereiopod 1. K. Pereiopod 3. L. Pereiopod 5. M. Uropod and telson.

Scale line = 1 mm for A, B, H; 0,5 mm for C-G, I-M.

very small spines on lower edge. Pereiopods 3 (Fig. 5F) and 4 similar, exopods present. Basis wide and stout, ischium short; carpus almost as long as basis; last three segments small. Pereiopod 5 much narrower than pereiopod 3, especially the basis.

Telsonic somite (Fig. 5G) longer than wide. Telson semicircular with a few fine hairs and one pair of small spines terminally. Peduncle of uropod twice length of telson, stout, with two small spines and several fine hairs on inner edge. Endopod 1-segmented. Complex spines at tip of exopod illustrated.

Ovigerous female, length 1,8 mm (NIWR station number "coast 4/Q3"). As male, except as follows: carapace (Fig. 5H) shorter and deeper; pseudorostrum less curved. Eyelobe (Fig. 5I) very shallow; carapace in dorsal view tapering smoothly anteriorly.

Flagellum of first antenna 2-segmented. Maxilliped 3 lacking exopod, basis longer than rest, carpus and propodus wider. Basis of pereiopod 1 (Fig. 5J) slightly longer, carpus slightly shorter. Pereiopods 3 (Fig. 5K) to 5 (Fig. 5L) similar, basis narrower and carpus shorter and stouter; last three segments subequal in length. Pereiopod 5 narrower.

Telsonic somite about as wide as long, telson small and semicircular. Endopod stouter with a single terminal spine. First segment of exopod stouter than second.

Length

Adult male 2,6 mm

Ovigerous female 1,8 - 2,4 mm

Remarks

G. curvirostris falls in the group of species in which the carapace is very smooth and evenly-rounded and the propodus of pereiopod 1 is setose. Most of these species have the endopod of the uropod 2- or 3-segmented, but G. curvirostris may be distinguished from those in which this ramus is

1-segmented as follows: in G. rotundicaudatus Gamo, 1961 the telson is longer than the peduncle of the uropod; in G. nitidus Harada, 1962 the basis of the second pereiopod is shorter than the rest of the limb; in G. similis Zimmer, 1914 the endopod of the uropod is 2-segmented in the female and the uropod is very short in both sexes; in G. fulgidus sp. nov. the basis of pereiopod 1 is longer than the rest of the limb, while the setae on the propodus are much shorter and more sparse, and the pseudorostrum is hardly bent downwards.

Distribution

Off Durban from 37 to 75 m.

Gynodiastylis profundus sp. nov.

Fig. 6

Records			adult ♂	♂	ovig. ♀	♀	juv.	total	no. of records
SST	35°S 22°E	200 m			1	1		2	1
SM	27-28°S 32°E	550-680 m	5	1	3	5	1	15	2
NIWR	29°S 31°E-30°S 30°E	80-94 m		1		1		2	1

Holotype

Ovigerous female, in the South African Museum, SAM-A15726, collected by the South African Museum, 22 May 1976. Type locality: 550 m, in the southern Mocambique Channel (27°59'S 32°40'E). SAM station number SM 86.

Description

Ovigerous female, holotype, length 4,6 mm. Integument translucent, finely and lightly striated. Carapace (Fig. 6A) twice as long as and slightly wider than deep, smoothly arched dorsally. Anterolateral angle rounded, obtuse. Antennal notch very shallow. Pseudorostrum (Fig. 6B) fairly long with a single pair of transparent, keeled submedian carinae running from level of eyelobe to anterior tip.

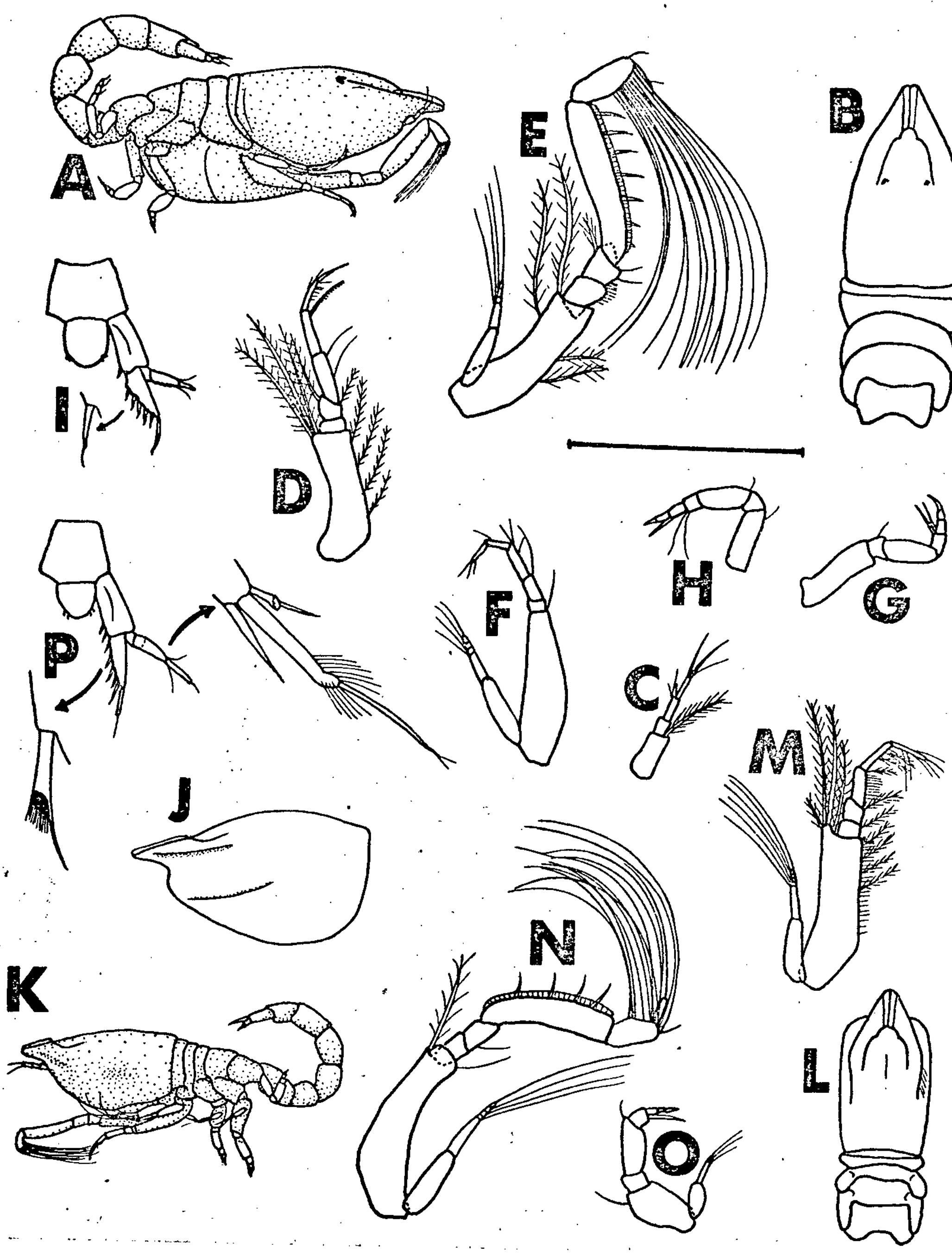

Fig. 6. Gynodiastylis profundus sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Pereiopod 5. I. Uropod and telson. J. Lateral view of carapace of specimen from Natal.

Adult male. K. Lateral view. L. Dorsal view of carapace. M. Maxilliped 3. N. Pereiopod 1. O. Pereiopod 3. P. Uropod and telson.

Scale line = 2 mm for A, B, J-L; 1 mm for C-I, M-P.

First pedigerous somite very narrow, next four subequal in length. Abdominal somites subcylindrical, abdomen subequal in length to carapace.

Antenna 1 (Fig. 6C) small, first segment subequal in length to next two. Both flagella small and 1-segmented.

Maxilliped 3(Fig. 6D) rather long, basis almost rectangular, shorter than remaining segments together. Ischium and merus short, carpus and propodus somewhat elongate, subequal in length.

Basis of pereiopod 1 (Fig. 6E) subequal in length carpus. Transparent, flanged lower edge of carpus with seven fine setae. Propodus stout with twelve long, fine serrate setae reaching back beyond distal tip of basis. Pereiopod 2 (Fig. 6F) fairly small, basis longer than rest of limb. Last three segments subequal in length. Pereiopods 3 (Fig. 6G) and 4 similar, merus subequal in length to last three segments together. Pereiopod 5 (Fig 6H) reflexed dorsally. Basis longest, last three segments subequal in length.

Telsonic somite (Fig. 6I) wider than long. Telson short, as wide as long, with two pairs of very small teeth laterally. Uropods very short, peduncle subequal in length to telson. Endopod slightly longer than exopod, 1-segmented and much wider proximally than distally with several short compound setae on inner edge.

Note: a single ovigerous female (Fig. 6J) from NIWR station 6/03 bears two extra pairs of short, sharp carinae below the eyelobe, but in all other respects seems to be similar to the holotype.

<u>Adult male</u>, <u>paratype</u>, length 3,7 mm. As female, except as follows: carapace (Fig. 6K) shorter, slightly compressed midlaterally and below pseudorostrum. Sides parallel in dorsal view.(Fig. 6L).

Third segment of antenna 2 strongly setose, segments of flagellum about twice as long as wide. Basis of maxilliped 3 (Fig. 6M) larger, distal segments relatively shorter. Basis of pereiopod 1 (Fig. 6N) longer and carpus shorter. Bases of pereiopods 2 to 4 larger and stouter.

Carpus of pereiopods 3 (Fig. 6 O) and 4 longer and much wider than last two segments together.

Telsonic somite (Fig. 6P) longer, telson relatively shorter with posterolateral teeth more evident. Peduncle longer relative to telson. Setae of rami complex.

Length

Adult male 3,5 - 4,2 mm

Ovigerous female 3,7 - 4,6 mm

Remarks

G. profundus is closest to G. carinirostris Hale, 1946 and to G. milleri Jones, 196 , all having a smooth carapace and a pair of submedian carinae on the pseudorostrum. However the endopod of the uropod is 3-segmented in both of the latter, while that of G. profundus is 1-segmented in both sexes.

The variation in sculpturing of the carapace in the ovigerous female mentioned above may be a simple genetic character or may be related to the shallower depth at which the specimen was found.

Distribution

From Still Bay to the southern Mocambique Channel, at depths from 80 to 680 m. This is by far the deepest record for any species in the family, the previous deepest records being about 120 m for two other species of Gynodiastylis from New South Wales.

Gynodiastylis lineatus sp. nov.

Fig. 7

Records

		adult ♂	♂	ovig. ♀	♀	juv.	total	no. of records
SCD 33°S 27°E	84 m			1			1	1
NIWR 29°S 31°E-30°S 30°E	50-103 m	4	2	4	1	3	14	8

Holotype

Ovigerous female, in the South African Museum, SAM-A15727, collected by the NIWR, 12 December 1972. Type locality: 54 m, off Tongaat, north of Durban ($29^{0}34$'S $31^{0}17$'E). NIWR station number 3/A2.

Description

Ovigerous female, holotype, length 3,1 mm. Integument slightly translucent and crystalline. Carapace (Fig. 7A) twice as long as deep with numerous sharp, shallow longitudinal ridges, fading at extreme posterior edge. Two major ridges run entire length of carapace, one dorsolaterally immediately below eyelobe and the second ventrolaterally at level of anterolateral angle; between them is a slight midlateral depression crossed anteriorly by a single dorsoventral ridge and posteriorly by three longitudinal ones. Below lower major ridge are two shorter longitudinal ones, and above the upper one are four, none extending onto eyelobe. Antennal notch very slightly excavated anteriorly, carapace behind this smooth for a short distance. Anterolateral angle inconspicuous, obtuse. Eyelobe (Fig. 7B) wider than long, eyeless. Pseudorostrum short.

Third pedigerous somite very wide. Abdominal somites subcylindrical. Carapace slightly longer than pereion and cephalothorax slightly longer than abdomen. Marsupium large and transparent with eight eggs.

First segment of antenna 1 (Fig. 7C) subequal in length to next two together; flagellum 2-segmented and accessory flagellum 1-segmented.

Basis of maxilliped 3 (Fig. 7D) much wider proximally than distally, highly setose.

Basis of pereiopod 1 (Fig. 7E) subequal in length to next three segments together. Carpus long and flattened and twice length of propodus with eight stout setae on lower edge. Propodus with seven long, stout serrate setae on expanded distal border. Exopod small. Pereiopod 2 (Fig. 7F) small, basis subequal in length to rest of limb. Ischium very short. Merus

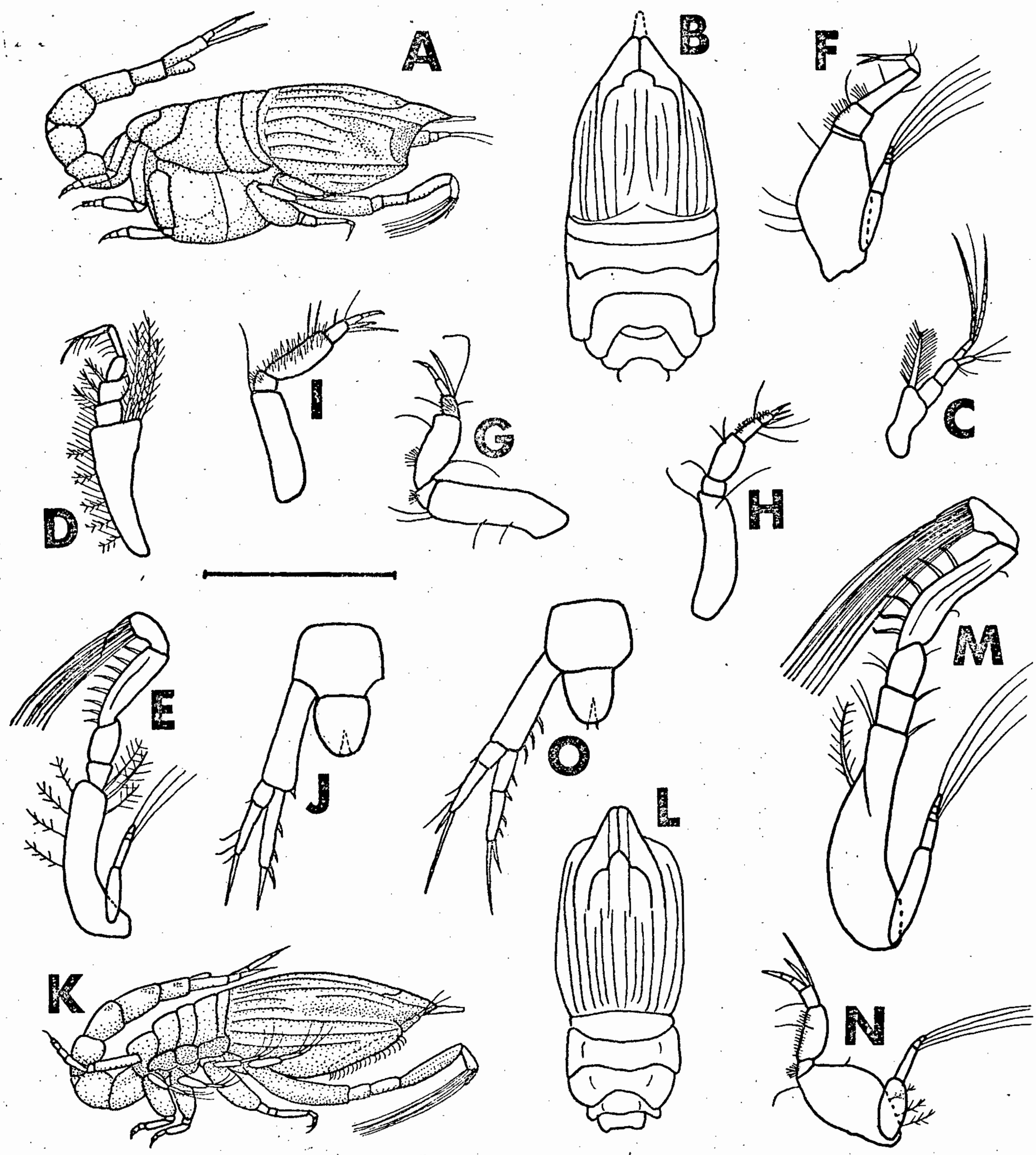

Fig. 7. Gynodiastylis lineatus sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Pereiopod 4. I. Pereiopod 5. J. Uropod and telson.

Adult male. K. Lateral view. L. Dorsal view of cephalothorax. M. Pereiopod 1. N. Pereiopod 2. O. Uropod and telson.

Scale line = 1 mm for A, B, K, L; 0,5 mm for C-J, M-O.

stout, propodus and dactyl short and very flexible. Ischium, merus and/or carpus of pereiopods 2 to 5 with brushes of very fine setae. Pereiopods 3 (Fig. 7G) and 4 (Fig. 7H) similar; merus of pereiopod 3 larger, propodus and dactyl of both small and of pereiopod 3 more slender. Ischium and merus of pereiopod 5 (Fig. 7I) with fine setae on lower edge; otherwise as pereiopod 4.

Telsonic somite (Fig. 7J) slightly wider than long, telson oval. Peduncle of uropod nearly twice length of telson and slightly wider distally. Endopod 1-segmented.

Adult male, length 2,6 mm (NIWR station number 2/33). As female, except as follows: carapace (Fig. 7K) slightly more than twice as long as deep, anterolateral angle rounded, antennal notch much deeper. Longitudinal ridges longer midlaterally with no obvious depression behind antennal notch. Eyelobe (Fig. 7L) as long as wide; pseudorostrum slightly longer with a pair of submedian ridges. Pedigerous somites narrower and strongly flanged laterally.

Flagellum of antenna 1 slightly longer. Segments of antenna 2 short and rounded with long setae; last basal segment visible through wall of carapace with long setae protruding ventrally. Basis of maxilliped 3 slightly stouter. Pereiopod 1 (Fig. 7M) relatively larger with eight setae on propodus. Ischium of pereiopod 2 hardly distinguishable, merus longer and carpus with fine hairs along entire length; exopod slightly larger. Pereiopods 3 (Fig. 7N) and 4 similar, bases much larger; exopods present.

Telson (Fig. 7 O) narrower with a pair of rudimentary spines terminally. Peduncle of uropod less than one and a half times length of telson. Endopod of uropod 2-segmented.

Length

Adult male 2,6 - 2,9 mm

Ovigerous female 2,4 - 3,4 mm

Remarks

This species differs slightly from the others which bear a brush of setae on the propodus of the first pereiopod in that it has only six or seven setae in the brush, while most species have eight to twelve. It forms a group with a number of other species which have the carapace bearing numerous longitudinal ridges, but this is the only one in which the female is known to have the endopod of the uropod unsegmented. Most of the species also have a very deep depression midlaterally on the carapace in both sexes, so that the carapace is almost square in cross-section. It is perhaps most similar to G. costatus Calman, 1911, the female of which differs in the presence of a row of denticles anteriorly on the carapace, and the much larger first antenna, as well as the endopod of the uropod being 2-segmented in both sexes.

Distribution

East London to Natal north of Durban at depths from 50 to 103 m.

Gynodiastylis fulgidus sp. nov.

Fig. 8

Records

			ovig. ♀	♀	juv.	total	no. of records
SST	34^{o}S 21^{o}E	50-80 m	1	2	1	4	2
FAL	34^{o}S 18^{o}E	29-61 m	8	1		9	9

Holotype

Ovigerous female, holotype,length 2,6 mm. Integument thin, shiny, and laterally with small, regularly spaced pits on carapace. Carapace (Fig. 8A) large and smooth, as wide as deep and less than one and a half times as wide as long. Anterolateral angle smoothly rounded, antennal notch obsolete. Pseudorostrum short, truncate anteriorly in

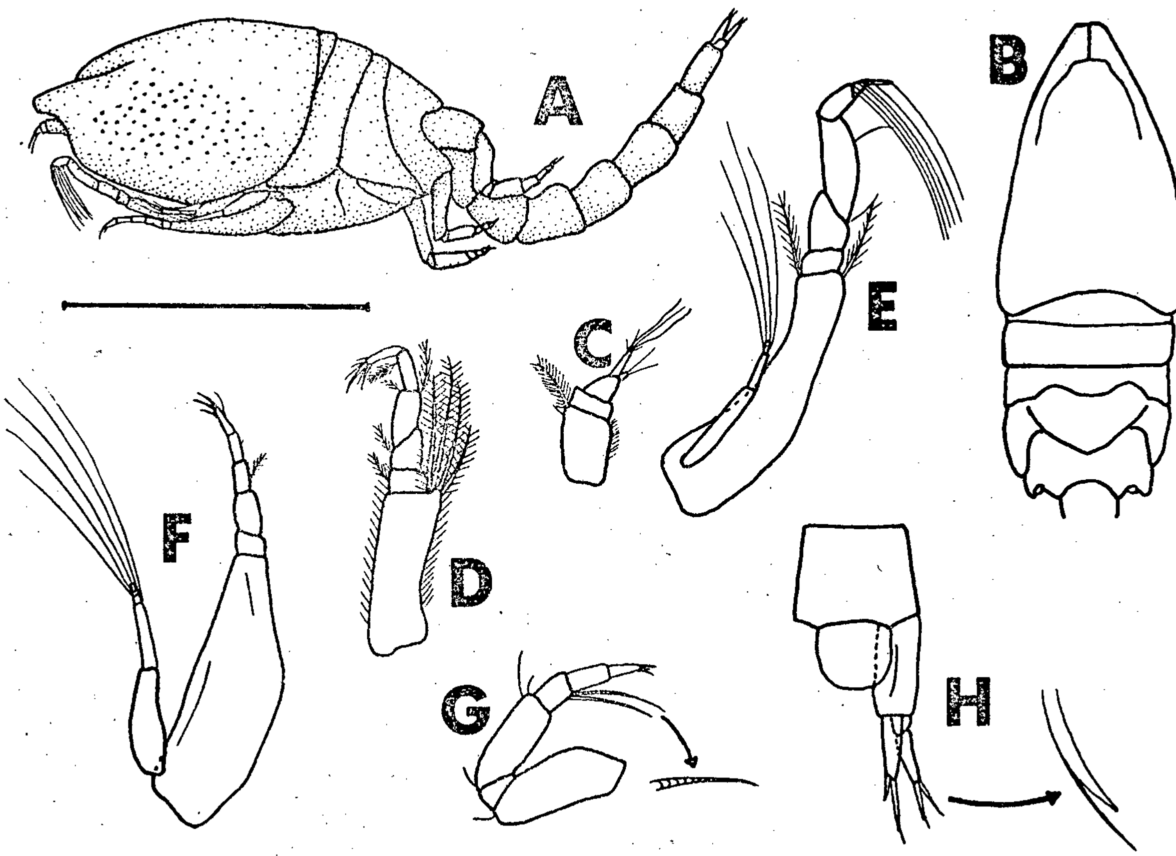

Fig. 8. Gynodiastylis fulgidus sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Uropod and telson.

Scale line = 1 mm for A, B; 0,5 mm for C-H.

lateral view. Eyelobe visible laterally above level of pseudorostrum, dorsally (Fig. 8B) very short and wide.

First pedigerous somite only visible dorsally, second to fourth wide. Abdominal somites subcylindrical, abdomen hardly longer than carapace. Marsupium fairly well-developed.

Descriptions and figures of appendages taken from paratype adult female, length 2,9 mm. Antenna 1 (Fig. 8C) very stout; first segment not much longer than wide and second twice as wide as long. Both flagella 1-segmented.

Basis of maxilliped 3 (Fig. 8D) rectangular, not greatly widened distally and shorter than remaining segments together. Ischium wider than long.

Basis of pereiopod 1 (Fig. 8E) distinctly longer than rest of limb. Exopod fairly small. Carpus unusually short for the genus: one and a half times length of propodus and less than half length of basis. Propodus with five shortish serrate setae reaching back to level of merus. Basis of pereiopod 2 (Fig. 8F) very large, nearly twice length of rest of limb. Remaining segments short and poorly armed. Pereiopods 3 (Fig. 8G), 4 and 5 similar. Basis longer than next two segments together; last three segments relatively large, carpus with a few fine, simple spines and one compound one distally.

Telsonic somite (Fig. 8H) not much wider than long. Telson unarmed, slightly wider than long and two-thirds length of peduncle of uropod. Peduncle stout, unarmed. Endopod 1-segmented, both rami with two slender terminal spines.

The male is unknown.

Length

Ovigerous female 2,4 - 3,0 mm

The brush of setae on the propodus of pereiopod 1 is shorter and more sparse in this species than in any of the others in which it occurs. But since the setae are long, this species must be placed in the group characterised by their possession. Within this group there are three other species which have both a 1-segmented endopod of the uropod and an unsculptured carapace. In G. rotundicaudatus Gamo, 1961, however, the telson is longer than the peduncle of the uropod; in G. nitidus Harada, 1962 the basis of pereiopod 2 is shorter than the rest of the limb, and in G. curvirostris sp. nov. the pseudorostrum is longer and strongly curved, the telson is smaller, the setae on the propodus of pereiopod 1 are much longer and more numerous, the first antenna is more slender and the integument is not pitted.

Distribution

From Still Bay to False Bay at depths from 29 to 80 m.

Haliana gen. nov.

Generic diagnosis

Antenna 1 of moderate size. Exopods entirely absent from thoracic limbs of female. Propodus of pereiopod 1 with a brush of long, stiff setae. Telson short and poorly armed with no post-anal part. Endopod of uropod 2-segmented. Male unknown.

Type species

H. eckloniae sp. nov. (by monotypy).

Remarks

Although the species for which this genus is erected is very similar to a large number of species of Gynodiastylis (and in particular G. sulcatus sp. nov.), its lack of exopods on all the thoracic limbs excludes it from this genus. Despite the fact that the existance of this species throws some doubt on the validity of using the number of exopods on the thoracic limbs in the female as a genuine generic character, Gynodiastylis is such a well-known and discrete genus that it would be inappropriate to place this species in it, with a consequent enlargement of the generic diagnosis. For this reason, the new genus is erected, although the author is aware that it does not appear to be a "good" one. In defence, however, all three female individuals lack thoracic exopods, so that the genus is not erected on the basis of a single abnormal individual.

Distribution of Haliana

The single sample was obtained from a depth of 4 m at Oudekraal on the Cape Peninsula. It was found in the holdfast of Ecklonia maxima, one of the species of giant kelp growing in abundance around the Cape.

Haliana eckloniae sp. nov.

Fig. 9

Records

CP 34°S 18°E 4 m 2 ovig. ♀♀, 1 ♀, 1 juv. (1 record)

Holotype

Ovigerous female, in the South African Museum, SAM-A15729, collected by C.L. Griffiths, 6 December 1974. Type locality: in the holdfast of Ecklonia maxima, 4 m, from Oudekraal, Cape Peninsula (34°58'S 18°21'E). UCT station number CP 837 A.

Description

Ovigerous female, holotype, length 2,8 mm. Integument well calcified and slightly shiny with irregular longitudinal rugosities, especially on sides of carapace and pedigerous somites. Carapace (Fig. 9A) little longer than deep with three very distinct lateral carinae. The first runs dorsolaterally from posterior edge for about two-thirds length of carapace; the second runs anterior to and slightly below this from level of eyelobe around entire anterior margin of flattened pseudorsotrum; the third is

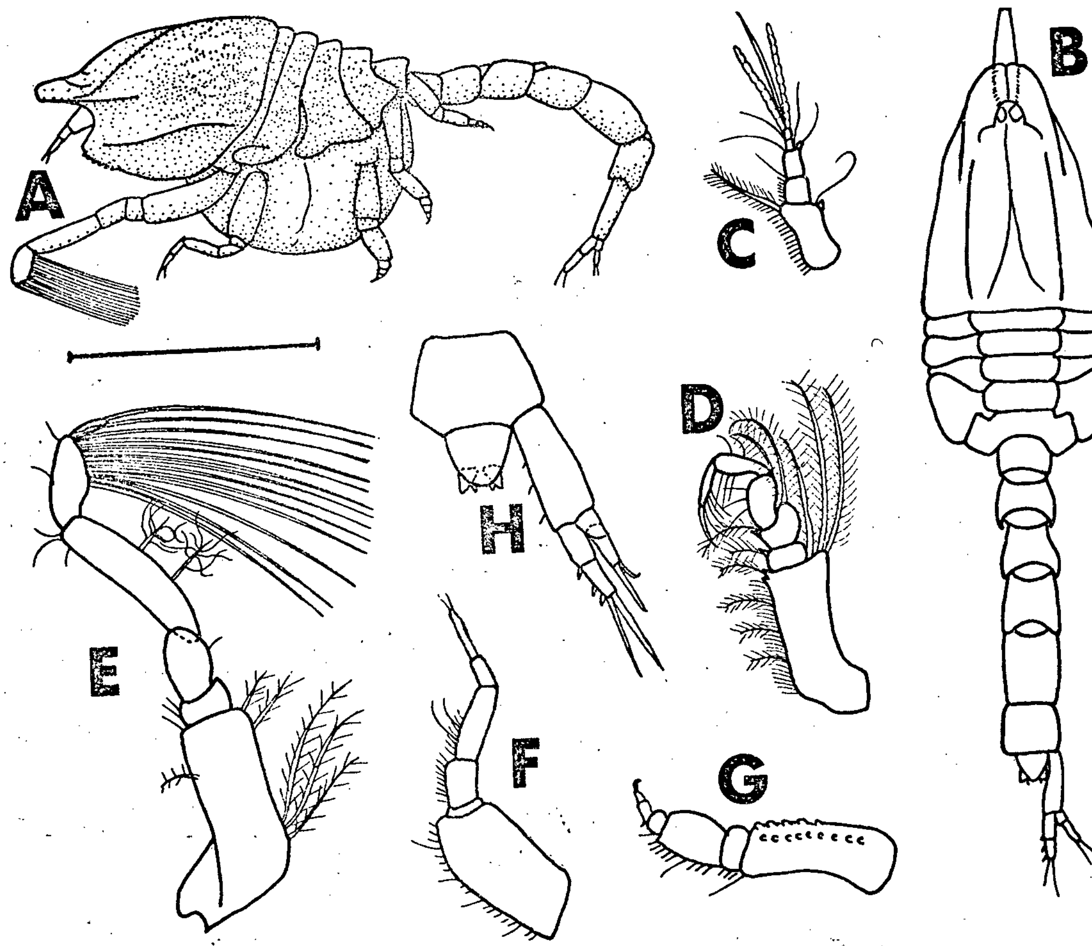

Fig. 9. Haliana eckloniae gen. nov., sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 4. H. Uropod and telson.

Scale line = 1 mm for A, B; 0,5 mm for C-H.

ventrolateral, extending along most of carapace. A fourth indistinct, minutely denticulate carina runs submedially from eyelobe to anterior tip of carapace. Antennal notch well excavated, anterolateral angle rounded with a few denticles below. Pseudorostrum wider than deep. Eyelobe (Fig. 9B) rounded with two lighter, slightly elevated areas (lenses?) but without pigment. Siphon short.

All five pedigerous somites clearly visible and widely flanged laterally, the third widest and longest. Abdominal somites cylindrical; cephalothorax slightly longer than abdomen. Marsupium well-developed.

Antenna 1 (Fig. 9C) short, first segment longer than next two together. Flagellum short and 2-segmented, accessory flagellum minute and 1-segmented.

Basis of maxilliped 3 (Fig. 9D) wide and stout with two small incisions distally on median edge. Ischium wider than long, merus slightly expanded.

Basis of pereiopod 1 (Fig. 9E) shorter than next three segments together. Ischium short and wide; merus about as wide as long; carpus elongate and subcylindrical; propodus about half length of carpus with 13 long, sharp, serrate setae distally on lower edge; dactyl short. Pereiopod 2 (Fig. 9F) small, 7-segmented. Basis subequal in length to next four segments together. Ischium very short; carpus subequal in length to ischium and merus together; dactyl slender and longer than propodus. Pereiopods 3 and 4 (Fig. 9G) similar, with two rows of small protuberances on basis; merus large and stout. Last three segments very short and stout. Pereiopod 5 slightly smaller.

Telson (Fig. 9H) semicircular in dorsal view and shorter than telsonic somite, with one pair of very small spines subterminally. Anal valves open in specimen figured. Peduncle of uropod nearly twice length of telson and one and a half times as long as endopod; poorly armed. Exopod two-thirds length of endopod, segments almost subequal in length. Endopod stouter, 2-segmented; segments subequal in length.

The *male* is unknown.

Length

Ovigerous female 2,8 mm

Remarks

See "Remarks" for the genus.

Distribution

See "Distribution" for the genus.

DISTRIBUTION OF THE GYNODIASTYLIDAE

The family is confined to shallow waters in the Indo-west-Pacific region, with species extending from the southern and south-eastern coasts of South Africa to Australia, New Zealand, south-east Asia and Japan. This pattern of distribution is unusual for marine organisms, since many of the groups confined to the Indo-west-Pacific are widely distributed within that region. But no shallow-water collecting has been done off the tropical east coast of Africa, virtually none in the Arabian Sea and not very much in India. Thus further collecting in these areas should provide a considerable number of species, and probably other genera, of the family. This hypothesis is supported by the fact that Kurian (1954) referred to *Gynodiastylis* a single damaged specimen from the Palk Strait between India and Ceylon.

That the family is a warm-termperate one is clear from the fact that more than 80% (47 out of 56) of species occur between 40°N and 40°S. Of the remainder, less than 10% (5 species) occur only in Tasmania or New Zealand between about 40 and 43°S and four are found both in Tasmania and New South Wales between 33 and 43°S. None are known from latitudes higher than 43°.

Three genera are endemic to Australia (*Zimmeriana*, *Sheardia* and

Allodiastylis), one to South Africa (Haliana), one is known from both Australia and South Africa (Dicoides) and one (Gynodiastylis)is widespread throughout the range.

All but one of the species are confined to depths of 120 m or less, and three are known intertidally. This again suggests a very strong dependence on warm water. The single deep-water species, Gynodiastylis profundus sp. nov. occurs at depths from 94 to 680 m in Natal and the southern Mozambique Channel. Possibly other species remain to be found in deeper waters where the temperature remains reasonably high on the bottom, such as in the Indian Ocean.

DISTRIBUTION OF THE SOUTHERN AFRICAN GYNODIASTYLIDAE

The fact that no species have been found on the cool west coast of southern Africa is a further indication that the family is a warm-water one. Three of the local species (Gynodiastylis sulcatus, G. lineatus and G. curvirostris) are known only from Natal at depths of less than 104 m, where temperatures do not drop much below 16°C throughout the year. Two species are found in False Bay and eastwards, G. fulgidus as far as Still Bay and Dicoides siphonatus as far as Durban.

The interesting fact about the distribution of G. profundus is its relatively great depth range. It occurs fairly frequently from Still Bay at 200 m to the southern Mozambique Channel at 550 to 680 m, and almost certainly extends well to the north of this region.

Haliana eckloniae is one of the few species in the family to be found in relatively cold waters (about 10-12°C). It is known only from the west coast of the Cape Peninsula, from the holdfasts of kelp, which habitat is known to support only two other species of Cumacea, probably members of the genus Nannastacus. Haliana is monotypic and would appear to be endemic.

No species in the family is known from the west coast north of the

Cape Peninsula, not even in the warm and relatively sheltered waters of Langebaan Lagoon and Saldanha Bay, which sometimes harbour south coast species which apparently cannot exist in the colder, open waters outside.

Beyond this it is not possible to draw general conclusions from depth records and distribution along the coast. Although seven species are now known from these waters, they are represented by only 102 individuals from 44 records. This gives a figure of 2,3 individuals per record and a specimen : species ratio of 14,5. Thus the density of specimens is very low while the species diversity is fairly high and comparable with that of the Lampropidae (15,7).

FAMILY DIASTYLIDAE Sars, 1879

Diagnosis

Flagellum of antenna 2 of male with many short segments and reaching at least to posterior end of thorax. Mandibles normally boat-shaped (widened at base in *Diastyloides*). Branchial filament divided into numerous leaflets. Exopods on maxilliped 3 and pereiopods 1 to 4 in male. Exopods present in female on maxilliped 3 (except in *Paradiastylis*) and on pereiopods 1 and 2; rudimentary on or absent from pereiopods 3 and 4. Male with two pairs of pleopods (none in *Atlantistylis*); no outer process to inner ramus. Telson variable, usually large, often with a long post-anal part or short and poorly armed; bearing one pair of terminal spines or none. Uropods usually long and slender, endopod 1-, 2- or 3-segmented.

Type genus

Diastylis Say, 1818

Remarks

With more than 200 species, this family is one of the largest in the order. A number of genera are based on one particular character and are quite distinctive. These are *Atlantistylis*, which apparently lacks pleopods in the adult male; Diastyloides with mandibles broad at the base; Paradiastylis which lacks exopods on maxilliped 3 of the female; Dic with the ischium of maxilliped 3 remarkably enlarged, and Oxyurostylis which lacks terminal spines on the telson but is otherwise similar to Diastylis.

The genera Anchistylis, Anchicolurus and Colurostylis are closely allied and are easily distinguished by the short, unarmed telson.

Several of the remaining genera are characteristic but others are not, and there are many intermediate species whose generic positions are doubtful. The majority of species have a "Diastylis facies" including: a lightly calcified integument, often with denticles or spines; short, fairly pointed, pseudorostral lobes; a serrate or spinose ventrolateral edge to the carapace; a short pereion and a subcylindrical abdomen. The main generic distinctions are based on characters of the telson, the degree of expansion of the bases of the first four pairs of pereiopods in the adult male and the degree of separation of the second and third pereiopods in the ovigerous female. Clearly these last two characters, while obvious in adult specimens, are not satisfactory since many species are based on immature individuals or those thought incorrectly to be adult.

However the four genera based on these characters are reasonably distinct. Diastylopsis and Brachydiastylis are characterised by the wide separation of pereiopods 2 and 3 in the ovigerous female, while Eklepto-stylis and Dimorphostylis have greatly expanded bases of the first four pairs of pleopods in the adult male.

It is the genera Diastylis, Leptostylis and Makrokylindrus which are problematical. While most species of these three genera conform to the "Diastylis facies", there are exceptions, particularly in Makrokylindrus. Leptostylis has been diagnosed as "like Diastylis but with the telson short and the body slender" and Makrokylindrus as "like Diastylis but with the telson very large". When these genera were erected such diagnoses were quite adequate, but since then so many intermediate species have been found that there is now an almost continuous series of species from Leptostylis through Diastylis to Makrokylindrus. The species obviously form a cline and should perhaps be considered as one genus, but such a genus would be so large as to be unsatisfactory. Thus clear dividing lines are needed to separate the genera. Since the main characters used so far concern the telson, different distinguishing features should be sought. In practice this is only possible in some cases.

In Leptostylis, particularly in adult males, the third segment of the first antenna is always very large, clubbed, highly setose and quite different from that of the female. The flagellum of the second antenna is short and reaches no further than the end of the thorax. Further, the telson is usually shorter than and never more than a quarter longer than the telsonic somite. The combination of these characters adequately diagnoses the genus, although absolute determination is possible only in the presence of adult males, which is a common problem in any sexually dimorphic group.

Distinction between Diastylis and Makrokylindrus is less simple. Makrokylindrus incorporates many of the features found in other genera, and it is only in the large telson that it is distinctive. It is characteristically a deep-water genus, and it is possible that a large telson is such an advantage that it has been acquired by representatives of different genera as they have descended to the depths. If so, Makrokylindrus is polyphyletic.

The dorsal fusion of the third and fourth pedigerous somites was used by Bacescu (1961a) to distinguish his subgenus Coalescuma, but as there are species in the subgenus Makrokylindrus which are very similar in all other respects, it would not help to elevate Coalescuma to generic rank.

The subgenus Vemakylindrus Bacescu, 1961b has characteristically long pseudorostral lobes. Several species of Diastylis share this feature and it is proposed to elevate Vemakylindrus to generic rank and include these species.

Three groups of species remain; one group is typically Diastylis, a second group is typically Makrokylindrus and a third is intermediate between the two. It is proposed to reinstate Stebbing's (1912) genus Adiastylis to accommodate this third group. But adequate generic diagnoses must be provided for each of the genera.

The type species of the genus Diastylis is D. arenarius Say, 1818, but Say's description is incomplete and could apply to virtually any adult male cumacean with a telson. The type material appears to have been lost, and D. arenarius was not described in Stebbing's (1913) monograph. The generic characters of the telsonic region of Diastylis have never been adequately defined, and in order to do this a new type species must be selected.

Cuma rathkei Kröyer, 1841 was referred by Bate (1856) to Diastylis since the genus Cuma was preoccupied, and D. rathkei appears to be the first species other than D. arenarius to have been assigned to the genus Diastylis, since it has page priority over D. lucifer (Kröyer, 1841). D. lucifer (Kröyer, 1841) and D. tumidus (Liljeborg, 1855) were added by Danielssen in 1859, D. cornutus (Boeck, 1864) and D. echinatus by Bate in 1865 and D. rugosus by Sars in 1865. All of these early additions to the genus are very similar to D. rathkei so that a generic diagnosis based on D. rathkei is adequate for the genus. The pre-anal part of the telson (i.e. that part anterior to the beginning of the anal valves) is subequal in length to or shorter than the post-anal part. In addition the telson is longer than the telsonic somite and bears lateral spines along the entire post-anal part.

In contrast, Makrokylindrus may be characterised by having the pre-anal part of the telson at least twice the length of the post-anal part and often much more. The telson is longer than the last two abdominal somites together. When lateral spines are present, they are confined to the extreme tip of the post-anal part.

In Adiastylis the pre-anal part of the telson is at least as long as the post-anal part but less than twice as long. The telson is seldom as long as the last two abdominal somites together and the lateral spines are few in number and extend down most of the post-anal part.

It should be stressed that any major generic diagnosis which depends on relative proportions of parts of an organism is less useful and more open to error than those which depend on distinctive individual characters. But in the present case the situation was so obviously unsatisfactory that it is felt that any reasoned attempt to distinguish the genera must be an improvement.

Adaptive features

In contrast with the gynodiastylids, the diastylids are often large, slender, rather attenuated animals in which reduction of appendages is minimal. Pleopods and exopods are well-developed, indicating that the animals are relatively mobile. The respiratory surfaces are enlarged by numerous gill filaments, allowing enhanced gas exchange, which in turn allows a larger body size. Thus the average length of the diastylids is about four times that of the gynodiastylids and the greatest length is 35 mm. The majority of diastylids appears to be filter-feeders (Dennell, 1934, Zimmer, 1932, Krüger, 1940). In these forms the distal segments of the first pereiopods are slender and often very long, appearing sensory rather than manipulative in function. The uropods and telson are usually both long and well-armed, presumably for cleaning the extensive setae on the anterior limbs. Finally, sexual dimorphism is extremely well-developed and the males appear to be far more mobile than the females.

KEY TO THE GENERA OF THE DIASTYLIDAE

Virtually any construction of a key to this family depends initially on characters confined to one sex. In this key other, less rigorous, characters have also been included to assist in the placing of single individuals.

1 No pleopods in adult male; telson very short, as deep as long, with a single pair of terminal spines . . . Atlantistylis Reyss, 1975

- Two pairs of pleopods in adult male; telson variable but seldom as deep as long 2

2 Mandibles broad at base; basis of pereiopod 2 usually abruptly wider than ischium with one or two large teeth at lower distal corner . . . . Diastyloides Sars, 1900

- Mandibles narrow at base; basis of pereiopod 2 narrow distally or abruptly wider than ischium but without one or two strong teeth at lower distal corner 3

3 Maxilliped 3 of female without exopod . Paradiastylis Calman, 1904

- Maxilliped 3 of female with exopod 4

4 Third (and often fourth and fifth) pedigerous somites produced posteriorly even in male, usually much wider at ventrolateral edge than second so that in ovigerous female pereiopods 3 and 4 are directed posteriorly and widely separated for pereiopod 2; fifth pedigerous somite usually dorsal to fourth 5

- Third and fourth pedigerous somites not produced or directed posteriorly, seldom wider at ventrolateral edge than second; pereiopods 3 to 5 usually directed ventrally and in ovigerous females not widely separated from pereiopod 2; fifth pedigerous somite seldom dorsal to fourth . 10

5 Ischium of maxilliped 3 enormously expanded . . . Dic Stebbing, 1910

- Ischium of maxilliped 3 not expanded 6

6 Telson with at least one pair of lateral spines (usually several); always more than half length of peduncle of uropod and usually longer than telsonic somite 7

- Telson with no lateral spines; usually less than half length of peduncle of uropod and never longer than telsonic somite 8

7 Female with rudimentary exopods on pereiopods 3 and 4; basis of pereiopod 2 narrow in male; pseudorostrum short and not upturned; telson usually with four or more pairs of lateral spines. Diastylopsis S.I. Smith, 1880

- Female without exopods on pereiopods 3 and 4; basis of pereiopod 2 wide in male; pseudorostrum long and upturned; telson with no more than four pairs of lateral spines . . . Brachydiastylis Stebbing, 1912

8 Pleopods uniramous with stout, modified setae; peduncle of uropod less than twice length of telsonic somite . . . Anchistylis Hale, 1945

- Pleopods biramous with normal plumose setae; peduncle of uropod twice length of telsonic somite or more 9

9 Endopod of uropod 3-segmented; basis of maxilliped 3 more than twice and of pereiopod 1 almost twice length of remaining segments together . . . . Anchicolurus Stebbing, 1912

- Endopod of uropod 2-segmented; basis of maxilliped 3 less than one and a half times length of remaining segments together and of pereiopod 1 shorter than remaining segments together . Colurostylis Calman, 1911

10 Telson (excluding terminal spines) shorter than telsonic somite or up to a quarter longer than telsonic somite but with no more than three pairs of lateral spines 11

- Telson (excluding terminal spines) one and a quarter times length of telsonic somite or more; if no longer than telsonic somite then with at least four pairs of terminal spines 14

11 Flagellum of antenna 2 of adult male reaching to end of body; basis of pereiopod 2 (and usually of pereiopods 1, 3 and 4) of male very

wide distally; abdomen excluding telson fairly stout and shorter than or subequal in length to cephalothorax; fifth abdominal somite not much longer than fourth or sixth; female usually without exopods on pereiopods 3 and 4 12

- Flagellum of antenna 2 of male not reaching beyond end of pereion; bases of pereiopods 2 to 4 of adult male not especially wide; abdomen excluding telson generally slender and longer than cephalothorax; fifth abdominal somite usually longer than fourth or sixth; female usually with exopods on pereiopods 3 and 4 13

12 Telson of female with about eleven pairs of lateral spines and of male deeply excavated dorsally with five pairs of lateral spines; minute exopods present on pereiopods 3 and 4 of female . Eckleptostylis Stebbing, 1912

- No more than four pairs of lateral spines on telson in either sex; telson of male not excavated dorsally; pereiopods 3 and 4 of female without exopods . . . . Dimorphostylis Zimmer, 1914*

13 Endopod of uropod longer than exopod; pereiopod 2 not very long with propodus much shorter than basis . . . . . Leptostylis Sars, 1869

- Endopod of uropod shorter than exopod; pereiopod 2 very long, propodus longer than basis . . . . Leptostyloides Jones, 1969

14 Pseudorostrum much more than half as long as rest of carapace . . . . Vemakylindrus (Bacescu, 1961)

- Pseudorostrum much less than half as long as rest of carapace. . . 15

15 Pre-anal part of telson at least as long as post-anal part; lateral spines usually confined to distal third or less of post 16

- Pre-anal part of telson shorter than post-anal part; lateral spines usually on posterior half at least 17

16 Pre-anal part of telson more than twice as long as post-anal part; telson longer than last two abdominal somites together (except in M. reyssi) . . . . Makrokylindrus Stebbing, 1912**

- Pre-anal part of telson less than twice as long as post-anal part; telson seldom as long as last two abdominal somites together . . . . *Adiastylis* Stebbing, 1912

17 Apical spines present on telson . . . . *Diastylis* Say, 1818

- Apical spines absent from telson . . . . *Oxyurostylis* Calman, 1912

**Pachystylis* Hansen, 1920 and males of *Paradiastylis* key out here.

***Dimorphostylis australis* keys out here because of its long telson

Dic Stebbing, 1910

Generic diagnosis

Carapace with transverse ridges across frontal lobe. Flagellum of antenna 2 of adult male reaching to end of body. Mandible narrow at base. Ischium of maxilliped 3 greatly expanded. Basis of pereiopod 2 large and stout in both sexes. Exopods on pereiopods 3 and 4 of female minute or absent. Male with two pairs of pleopods. Third and fourth pedigerous somites wide and sometimes coalseced. Pereiopods 2 and 3 of ovigerous female somewhat separated. Telson longer than telsonic somite and at least as long as peduncle of uropod; pre-anal part longer than post-anal part. Uropods slender and at least as long as last two abdominal somites together. Endopod of uropod 3-segmented.

Type species

Dic calmani Stebbing, 1910

Remarks

The genus was erected by Stebbing for a small number of individuals of a single species from South Africa on "the unique characters of the third maxillipeds and telson", the ischium of maxilliped 3 being very large and flat and the telson of that species very long and tubular with no post-anal part. Stebbing described and figured a young male (which no longer appears to be extant) and it has generally been assumed since then that adult males would prove to lack pleopods. For this reason the genus has always been placed near to Gynodiastylis. The finding of large numbers of males with two pairs of pleopods denies an affinity between the two genera and places Dic quite definitely in the Diastylidae. Should further confirmation be needed, two further species are now available from South Africa, one of which has a distally armed telson very similar to that of some species of Adiastylis. Further, the gill plate is divided into numerous filaments, despite Stebbing's statement to the contrary.

Variations in the nature of the telson in the species now known has required an alteration of the generic diagnosis to accommodate them, and the third maxilliped becomes the diagnostic feature. For this reason, a fourth species may be added to the genus. This is Diastylopsis thileniusi (Zimmer, 1902), from New Zealand. Its telson is not tubular but the third maxilliped is very similar to those of the other three species, and the carapace is sculptured in the same way. The large size of the third and fourth pedigerous somites appears to be an extreme example of the trend which is already noticable in the other species.

Diastylis fistularis Calman, 1911 from the Gulf of Siam is very reminiscent of Dic in the nature of the telson, the third maxilliped , the carapace and the fusion of the third and fourth pedigerous somites. But it appears from Calman's figures of a very young animal that the basis rather than the ischium of the third maxilliped is widely expanded. Thus on the available evidence the species cannot be admitted to Dic and any further descisions will have to await the collection of more, preferrably adult, material.

In his original discussion of the genus, Stebbing suggested that Diastylis tubulicaudata should be placed in Dic. Examination of new material by Fage (1929) showed quite clearly that the third maxilliped is not modified and that the species belongs in Makrokylindrus.

Distribution of Dic

Three species are known from South Africa at depths from 11 to 200 m and one from New Zealand at depths from 0 to 43 m.

KEY TO THE SPECIES OF DIC

1 Telson a long, straight tube with virtually no post-anal part and without lateral spines 2

- Telson flattened distally; at least a third of its length post-anal with two or more pairs of strong lateral spines 3

2 Carapace without hairs; anal valves pointing posteriorly; telson terminally without denticles in female and with four short, rounded teeth in male . . . . D. formosae sp. nov.

- Carapace finely hairy; anal valves pointing ventrally; telson terminally with several minute denticles in both sexes . . . . . D. calmani Stebbing, 1910 - South Africa

3 Pedigerous somites 3 and 4 not coalesced dorsally; telson hardly longer than telsonic somite with 6-8 pairs of lateral spines . . . . D. thileniusi (Zimmer, 1902) - New Zealand

- Pedigerous somites 3 and 4 coalesced dorsally; telson distinctly longer than telsonic somite with 2-5 pairs of lateral spines . . . . D. platytelson sp. nov.

Dic calmani Stebbing, 1910

Figs 10-11

Dic calmani Stebbing, 1910: 416, pls 46-47; 1913: 160-161; Jones 1960a: 179.

Records

			adult ♂	sub-adult ♂	♂	ovig. ♀	♀	juv.	total	no. of records
SST	34°S 21°E	15-20 m	2	8	1	9	1	1	22	6
SCD	33°S 25°E-34°S 23°E	11-44 m	11	7	3	19	5	3	48	7
NIWR	27°S 32°E-30°S 30°E	43-80 m		1	3	4	6	3	17	7

Previous records

Type locality only.

Syntypes

The young male described and figured by Stebbing (1910) as D. calmani is no longer extant. Type locality: 75 m, off East London ($32^{o}53$'S $28^{o}11$'E). The other specimens of "syntypes" do not belong to this species but to D. formosae sp. nov.

Description

Ovigerous female, length 7,0 mm (SCD 378K). Integument minutely reticulate, somewhat translucent, with fine scattered hairs. Carapace (Fig. 10A) less than twice as long and slightly wider than deep with two transverse ridges. Posterior ridge runs from ventral edge of carapace about a third from anterior end to join posterior edge of frontal suture; anterior ridge equidistant between posterior ridge and anterior tip of pseudorostrum, ending midlaterally. Both ridges continuous on eyelobe. (A third short ridge is sometimes present behind and parallel to the first two.) Anterolateral angle not evident, antennal notch smooth, poorly excavated. Pseudorostral lobes fairly short, roundly pointed anteriorly. Carapace slightly produced posterolaterally, obscuring part of first pedigerous somite. Eyelobe (Fig. 10B) short with three small, clear lenses.

Second pedigerous somite narrow, third and fourth wide and fused dorsally; fifth situated dorsal to fourth. Marsupium well-developed. Abdominal somites subcylindrical, abdomen subequal in length to cephalothorax.

Antenna 1 (Fig. 10C) fairly small, first segment longest. Flagellum 2-segmented with two aesthetascs; accessory flagellum small and 3-segmented.

Antenna 2 of moderate size, 5-segmented.

Maxilliped 3 (Fig. 10D) very wide distally, basis less than three times as long as wide at widest point and slightly serrated on inner edge; proximally much narrower. Exopod of moderate size. Ischium greatly expanded,

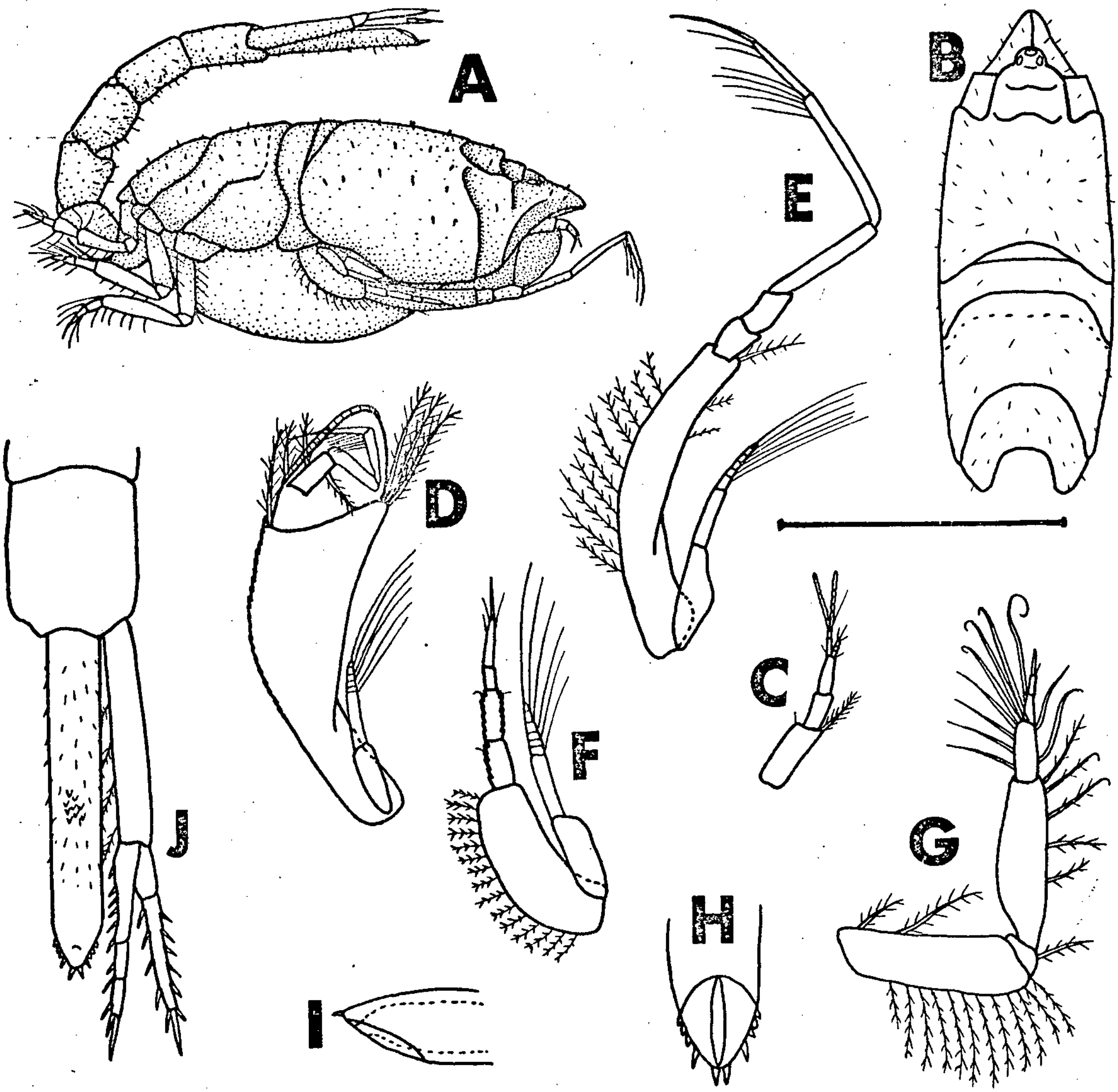

Fig. 10. Dic calmani

Ovigerous female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Tip of telson in ventral view. I. Tip of telson in lateral view. J. Uropod and telson.

Scale line = 4 mm for A, B; 2 mm for C-G, J; 0,5 mm for H, I.

as wide as long and smoothly rounded distally. Last four segments subequal in length and protected by ischium when folded in on each other.

Pereiopod 1 fairly long, basis slender with some plumose setae on lower border. Ischium and merus short, subequal in length; carpus subequal in length to ischium and merus together and slightly shorter than propodus. Exopods of pereiopods 1 and 2 of moderate size. Pereiopod 2 (Fig. 10F) 6-segmented. Basis stout with numerous short plumose setae on lower edge. Merus, carpus and dactyl subequal in length and propodus slightly shorter. Basis and merus of pereiopod 3 (Fig. 10G) stout and subequal in length; ischium short. Carpus subequal in length to last two segments together and armed with many sharp setae. Armature of distal segments of pereiopods 4 and 5 differs slightly from that of pereiopod 3, limbs otherwise very similar.

Telsonic somite (Fig. LOJ) slightly longer than wide; telson covered with very small triangular denticles, twice length of telsonic somite, tubular and tapering at tip with one pair of small terminal spines flanked by several even smaller denticles. Anal valves pointing almost ventrally (Figs 10H, I). Peduncle of uropod fairly slender, about two-thirds length of telson and slightly longer than subequal rami. Endopod 3-segmented, first segment about subequal in length to next two together.

Adult male, length 6,9 mm (SCD 378K). As female, except as follows: carapace (Fig. 11A) slightly more than twice as long as deep, produced posterolaterally to obscure first two and part of third pedigerous somites. Posterior transverse ridge(s) often very faint or absent. Pseudorostrum (Fig. 11B) slightly shorter and less pointed.

Third segment of antenna 1 (Fig. 11C) much shorter and stouter; flagellum 5-segmented and surrounded by many fine setae; accessory flagellum 4-segmented. Basis of maxilliped 3 as wide proximally as distally and four times length of ischium; exopod larger. Basis of pereiopod 1 very slightly

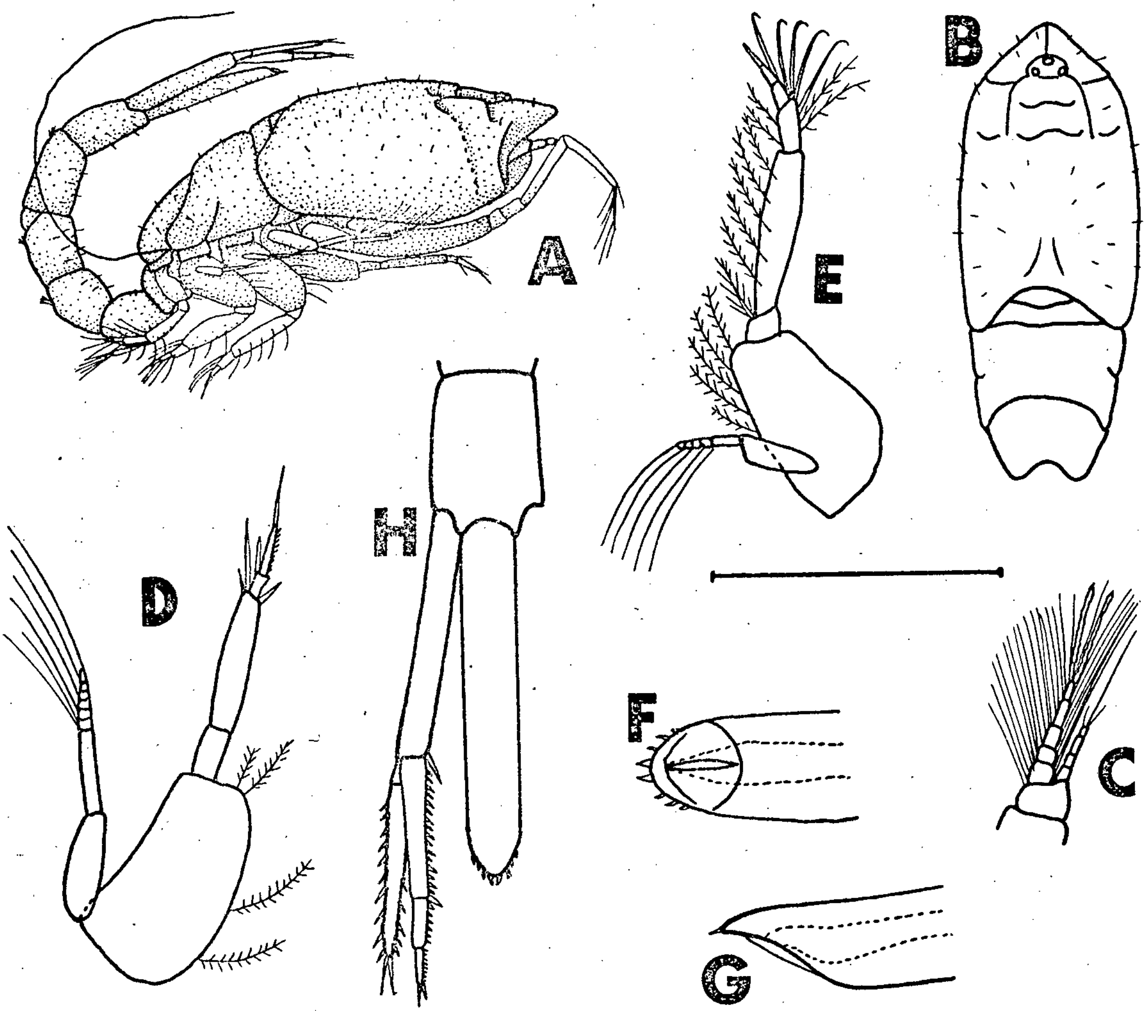

Fig. 11. Dic calmani

Adult male. A. Lateral view. B. Dorsal view of cephalothorax. C. Detail of distal tip of antenna 1. D. Pereiopod 2. E. Pereiopod 3. F. Tip of telson in ventral view. G. Tip of telson in lateral view. H. Uropod and telson.

Scale line = 4 mm for A, B; 2 mm for D, E, H; 1 mm for F, G; 0,5 mm for C.

longer than rest of limb. Basis of pereiopod 2 (Fig. 11D) very large, carpus more than twice length of merus. Bases of pereiopods 3 (Fig. 11E) to 5 stouter, segments distal to basis relatively more slender. Two pairs of pleopods present.

Telson (Fig. 11H) and peduncle of uropod slightly longer, anal valves subterminal. Endopod longer than exopod by one segment, longer than telson by two segments; last two segments together distinctly shorter than the first.

Length

Adult male 5,6 - 6,9 mm

Ovigerous female 5,0--7,1 mm

Remarks

The syntypes (a young female, two juveniles and a manca) labelled "Dic calmani" and examined by the author do not belong to this species but to D. formosae sp. nov. But Stebbing's (1910) figures and descriptions clearly belong to the same species as that described above, and therefore called D. calmani. There is little resemblance between Stebbing's figure of the carapace and any actual specimen, but it appears that the carapace of his specimen was flattened and damaged, so that in the figure the pseudorostral lobes are divergent and there appear to be three lenses far back behind the eyelobe. The shape is also odd. But the figures of the limbs are undistinguishable from those of the present specimens, with a few exceptions due to the immaturity of Stebbing's individual. The basis of pereiopod 1 is shorter and the segments of maxilliped 3 distal to the ischium are longer than in adult males. The carpus of pereiopod 2, the bases and exopods of pereiopods 3 and 4 and the proportions of the uropods are as in the ovigerous females, rather than adult males.

The juvenile and manca "syntypes" are in a poor state of preservation but the large young female (length 6,9 mm) is well preserved and clearly belongs to D. formosae rather than to D. calmani. The integument is reticulate and rugose, the ischium of maxilliped 3 is excavate and the carpus of pereiopod 2 longer than the merus, while the distal tips of pereiopods 3 to 5 and in particular the uropods and telson are identical with those figured below for *D. formosae*.

In Stebbing's defence, it is not at all surprising that he should have considered there to be only one species, since he had only a single male and female of any size to work from, and the two species are very similar. In fact it was only after examining some hundreds of specimens that the author became aware of the presence of two species. They also overlap geographically in just that area from which Stebbing's material was obtained.

In both species there is considerable intraspecific variation in the sculpturing of the carapace, particularly in the males where the transverse ridges may be well defined (as in the female), evanescent or wanting. Thus separation of *D. calmani* and *D. formosae* is not easy. A comparison of the two species follows the description of the latter.

Distribution

From Still Bay to northern Natal at depths from 11 to 62 m.

Dic formosae sp. nov.

Figs 12 - 13

Records

			adult ♂	sub-adult ♂	♂	ovig. ♀	♀	juv.	total	no. of records
SB	33°S 17°E	26-31 m	1				1		2	2
SAM	-		1					2	3	1
FAL/FBY	34°S 18°E	15-100 m	20	56	54	48	107	20	305	50
SST	34°S 22°E-33°S 21°E	30-200 m	13	9	15	17	24	7	85	8
SCD	34°S 21°E-33°S 25°E	44-183 m	7	11	7	12	10	1	48	13

Holotype

Ovigerous female, in the South African Museum, SAM-A15730, collected by UCT, 21 June 1972. Type locality: 80 m on the Still Bay transect (34°40'S 21°39'E). UCT station number SST 26J.

Description

Ovigerous female, holotype. length 8,8 mm. General form very much as in D. calmani. Integument smooth, faintly reticulate with no hairs. Carapace (Fig. 12A) with two transverse ridges anteriorly (and sometimes a shorter one posteriorly). Pseudorostral lobes (Fig. 12B) fairly pointed. Eye with three lenses. Carapace very slightly wider than deep and fractionally more than twice as long as deep. First pedigerous somite obscured laterally by posterior expansion of carapace and second by anterior expansion of third. Third and fourth pedigerous somites coalesced dorsally, fifth dorsal to fourth. Cephalothorax subequal in length to abdomen excluding telson; abdominal somites subcylindrical.

Antenna 1 (Fig. 12C) of moderate length, first segment slightly longer than next two subequal ones together. Both flagella short and 2-segmented.

Antenna 2 (Fig. 12D) 5-segmented, first segment long and last very short with a stout spine.

Maxilliped 1 with numerous leaflike gill filaments.

Maxilliped 3 (Fig. 12E) much wider distally than proximally. Ischium wider than long, greatly expanded on inner edge and excavated on outer edge to accommodate merus; bordered with very fragile denticles. Last four segments subequal in length.

Basis of pereiopod 1 (Fig. 12F) very slightly shorter than rest of limb. Carpus more than twice length of merus, slightly shorter than propodus. Pereiopod 2 (Fig. 12G) 6-segmented; basis wide, subequal in length to rest of limb; carpus distinctly longer than merus. Pereiopods 3 (Fig. 12H) and 4 similar; basis subequal in length to merus; carpus longer than propodus

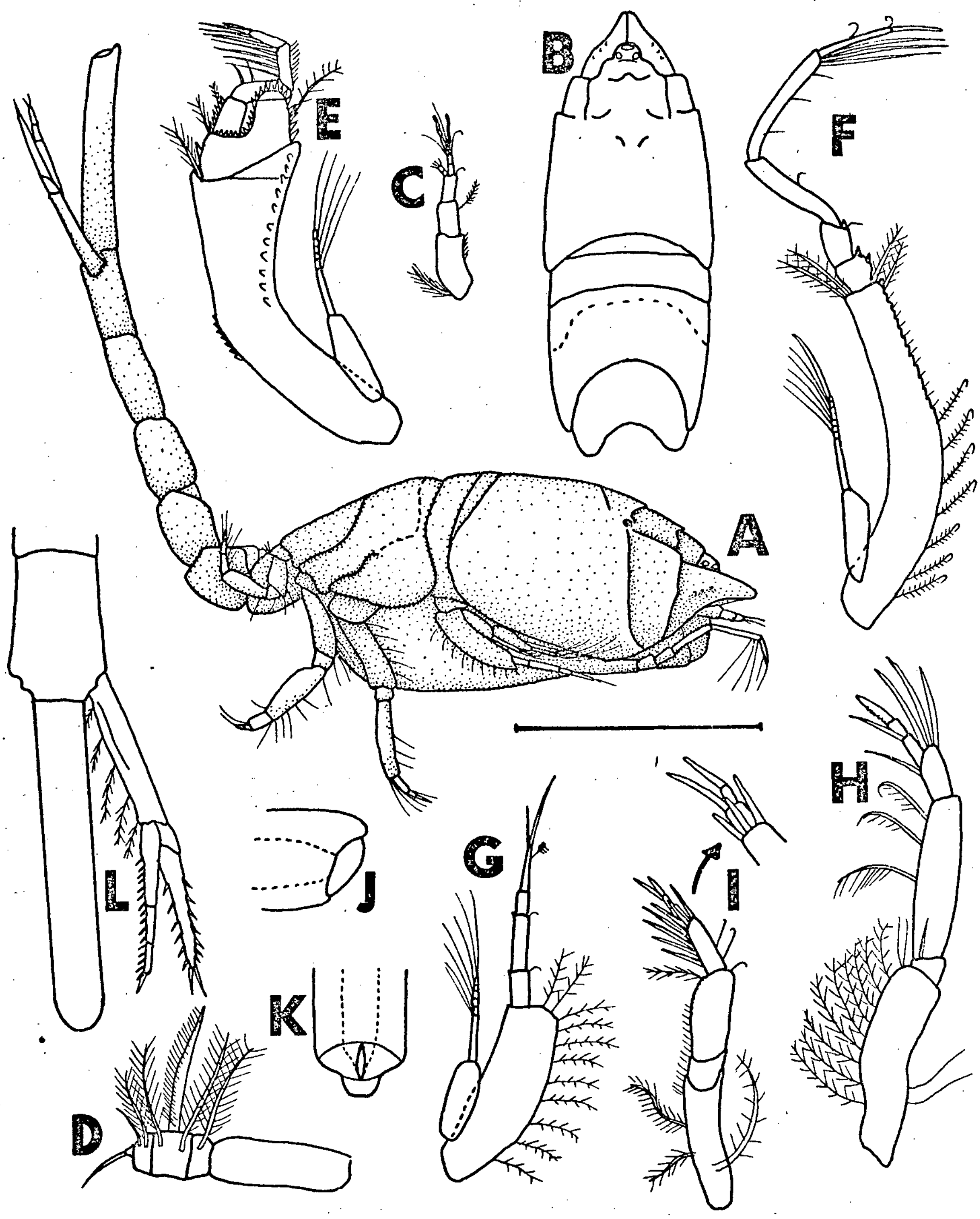

Fig. 12. Dic formosae sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Antenna 2. E. Maxilliped 3. F. Pereiopod 1. G. Pereiopod 2. H. Pereiopod 3. I. Pereiopod 5. J. Tip of telson in lateral view. K. Tip of telson in ventral view. L. Uropod and telson.

Scale line = 4 mm for A, B; 2 mm for C, E-I, L; 1 mm for D, J, K.

and dactyl together; dactyl with very strong serrate spine terminally. Basis of pereiopod 5 (Fig. 12I) slightly longer than merus; carpus nearly twice length of propodus and dactyl together.

Telsonic somite (Fig. 12L) one and a half times as long as wide. Telson in lateral view (Fig. 12J) rounded, anal valves posterior and almost terminal; in ventral view (Fig. 12K) with slight dorsal projection beyond anal valves. Telson more than twice length of telsonic somite, distinctly longer than uropods and quite cylindrical, without hairs, terminal spines or denticles. Peduncle of uropod subequal in length to telsonic somite, half length of telson, subequal in length to rami. First segment of endopod subequal in length to next two together.

Adult male, paratype, length 9,3 mm. As female, except as follows: carapace (Fig. 13A) nearly two and a half times as long as wide, transverse ridges (except on eyelobe) usually much less evident. Antennal notch excavated with a short dorsoventral ridge behind. First two and part of third pedigerous somite obscured laterally by posterior expansion of carapace, third not produced anteriorly. Fifth pedigerous somite produced to a point posteriorly. Abdominal somites grooved ventrally to accommodate flagellum of second antenna.

Third segment of antenna 1 (Fig. 13B) as wide as long with numerous fine setae. Flagellum 6-segmented and accessory flagellum 3-segmented. Flagellum of antenna 2 reaching almost to end of telson, consisting of 18 very long, sparsely setose segments. Basis of maxilliped 3 as wide proximally as distally. Basis of pereiopod 1(Fig. 13C) subequal in length to rest of limb, last three segments subequal in length. Basis of pereiopod 2 (Fig. 13D) very wide; carpus two-thirds length of basis, nearly twice length of propodus and dactyl together. Dactyl of pereiopod 3 (Fig. 13E) small and projecting laterally. Basis and merus of pereiopods 3 (Fig. 13F) and 4 very stout. Basis of pereiopod 5 (Fig. 13G) excavated dorsally. Rami of pleopods (Fig. 13H) 1-segmented with long plumose setae.

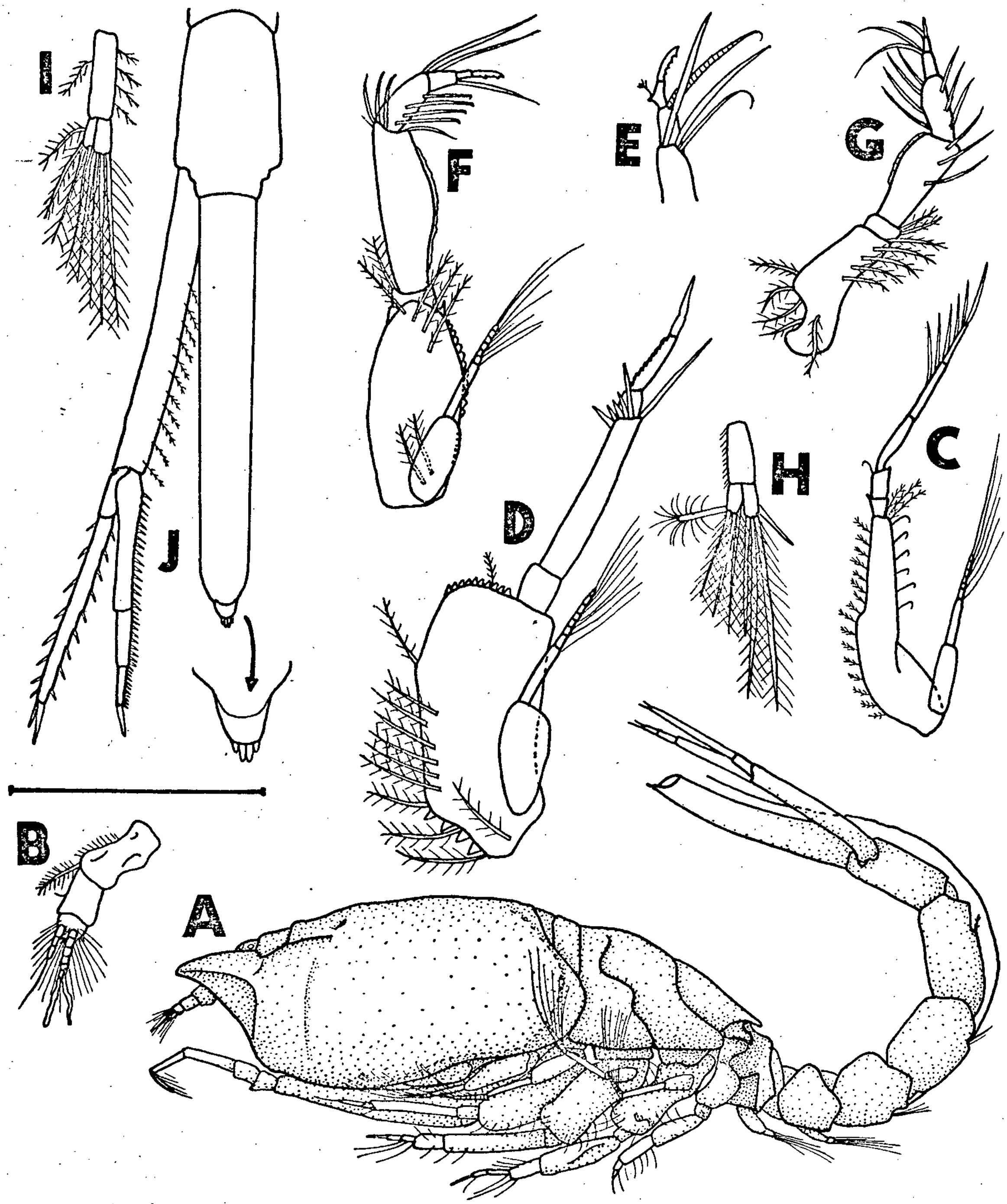

Fig. 13. Dic formosae sp. nov.

Adult male. A. Lateral view. B. Antenna 1. C. Pereiopod 1. D. Pereiopod 2. E. Tip of pereiopod 3. F. Pereiopod 3. G. Pereiopod 5. H. Pleopod 1. I. Pleopod 2. J. Uropod and telson.

Scale line = 4 mm for A, C; 2 mm for B, D, F-J; 1 mm for E.

Telsonic somite (Fig. 13J) nearly twice as long as wide, less than half length of telson. Telson with four short, blunt spines terminally on a short, projecting posterior flange. Peduncle of uropod two-thirds length of telson, rami extending well beyond tip of telson. Exopod very slightly longer than endopod, subequal in length to peduncle.

Length

Adult male 6,8 - 9,9 mm

Ovigerous female 7,3 - 10,3 mm

Remarks

D. formosae and *D. calmani* are the only two species of *Dic* possessing an almost tubular telson, and are very similar in general appearance. A number of distinguishing features are tabled below.

	D. calmani	*D. formosae*
integument	hairy, slightly translucent	reticulate, often highly calcified
ischium of maxilliped 3	rounded distally	notched to accommodate merus
pereiopod 1	basis subequal in length to carpus plus propodus	basis shorter than carpus plus propodus
pereiopod 2 ♀	merus and carpus subequal	merus two-thirds length of carpus
pereiopod 3 ♂	merus half width of basis, carpus a third length of basis	merus little narrower than basis, carpus nearly half length of basis
telson	anal valves ventral	anal valves posterior
telson ♂	smoothly rounded terminally with about 8 sharp denticles	slightly protruding terminally with four blunt spines
telson ♀	shorter than uropods	longer than uropods
uropods ♂	endopod longer	rami subequal in length
uropods ♀	peduncle two-thirds length of telson, longer than rami	peduncle half length of telson, subequal in length to rami

Within D. formosae the carapace is variable: the integument may be almost smooth, is usually distinctly reticulate but may occasionally be rugose. The two major transverse ridges may extend laterally for only a short distance or may reach the ventral edge of the carapace. A third short dorsal transverse ridge may be present or absent.

Distribution

Saldanha Bay to Port Elizabeth at depths from 15 to 200 m. A very common species.

Dic platytelson sp. nov.

Fig. 14

Records

NIWR 29°S 31°E-26°S 32°E 75-100 m. 2 adult ♀♀ (2 records)

Holotype

Adult female, in the South African Museum, SAM-A15731, collected by the NIWR, 3 September 1975. Type locality: 100 m, off the coast of Zululand (26°S 32°E). NIWR station number MN 75/24/H3.

Description

Adult female, holotype, length 6,2 mm. Integument well calcified, white, reticulate. Carapace (Fig. 14A) nearly twice as long as deep, with two transverse ridges , the first completely encircling the carapace about a third from anterior tip, second about midway along carapace and not reaching ventral edges. Pseudorostral lobes moderately long, roundly pointed in lateral view with short carinae midlaterally reaching from below eyelobe nearly to anterior transverse ridge. Antenna notch shallow and smoothly rounded. Carapace in dorsal view (Fig. 14B) nearly twice as long as deep, pseudorostrum narrow, about three times length of eyelobe. Eyelobe wider than long with three clear lenses. Carapace abruptly narrower in front of each transverse ridge.

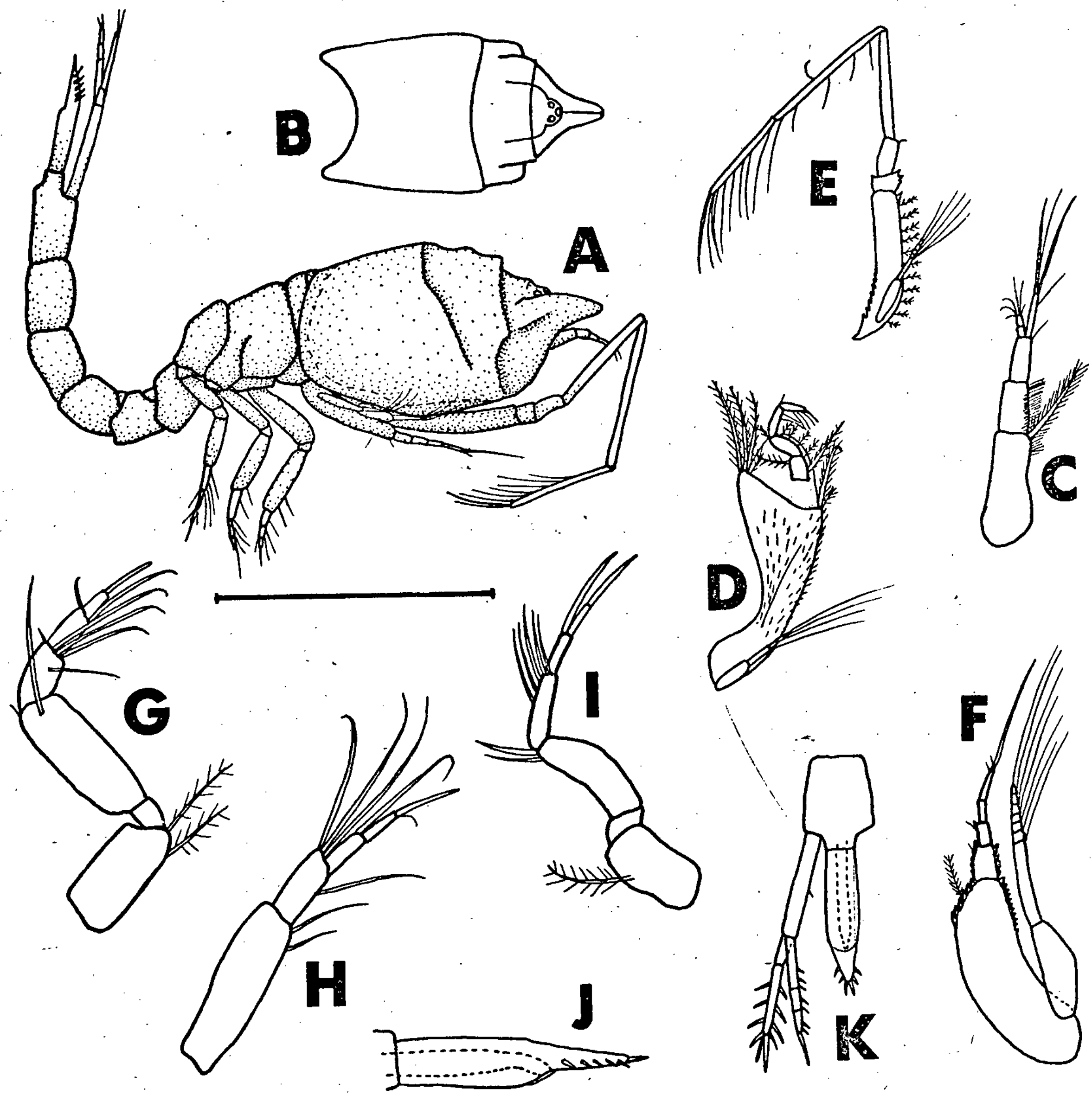

Fig. 14. Dic platytelson sp. nov.

Adult female. A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Pereiopod 4. I. Pereiopod 5. J. Telson in lateral view. K. Uropod and telson.

Scale line = 2 mm for A, B; 1 mm for D-I, K; 0,5 mm for C, J.

First two pedigerous somites visible dorsally only; third and fourth fused dorsally, third much wider laterally than fourth, fifth slightly dorsal. Abdominal somites subcylindrical, together subequal in length to cephalothorax.

Figures and descriptions of appendages (Figs C-I and K) are taken from the smaller damaged female and not the holotype.

Antenna 1 (Fig. 14C) moderately large, first segment subequal in length to next two together. Flagellum 1-segmented with two aesthetascs; accessory flagellum short and 2-segmented. Antenna 2 short and 3-segmented.

Basis of maxilliped 3 (Fig. 14D) enormously expanded distally, wider than length of next three segments together. Ischium widely expanded; last four segments short and subequal in length. Exopod small.

Pereiopod 1 (Fig. 14E) very long. Basis little more than a third length of rest of limb, serrated proximally on inner edge. Ischium wider than long, merus twice length of ischium; carpus twice length of ischium and merus together; propodus very slender, long, subequal in length to basis. Dactyl two-thirds length of propodus. Pereiopod 2 (Fig. 14F) 6-segmented. Basis very large, a third as wide as long, nearly twice length of remaining segments together. Distal segments short, exopod very large. Pereiopods 3 and 4 without exopods. Basis of pereiopod 3 (Fig. 14G) short, stout. Ischium very small, merus longer than basis. Last three segments of similar length, carpus with three long, hooked setae distally. Basis of pereiopod 5 (Fig. 14I) short; ischium wide, merus long and curved; last three segments elongate, carpus with five sharp setae distally.

Telsonic somite slightly longer than wide, protruding for a short distance between uropods. Telson (Fig. 14J, K) less than one and a half times length of telsonic somite, narrowed for distal , post-anal third with five pairs of lateral and one pair of terminal spines. Peduncle of uropod nearly as long as telson; first segment of exopod a third length of second. Rami subequal in length, first segment of endopod about as long as next two together.

Length

Female 5,4 - 6,2 mm

Remarks

With the very large ischium of the third maxilliped, this species is clearly a member of Dic. It is easily distinguished from the other two South African species by the long, spinose post-anal part of the telson and the very long distal segments of pereiopod 1. It is closest to D. thileniusi (Zimmer, 1902) from New Zealand, from which it is distinguished by its longer telson and shorter, fused third and fourth pedigerous somites.

Distribution

Known only from two samples from 75 and 100 m off northern Natal and Zululand.

Vemakylindrus Bacescu, 1961 (n. comb.)

Generic diagnosis

Pseudorostrum long, approaching or exceeding length of carapace. Third and fourth pedigerous somites not fused. Exopods absent from pereiopods 3 and 4 of female. Male with two pairs of pleopods. Telson longer than telsonic somite, usually longer than peduncle of uropods; pre-anal part of variable length in relation to post-anal part; post-anal part with 0-9 pairs of lateral spines; terminal spines present or absent.

Type species

V. gladiger (Bacescu, 1961) (as Makrokylindrus (Vemakylindrus) gladiger).

Remarks

Justification for the elevation of Vemakylindrus from subgenus to genus is presented in the remarks on the family above. The long pseudorostrum is presumably of functional as well as of taxonomic significance, although why the exhalant siphon should be situated so far from the mouthparts is not clear. The telson is very variable in size, in the number of pairs of lateral spines and the length of the post-anal part so that some species approach Diastylis in this respect, while some are very close to Makrokylindrus.

Distribution

The genus is widely distributed, with species from the Mediterranean, the Pacific and the Arctic as well as the one from South Africa. Most are very deep-water species, one being known from 63 m and the rest from depths greater than 400 m.

KEY TO THE SPECIES OF VEMAKYLINDRUS

1 In lateral view, distance from anterior tip of eyelobe to distal tip of pseudorostrum (or siphon if longer) less than distance from anterior tip of eyelobe to posterior tip of carapace 2

\- In lateral view, distance from anterior tip of eyelobe to distal tip of pseudorostrum (or siphon if longer) greater than distance from anterior tip of eyelobe to posterior tip of carapace 4

2 Distal third of telson with four pairs of lateral spines; carapace (excluding pseudorostrum) hardly longer than deep . . . . V. doryphorus (Fage, 1940) - Mediterranean

\- Distal half of telson with five to nine pairs of lateral spines; carapace (excluding pseudorostrum) at least one and a half times as long as deep 3

3 Post-anal part of telson very narrow (about a quarter width of pre-anal part) with five pairs of lateral spines; angle between pseudorostrum and dorsum of carapace much more than 90^{o} . . . . V. hastatus (Hansen, 1920) - Davis Strait

\- Post-anal part of telson half width of pre-anal part with nine pairs of lateral spines; angle between pseudorostrum and dorsum of carapace about 90^{0} . . . . V. stebbingi sp. nov.

4 Angle between pseudorostrum and dorsum of carapace about 90^{0} . . . 5

- Angle between pseudorostrum and dorsum of carapace more than 140^{0} . 6

5 Length from anterior tip of eyelobe to tip of pseudorostrum equal to length from anterior tip of eyelobe to posterior edge of last pereion somite . . . . V. vemae (Bacescu, 1961) - Mediterranean

- Length from anterior tip of eyelobe to tip of pseudorostrum equal to length from anterior tip of eyelobe to posterior edge of third pereion somite . . . . . V. charcoti (Reyss, 1974) - Mediterranean

6 Length of carapace posterior to anterior tip of eyelobe shorter than free pereion somites together; telson with hardly any post-anal part . . . . . . V. gladiger (Bacescu, 1961) - Off Columbia

- Length of carapace posterior to anterior tip of eyelobe greater than free pereion somites together; telson (where known) with at least one-fifth its length post-anal 7

7 Endopod of uropod apparently 1-segmented and half length of peduncle . . . . V. sp. A (Gamo, 1971) - Japan

- Endopod of uropod 3-segmented and a third length of peduncle or less . 8

8 Carpus of pereiopod 2 about half length of basis; distal part of telson very strongly dentate dorsally . . . . V. prolatus (Jones, 1969) - Kermadec Trench

- Carpus of pereiopod 2 nearly as long as basis; distal part of telson finely serrate or smooth 9

9 Carapace dorsally with about nine pairs of spines very much larger than the majority; last two abdominal somites strongly dentate . . . . V. sp. B (Gamo, 1971) - Japan

- Carapace dorsally and laterally with many spines larger than the majority; last two abdominal somites minutely denticulate . . . . V. costaricanus (Bacescu, 1961) - Pacific coast of Costa Rica

<u>Vemakylindrus stebbingi</u> sp. nov.

Fig. 15

<u>Records</u>

SAM 34^{O}S 17^{O}E (PF 17440) 800 m 1 subadult ♂, 1 ovig. ♀, 2 ♀♀(1 record)

SM 30^{O}S 30^{O}E 850 m 1 ♀(1 record)

<u>Holotype</u>

Subadult male, in the South African Museum, SAM-A15732, collected by the S.S. <u>Pieter Faure</u> in about 1900. Type locality: 800 m, off the Cape Peninsula (34^{O}25'S 17^{O}45'E). SAM station number SAM-A10602.

<u>Description</u>

<u>Subadult male</u>, <u>holotype</u>, length 4,7 mm. Integument thin and reticulate. Carapace (Fig. 15A) and lower edge of siphon covered with very small denticles. Pseudorostral lobes not as long as rest of carapace, tilted upwards at angle of about 90^{O} to dorsum. Entire anterior and ventral edges with very large hooked spines. Eyelobe small and eyeless. Carapace about one and a half times as long as wide at level of first antenna, twice length of pereion somites together.

First two pedigerous somites narrow, third and fourth slightly flanged laterally. Abdominal somites subcylindrical, fifth longest. Cephalothorax excluding pseudorostrum and abdomen excluding telson subequal in length.

Antenna 1 very large, protruding beyond tip of pseudorostrum. Three basal segments subequal in length. Flagellum 3-segmented and accessory flagellum very short and 1-segmented.

Basis of maxilliped 3 (Fig. 15B) stout and much longer than remaining segments together, with two spines at lower distal edge.

Pereiopod 1 (Fig. 15C) fairly stout, basis strongly spinose and about two-thirds length of remaining segments together. Merus twice length of ischium; carpus and propodus stout and subequal in length. Pereiopod 2

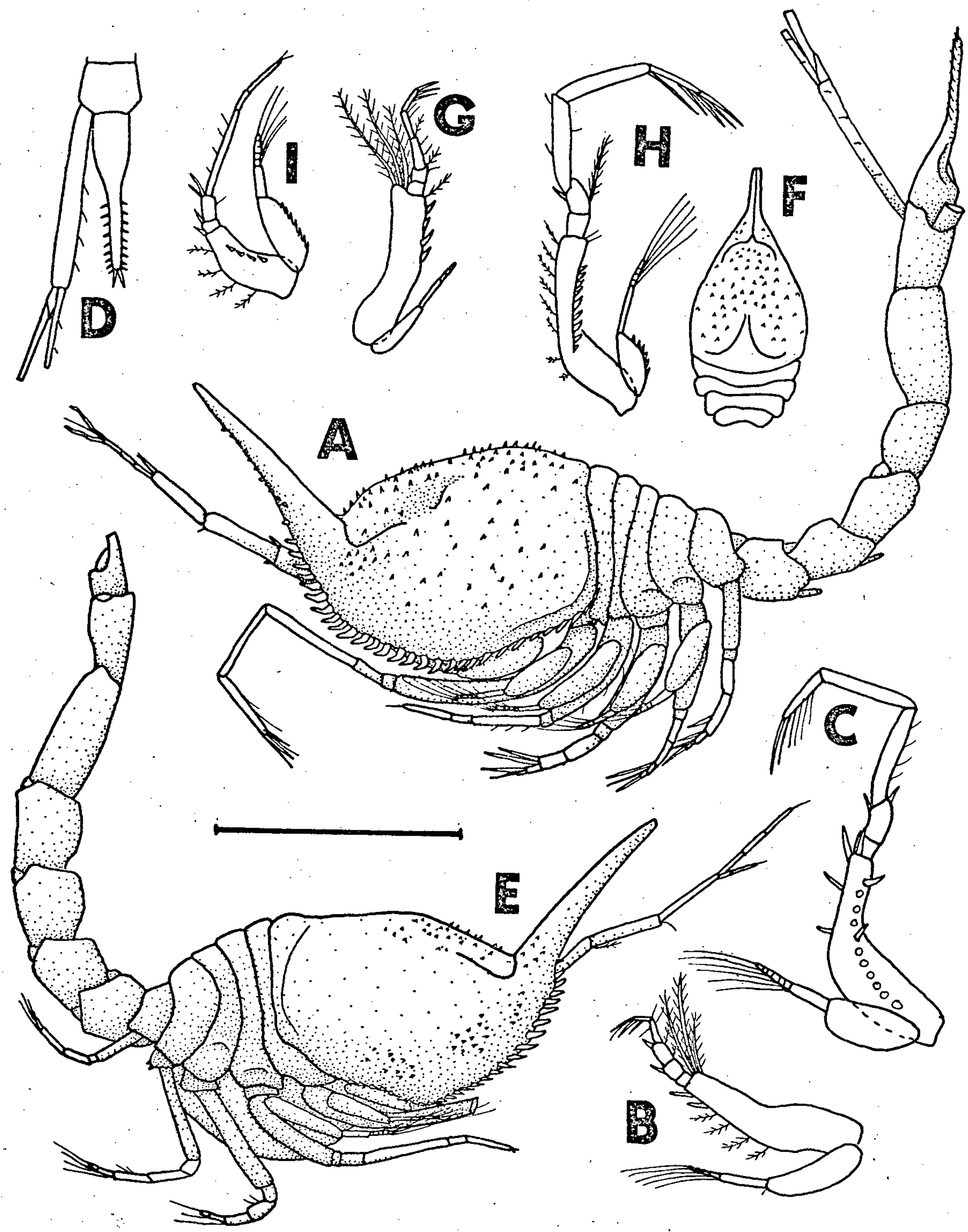

Fig. 15. Vemakylindrus stebbingi sp. nov.

Subadult male. A. Lateral view. B. Maxilliped 3. C. Pereiopod 1. D. Uropod and telson.

Ovigerous female. E. Lateral view. F. Dorsal view of cephalothorax. G. Maxilliped 3. H. Pereiopod 1. I. Pereiopod 2.

Scale line = 2 mm for F; 1 mm for A, D, E; 0,5 mm for B, C, G-I.

as in female. Pereiopods 3 to 5 stout, basis of pereiopod 3 longer than rest of limb and of pereiopod 5 much shorter.

Telsonic somite (Fig. 15D) slightly wider than long, about a third length of telson. Telson about twice as wide proximally as distally; pre-anal part about half length of post-anal part and smooth laterally. Post-anal part with about nine pairs of stout lateral spines. Peduncle of uropod slightly longer than telson, fairly stout and armed with three very fine hairs. First segment of endopod apparently long and slender; distal tips of both rami broken.

Ovigerous female, paratype, length 4,6 mm. As male except as follows: pseudorostrum (Fig. 15E) slightly shorter and more slender, not denticulate below. Carapace slightly longer and in dorsal view (Fig. 15F) stouter posteriorly. Abdominal somites stouter.

Distal segments of antenna 1 longer. Basis of maxilliped 3 (Fig. 15G) wider distally and segments more slender. Basis of pereiopod 1 (Fig. 15H) shorter and exopod longer. Pereiopod 2 (Fig. 15I) hardly reaching beyond distal tip of basis of pereiopod 1. Basis short and stout, exopod large. Carpus twice length of ischium and merus together; propodus and dactyl slender and together shorter than carpus. Pereiopods 3 and 4 more slender, lacking exopods. Pereiopod 5 shorter.

Telson broken immediately behind anus. Uropods missing.

Length

Subadult male 4,7 mm

Ovigerous female 4,5 mm

Remarks

This species is most similar to V. hastatus Hansen, 1920 from the Davis Strait. There are few significant differences between the present specimens and Hansen's rather limited figures. V. hastatus is more slender in build and the telson is about twice as long as the telsonic somite with five pairs of lateral spines. In V. stebbingi the telson is three times as long as the telsonic somite with nine pairs of lateral spines. Other minor differences include the lack of spines on the pedigerous somites and the more sharply angled pseudorostrum in V. stebbingi. The only other species in which the pseudorostrum is shorter than the rest of the carapace is V. doryphorus in which the carapace is even shorter and the telson has only four pairs of lateral spines.

Distribution

Known from two records, one from 800 m off the Cape Peninsula and one from 850 m off Durban.

Makrokylindrus Stebbing, 1912

Generic diagnosis

Pseudorostrum short, less than a third total length of carapace. Third and fourth pedigerous somites fused or free. Antenna 1 moderate to large. Bases of pereiopods 2 or 2 to 4 often broad in adult male. Pereiopods 3 and 4 with exopods rudimentary or absent in female. Telson at least as long as last two abdominal somites together and reaching distal tip of peduncle of uropod; pre-anal part at least twice length of post-anal part, which bears no more than five pairs of lateral spines at the tip. Terminal spines present or absent. Endopod of uropod 2- or 3-segmented.

Type species

M. fragilis Stebbing, 1912

Remarks

In restricting Makrokylindrus to species in which at least two-thirds of the telson is pre-anal and removing the subgenus Vemakylindrus, the number of species is reduced to 27. These species are all allied with M. fragilis in the nature of the telson, although the genus is still a variable one.

Justification for the restriction of the genus is given in the remarks on the family above. All species now accepted in the genus are listed in the key below.

The specimen:species ratio in the genus is very high and many species are known from only a few individuals. Thus some forms described may merely be slight variants of a single species. With little material available from deep water the degree of variability is not known and in the key below no attempt has been made to sink previously described species which may well prove to be synonymous.

Distribution

Two species have previously been found of the south-east coast of southern Africa. One of these, M. fragilis, is available in the present collection, together with four new species, all from depths greater than 500 m.

The genus is a deep-water one and includes the deepest record for a cumacean, M. hadalis, from 7 160 m in the Java Trench. Only two species are known from depths of less than 500 m, and one of these is a doubtful member of the genus.

KEY TO THE SPECIES OF MAKROKYLINDRUS

Note: "pre-anal" refers to that part of the telson anterior to the beginning of the anal valves; "post-anal" refers to that part of the telson posterior to the beginning of the anal valves. When measuring the length of the telson in relation to the uropods, it is assumed that they are in place in the animal and are parallel to each other, since the peduncle is usually inserted anterior to the insertion of the telson. Characters of the uropods and telson are of greatest value in separating species, but since these are often damaged, other features are included where possible.

M? mersus is included twice in the key because the tip of the telson is unknown. Both it and M. fistularis are doubtful members of the genus in the presence of inadequate information.

1 Anal valves almost terminal and post-anal part of telson extremely short or non-existant 2

- A quarter or more of telson post-anal 10

2 Third and fourth pedigerous somites coalesced dorsally 3

- Third and fourth pedigerous somites not coalesced dorsally 5

3 Integument without spines or denticles; carapace with three or four pairs of longitudinal ridges; telson reaching beyond tip of rami of uropods . . . . <u>M? fistularis</u> Calman, 1911 - Gulf of Siam

- Spines and/or denticles present at least anteriorly on carapace; carapace without longitudinal ridges; telson not reaching tip of rami of uropods 4

4 Carapace twice as long as deep with few spines, all of even length; endopod of uropod longer than exopod . <u>M? mersus</u> Jones, 1969 - Tasman Sea

- Carapace less than twice as long as deep with two transverse rows of spines larger than the rest; endopod of uropod shorter than exopod . . . . <u>M. cinctus</u> Jones, 1969 - off Bali

5 Anterolateral corner of carapace smooth or minutely tuberculate . . 6

- Anterolateral corner of carapace dentate or serrate 7

6 Integument smooth with a few fine hairs; telson shorter than last three abdominal somites together, with one pair of terminal spines . . . . <u>M. alleni</u> Reyss, 1974 - Canary Islands

- Integument minutely tuberculate, without hairs; telson almost as long as last four abdominal somites together, without terminal spines . . . . <u>M. fagei</u> Bacescu, 1962 - Madagascar

7 Spines confined to dorsal and anterior parts of carapace, with one pair on some pereion and pleon somites; telson hardly as long as last two abdominal somites together . <u>M. myriamae</u> Reyss, 1974 - North Atlantic

- Entire integument covered with many slender spines; telson longer than last two abdominal somites together 8

8 Basis of pereiopod 1 longer than carpus and propodus together; telson as long as last two and a half abdominal somites together . . . . M. tubulicauda (Calman, 1905) - North Atlantic

- Basis of pereiopod 1 considerably shorter than carpus and propodus together; telson about as long as last three abdominal somites together 9

9 Carpus of pereiopod 2 longer than three preceding segments together and entire limb longer than carapace . M. hadalis Jones, 1969 - Java trench

- Carpus of pereiopod 2 about as long as basis, and entire limb shorter than carapace . . . . M. spinifer sp. nov.

10 Carapace entirely lacking spines, denticles or tubercles even at ventrolateral edge 11

- Carapace with spines, denticles or tubercles at ventrolateral edge or elsewhere 12

11 Pedigerous somites 3 and 4 coalesced; carapace about twice as long as deep with fine scattered hairs . . . . M. mundus sp. nov.

- Pedigerous somites 3 and 4 not coalesced; carapace less than twice as long as deep, without hairs . M. gibraltarensis Bacescu, 1961 - Mediterranean

12 Carapace with one or two strong transverse ridges 13

- Carapace without transverse ridges 16

13 Integument of carapace without scattered spines 14

- Integument of carapace with scattered spines 15

14 Carapace with one transverse ridge; endopod of uropod longer than exopod; telsonic somite little produced between uropods . . . . M. fragilis Stebbing, 1912 - South Africa

- Carapace wtih two transverse ridges; endopod of uropod shorter than exopod; telsonic somite produced between uropods for nearly half its length . . . . M. deinotelson sp. nov.

15 Telson as long as last two abdominal somites together with several pairs of lateral spines . .. . M. sp. Gamo, 1971- Japan

- Telson subequal in length to last three abdominal somites together with one pair of lateral spines . M. cingulatus (Calman, 1905) - Malaya

16 Pseudorostrum nearly a third of total length of carapace with a few denticle above; rest of carapace unsculptured; pereion and pleon minutely denticulate above . M. baceskei Lomakina, 1968 - Antarctic

- Pseudorostrum distinctly less than a third of total length of carapace; denticles not confined to pseudorostrum; pereion and pleon armed or not 17

17 Pedigerous somites 3 and 4 coalesced dorsally 18

- Pedigerous somites 3 and 4 not coalesced dorsally 22

18 Basal part of telson quite smooth laterally 19

- Basal part of telson serrate or dentate laterally 20

19 Pre-anal part of telson shorter than peduncle of uropod . . . . M? mersus Jones, 1969 - Tasman Sea

- Pre-anal part of telson reaching distal tip of peduncle of uropod . . . . M. longipes (Sars, 1871) - Bay of Biscay

20 Telson slightly longer than last two abdominal somites together with about five pairs of lateral spines; spines on carapace concentrated anteriorly . . . . M. balinensis Jones, 1969 - off Bali

- Telson at least as long as last three abdominal somites together with 0 - 1 pairs of lateral spines; spines scattered over entire carapace . 21

21 Telson nearly reaching distal tip of uropods, with one pair of lateral spines; carapace more than twice as long as deep; pleon devoid of spines . . . . M. menziesi Bacescu, 1962 - Galapagos Is.

- Telson nearly reaching distal tip of first segment of endopod of uropod, without lateral spines; carapace slightly less than twice as long as deep; pleon strongly spinose . M. josephinae (Sars, 1871) - North Atlantic

22 Post-anal part of telson deeply serrated . . . .
. . . . M. serricauda (Scott, 1912) - North Atlantic
- Post-anal part of telson with 0 to 2 pairs of lateral spines . . . 23

23 Telson no longer than last two abdominal somites together 24
- Telson distinctly longer than last two abdominal somites together . 25

24 Eyelobe spinulose . . . . M. sandersi Reyss, 1974 - North Atlantic
- Eyelobe not spinulose . . M. hessleri Reyss, 1974 - North Atlantic

25 Basal segment of antenna 1 shorter than next two together; one or two pairs of very small lateral spines on telson . . . .
. . . . M. americanus Bacescu, 1962 - East Pacific
- Basal segment of antenna 1 longer than next two together; no lateral spines on telson 26

26 Carapace with a pair of anterolateral horns lateral to frontal lobes; last three pedigerous somites spinose . . . M. bicornis sp. nov.
- Carapace without anterolateral horns and last three pedigerous somites without spines . . . M. wolffi Bacescu, 1962 - south-eastern Africa

Makrokylindrus fragilis Stebbing, 1912

Fig. 16

M. fragilis Stebbing, 1912: 150-152, pls. 54-55; 1913: 117-118, figs. 72-73.

Records

SM & SAM 30°S 30°E-30°S 31°E 805-900 m 1 adult ♂, 1 subadult ♂, 2 ♂♂, 1 ovig. ♀, 9 ♀♀ (3 records) (including some paratypes from SAM-A10601)

Previous records

Syntypes only.

Syntypes

Deposited by Stebbing in the British Museum (Natural History). Type locality: 805 m off Durban (30°33'S 30°58'E).

Description

Ovigerous female, length 10,9 mm. Integument minutely reticulate, lightly calcified. Carapace (Fog. 16A) less than twice as long as deep with a strong ridge running transversely around entire width and with two short longitudinal ridges branching from the major one, one short pair ventro-laterally and the other midlaterally, reaching posterior edge of pseudo-rostrum. Transverse and upper lateral ridges with fine hairs, lateral one interspersed with several strong teeth (which are easily damaged or lost). Pseudorostrum (Fig, 16B) short and pointed with several small denticles. Eyelobe small, rounded, eyeless. Carapace widest immediately behind transverse ridge. Anterolateral angle and antennal notch wanting, antero-lateral edge strongly serrated.

First pedigerous somite obscured laterally, second narrow, third and fourth coalesced. Marsupium large. Abdominal somites subcylindrical, abdomen including telson slightly longer than cephalothorax. Pedigerous and abdominal somites entirely lacking spines and denticles.

Antenna 1 (Fig. 16C) long and slender, protruding beyond anterior tip of pseudorostrum. Three basal segments subequal in length; flagellum 5-segmented and accessory flagellum shorter and 3-segmented.

Antenna 2 (Fig. 16D) short, 3-segmented; first segment very stout.

Basis of maxilliped 3 (Fig. 16E) considerably produced distally, reaching half way along merus. Ischium short, remaining segments subequal in length. Exopod short.

Basis of pereiopod 1 (Fig. 16F) strongly setose on both edges with a row of spines below. Ischium and merus subequal in length. Part of carpus present, remaining segments missing. Pereiopod 2 (Fig. 16G) slender, basis

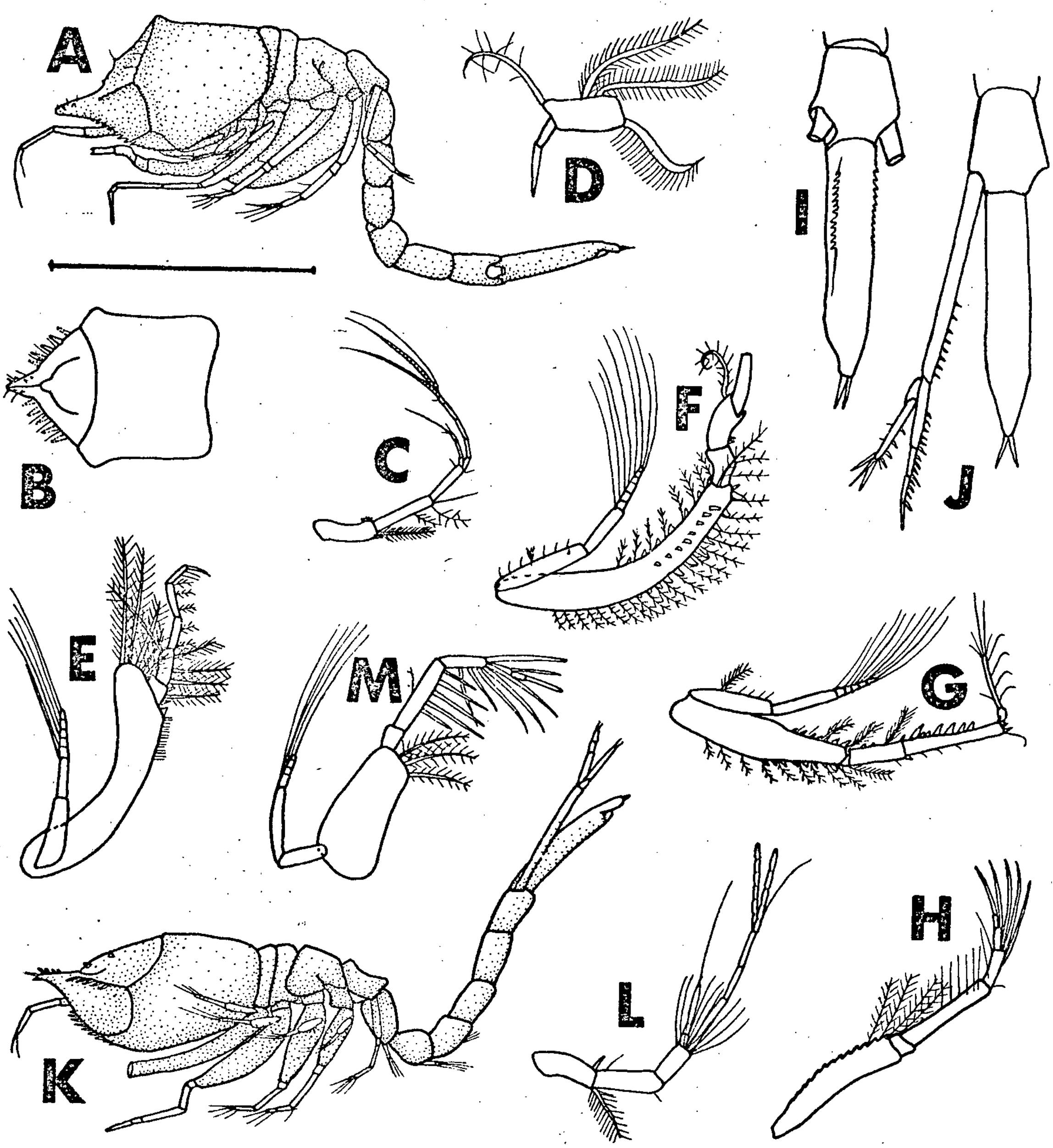

Fig. 16. Makrokylindrus fragilis

Ovigerous female. A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Antenna 2. E. Maxilliped 3. F. Pereiopod 1. G. Pereiopod 2. H. Pereiopod 3. I. Dorsolateral view of telson. J. Uropod and telson of younger female.

Adult male. K. Lateral view. L. Antenna 1. M. Pereiopod 2.

Scale line = 4 mm for A, B, K; 2 mm for C, E-J, L, M; 1 mm for D.

slightly longer than next three segments together. Ischium very small; carpus longest of remaining segments. Pereiopod 3 (Fig. 16H) and 4 similar, slender, without exopods. Pereiopod 5 shorter and still more slender.

Telson (Fig. 16I) elongate, subequal in length to last three abdominal somites together, slightly keeled and serrate on lateral borders of proximal half. About one quarter of telson post-anal, smooth, with a single pair of terminal spines. Uropods missing from ovigerous female. Uropod (Fig. 16J) of young female slender, peduncle reaching level of anus. Exopod about three-quarters length of 3-segmented endopod and about half length of peduncle. First segment of endopod subequal in length to next two together.

Adult male, length 10,6 mm. As female, except as follows: carapace (Fig. 16K) much shallower, transverse ridge more clearly interrupted by branching off of longitudinal ridges. Denticles of pseudorostrum, ventro-lateral edge and transverse ridges larger. A few denticles scattered on eyelobe. Last three pedigerous somites relatively larger.

Antenna 1 (Fig. 16L) stouter, first and third segments slightly shorter; flagella surrounded by numerous short sensory setae; flagellum longer and 4-segmented. Basis of maxilliped 3 stouter. Distal segments of pereiopod 1 missing. Basis of pereiopod 2 very stout, longer relative to distal segments. Bases of pereiopods 3 (Fig. 16M) and 4 very stout, less than twice as long as wide, exopods rather long and slender. Basis of pereiopod 4 shorter than that of pereiopod 3. Pleopods rather short. Uropod and telson as in female.

Length

Adult male 10,6 mm

Ovigerous female 10,9 mm

Remarks

These specimens correspond well with Stebbing's figures except for a few discrepancies in the figures of the whole animal. The sculpturing of the carapace is quite distinctive and cannot be confused with that of any other species of Makrokylindrus.

Distribution

Known from three samples from the region of the type locality: 805 to 900 m off Durban and vicinity.

Makrokylindrus deinotelson sp. nov.

Fig. 17

Records

SM 27^{o}S 32^{o}E 550 m 1 ♀, 2 juvs (1 record)

Holotype

Female, in the South African Museum, SAM-A15733, collected by the SAM, 22 May 1976. Type locality: 550 m, in the southern Mocambique Channel, (27^{o}59'S 32^{o}40'E).

Description

Female, holotype, length 6,8 mm. Broken in two, but otherwise undamaged. Integument thin, very lightly calcified, rugose posteriorly on carapace, otherwise lightly reticulate. Carapace (Fig. 17A) about one and a half times as long as deep with two very strong transverse ridges meeting laterally. Posterior ridge tuberculate, slightly posterior to middle of carapace and bearing remains of spines; forming deepest part of carapace, turning forward below midlateral level and running for a short distance to meet anterior transverse ridge which encircles entire carapace about a third from anterior edge and which bears some tubercles and broken spines and forms the widest part of the carapace. Pseudorostrum (Fig. 17B) moderately long, with scattered denticles and spines. Eyelobe very small and triangular. No antennal notch present, anterolateral edge minutely serrated. Posterior part of carapace lightly rugose.

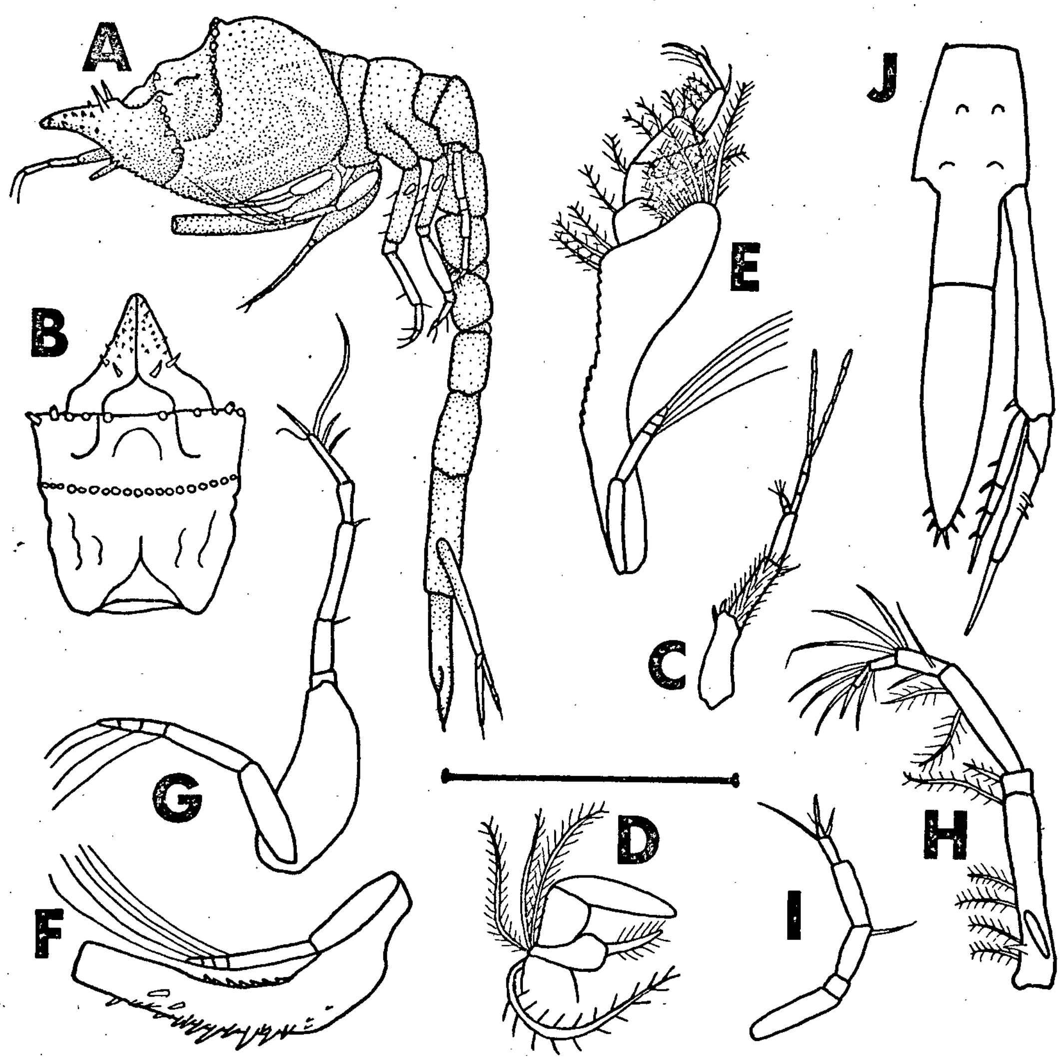

Fig. 17. Makrokylindrus deinotelson sp. nov.

Female. A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Antenna 2. E. Maxilliped 3. F. Basis of pereiopod 1. G. Pereiopod 2. H. Pereiopod 3. I. Pereiopod 5. J. Uropod and telson.

Scale line = 2 mm for A, B; 1 mm for C, E-J; 0,5 mm for D.

First and part of second pedigerous somites obscured laterally by posterolateral extension of carapace, third and fourth narrow and coalesced dorsally. Cephalothorax and abdomen (excluding telson) subequal in length. Abdominal somites subcylindrical.

Antenna 1 (Fig.17C) fairly long, first and second segments subequal in length, second finely setose, third slightly shorter. Accessory flagellum short and 2-segmented, flagellum 3-segmented.

Antenna 2 (Fig. 17D) fairly large, 4-segmented; last segment longest.

Basis of maxilliped 3 (Fig. 17E) very large, expanded distally to reach level of merus and much wider here with numerous plumose setae. Ischium fairly large, last four segments subequal in length.

Distal segments of pereiopod 1 missing. Basis (Fig. 17F) fairly stout with numerous spines on lower edge. Basis of pereiopod 2 (Fig. 17G) short and stout, about two and a half times as long as wide, unarmed; ischium short; carpus longest of remaining segments, subequal in length to propodus and dactyl together. Pereiopods 3 (Fig. 17H) and 4 with a very small, 1-segmented exopod. Merus longest of distal segments; last three segments each shorter than preceding one. Pereiopod 5 (Fig. 17I) similar to pereiopod 4 but basis and merus much shorter.

Telsonic somite (Fig. 17J) very long, twice as long as wide and nearly three times as long as deep, protruding between uropods for nearly half its length and subequal in length to telson. Telson with less than a third its length post-anal, tapering posteriorly with one pair of terminal spines and two pairs of lateral spines; almost reaching posterior tip of rami of uropod. Peduncle of uropod reaching half way down telson, slightly less than twice length of endopod. Exopod slightly longer than endopod; endopod 3-segmented, first segment subequal in length to next two together.

Length

Female 6,8 mm

Remarks

As the specific name indicates, the telson and telsonic somite of this species are unique in that the telsonic somite protrudes well beyond the insertion of the uropods. Thus although the telson is no longer than the telsonic somite, the length of the telson plus telsonic somite posterior to the insertion of the uropods is comparable with that of many species of Makrokylindrus. The character may prove worthy of generic distinction, but it does not seem to be sufficiently unusual to warrant the erection of a new genus on the basis of three individuals, none of which is adult.

M. deinotelson is easily distinguished from all other species in the genus on this character alone. But in other respects it resembles M. fragilis, M. cinctus Jones, 1969 and M. cingulatus (Calman, 1905), all of which have transverse ridges on the carapace. In both M. cinctus and M. cingulatus the carapace bears scattered spines apart from those on the transverse ridge(s) and M. fragilis has a single transverse ridge.

Distribution

Known only from a single sample from 550 m in the southern Mocambique Channel.

Makrokylindrus mundus sp. nov.

Fig. 18

Records

SM 27^{o}S 32^{o}E 800-810 m 1 ♀(1 record)

Holotype

Female, in the South African Museum, SAM-A15734, collected by the SAM, 19 May 1976. Type locality: 800-810 m, in the southern Mocambique Channel ($27^{o}09'$S $32^{o}58'$E).

Description

Female, holotype, length 5,4 mm. Integument very lightly calcified, smooth and faintly reticulate, with no spines or denticles but with a few hairs on the carapace. Carapace (Fig. 18A) elongate-oval, slightly more than twice as long as deep with no antennal notch or anterolateral angle. Pseudorostrum (Fig. 18B) fairly short and wide; eyelobe small, triangular and eyeless.

First and part of second pedigerous somites obscured by posterolateral expansion of carapace; third and fourth coalesced dorsally; fifth short. Abdominal somites subcylindrical, together barely longer than carapace.

Antenna 1 (Fig. 18C) fairly long, first segment slightly longer than second, and twice as long as third. Flagellum long and 3-segmented, accessory flagellum short and 2-segmented.

Antenna 2 very similar to that of M. deinotelson and maxilliped 3 similar to that of M. fragilis, but ischium slightly longer.

Segments distal to basis of pereiopod 1 missing. Pereiopod 2 (Fig. 18D) long and slender; exopod fairly large and elongate. Basis narrow, subequal in length to merus and carpus together; ischium short; carpus equal in length to propodus and dactyl together. Pereiopods 3 (Fig. 18E) and 4 similar, with fairly large exopods. Basis fairly stout, little longer than merus. Pereiopod 5 (Fig. 18F) short, merus and carpus subequal in length.

Telsonic somite (Fig. 18G) wider than long, less than a third length of telson. Telson longer than last three abdominal somites together, cylindrical for most of its length. Post-anal part a third of total length, tapering to tip with three pairs of lateral and one pair of terminal spines. Telson almost reaching posterior edge of first segment of endopod. Endopod 3-segmented, its first segment subequal in length to next two together. Rami subequal in length.

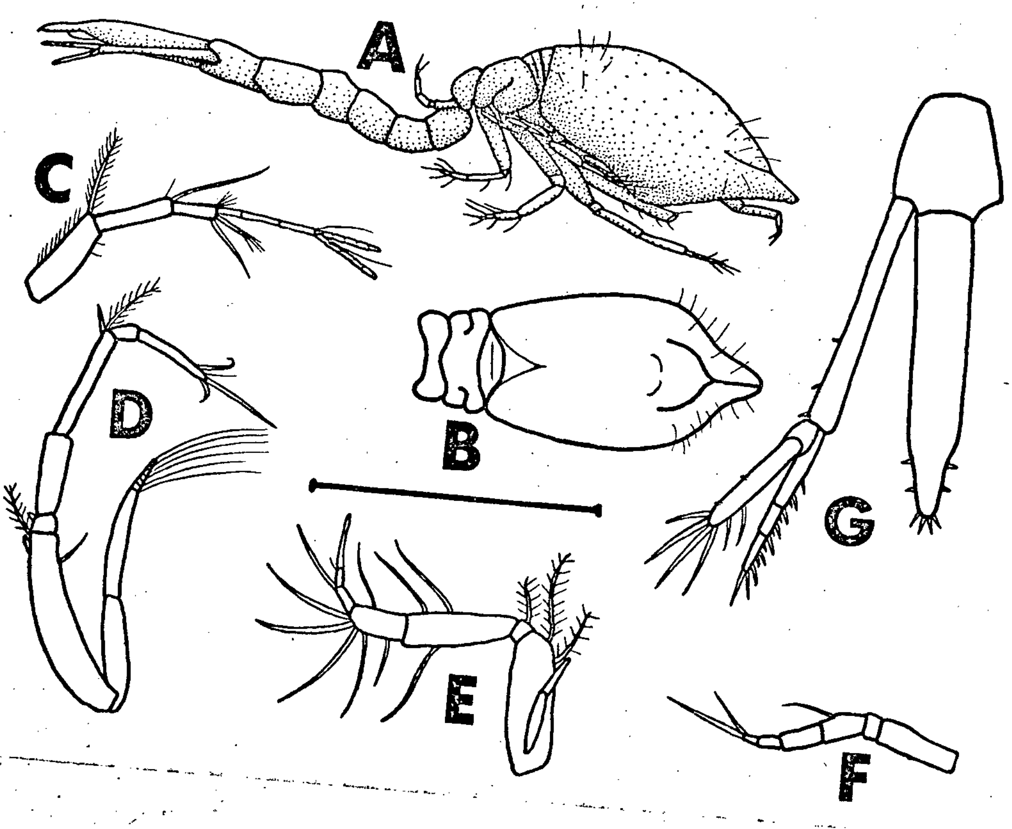

Fig. 18. Makrokylindrus mundus sp. nov. Female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Pereiopod 2. E. Pereiopod 3. F. Pereiopod 5. G. Uropod and telson.

Scale line = 2 mm for A, B; 1 mm for C-G.

Length

Female 5,4 mm

Remarks

This species is closest to M. longipes (Sars, 1871) but is distinguished by the smooth integument without any spines or denticles, the shorter carpus of pereiopod 2 and the relatively longer telson. Although it is rather unlike most other species of Makrokylindrus in the unarmed integument, this species must be placed in the genus because of its very characteristic telson.

Distribution

A single female known from 800-810 m in the southern Mocambique Channel.

Makrokylindrus spinifer sp. nov.

Figs 19 - 20

Records

SAM (PF 17440) 34°S 17°E 800 m 1 adult ♂, 1 ♀ (1 record)

SM 27°S 32°E-30°S 31°E 800-900 m 1 ovig. ♀, 4 ♀♀ (2 records)

Holotype

Young female, in the South African Museum, SAM-A15735, collected by the SAM, 19 May 1976. Type locality: 800-810 m, in the southern Mocambique Channel (27°09'S 32°58'E). South African Museum station number SM 60.

Description

Young female, holotype, length 6,2 mm. Entire integument strongly spinose and lightly calcified. Carapace (Fig. 19A) less than twice as long as deep, shallowly arched dorsally, evenly covered with moderately large, sharp spines. Spines at ventral edge particularly long, especially anteriorly. Pseudorostrum (Fig. 19B) rather short, blunt; eyelobe small

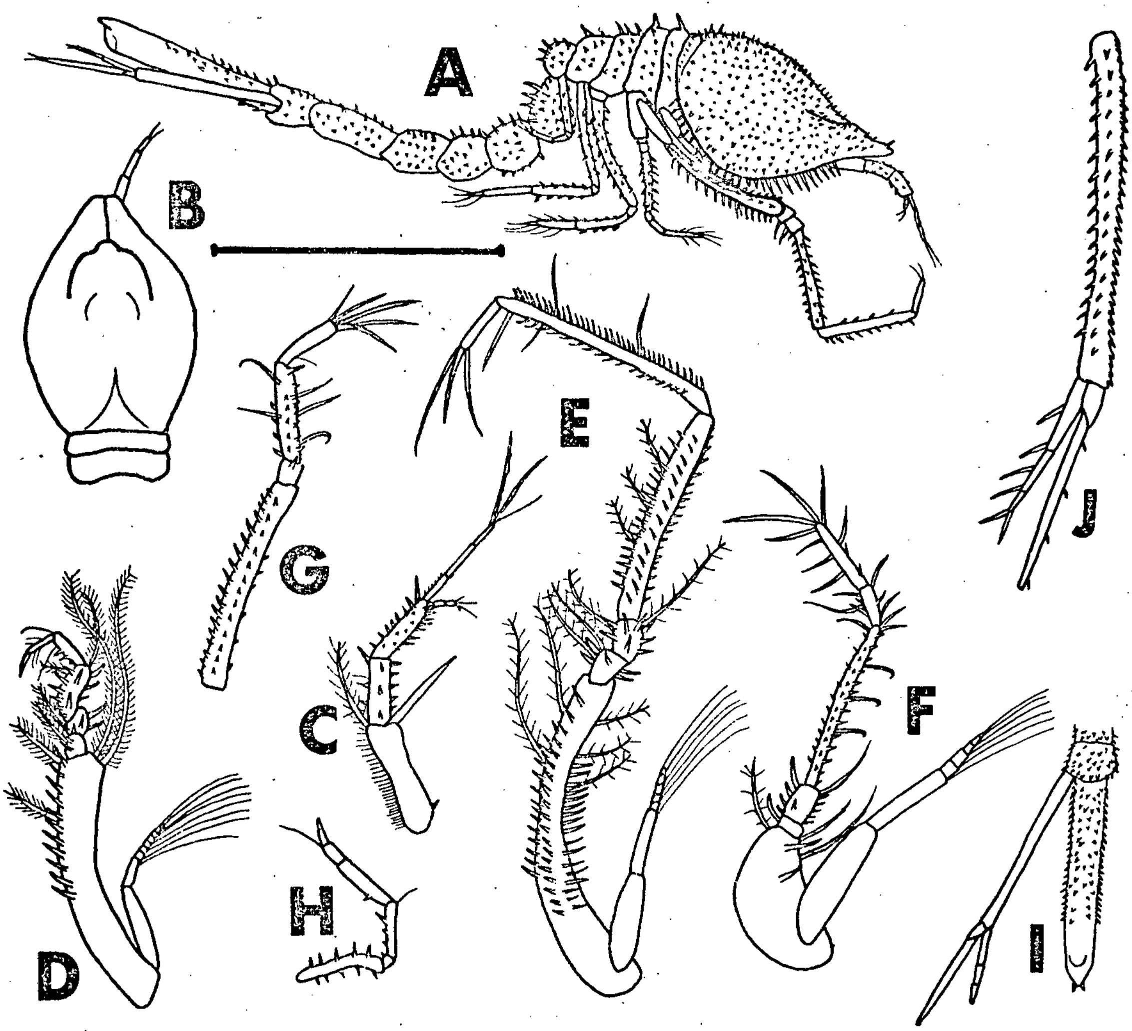

Fig. 19. Makrokylindrus spinifer sp. nov.

Young female. A. Lateral view. B. Dorsal view of carapace (spines omitted). C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Pereiopod 5. I. Uropod and telson. J. Uropod.

Scale line = 2 mm for A, B, I; 1 mm for C-H, J.

and eyeless.

All five pedigerous somites moderately wide and last situated somewhat dorsally; together about half length of carapace. Abdominal somites subcylindrical, spinose, fifth longest. Abdomen (excluding telson) subequal in length to cephalothorax.

Antenna 1 (Fig. 19C) large; first segment slightly longer than next two subequal, spinose segments together. Accessory flagellum short and 3-segmented, flagellum much longer and 3-segmented.

Basis of maxilliped 3 (Fig. 19D) not much wider distally than proximally with a single row of spines on lower edge. Ischium and merus subequal in length, carpus slightly longer. Exopod small.

Pereiopod 1 (Fig. 19E) very long and strongly spinose on all segments except dactyl. Basis equal in length to next three segments together; carpus and propodus subequal in length, each hardly shorter than basis; dactyl short. Basis of pereiopod 2 (Fig. 19F) very short and stout, twice as long as wide with very large exopod. Ischium short, merus slightly longer; carpus subequal in length to basis, ischium and merus together and longer than propodus and dactyl together, with small spines. Pereiopods 3 (Fig. 19G) and 4 similar, slender and spinose. Basis of pereiopod 3 longer than rest of limb and of pereiopod 4 slightly shorter. Pereiopod 5 (Fig. 19H) with a few spines on basis and merus only.

Telsonic somite (Fig. 19I) about as long as wide, less than a quarter length of telson. Telson very long, tubular and spinose, considerably longer than last three abdominal somites together; post-anal part a small fraction of total length with a single pair of terminal spines. Peduncle of uropod slender, tip not reaching level of anus. Endopod (Fig. 19J) 3-segmented, about three-quarters length of exopod and less than half length of peduncle; first segment slightly longer than next two together.

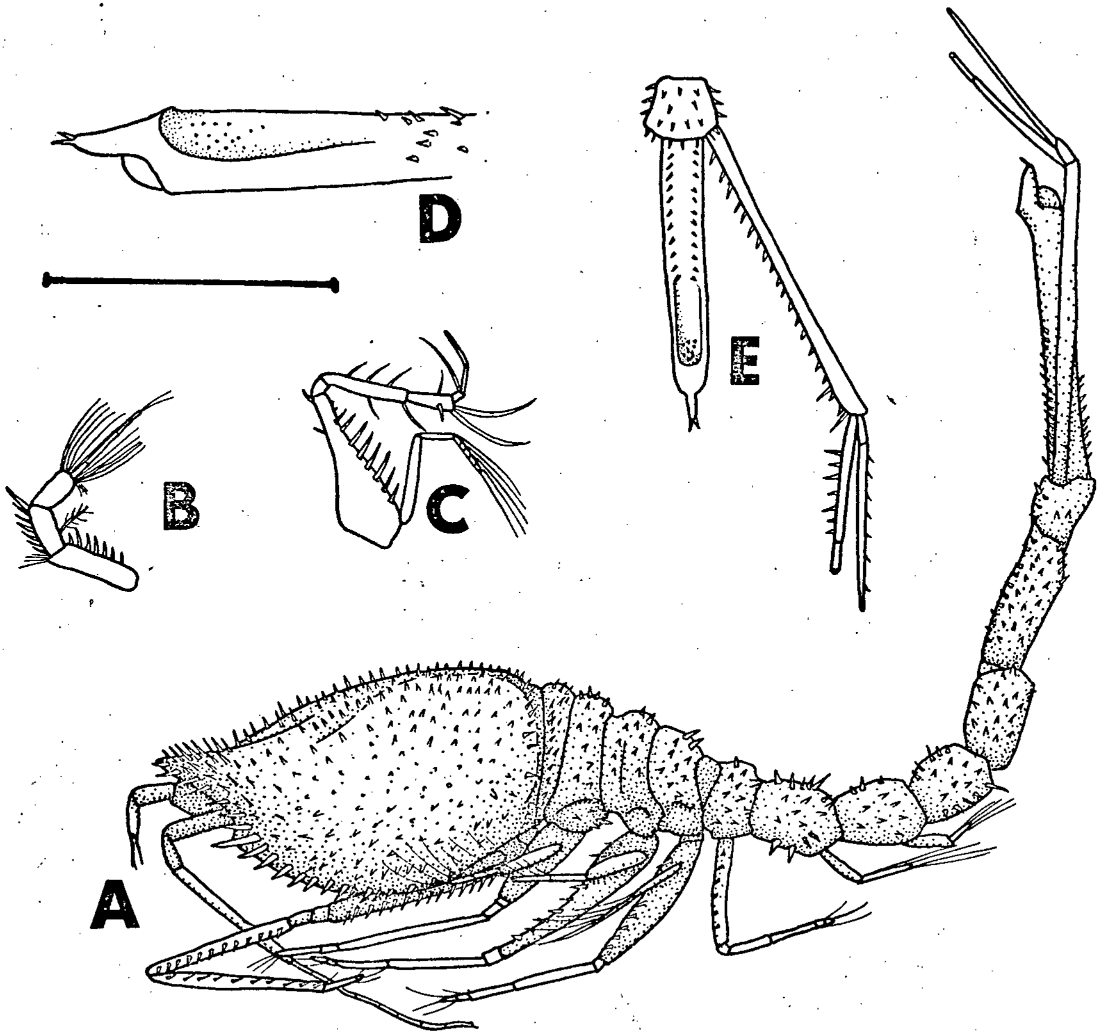

Fig. 20. Makrokylindrus spinifer sp. nov.

Adult male. A. Lateral view. B. Antenna 1. C. Pereiopod 3. D. Telson in dorsolateral view. E. Uropod and telson.

Scale line = 2 mm for A, 1 mm for B-E.

Makrokylindrus bicornis sp. nov.

Fig. 21

Records

SAM $34^{\circ}S$ $17^{\circ}E$ 800 m 2 ♀♀ (1 record)

Holotype

Female, in the South African Museum, SAM-A15739, collected by the SAM, in about 1900. Type locality: 800 m, off the Cape Peninsula ($34^{\circ}25'S$ $17^{\circ}45'E$). SAM station number SAM-A10602

Description Female, holotype, length 8,5 mm.

Integument lightly calcified, slightly brittle, smooth. Carapace (Fig. 21A) large, rounded, well arched dorsally, with a single pair of large pointed anterolateral horns visible in dorsal view (Fig. 21B) with several minute tubercles between them. Anterolateral angle wanting, ventrolateral edge spinose. Pseudorostrum moderately short and pointed. Eyelobe small, rounded and eyeless. Carapace nearly three times length of pereion; first somite obscured laterally by posterior protrusion of carapace, next two very narrow. Last three pedigerous and first three abdominal somites with a pair of short, sharp dorsolateral spines, second to fourth pedigerous somites also with a pair of lateral spines. Abdominal somites including telson slightly longer than cephalothorax, subcylindrical.

First segment of antenna 1 (Fig. 21C) slender, slighly shorter than next two together. Flagellum 3-segmented, rather short; accessory flagellum apparently 1-segmented.

Basis of maxilliped 3 (Fig. 21D) more than twice length of rest of limb, slightly widened distally. Ischium and merus short and stout; carpus very slightly expanded distally; last two segments subcylindrical.

Segments distal to basis of pereiopod 1 missing. Basis (Fig. 21E) curved with a row of sharp spines on lower edge. Exopod apparently 3-segmented. Basis of pereiopod 2 (Fig. 21F) fairly short, strongly spinose

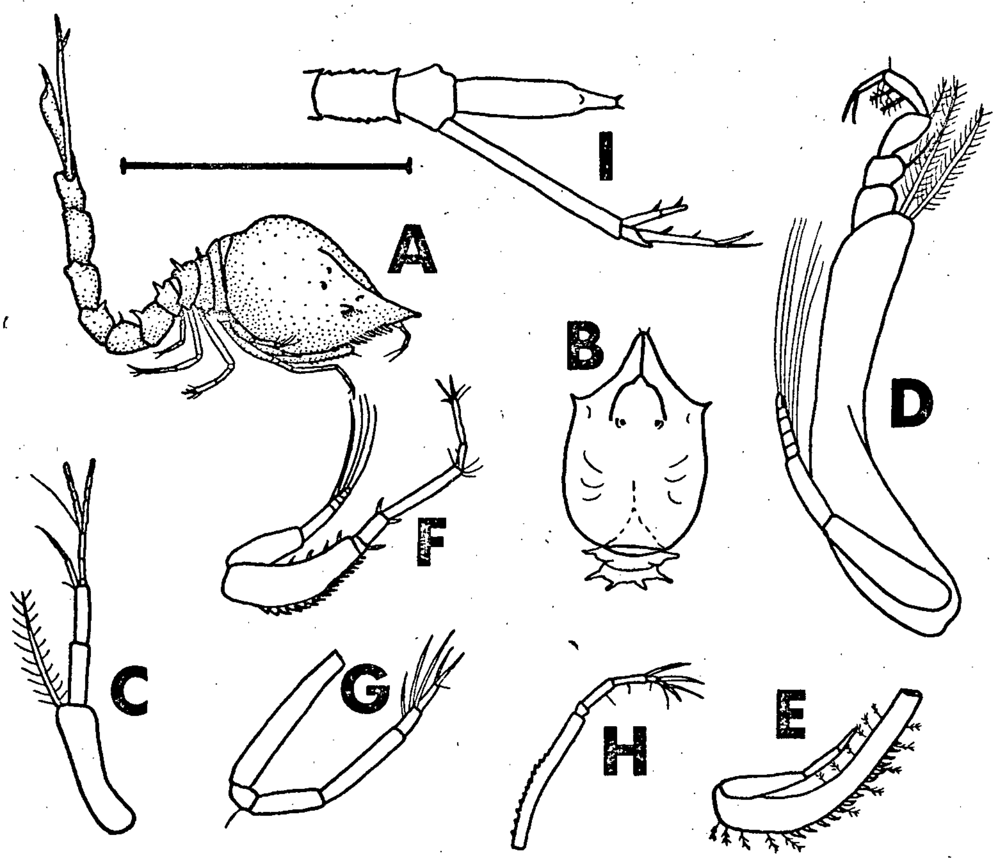

Fig. 21. Makrokylindrus bicornis sp. nov.

Female. A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Maxilliped 3. E. Basis of pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Pereiopod 5. I. Uropod and telson.

Scale line = 4 mm for A, B; 2 mm for E-I; 1 mm for C, D.

on lower edge, subequal in length to next three segments together. Carpus slender, slightly longer than next two segments together. Pereiopods 3 (Fig. 21G) and 4 similar, without exopods; basis of pereiopod 3 subequal in length to rest of limb. Basis of pereiopod 5 (Fig. 21H) rather longer than rest of limb, serrated on front edge.

Telson (Fig. 21I) slightly longer than last two abdominal somites together; post-anal part less than a third total length and narrower than pre-anal part with a single pair of terminal spines. Peduncle of uropod slightly longer than telson, apparently unarmed. First segment of endopod slightly longer than second, third missing. Exopod half length of peduncle.

Length

Female 6,2 - 8,5 mm

Remarks

M. bicornis is the only species in the genus to possess an obvious pair of anterolateral horns now that M. insignis has been removed to Adiastylis. It is rather similar to both A. insignis and Diastylis hexaceros in this way, but is clearly a member of Makrokylindrus with its long telson. The peduncle of the uropods is also much longer than in these two species.

Distribution

A single record from 800 m off the Cape Peninsula.

Adiastylis Stebbing, 1912

Generic diagnosis

Pseudorostrum short, less than a third total length of carapace. Third and fourth pedigerous somites coalesced or free. Antenna 1 of moderate size. Pereiopods 3 and 4 of female with exopods rudimentary or absent. Basis of pereiopod 2 often fairly wide, especially in male. Male with two pairs of pleopods. Telson much longer than telsonic somite, seldom much longer than last two abdominal somites together; post-anal part between a third and a half of total length of telson with 0-8 pairs of lateral spines. Endopod of uropod 2- or 3-segmented.

Type species

Adiastylis acanthodes Stebbing, 1912

Remarks

This genus was erected by Stebbing (1912) to accommodate a new species, A. acanthodes, and three species previously placed in Diastylis, A. longicaudatus, A. longipes and A. costatus. He distinguished the genus by the telson being "cylindric, with lateral spines on the short, narrowed distal section". This last character of spines on the post-anal part is now ambiguous since the number and size of the spines vary enormously so that the character no longer offers a clear distinction between Adiastylis and Diastylis. The generic diagnosis has therefore been expanded to accommodate all those species intermediate between Diastylis and Makrokylindrus in the nature of the telson. The genus now includes 23 species, all of which are included in the key below. Even the revival of this genus does not entirely remove the problem of dividing species into genera, and it should be stressed that Adiastylis is a convenient rather than natural assemblage of species. It includes some doubtful species, such as A. granulatus and A. californicus in which the telson is very short, and A. jedsi in which the posterior part of the telson is unknown. But it is felt more satisfactory to maintain Diastylis as a unified genus rather than as the general repository it has become.

Distribution

The genus is widely distributed and has been recorded from shallow depths to nearly 5 000 m. Three species are known from the southern African region and two of these are available in the present collection.

KEY TO THE SPECIES OF ADIASTYLIS

No attempt has been made to unite species which appear very similar to each other and may in fact prove to be synonymous when more material becomes available. "Pre-anal" refers to that part of the telson anterior to the beginning of the anal valves and "post-anal" to that part posterior to the beginning of the anal valves. The relative lengths of the telson and peduncle of the uropods are measured with both of these in place in the animal and parallel to each other, since the uropods are often inserted anterior tothe insertion of the telson.

1 Carapace with two pairs of strong unserrated carinae 2

- Carapace without carinae, or with one pair of unserrated or two pairs of serrated carinae 3

2 Longitudinal carinae linked by two transverse carinae on each side; propodus and dactyl of pereiopod 1 each longer than ischium, merus and carpus together . . . A? californicus (Zimmer, 1943) - California

- Longitudinal carinae linked by one transverse carina on each side; propodus and dactyl of pereiopod 1 each shorter than ischium, merus and carpus together . . . . . A. bacescui (Brum, 1971) - Brazil

3 Anterolateral edge of carapace smooth 4

- Anterolateral edge of carapace with spines or fine serrations . . . 5

4 Carapace smooth with no carinae or depressions; telson slightly longer than peduncle of uropods with no lateral spines . . . . A. inermis (Fage, 1929) - Azores

- Carapace with a pair of oblique dorsolateral carinae; telson distinctly shorter than peduncle of uropod with about five pairs of lateral spines . . . . . A. planifrons (Calman, 1912) - Strait of Magellan

5 Telson (excluding terminal spines) no longer than last two abdominal somites together 6

- Telson (excluding terminal spines) distinctly longer than last two abdominal somites together 20

6 Front half or more of carapace with evenly distributed spines or denticles of more or less uniform length, or larger spines confined to frontal lobe 7

- Front half or more of carapace without spines or denticles, or those present unevenly distributed or larger spines not confined to frontal lobe 13

7 Pseudorostrum and frontal lobe with no particularly large spines . . 8

- At least one pair of spines on pseudorostrum twice length of majority or more 10

8 Telson distinctly shorter than peduncle of uropod . . . . A. longicaudatus (Bonnier, 1896) - North Atlantic

- Telson subequal in length to or longer than peduncle of uropod . . 9

9 Telson with one or two pairs of lateral spines; endopod of uropod 2-segmented . . . . A. mystacinus (Sars, 1887) - North Atlantic

- Telson with three to four pairs of lateral spines; endopod of uropod 3-segmented . . . . A. aculeatus sp. nov.

10 Telson without lateral spines; pseudorostrum with two pairs of large erect spines submedially . . A. monodi (Reyss, 1974) - North Atlantic

- Telson with at least three pairs of lateral spines; pseudorostrum with one piar of large erect spines or none 11

11 Frontal lobe without a pair of large erect spines; telson with three pairs of lateral spines . . . . A. armatus (Norman, 1879) - Arctic

- Frontal lobe with a pair of large, erect spines; telson with 6 to 7 pairs of lateral spines 12

12 Pseudorostrum without a pair of large erect spines; telson with seven pairs of lateral spines . . A. jonesi (Reyss, 1972) - Mediterranean

- Pseudorostrum with a pair of large erect spines; telson with six pairs of lateral spines . . A. peresi (Reyss, 1974) - North Atlantic

13 Third and fourth pedigerous somites coalesced middorsally . . . .
. . . . *A. aegaeus* (Reyss, 1974) - Mediterranean

- Third and fourth pedigerous somites not coalesced middorsally . . 14

14 Posterior half of carapace without spines, denticles or tubercles . 15

- Posterior half of carapace with spines, denticles or tubercles . . 18

15 Carapace with about three oblique ridges on either side; base of telson serrate laterally . . . . . *A. mawsoni* (Calman, 1918) - Antarctic

- Carapace with no more than one oblique ridge on either side; base of telson not serrate laterally 16

16 Post-anal part of telson tapering smoothly from pre-anal part with 5-6 pairs of lateral spines on posterior quarter; carapace coarsely pitted . . . . *A. delicatus* (Jones, 1969) - Tasman Sea

- Post-anal part of telson abruptly narrower than pre-anal part with 4-5 pairs of lateral spines on posterior third; carapace smooth . 17

17 Telson shorter than peduncle of uropod; basis of pereiopod 2 slightly shorter than rest of limb . . . . *A. nitens* (Gamo, 1968) - Japan

- Telson longer than peduncle of uropod; basis of pereiopod 2 slightly longer than rest of limb . *A. gibberus* (Jones, 1969) - Great Australian Bight

18 Telson longer than peduncle of uropod . *A. inscriptus* (Jones, 1969) - Antarctic

- Telson shorter than peduncle of uropod 19

19 Peduncle of uropod at least as long as last three abdominal somites together; carapace knobbly, covered with large scattered tubercles bearing delicate spines . *A. acanthodes* Stebbing, 1912 - South Africa

- Peduncle of uropod shorter than last two abdominal somites together; carapace smooth with several rows of small, rounded spineless tubercles . . . . *A? granulatus* (Zimmer, 1921) - Argentine

20 Carapace with a pair of large rounded lateral horns . . . . . .
. . . . *A. insignis* (Sars, 1871) - North Atlantic

- Carapace without lateral horns 21

21 Telson with a narrowed collar behind the anus . . . .
. . . . A. abyssi (Lomakina, 1955) - Arctic
- Telson with no narrowed collar behind the anus 22

22 Posterior half of carapace without spinules; pereion and pleon without spinules or with several rows of them 23
- Entire carapace and most of pereion and pleon covered with numerous close-set spinules 26

23 Telson shorter than peduncle of uropod, basal part with short setae laterally . . A. exilicaudus (Jones, 1969) - Great Australian Bight
- Telson longer than peduncle of uropod, basal part without setae laterally . 24

24 Telson laterally smooth at base . A. vitiasi (Lomakina, 1958) - Kamchatka
- Telson laterally serrate at base 25

25 Carapace with several oblique ridges running down from posterior mid-dorsal line towards anterolateral edge . . . .
. . . . A. costatus (Bonnier, 1896) - North Atlantic
- Carapace with no obvious oblique ridges; a row of small tubercles may run obliquely upwards from posterolateral edge towards eyelobe . .
. . . . A. neptunius (Jones, 1969) - Tasman Sea

26 Spinules on carapace (other than pseudorostrum) interspersed by much larger spines more than twice length of spinules 27
- Spinules on carapace (other than pseudorostrum) of more or less uniform size 28

27 Telson shorter than peduncle of uropod with three pairs of lateral spines; pedigerous somites 3 and 4 coalesced dorsally . . . . .
. . . . A. utinomii (Gamo, 1968) - Japan
- Telson longer than peduncle of uropod with about eight pairs of lateral spines; pedigerous somites 3 and 4 not coalesced . . . .
. . . . A. anomalus (Bonnier, 1896) - North Atlantic

28* Fifth abdominal somite hardly longer than sixth; second segment of antenna 1 the shortest; telson with one pair of lateral spines . . . . <u>A. stocki</u> (Reyss, 1974) - North Atlantic

\- Fifth abdominal somite longer than sixth; second segment of antenna 1 no shorter than third; telson without lateral spines or with several pairs 29

29 Telson with about eight pairs of lateral spines; surface of carapace raised into low, spine-covered nodules . <u>A. omorii</u> (Gamo, 1968) - Japan

\- Telson with 0-1 pairs of lateral spines; surface of carapace smooth apart from spinules 30

30 Pleon smooth; antenna 1 stout, first segment slightly longer than next two together; dactyl of pereiopod 1 no longer than propodus . . . . <u>A. lomakinae</u> (Bacescu, 1962) - south-eastern Africa

\- Pleon covered with small spines; antenna 1 slender, first segment shorter than next two together; dactyl of pereiopod 1 half as long again as propodus . . . <u>A. erinaceus</u> (Sars, 1887) - North Atlantic

*<u>A. jedsi</u> cannot be keyed beyond this point because of the incomplete nature of the available material.

<u>Adiastylis acanthodes</u> Stebbing, 1912

Fig. 22

<u>Adiastylis acanthodes</u> Stebbing, 1912: 148-149, pl. 53.

<u>Diastylis acanthodes</u> Jones, 1969: 169.

<u>Makrokylindrus acanthodes</u> Bacescu, 1962: 222.

<u>Records</u>

SM 27°S 32°E-30°S 31°E 550-900 m 3 adult ♂♂, 21 subadult ♂♂, 2 immature ♂♂, 10 ovig. ♀♀, 27 ♀♀, 14 juvs (4 records)

<u>Previous records</u>

Holotype only

Holotype

Adult male, deposited by Stebbing in the British Museum (Natural History). Type locality: 805 m, off Durban (about 30°S 30°E).

Description

Ovigerous female, length 7,4 mm (from SM 151 off Durban). Integument lightly calcified, reticulate, hairy; some hairs very fine, causing particles of debris to adhere and thus appearing floury. Carapace with many minute, curved spines and some larger nodules bearing long, slender delicate spines (usually lost or damaged). Carapace (Fig. 22A) fairly deep in midportion, inflated posterolaterally with a narrow depressed groove running around posterior edge. Anterolateral angle wanting, anterolateral edge with several very large spines. Pseudorostrum (Fig. 22B) fairly short and smoothly rounded; eyelobe small, triangular and eyeless.

Pereion nearly as long as carapace; second to fourth somites slightly flanged laterally. Cephalothorax and abdomen (excluding telson) subequal in length, abdominal somites with few small spines and several patches of light discoloration.

Antenna 1 (Fig. 22C) rather large, first segment slightly larger than each of next two; flagellum 4-segmented and accessory flagellum 2-segmented.

Exopod of maxilliped 3 (Fig. 22D) large. Basis slightly longer than rest of limb and somewhat produced distally. Last three segments subcylindrical and subequal in length.

Pereiopod 1 damaged in all ovigerous females. In young female (Fig. 22E) very long, basis less than a third total length. Last three segments elongate; propodus as long as basis. Basis of pereiopod 2 (Fig. 22F) short, moderately narrow, less than a third total length of limb. Merus about three times length of ischium; carpus twice length of merus. Exopod moderately large. Pereiopods 3 and 4 without exopods; bases long and cyl-

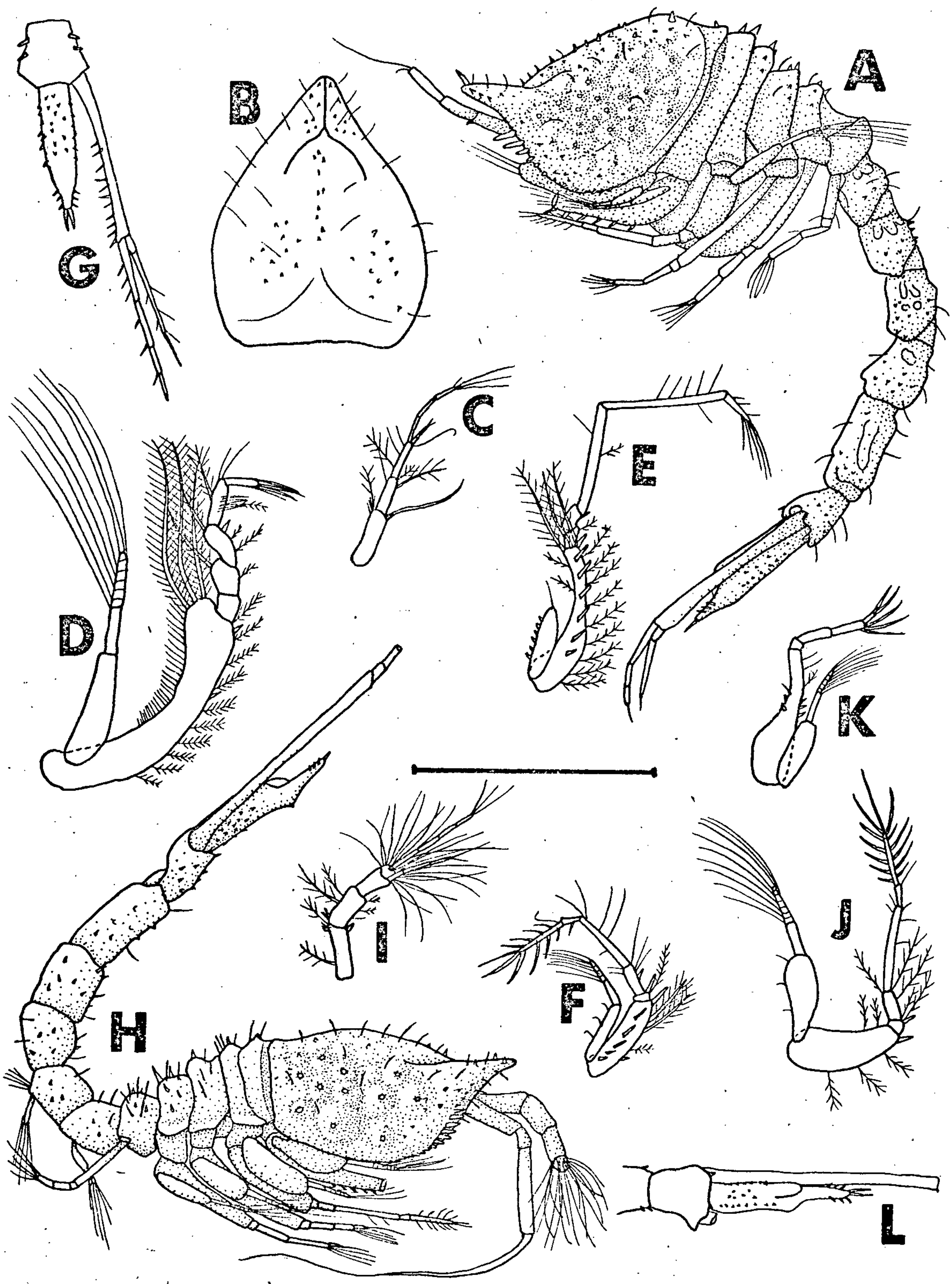

Fig. 22. Adiastylis acanthodes

Ovigerous female. A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Uropod and telson.

Adult male. H. Lateral view. I. Antenna 1. J. Pereiopod 2. K. Pereiopod 3. L. Telson and peduncle of uropod.

Scale line = 2 mm for A, B, H; 1 mm for C-G, I-L.

indrical, merus and carpus subequal in length. Basis of pereiopod 5 shorter than rest of limb.

Telsonic somite (Fig. 22G) slightly wider than long with two pairs of small spinules laterally. Telson twice length of telsonic somite, slightly shorter than last two abdominal somites together; pre-anal part less than twice length of post-anal part, with numerous spinules dorsally and laterally on basal part. Post-anal part tapering evenly, with three pairs of lateral and a much longer pair of terminal spines. Peduncle of uropod a quarter as long again as telson, slender, with several fine spines on inner edge. Endopod longer by one segment than exopod, three-segmented; each segment slightly longer than succeeding one. Exopod very slender.

Adult male, length 7,8 mm (SM 151). As female, except as follows: carapace (Fig. 22H) shallower, spinose nodules less elevated. Teeth at anterolateral edge originating slightly behind margin. First four pedigerous somites much shallower, second to fourth strongly flanged laterally; pereion somites slightly more hairy and spinules longer. Abdominal somites without patches of discoloration.

Antenna 1 (Fig. 22I) stouter, third segment bearing numerous sensory setae; accessory flagellum longer. Antenna 2 short, hardly reaching beyond end of thorax. Distal segments of pereiopod 1 missing from all adult males. Basis of pereiopod 2 (Fig. 22J) larger and not spinose; exopod larger. Bases of pereiopods 3 (Fig. 22K) and 4 stouter, exopods present.

Telson (Fig. 22L) shorter relative to elongate peduncle of uropod with a short raised keel surrounding depressed middorsal area. Pre-anal part relatively shorter. Peduncle of uropod apparently unarmed, rami missing from all specimens.

Length

Adult male 7,1 - 7,8 mm

Ovigerous female 7,4 - 8,5 mm

Remarks

A. acanthodes was described by Stebbing (1912) on the basis of a single adult male from South Africa. The present specimens differ from Stebbing's figures in minor respects only. The spines on the entire body are more marked in his figures, but these spines are extremely delicate and are usually lost. The lateral spines of the telson are spaced more widely and the peduncle of the uropod bears numerous rather long setae in his figure.

The very uneven nodular surface of the carapace is found only in A. acanthodes and A. nitens (Gamo, 1968). The two species are similar in many ways, but in A. nitens the anterolateral serrations are much smaller, the first segment of antenna 1 is longer, the pre-anal part of the telson is shorter and the telson is longer than the peduncle of the uropod. There are other minor differences in the proportions of the appendages.

Distribution

Known only from the coast of Natal near Durban at depths from 550 to 900 m.

Adiastylis aculeatus sp. nov.

Fig. 23

Records

SAM 34^{o}S 17^{o}E 800 m 1 subadult ♂, 1 ♀, 1 juv. (1 record)

Holotype

Female, in the South African Museum, SAM-A15741, collected by the SAM, in about 1900. Type locality: 800 m, off the Cape Peninsula ($34^{o}25'$S $17^{o}45'$E). SAM station number SAM-A10602 (PF 17440).

Description

Female, holotype, length 8,8 mm. Integument lightly calcified, fairly brittle; carapace densely covered with short pointed spines; pedigerous and anterior abdominal somites with a few spinules, posterior abdominal somites smooth and reticulate. Carapace (Fig. 23A) large, twice as long as wide, gently arched and slightly inflated posteriorly. No antennal notch; anterolateral edge with very slightly longer spines than elsewhere. Pseudorostrum rather sharp in lateral view, rounded anteriorly in dorsal view (Fig. 23B) with fewer spinules. (Most spinules omitted in Fig. 23B). Eyelobe small, triangular and eyeless.

Pereion less than half length of carapace, first two somites poorly spinose and last three with pairs of rather large, erect spines dorsally. Abdomen hardly longer than carapace; somites cylindrical, first two with a pair of large spines dorsolaterally.

Antenna 1 (Fig. 23C) rather small, first segment longer than and twice as wide as next two together. Flagellum 3-segmented and accessory flagellum 2-segmented.

Basis of maxilliped 3 (Fig. 23D) twice length of rest of limb, uniformly wide along entire length; merus short and very slightly expanded; last three segments cylindrical. Exopod fairly small.

Segments distal to basis of pereiopod 1 missing. Basis (Fig. 23E) strongly spinose. Basis of pereiopod 2 (Fig. 23F) subequal in length to next four segments together, moderately wide. Carpus longer than propodus and dactyl together. Pereiopod 3 (Fig. 23G) longer than pereiopod 2, shorter than pereiopod 4 with basis less than half total length of limb. Pereiopods 4 and 5 (Fig. 23H) similar to pereiopod 3. Dactyl of pereiopod 5 missing. Pereiopods 3 and 4 without exopods.

Telsonic somite (Fig. 23I) as long as wide, less than half length of telson. Telson stout, more than a quarter as wide as long at base; pre-anal part cylindrical and little longer than post-anal part, slightly depressed middorsally above anal valves. Post-anal part with three pairs of lateral spines, all situated rather more dorsally than usual. Terminal spines slender. Peduncle of uropod slender, shorter than telson and subequal in length to last two abdominal somites together with two spines on inner edge (rest probably lost). Exopod fairly short and stout; endopod represented

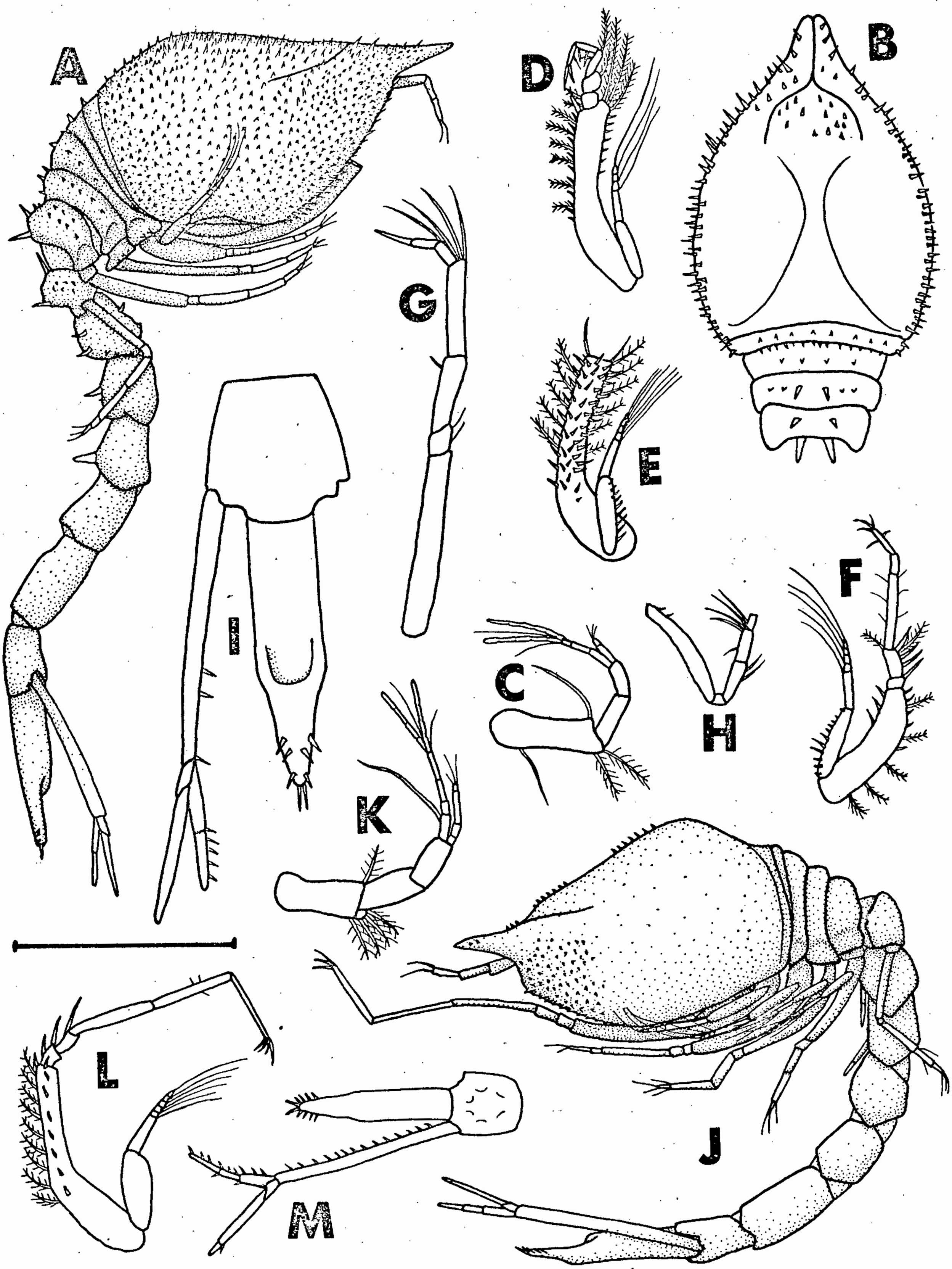

Fig. 23. Adiastylis aculeatus sp. nov.

Female. A. Lateral view. B. Dorsal view of carapace (most spines omitted). C. Antenna 1. D. Maxilliped 3. E. Basis of pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Pereiopod 5. I. Uropod and telson.

Subadult male; J. Lateral view. K. Antenna 1. L. Pereiopod 1. M. Uropod and telson.

Scale line = 2 mm for A, B, J, M; 1 mm for C-I, K, L.

by first two segments only, third apparently mutilated; first slightly longer than remainder of second.

Subadult male, paratype, length 9,2 mm. As female except as follows: integument very brittle: individual apparently in pre-moult condition with parts of carapace having lost outer, spinose integument and being soft and smooth underneath. Integument where whole with finer, shorter spinules. Carapace (Fig. 23J) slightly more vaulted postero-dorsally and nearly twice as long as wide. Pereion and pleon entirely without spinules.

First segment of antenna 1 (Fig. 23K) shorter, second and third wider; both flagella 4-segmented. Basis of pereiopod 1 (Fig. 23L) subequal in length to next four segments together with a single row of rather small spines; ischium and merus small and subequal in length; carpus and propodus slender and subequal in length, each slightly longer than dactyl.

Telsonic somite (Fig. 23M) slightly depressed middorsally, slightly less than half length of telson. Pre-anal part of telson slightly longer with no middorsal depression; distal tip of telson with four pairs of lateral spines. Peduncle of uropod slender, as long as last two and a half abdominal somites together, slightly longer than telson and armed with about 14 small spines on inner edge. Endopod 3-segmented, half length of peduncle; second segment slightly shorter than first or third. Endopod very slightly longer than exopod with a stout terminal spine.

Length

Subadult male 9,2 mm

Female 8,8 mm

Remarks

It is not certain that the female and male described above belong to the smae species. In general appearance and the structure of most of the limbs they are very similar but the uropods and telson differ rather more than is usual in the genus. Finality on the matter will have to await the collection of more material.

A. aculeatus is closest to A. mystacinus (Sars, 1887) (for which only the female is known) in general form and spination of the integument. However in A. mystacinus the carapace is slightly shorter and more vaulted, the pseudorostrum shorter, the telson lacks a depressed dorsal area and bears only one or two pairs of lateral spines subterminally.

Distribution

Known from a single sample from 800 m off the Cape Peninsula.

Diastylis Say, 1818

Generic diagnosis

Pseudorostrum less than a third total length of carapace. Third and fourth pedigerous somites not coalesced, fifth produced posteriorly. Antenna 1 of moderate size. Bases of pereiopods not widened in male and periopods 2 and 3 not widely separated in ovigerous female. Rudimentary exopods present or absent on pereiopods 3 and 4 of female. Male with two pairs of pleopods. Post-anal part of telson longer and more slender than pre-anal part with at least three (usually more than five or six) pairs of lateral spines. Endopod of uropod 1-, 2- or 3-segmented.

Type species

D. rathkei (Kröyer, 1841) (as Cuma rathkei)replacing D. arenarius Say.

Remarks

The genus Diastylis has gradually become a repository of species with generalised diastylid characters. In the discussion on the family on pages 39 et seq. above, new restrictive generic characters are proposed which reduce the number of species in the genus to about 60. This number is approximate because in some cases generic positions are uncertain and can only be determined with reference to type material or require the presence of additional information.

The type species, D. arenarius, was inadequately described by Say (1818). It is proposed (p. 42 above) to replace it with D. rathkei (Kröyer, 1841) which was the first species subsequently described (Kröyer 1841), or placed in the genus (Bate 1856) as well as being one of the best known species of Cumacea.

Distribution

The genus is cosmopolitan and the depth ranges are rather wider than are usual in the order. Several species, particularly from the northern hemisphere, are known from depths of less than 20 to more than 1 000 m.

KEY TO THE SPECIES OF DIASTYLIS FROM THE SOUTHERN HEMISPHERE

Only species from the southern hemisphere are included in the key below. Since many species are strongly sexually dimorphic, it has sometimes been necessary to key out males and females separately. Where the sex is not stated the characters apply equally to male and female. No attempt has been made to join apparently synonymous species.

1 Abdomen including telson twice length of cephalothorax . . . . ♀ D. tenuicaudus Lomakina, 1967 - Tasman Sea

\- Abdomen including telson subequal in length to cephalothorax 2

2 Carapace smooth with three pairs of horns anteriorly below eyelobe . . . . ♀ D. hexaceros Zimmer, 1908 - South Africa

\- Carapace smooth or spinose but without horns 3

3 Peduncle of uropod extending beyond tip of telson for at least a third its length 4

\- Peduncle of uropod extending posteriorly about as far as telson . . 10

4 Carapace smooth with no ridges 5

\- Carapace with at least one pair of oblique or transverse ridges . . 6

5 Basis and following three segemnts of maxilliped 3 widened distally with one or more teeth; ischium, merus and carpus of pereiopod 2 together longer than propodus and dactyl together; female with antennal notch and male without . D. pseudinornatus Ledoyer, 1977 - Antarctic

- Basis and following three segments of maxilliped 3 not widened distally nor bearing teeth; ischium, merus and carpus of pereiopod 2 together shorter than propodus and dactyl together; antennal notch absent in female, male unknown . . . . ♀ D. inornatus Hale, 1937 - Antarctic

6 Endopod of uropod 1-segmented . . . D. gayi (Nicolet, 1849) - Chile

- Endopod of uropod 3-segmented 7

7 Telson half as long again as telsonic somite in female and twice as long in male; carapace with 10-12 pairs of oblique ridges . . . . D. anderssoni Zimmer, 1907 - Antarctic

- Telson subequal in length to telsonic somite in female and less than half as long again in male; ornamentation of carapace variable . . 8

8 Pseudorostrum slightly upturned; pereiopods 3 and 4 without exopods . . . . ♀ D. hammoniae Zimmer, 1902 - South Atlantic

- Pseudorostrum slightly downbent; pereiopods 3 and 4 of female with rudimentary exopods 9

9 Sides of carapace with three oblique ridges and no spines . . . . D. neozeylanicus Thomson, 1892 - New Zealand

- Sides of carapace with an oblique row of spines; rest of carapace covered with spinules in female and smooth in male . . . . D. insularum Calman, 1908 - New Zealand

10 Endopod of uropod 1- or 2-segmented 11

- Endopod of uropod 3-segmented 17

11 Carapace with some large spines interspersed among numerous smaller spinules 12

- Carapace smooth or covered with spinules of uniform length 13

12 Endopod of uropod 1-segmented; telson slightly longer than peduncle of uropod . . . . *D. helleri* Zimmer, 1907 - Antarctic

- Endopod of uropod 2-segmented; telson slightly shorter than peduncle of uropod . . . . *D. horridus* Sars, 1887 - Antarctic, Kerguelen

13 Female, juvenile or young male 14

- Adult male 16

14 Anterior part of carapace uniformly covered with spinules; carapace twice as long as deep (male unknown) . ♀ *D. zimmeri* Ledoyer, 1977 - Antarctic

- Carapace not covered with spinules; carapace about one and two-thirds as long as deep 15

15 Telson subequal in length to peduncle of uropods with three pairs of lateral spines; peduncle with four spines on inner edge . . . . ♀ *D. fimbriatus* Sars, 1873 - south-west Atlantic

- Telson slightly shorter than peduncle of uropod with five to six pairs of lateral spines; peduncle unarmed . . . . ♀ *D. argentatus* Calman, 1912 - South Atlantic

16 Pseudorostrum with a row of spinules; posterior tooth of fifth pedigerous somite bifid . . ♂ *D. argentatus* Calman, 1912 - South Atlantic

- Pseudorostrum without spinules; posterior tooth of fifth pedigerous somite with a single point . ♂ *D. fimbriatus* Sars, 1873 - south-west Atlantic

17 Carapace with two rows of large curved spines laterally . . . . subadult ♂ *D. corniculatus* Hale, 1937 - Antarctic

- Carapace without rows of large, curved spines 18

18 Telson shorter than last one and a half abdominal somites together . 19

- Telson almost or as long as last two abdominal somites together . . 20

19 Numerous spinules on carapace; anterolateral edge with two or three small teeth; telson abruptly narrower posteriorly with eight to nine pairs of lateral spines . . ♀ *D. acuminatus* Jones, 1960 - Chatham Is.

- A few spinules anteriorly on carapace; anterolateral edge strongly dentate; telson tapering posteriorly with no more than six pairs of lateral spines . . . . D. namibiae sp. nov.

20 Fifth pedigerous somite very little produced backwards in female and young male (adult male unknown); carapace with several vertical rows of spinules; pre-anal part of telson almost as long as post-anal part . . . . . ♀ D. denticulatus Jones, 1956 - South West Africa

\- Fifth pedigerous somite produced backwards forming a strong point in both sexes; carapace smooth or scattered with minute spinules; pre-anal part of telson distinctly shorter than post-anal part . . . . D. algoae Zimmer, 1908 - South and South West Africa

Diastylis algoae Zimmer, 1908

Figs 24 - 25

Diastylis algoae Zimmer, 1908: 188-189, pl. 9, 10; Stebbing, 1910: 418; Stebbing, 1912: 147-148; Jones, 1960: 178.

Diastylis rufescens Jones, 1955: 288-290, figs 6-7.

Records

			adult ♂	sub-adult ♂	♂	ovig. ♀	♀	juv.	total	no. of records
SWD	26°S 15°E	26 m	5	22	15	15	61	38	156	1
WCD	32°S 17°E-34°S 18°E	20-172 m	95	208	185	339	660	259	1746	28
LBT	32°S 18°E	40-100 m		4	6	7	10	1	28	5
SB	33°S 17°E	11-56 m	14	26	6	45	89		180	10
FAL & FBY	34°S 18°E	27-102 m	34	44	20	76	56	41	271	57
SCD	34°S 21°E-33°S 25°E	32-172 m	8	19	9	15	46	12	109	21
SST	34°S 21°E-35°S 22°E	30-200 m	7		10	57	50	63	216	9
SAM	34°S 18°E-33°S 25°E	37-110 m	2	1		2	5		10	6
FISH		plankton				2	8	13	23	4

Syntypes

Two females, at least one ovigerous, deposited by Zimmer in the Berlin

Zoologisches Museum. Type locality: 40 m, in Algoa Bay (Port Elizabeth) (33^oS 25^oE)

Previous records

Algoa Bay (33^oS 25^oE) - 40 m (Zimmer 1908); Still Bay (34^oS 20^oE) - 44 m, Algoa Bay 51-57 m, East London (32^oS 28^oE) - 75 m (Stebbing 1910, 1912); Orange River Mouth (28^oS 16^oE) - plankton (Jones 1955); Lambert's Bay (32^oS 18^oE) - plankton, False Bay (34^oS 18^oE) - 82 m (Jones 1960a).

Description

Adult male, length 10,6 mm (FBY 51G). Integument reticulate and covered with minute spinules. Carapace (Fig. 24A) two and a half times as long as deep, slightly arched dorsally with a pair of shallow depressions posterolaterally on the frontal lobe and a line of small spinules ventrolaterally on the posterior half. Pseudorostrum straight and pointed, about a fifth total length of carapace with a few slightly larger spinules and one fairly obvious apical pair. Anterolateral edge finely dentate and bearing several plumose setae; antennal notch fairly deep, anterolateral angle wanting. In dorsal view (Fig. 24B) anterolateral corners widely bowed outwards and denticles visible. Eyelobe rounded, slightly wider than long with three indistinct lenses.

Pereion including posterior projection of fifth pedigerous somite about half length of carapace. First pedigerous somite very narrow and obscured laterally by carapace; second to fourth flanged laterally; posterior projection of fifth very long, slightly curved, with a large terminal spine. Abdomen (excluding telson) subequal in length to carapace; first abdominal somite with two pairs of small ventral spines; second almost smooth. Third to fifth with scattered denticles plus two rows of small sharp denticles dorsolaterally and two ventrolaterally; second to fourth with brushes of setae posteroventrally. All abdominal somites deeply grooved ventrally to accommodate flagellum of second antenna.

First segment of antenna 1 (Fig. 24C) slightly longer than next two subequal segments together; third segment twice as long as broad with many

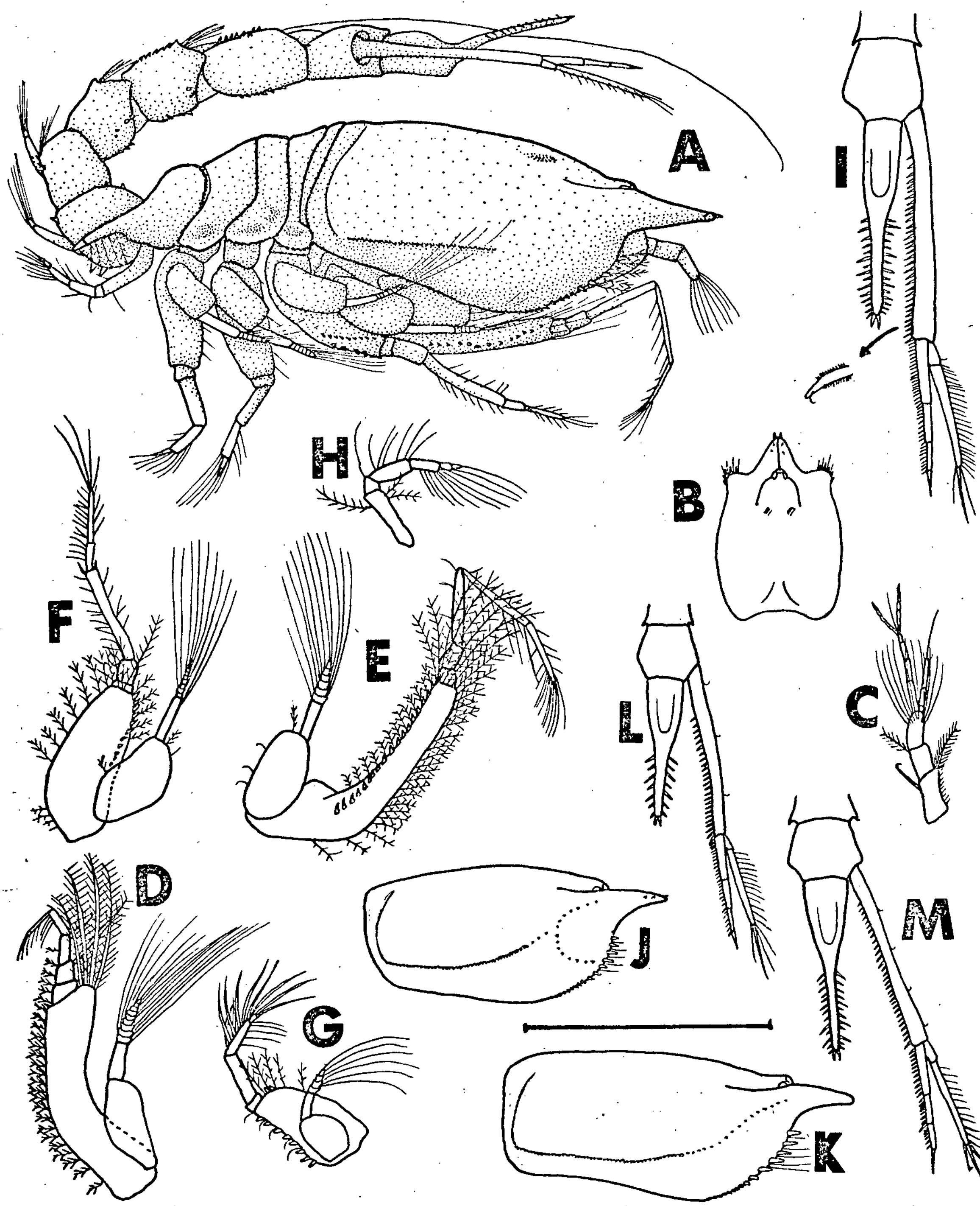

Fig. 24. Diastylis algoae

Adult male. FAL: A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Pereiopod 5. I. uropod and telson. WCD: J. Lateral view of carapace. L. Uropod and telson. SWD: K. Lateral view of carapace. L. Uropod and telson.

Scale line = 4 mm for B, 2 mm for A, C-M.

sensory setae. Flagellum 4-segmented and accessory flagellum 3-segmented.

Flagellum of antenna 2 reaching well beyond distal tip of uropods, segments long.

Basis of maxilliped 3 (Fig. 24D) stout, little produced distally and slightly less than twice as long as remainder of limb. Exopod large.

Basis of pereiopod 1 (Fig. 24E) subequal in length to rest of limb; wide proximally and strongly setose with a row of spines on outer surface; exopod very large. Ischium and merus short, together half length of carpus; carpus slightly longer than dactyl and slightly shorter than propodus. Basis of pereiopod 2 (Fig. 24F) subequal in length to next four segments together, fairly wide and setose with a row of spines on outer surface. Ischium very short; carpus slightly longer than propodus and dactyl together. Exopod very large. Pereiopods 3 (Fig. 24G) and 4 similar; basis wide, exopod large, merus and carpus long. Pereiopod 5 (Fig. 24H) rather small. Distal three segments of last three pereiopods bearing numerous fossorial setae.

Telsonic somite (Fig. 24I) as wide as long, less than half length of telson. Telson as long as last two and a half abdominal somites together, pre-anal part about two-fifths total length with a depressed middorsal region bounded by a sharp keel. Post-anal part with 15 (varies between 12 and 20) pairs of short, sharp lateral spines. Peduncle of uropod slightly longer than telson, strongly spinose on inner margin. Endopod slightly longer than exopod, less than half length of peduncle and 3-segmented. First segment subequal in length to next two together.

Adult male, length 8,6 mm (WCD 69F). As male from False Bay except: carapace (Fig. 24J) slightly more than twice as long as deep, eyelobe slightly protruding dorsally. Lateral line of spinules bending slightly upwards and joining faint semicircular ridge running backwards from base of eyelobe and turning forwards to anterolateral corner. Frontolateral edge deeper with shorter, non-plumose setae. Telsonic somite (Fig. 24L) slightly wider than long; telson slightly shorter, pre-anal part relatively longer, post-anal part with seven (varies between six and nine) pairs of lateral spines.

Adult male, length 7,8 mm (SWD 16E). As FAL and WCD males except: carapace (Fig. 24K) more than two and a half times as long as deep, laterally without semicircular ridge anterolaterally, frontolateral teeth slightly larger, not interspersed with setae. Telsonic somite (Fig. 24M) slightly less than three times length of telson; proportions of pre- and post-anal parts of telson intermediate between those of FAL and WCD specimens with 13 (varies between 10 and 12 pairs) of lateral spines. Telson subequal in length to peduncle of uropod.

Ovigerous female, length 9,6 mm (FBY 51G). As adult male from FAL except as follows: integument with short, scattered hairs; spinules more evident on eyelobe; eye visible only as gaps between spinules. Carapace (Fig. 25A) twice as long as deep, without lateral line of spinules. Pseudorostrum nearly a quarter total length of carapace, slightly upturned; apical teeth very distinct, but no other large ones evident. Teeth at anterolateral edge much smaller; no plumose setae present. Carapace in dorsal view (Fig. 25B) wider posteriorly than anteriorly; anterolateral corners not produced or visible.

Carapace almost as long as pereion; first pedigerous somite wider, all without obvious lateral flanges; posterior projection of fifth shorter. Abdominal somites subcylindrical and without spinules, together equal in length to carapace and first two pedigerous somites only.

All segments of antenna 1 (Fig. 25C) longer and more slender; both flagella 3-segmented. Antenna 2 short. Bases and exopods of pereiopods 1 and 2 smaller. Pereiopods 3 (Fig. 25D) and 4 similar, without exopods; bases very much more slender.

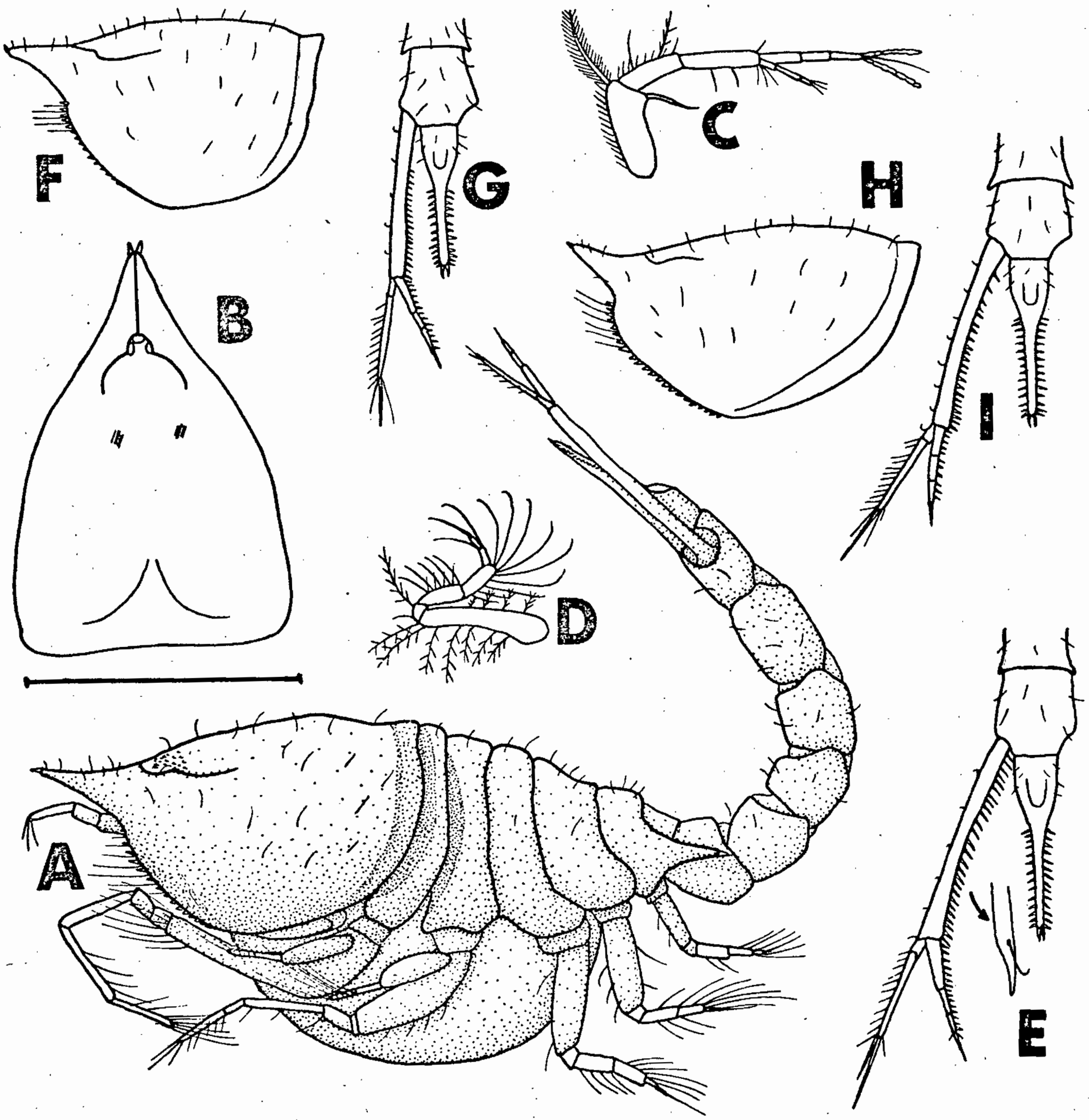

Fig. 25. Diastylis algoae

Ovigerous female. FAL: A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Pereiopod 3. E. Uropod and telson. WCD: F. Carapace. G. Uropod and telson. SWD: H. Carapace. I. Uropod and telson. Scale line = 2 mm for A, B, D-I; 1 mm for C.

Telson twice length of telsonic somite (Fig. 25E) with 14 (varies between 11 and 17) pairs of lateral spines; pre-anal part relatively shorter, middorsal depressed area shallower and less evident. Endopod of uropod half length of peduncle and slightly shorter than exopod.

Ovigerous female, length 7,8 mm (WCD 69F). As FAL ovigerous female except: carapace (Fig. 25F) less than twice as long as deep, frontal edge deeper with setae between the spines. Posterior groove quite distinct. Pre-anal part of telson (Fig. 25G) shorter, post-anal part with 13 (varies between 11 and 16) pairs of lateral spines. Third segment of endopod slightly longer than second.

Ovigerous female, length 7,5 mm (SWD 16E). As ovigerous females from FAL and WCD except: pseudorostrum (Fig. 25H) slightly shorter and more upturned; posterior depression running further forward along ventral edge. Anterolateral teeth extending further back with setae interspersed between the spines. Post-anal part of telson (Fig. 25I) with 15 (varies between 13 and 16) pairs of lateral spines. Endopod of uropod less than half length of peduncle, all three segments subequal in length.

Length

Adult male: SWD forms 7,4 - 8,3 mm; WCD forms 8,0 - 10,8 mm; FAL forms 8,0 - 10,6 mm; SCD forms 7,7 - 9,3 mm.

Ovigerous female: SWD forms 6,7 - 8,6 mm; WCD forms 7,0 - 10,6 mm; FAL forms 6,7 - 9,6 mm; SCD forms 6,7 - 9,0 mm.

Remarks

Two species of Diastylis, D. algoae and D. rufescens Jones, 1955 have been described from southern African waters. D. algoae was described from two ovigerous females from Algoa Bay on the south coast and D. rufescens from adult males and females from plankton samples taken off the Orange River Mouth. Comparison of the original figures of the females of the two species suggests that they are very easily distinguished, particularly in the relative lengths of the carapace and the whole body, the distal segments of pereiopod 1 and the endopod of the uropod. However, on examination of hundreds of specimens of Diastylis available in the present collection, taken from Lüderitz to East London, it has become apparent that there are not only specimens approaching both D. algoae and D. rufescens but that there is a range of intermediates , which appear to form a single highly polymorphic species. The length of the carapace in proportion to the depth varies from less than two to almost three; the anterolateral region of the carapace is shallow in some and deep in others; the proportions of the pre- and post-anal parts of the telson vary, as do the number of pairs of lateral spines and the relative length of the telson and uropods. The lengths of the animals are also variable.

In short, it is apparently impossible to distinguish two species, icularly since variable characters are not always found together in the same group of individuals or those from a part of the geographic range. There is a tendency for those animals from the north-west to be most elongate and for those from the east to be rather short and stout; otherwise the variability is not constant. Thus it is proposed to place all of the specimens in a single species. Since Zimmer's is the older name, the species must be called D. algoae, with D. rufescens becoming a synonym.

One of the major characters used by Jones to distinguish his species from D. algoae was the anterior emargination of the pseudorostrum in the female of this species. In fact this "emargination" shown by Zimmer is a poor representation of the pair of apical spines which is present in most specimens of both sexes, but which may be absent. The absence sometimes appears to be due to mutilation but in other cases there is no sign that the spines were ever present. The three distal segments of pereiopod 1 appear to be shorter in D. rufescens than in any of the specimens seen by the author, but this single character is not sufficient to warrant the separation of the species.

Within Diastylis, D. algoae appears to be most similar to D. laevis Norman, 1869, which however differs in the presence, in the male, of oblique folds on the carapace and the longer telson in both sexes. Of the species from the southern hemisphere, D. denticulatus is closest to D. algoae. D. denticulatus is distinguished by the longer pre-anal part of the telson, the vertical rows of spinules on the carapace and the shorter posterior protrusion of the fifth pedigerous somite. The adult male of D. denticulatus is unknown.

Distribution

As well as being a highly polymorphic species, D. algoae is one of the most widely distributed southern African Cumacea. It is known from Lüderitz to East London at depths from 20 to 200 m and is the most abundant species on the coast.

Diastylis namibiae sp. nov.

Fig. 26

Records			sub-adult ♂	♂	ovig. ♀	♀	total	no. of records
SWD	26°S 15°E	26 m		2	1		3	1
WCD	32-33°S 17°E	78-142 m	1	1		1	3	2
LBT	32°S 17°E	200-280 m		1		2	3	2

Holotype

Adult female, in the South African Museum, SAM-A15740, collected by UCT, 15 September 1970. Type locality: 280 m, off Lambert's Bay (32°05'S 17°00'E). UCT station number LBT 24K.

Description

Adult female, holotype, length 6,4 mm. Carapace (Fig. 26A) rather large, less than twice as long as deep and slightly wider than deep. Integument yellowish, well calcified, reticulate with a few small hairs and scattered spinules. Pseudorostrum short, fairly deep. Anterolateral angle wanting, fronterolateral edge deep; this and anterolateral edge bearing numerous blunt, forward-pointing teeth. Eyelobe (Fig. 26B) wider than long, eyeless, with a few scattered spinules on it and on frontal lobe. Lateral to frontal suture is a row of about six small spinules running longitudinally, ending in a pair of short protuberances at posterior edge of frontal suture.

Pereion less than half length of carapace, first segment obscured laterally, fifth abruptly lower than fourth and slightly protruding posteriorly with a small spine at tip. Cephalothorax slightly shorter than abdomen; abdominal somites narrower anteriorly, sybcylindrical posteriorly, last five with several small, clear patches.

Appendages taken from <u>ovigerous female</u>. Antenna 1 moderately large (Fig. 26C), first segment longer than each of next two subequal segments. Flagellum quite stout and 3-segmented; accessory flagellum short and 2-segmented.

Basis of maxilliped 3 (Fig. 26D) stout, slightly produced distally. Exopod narrow. Ischium short, as wide as merus. Last three segments narrow and longer.

Basis of pereiopod 1 (Fig. 26E) subequal in length to carpus and propodus together. Ischium and merus short; carpus and propodus long, fairly stout and subequal in length; dactyl short. Basis of pereiopod 2 (Fig. 26F) short, little more than half length of rest of limb. Ischium short; merus twice length of ischium; carpus long and subequal in length to dactyl. Pereiopods 3 (Fig. 26G) and 5 similar, without exopods. Bases with numerous fine spines as well as setae. Distal segments stout, merus and carpus subequal in length.

Telsonic somite (Fig. 26H) about as long as wide, slightly shorter than telson. Telson little narrower posteriorly than anteriorly, post-anal part longer than pre-anal with six pairs of lateral spines and a pair

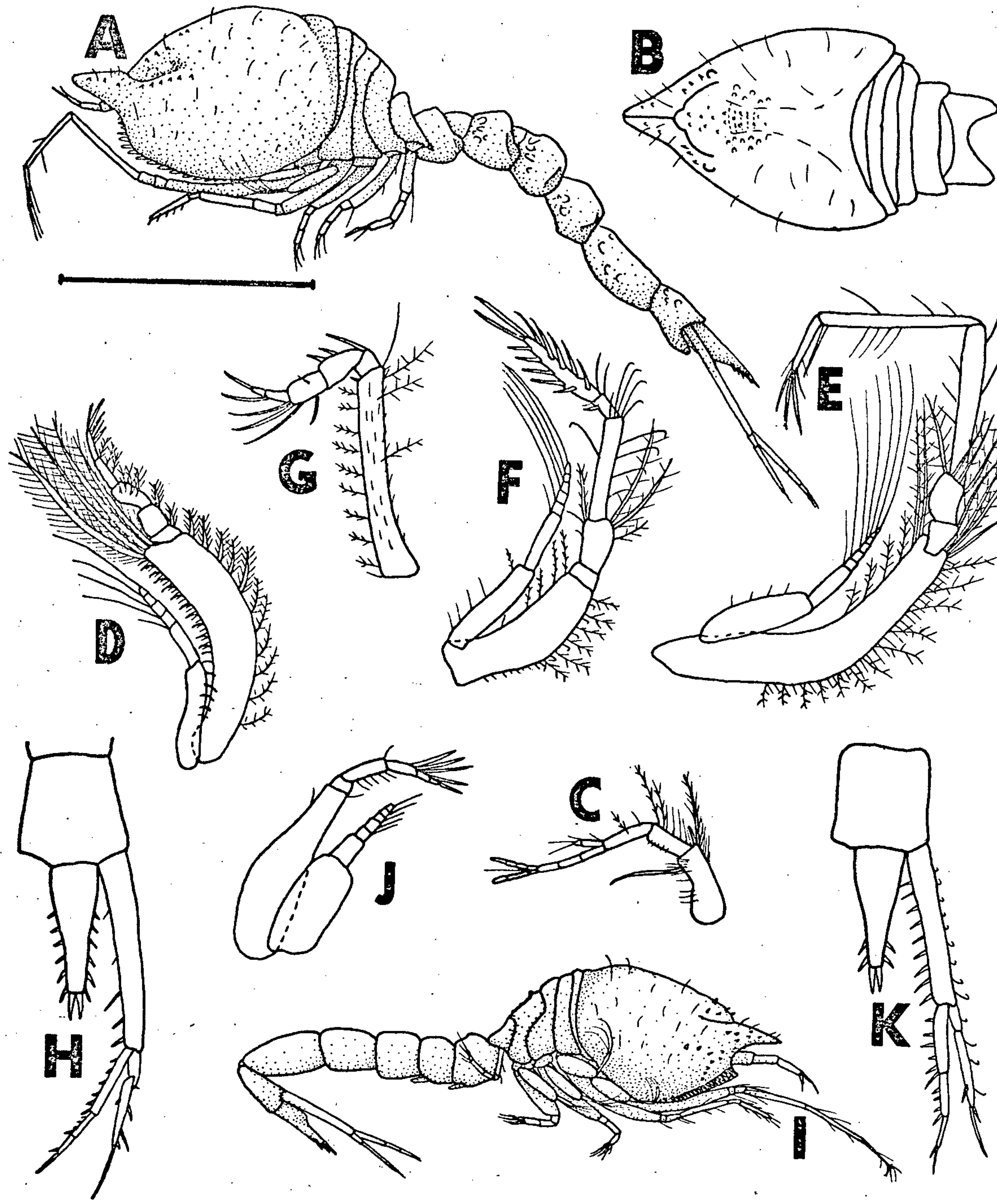

Fig. 26. Diastylis namibiae sp. nov.

Adult female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 2. G. Pereiopod 3. H. Uropod and telson.

Subadult male. I. Lateral view. J. Pereiopod 3. K. Uropod and telson.

Scale line = 2 mm for A, B, I; 1 mm for C-H, J, K.

of larger terminal ones. Peduncle of uropod a third as long again as telson with few spines on inner edge. Rami rather slender; endopod 3-segmented, longer than exopod and two-thirds length of peduncle; first segment of endopod subequal in length to next two subequal segments together.

Subadult male, length 4,8 mm (WCD). As female, except as follows: pseudorostrum (Fig. 26I) shallower and more pointed; anterolateral angle evident; antennal notch present; anterolateral edge with longer, more numerous pointed spines. Anterior part of carapace with more and slightly longer spinules. Abdomen slightly longer than cephalothorax, somites cylindrical.

Second and third basal segments of antenna 1 stouter, flagellum 4-segmented. Carpus and merus of pereiopod 1 slightly shorter and propodus a little longer. Carpus of pereiopod 2 slightly shorter. Bases of pereiopods 3 (Fig. 26J) and 4 slightly stouter, exopods well developed; distal segments much more slender. Telson (Fig. 26K) with two pairs of spines.

Length

Subadult male 4,8 mm

Ovigerous female 5,4 mm

Remarks

This is one of the species which is accommodated in Diastylis without being typical of the genus. It is rather stouter than is usual and the telson approaches that of Leptostylis. However, it is nearer to Diastylis and is therefore placed in this genus in the absence of adult males which would confirm the generic position. In the short length of the telson it is most similar to D. insularus Calman, 1908 and D. neozeylanicus Thomson, 1892 from New Zealand, differing from these in the shorter peduncle of the uropod, the shorter carapace and the stouter body as well as the arrangement of spinules.

Distribution

Known only from the south-western coast of Africa from Lüderitz to Saldanha Bay at depths from 26 to 280 m.

Diastylis hexaceros Zimmer, 1908

Diastylis hexaceros Zimmer, 1908: 187, figs. 93-95; Stebbing, 1913: 137.

Previous records

Type locality only

Holotype

Ovigerous female, deposited by Zimmer in the Berlin Zoologisches Museum. Type locality: 565 m, on the Agulhas Bank (39°09'S 18°32'E).

Remarks

This species is known only from the holotype. It seems to be close to Makrokylindrus bicornis sp. nov., but possesses three pairs of lateral horns on the carapace rather than one. From Zimmer's figures the telson appears to be typical of Diastylis but confirmation of the generic position will have to await the availability of more material.

Leptostylis Sars, 1869

Generic diagnosis

Pseudorostrum short and body slender. Fifth pedigerous somite not produced posteriorly. Third segment of antenna 1 of adult male large, clubbed and setose, quite different from that of adult female. Flagellum of antenna 2 of adult male not reaching beyond end of thorax. Rudimentary exopods usually present on pereiopods 3 and 4 of female. Male with two pairs of pleopods. Telson usually shorter than and never more than a quarter as long again as telsonic somite with no more than four pairs of lateral spines. Uropods elongate, peduncle longer than telson and endopod 3-segmented.

Type species

Not designated. When erecting the genus, Sars included L. ampullaceus (Liljeborg, 1855), L. longimanus (Sars, 1865), L. villosus and L. macrurus.

Remarks

The genus is discussed in the remarks on the family on page 41 above. The slender form, short telson and large clubbed first antenna in adult males make it one of the more easily recognised of the Diastylis group of genera. Some species are close to Diastylis in the length of the telson; finality on the generic position of these species is only possible when adult males are available.

KEY TO THE SPECIES OF LEPTOSTYLIS FROM THE SOUTHERN HEMISPHERE

1 Rami of uropods subequal in length 2

\- Endopod of uropod longer than exopod 3

2 Peduncle of uropod with three spines and endopod smooth on inner edge; telson with one pair of lateral spines . L. mancus Sars, 1873 - Brazil

\- Peduncle of uropod with nine spines and endopod serrate on inner edge; telson with two pairs of lateral spines . . . . L. mancoides Bacescu-Meister 1967 - Brazil

3 Telson no more than a third length of peduncle of uropod 4

\- Telson nearly half length of peduncle of uropod or more 5

4 Carapace with depressed anterodorsal area bounded by carina; integument without hairs; basis of maxilliped 3 twice length of remaining segments together . . . . L. antipus Zimmer, 1909 - Antarctic

\- Carapace without carinate depressed area; integument without hairs; basis of maxilliped 3 one and a half times length of remaining segments together . . . . . L. profundus Jones, 1969 - Tasman Sea

5 Telson (excluding terminal spines) subequal in length to fifth abdominal somite, with no lateral spines; integument of carapace and abdomen evenly denticulate . . L. vercoi Hale, 1928 - Australia

- Telson (excluding terminal spines) distinctly shorter than fifth abdominal somite with at least one pair of lateral spines; integument of carapace variable and of abdomen not denticulate 6

6 Telson with no distinct post-anal part, anus elevated and protruding . . . . L. crassicaudus Zimmer, 1907 - Antarctic

- Telson with distinct post-anal part, not elevated nor protruding . 7

7 Terminal third or less of telson abruptly shallower than rest and midpart carinate dorsolaterally around a shallow concavity . . . 8

- Terminal part of telson not abruptly shallower than rest and midpart not carinate nor concave 9

8 Carpus of pereiopod 2 subequal in length to propodus and dactyl together; eyelobe in lateral view almost level with pseudorostrum; carapace bearing a pair of crenellate ventrolateral carinae running parallel to crenellate ventrolateral edge; integument with small tubercles . . . . L. macruroides Stebbing, 1912 - South Africa

- Carpus of pereiopod 2 two-thirds length of propodus and dactyl together; eyelobe in lateral view abruptly raised above pseudorostrum; carapace without ventrolateral carinae and ventrolateral edge with several sharp teeth; integument minutely denticulate . . adult ♂ L. gilli sp. nov.

9 Anterolateral edge of carapace crenellate 10

- Anterolateral edge of carapace serrate or dentate 11

10 Telson at least as long as telsonic somite with three pairs of lateral spines; antenna 1 much less than half length of carapace . . . . L. vemae Bacescu-Meister, 1967 - western Atlantic

- Telson distinctly shorter than telsonic somite with one pair of lateral spines; antenna 1 at least half length of carapace . L. attenuatus sp. nov.

11 Denticles present on pseudorostral lobes as well as anterolateral edge of carapace 12

\- Carapace entirely without denticles except at anterolateral edge . 13

12 Exopods absent from pereiopod 3; telson with four pairs of long lateral spines and smoothly tapering from base to tip . . . . ♀ and immature ♂ *L. gilli* sp. nov.

\- Exopods present on pereiopod 3; telson with no more than three pairs of short lateral spines and abruptly narrower at tip . *L. faurei* sp. nov.

13 Endopod of uropod very slightly shorter than peduncle, first segment almost as long as next two together; basis of maxilliped 3 hardly longer than rest of limb . *L. chileanus* Bacescu-Meister, 1967 - Chile

\- Endopod of uropod no more than two-thirds length of peduncle, segments subequal in length; basis of maxilliped 3 distinctly longer than rest of limb 14

14 Telson more than twice as long as deep; exopods of pereiopods 3 and 4 of female about a tenth length of basis; anterolateral edge of carapace regularly and deeply serrate . *L. recalvastrus* Hale, 1945 - Australia

\- Telson less than twice as long as deep; first segment of exopods of pereiopods 3 and 4 more than a quarter length of basis in female (male unknown); anterolateral edge of carapace unevenly and shallowly dentate . . . . *L. azaniensis* Jones, 1969 - off Kenya

Leptostylis gilli sp. nov.

Figs 27-28

Records			adult ♂	sub-adult ♂	♂	ovig. ♀	♀	total	no. of records
SWD	$28^{o}S$ $15^{o}E$	170 m					2	2	1
WCD	$33^{o}S$ $17^{o}E$-$34^{o}S$ $18^{o}E$	68-200 m	1	1		3		5	4
LBT	$32^{o}S$ $17^{o}E$-$32^{o}S$ $18^{o}E$	30-280 m	8	42	2	21	103	176	6
SST	$34^{o}S$ $21^{o}E$-$35^{o}S$ $22^{o}E$	50-200 m	5	6	2	36	10	59	5
SCD	$34^{o}S$ $22^{o}E$-$34^{o}S$ $25^{o}E$	106-183 m	2	1	1		4	8	5

Holotype

Ovigerous female, in the South African Museum, SAM-A15736, collected by UCT during the LBT transect, 24 September 1972. Type locality: 200 m, on the Lambert's Bay transect ($32^{0}04$'S $17^{0}12$'E). UCT station number LBT 67F.

Description

Ovigerous female, holotype, length 5,9 mm. Integument very thin, delicate, somewhat reticulate and minutely denticulate with a few short hairs on carapace. Carapace (Fig. 27A) about one and a half times as long as deep, slightly furrowed laterally and covered with small denticles (difficult to see in newly-moulted animals). Antennal notch small but evident, anterolateral angle small and rectangular, minutely serrate below. Pseudorostral lobes short and rounded, slightly upturned, with a single row of denticles laterally. Eyelobe (Fig. 27B) small, triangular, eyeless.

Pereion less than half length of carapace, first two somites narrow and the third fairly wide. Abdominal somites relatively stout, subcylindrical; fifth almost as long as peduncle of uropod. Abdomen longer than cephalothorax by one somite.

Antenna 1 (Fig. 27C) of moderate length, first segment subequal in length to next two subequal segments together. Flagellum 4-segmented and accessory flagellum 2-segmented.

Antenna 2 (Fig. 27D) short and 3-segmented.

Basis of maxilliped 3 (Fig. 27E) about one and a half times as long as rest of limb; ischium, merus and carpus subequal in length; propodus and dactyl slightly longer and more slender.

Pereiopod 1 (Fig. 27F) very long and slender, basis less than half length of rest of limb. Ischium and merus short, subequal in length; carpus long, propodus longer, subequal in length to merus and carpus to together; dactyl short. Basis of pereiopod 2 (Fig. 27G) fairly broad,

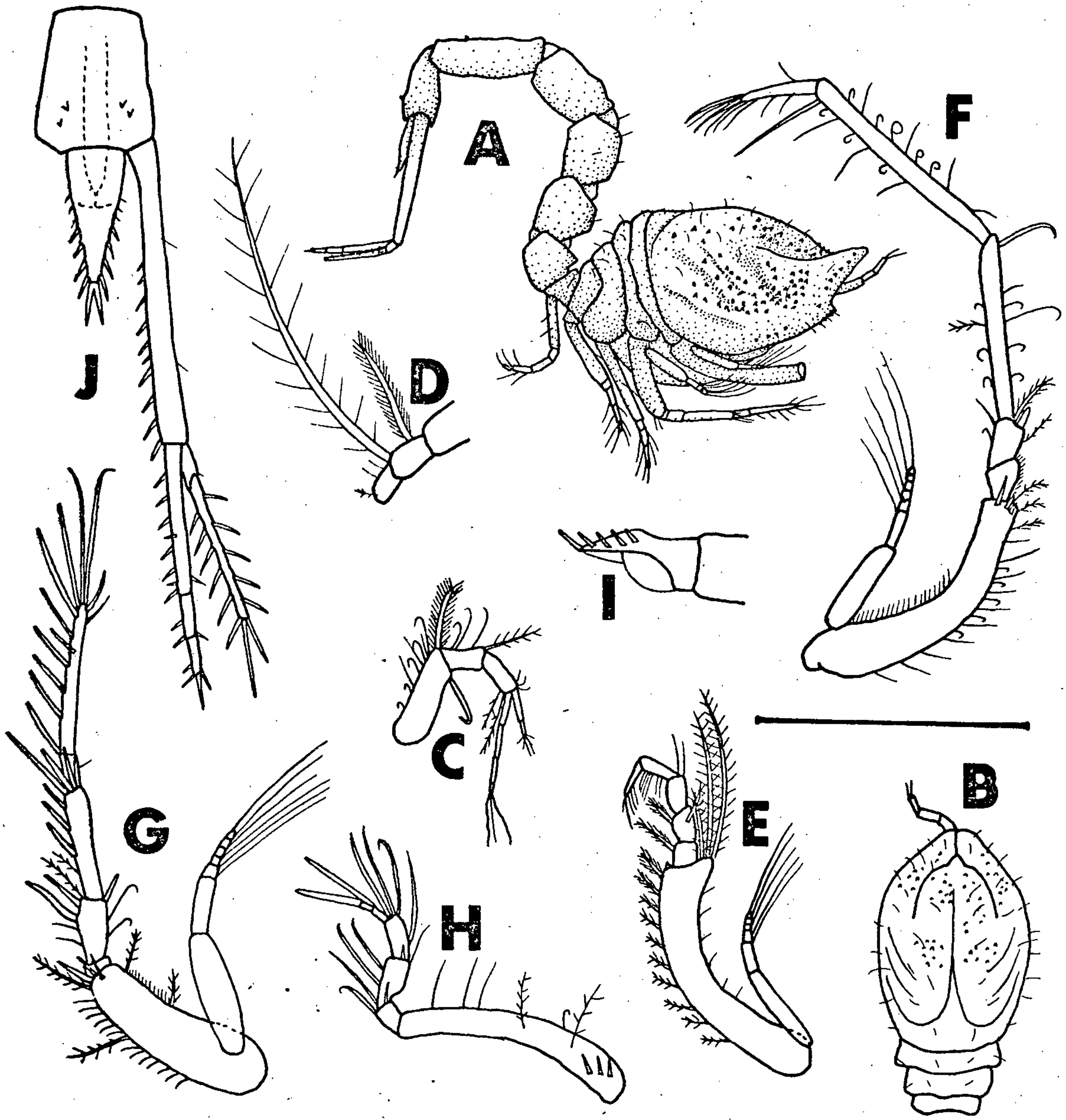

Fig. 27. Leptostylis gilli sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Antenna 2. E. Maxilliped 3. F. Pereiopod 1. G. Pereiopod 2. H. Pereiopod 3. I. Telson in lateral view. J. Uropod and telson.

Scale line = 2 mm for A, B; 1 mm for C-J.

hardly half length of rest of limb. Ischium very short; merus plus carpus subequal in length to propodus plus dactyl. Pereiopods 3 (Fig. 27H) and 4 similar, pereiopod 3 slightly the longer; exopods absent. Merus and carpus subequal in length, propodus and dactyl both small. Merus and carpus of pereiopod 5 relatively large.

Telsonic somite (Fig. 27J) slightly longer than telson (excluding terminal spines), with two pairs of small spines dorsally. Telson evenly tapering from base; post-anal part slightly longer than pre-anal (Fig. 27I) with four pairs of stout and two or three pairs of very slender spines laterally. Terminal spines long. Peduncle of uropod slightly more than twice length of telson with several small spines on inner edge. Endopod of uropod longer than exopod by one segment and three-quarters length of peduncle; first segment of endopod much longer than next two together.

Adult and subadult male, paratypes, lengths 6,2 and 5,7 mm. All adult males are very delicate and none is undamaged. Thus the figures and descriptions of the whole animal (Figs 28A, B) are of a subadult male, which as far as can be seen differs from the adults only in the telson. Figures 28C-J are of an adult male paratype. The males differ from the females as follows: anterolateral angle and antennal notch (Fig. 28A) wanting; ventrolateral edge of carapace with several large spines. Eyelobe elevated somewhat above level of pseudorostral lobes (Fig. 28B). Pereion not as deep and first somite obscured laterally by posterior expansion of carapace. Fifth abdominal somite shorter.

Antenna 1 (Fig. 28C) clubbed; third segment short and broad, bearing numerous sensory setae. Accessory flagellum longer and 4-segmented. Flagellum of antenna 2 not reaching end of thorax. Basis of maxilliped 3 (Fig. 28D) curved, slightly longer. Segments distal to basis missing from pereiopod 1 in all cases. Basis of pereiopod 2 (Fig. 28E) longer, merus more slender. Exopod very well developed. Pereiopods 3 (Fig. 28F) and 4

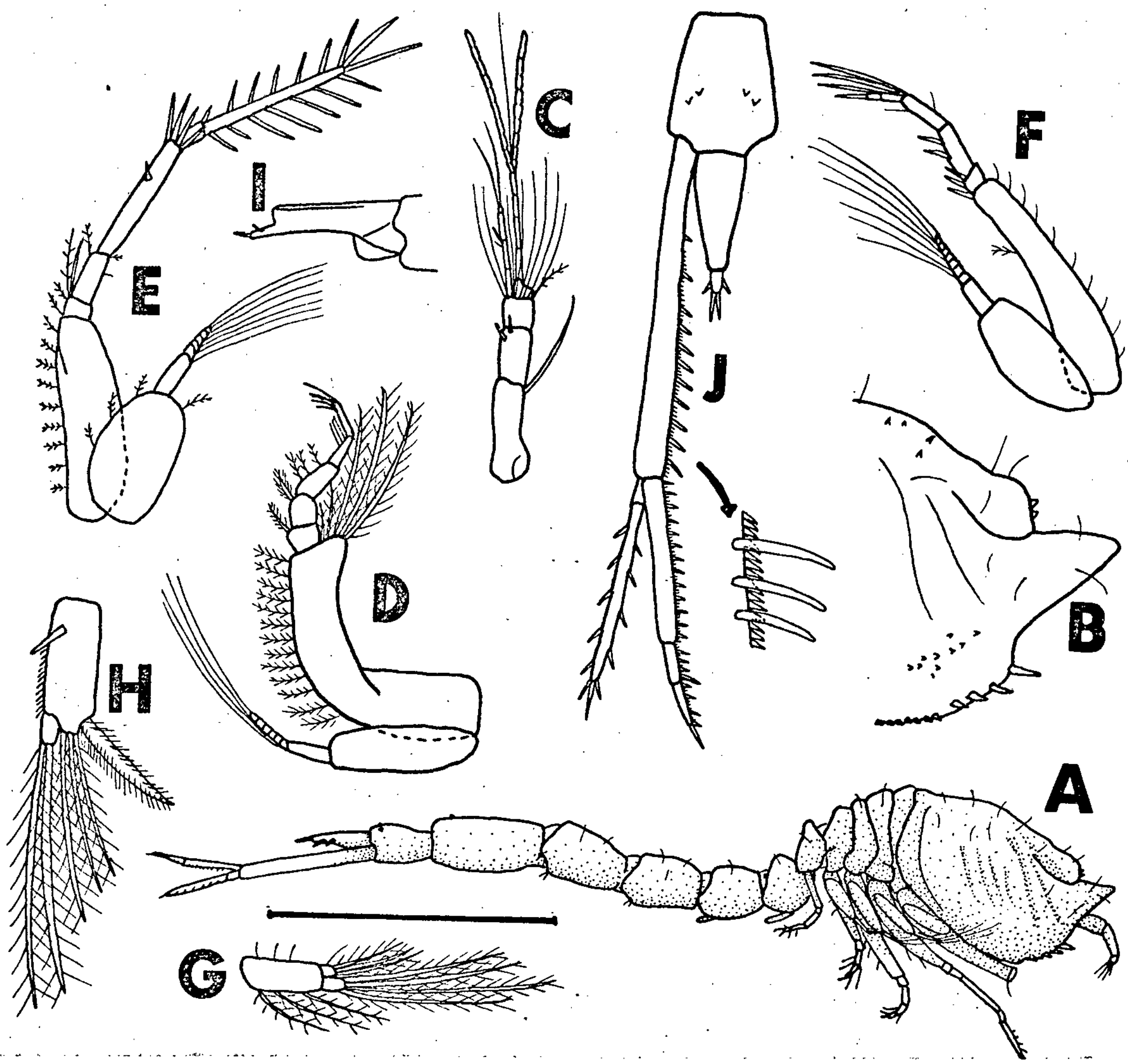

Fig. 28. Leptostylis gilli sp. nov.

Subadult male. A. Lateral view. B. Detail of anterior tip of carapace.

Adult male. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 3. G. Pleopod 1. H. Pleopod 2. I. Telson in lateral view. J. Uropod and telson.

Scale line = 2 mm for A; 1 mm for B-J.

with segments distal to basis less stout. Rami of pleopod 1 (Fig. 28G) short and 1-segmented. Only the inner ramus of pleopod 2 (Fig. 28H) developed. Both pleopods strongly setose.

Telson slightly longer, post-anal part (Fig. 28I) much longer, shallower and abruptly narrowed at tip with a single pair of terminal spines; keeled dorsally around a shallow concavity. Peduncle of uropod (Fig. 28J) slightly stouter and more strongly armed with minute denticles between the spines. First segment of endopod longer.

Length

Adult male about 5,8 - 6,8 mm

Ovigerous female 4,2 - 6,8 mm

Remarks

In many respects, particularly in the nature of the telson in the adult male and the denticulation of the carapace, this species shows a greater resemblance to Dimorphostylis than to Leptostylis. But the unwidened bases of pereiopods 1 to 4 and the short flagellum of the second antenna in adult males, together with the poorly developed pleopods, require it to be placed in Leptostylis. Also, the third segment of antenna 1 in adult males is typical of Leptostylis, although it should be pointed out that this character is approached in several species of Dimorphostylis, so that the genera are obviously very close.

Within Leptostylis, L. gilli most closely approaches L. crassicaudus Zimmer, 1907 from the Antarctic, but the latter lacks denticles and folds on the carapace, which is much larger and stouter and lacks an anterolateral angle. Further, the peduncle of the uropod and first segment of the endopod are considerably shorter in L. crassicaudus and the telson differs from that of L. gilli.

Distribution

Known from Lüderitz to Port Elizabeth at depths from 30 to 280 m.

Leptostylis faurei sp. nov.

Fig. 29

Records

SAM 34°S 17°E 800 m (PF 17440) 3 subadult ♂♂, 5 ♂♂, 2 adult ♀♀, 4 ♀♀ (1 record)

Holotype

Subadult male, in the South African Museum, SAM-A15737, collected by the SAM in about 1900. Type locality: 800 m, off the Cape Peninsula (34°25'S 17°45'E). SAM station number SAM-A10602.

Description

Subadult male, holotype, length 8,0 mm. Integument lightly calcified and reticulate. Carapace (Fig. 29A) slightly less than twice as long as deep, minutely reticulate with a longitudinal row of denticles laterally on the pseudorostrum and a few scattered on the eyelobe. Pseudorostrum short and pointed; anterolateral angle and antennal notch wanting; ventrolateral edge with a row of strong, sharp spines. Eyelobe (Fig. 29B) short, rounded, eyeless.

Pereion less than half length of carapace; first somite obscured laterally by posterior extension of carapace, the rest narrow. Abdominal somites subcylindrical, together longer than cephalothorax by two somites; fifth subequal in length to peduncle of uropod.

First segment of antenna 1 (Fig. 29C) shorter than next two together; second and third short and broad, third with a few sensory setae. Flagellum 5-segmented and accessory flagellum 3-segmented.

Basis of maxilliped 3 (Fig. 29D) large and stout, slightly less than twice length of remaining segments together. Ischium small, merus slightly longer; last three segments fairly stout and cylindrical.

Basis of pereiopod 1 (Fig. 29E) half as long as rest of limb with a row of small spines on lower edge. Ischium and merus small, subequal in

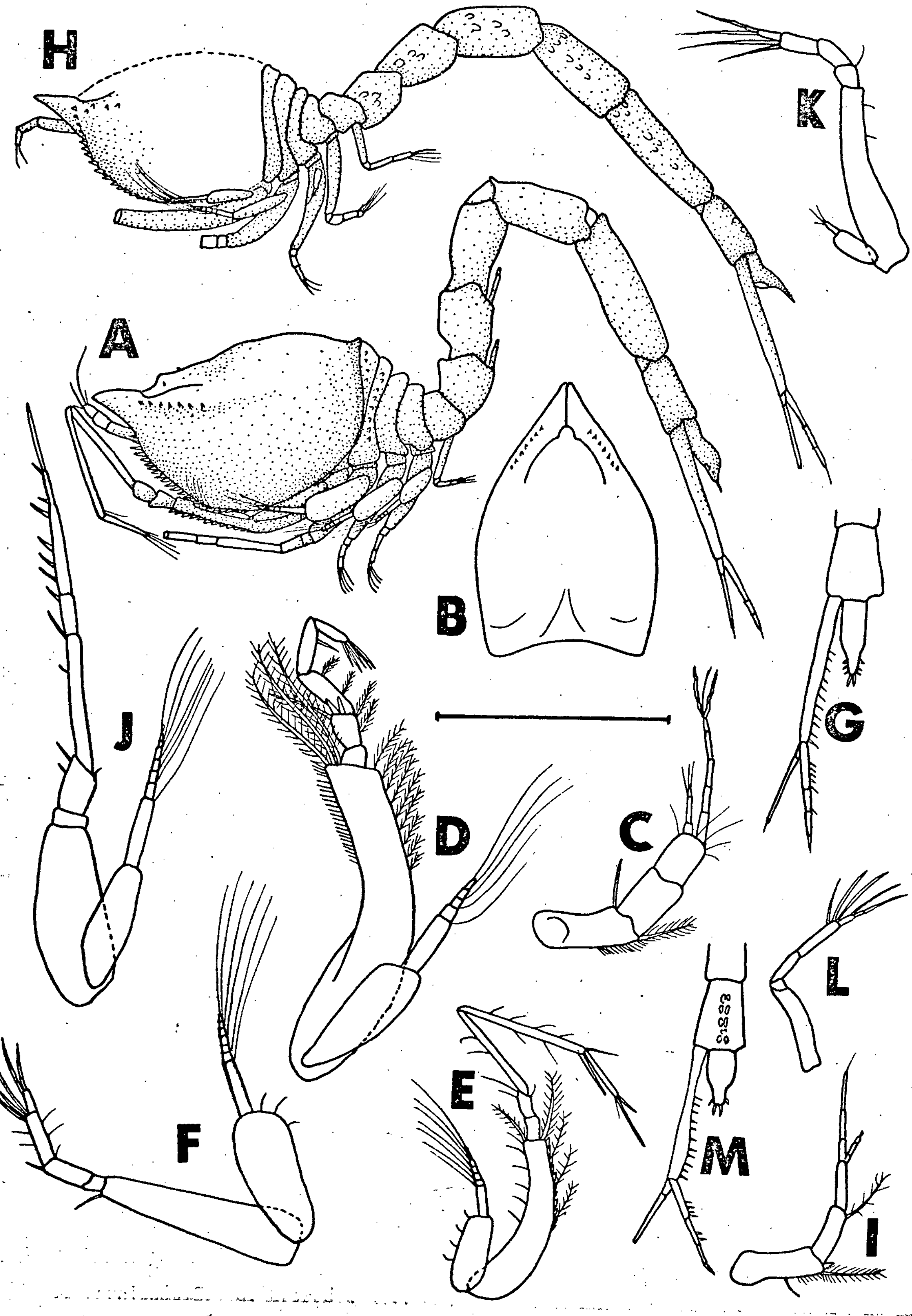

Fig. 29. Leptostylis faurei sp. nov.

Subadult male. A. Lateral view. B. Dorsal view of carapace. C. Antenna 1. D. Maxilliped 3. E. Pereiopod 1. F. Pereiopod 3. G. Uropod and telson. Adult female. H. Lateral view. I. Antenna 1. J. Pereiopod 2. K. Pereiopod 3. L. Pereiopod 5. M. Uropod and telson.

Scale line = 2 mm for A, B, H; 1 mm for C-G, I-M.

length. Carpus and propodus very slender, carpus slightly the shorter. Dactyl short and slender. Distal segments of pereiopod 2 missing. Bases of pereiopods 3 (Fig. 29F) and 4 not much longer than remaining segments together, exopods very large. Pereiopod 5 small, basis short.

Telson (Fig. 29G) subequal in length to telsonic somite with three pairs of small spines laterally and one terminally. Peduncle of uropod nearly twice length of telson, half as long again as endopod. Endopod slightly longer than exopod, first segment subequal in length to next two together.

Adult female, paratype, length 7,4 mm. In two pieces, and badly damaged. Fig. 29H is a reconstruction. As male, except as follows: pseudorostral lobes slightly sharper, spination of ventrolateral edge of carapace continuous onto pseudorostral lobes. Carapace apparently not produced posteriorly. Abdomen relatively shorter and peduncle of uropod slightly longer.

Segments 2 and 3 of antenna 1 longer and more slender. Ischium of maxilliped 3 shorter and wider. Distal segments of pereiopod 1 missing. Basis of pereiopod 2 (Fig. 29J) fairly stout, half length of rest of limb; ischium very short, merus longer and stout; carpus little shorter than basis and slightly longer than dactyl. Exopods present on pereiopod 3 and absent from pereiopod 4. Merus and carpus of pereiopod 5 (Fig. 29L) relatively large.

Telson (Fig. 29K) shorter than telsonic somite with one pair of lateral spines.

Length

Subadult male 7,4 - 9,0 mm

Adult female 7,4 mm

Remarks

L. faurei is a typical member of the genus. It is most similar to *L. azaniensis* Jones, 1969 and is also close to *L. recalvastrus* Hale, 1945, *L. attenuatus* sp. nov. and *L. gilli* sp. nov. It is the only species in which an exopod is present on pereiopod 3 but not on pereiopod 4 in the female. The presence in *L. faurei* of a row of small spines on the pseudorostrum further distinguishes it from *L. azaniensis* and *L. recalvastrus*; the smooth carapace distinguishes it from *L. gilli* and the much shorter abdomen distinguishes it from *L. attenuatus*.

Distribution

Known from a single sample from 800 m off the Cape Peninsula.

Leptostylis attenuatus sp. nov.

Fig. 30

Records

SM	27°S 32°E-30°S 30°E	800-1 000 m	3 ovig. ♀♀ (2 records)
SAM	34°S 17°E	800 m	3 subadult ♂♂ (1 record)

Holotype

Ovigerous female, in the South African Museum, SAM-A15738, collected by the SAM, 17 May 1977. Type locality: 1 000 m, off Durban (30°14'S 31°27'E). SAM station number SM 151.

Description

Ovigerous female, holotype, length 4,5 mm. Integument smooth and well calcified with minute reticulations; abdomen with several extremely long and fairly stout setae. Carapace (Fig. 30A) less than twice as long as deep, smoothly arched dorsally; anterolateral angle and antennal notch wanting, ventrolateral edge strongly crenellate. Pseudorostral lobes short, pointed anteriorly, bearing four or five small denticles in a

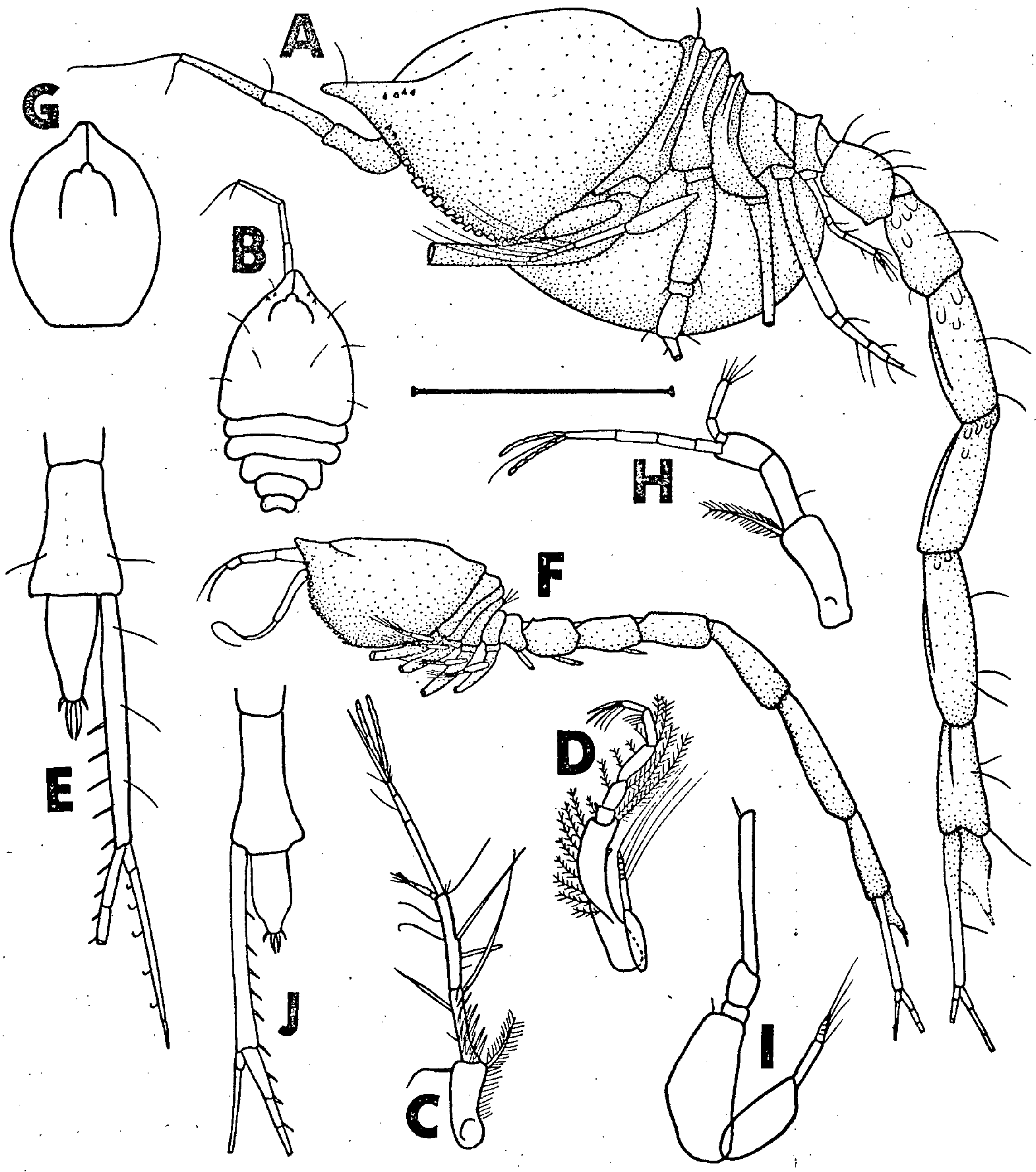

Fig. 30. Leptostylis attenuatus sp. nov.

Ovigerous female. A. Lateral view. B. Dorsal view of cephalothorax. C. Antenna 1. D. Maxilliped 3. E. Uropod and telson.

Subadult male. F. Lateral view. G. Dorsal view of carapace. H. Antenna 1. I. Pereiopod 2. J. Uropod and telson.

Scale line = 2 mm for B, F, G; 1 mm for A, C, D; 0,5 mm for E, H, I, J.

longitudinal row laterally. Eyelobe (Fig. 30B) small, rounded and eyeless.

Pereion subequal in length to carapace; first three somites ridged transversely, last two smooth. Cephalothorax hardly longer than first four abdominal somites together. Abdominal somites elongate, with some clear patches anteriorly; last four slightly keeled ventrolaterally.

Antenna 1 (Fig. 30C) extremely long, visible part more than half length of carapace; segments subequal in length. Flagellum very long and accessory flagellum short; both 3-segmented.

Basis of maxilliped 3 (Fig. 30D) no longer than rest of limb; remaining segments fairly stout.

Distal segments of pereiopod 1 missing. Last three segments of pereiopod 2 and distal segments of pereiopod 3 missing from all females. Basis of pereiopod 4 slender, longer than remaining segments together. Pereiopod 5 much smaller and more slender.

Telson and distal tips of rami missing from holotype. Uropods and telson in Fig. 30J are from an ovigerous female from SM 60. Telson about three-quarters length of telsonic somite with one pair each of lateral and terminal spines. Peduncle of uropod more than twice length of telson with few spines on inner and several long hairs on outer margin. Exopod slightly shorter than peduncle of uropod. Tip of second segment of endopod broken and all of third missing.

Subadult male, length 5,6 mm (SAM-A10602). The specimens of *L. attenuatus* in this sample all have very few spines and setae. This is apparently due to the long period of preservation of very delicate animals.

As female, except as follows: integument lacking hairs but with very small pits. Carapace (Fig. 30F) less arched dorsally and lacking denticles dorsolaterally on pseudorostral lobes (Fig. 30G), which are slightly longer. Pedigerous somites not ridged. Cephalothorax as long as first three and a half abdominal somites together. Fourth and especially fifth abdominal somites very long.

Third segment of antenna 1 shorter and rather stouter; flagellum 4-segmented. Carpus of pereiopod 2 (Fig. 30I) subequal in length to basis and ischium together; last two segments missing. Distal segments of other appendages missing.

Telsonic somite (Fig. 30J) longer and peduncle of uropod slightly shorter. Peduncle of uropod two and a half times length of telson. Distal tips of both rami missing.

Length

Subadult male 5,6 - 5,9 mm

Ovigerous female 4,5 - 6,2 mm

Remarks

This species is characterised by the combined presence of very long first antennae and crenellate spines on the anterolateral edge of the carapace. It is difficult to be certain that the individuals of all three samples belong to the same species, because some are not very well preserved or strongly calcified. However the large first antennae and the very long abdomen indicate that the specimens are conspecific.

L. macruroides Stebbing, 1912, known from a single adult male from 800 m off Durban, is most similar to L. attenuatus, and the two species may prove to be synonymous. It is difficult to be sure about the relationship, because there is often considerable variation between adult and subadult males. The abdomen in L. macruroides is very long, and Stebbing's figure of the pedigerous somites suggests that they are ridged, although no mention is made of this in the text. The most obvious difference is that L. macruroides is described by Stebbing as possessing a pair of long, curved crenellate lateral carinae above the ventrolateral edge of the carapace. This is not found on any of the present specimens, and is unlikely to be a male sexual character. For this reason, the two species must be considered to be distinct, at least until more material becomes available.

Distribution

Known from the southern Mocambique Channel to the Cape Peninsula at depths from 800 to 1 000 m.

Leptostylis macruroides Stebbing, 1912

Leptostylis macruroides Stebbing, 1912: 153-154, pl. 56.

Previous records

Type locality only.

Holotype

Adult male, deposited by Stebbing in the British Museum (Natural History). Type locality: 800 m, off Durban (about 30°S 30°E).

Remarks

This species is known from a single adult male. It is characterised by the presence of a crenellate lateral carina running parallel to and slightly above the crenellate anterolateral edge of the carapace, which makes it unique in the genus. The possible synonymy of L. macruroides and L. attenuatus sp. nov. is discussed in the remarks on the latter on page 116 above.

DISTRIBUTION OF THE DIASTYLIDAE

The distribution of diastylid genera is variable. Those predominating in deep waters are cosmopolitan, while shallow-water genera tend to have much narrower geographical ranges.

Of the four deep-water genera, Leptostylis predominates at depths between 200 and 2 000 m and has equal representation in northern and

Only 14% of the total number of species is found in the tropics between 20°N and 20°S, while 54% occur north of 20°N and 34% south of 20°S, the predominance in the north once again being partly a reflection of collecting effort.

The majority of species (62%) occurs between latitudes of 20° and 50°, indicating a preference for temperate conditions. Nevertheless the very wide depth ranges of many species suggests that the family is generally less depth- (and therefore temperature-) dependent than other families (Day 1978a, 1978b). Thus the family is cosmopolitan and eurybathal.

	0-200 m		<200->1 000 m		200-2 000 m		>2 000 m		total	
	no.	%	no.	%	no.	%	no.	%	no.	%
N of 70°N	2	1	10	5	0	0	0	0	12	6
50-70°N	6	3	8	4	0	0	5	2	19	9
20-50°N	26	12	24	11	20	9	14	7	84	39
20°N-20°S	16	7	2	1	6	3	6	3	30	14
20-50°S	28	13	3	1	17	8	4	2	52	23
50-70°S	4	2	0	0	6	3	0	0	14	7
S of 70°S	2	1	2	1	4	2	0	0	8	4
TOTAL	4	38	49	23	53	25	29	14	215	100

Table 2. Distribution of Diastylidae according to depth and latitude. Data mainly from Jones (1969).

DISTRIBUTION OF THE SOUTHERN AFRICAN DIASTYLIDAE

Most of the 18 species of diastylids known from southern Africa are from deep water. The entire family may be divided into faunistic groups, but the evidence is so scanty that little can be deduced from their distribution. The species may be divided into the following groups:

1. Shallow-water, cool temperate species from the west coast only:

   Diastylis namibiae

2. Shallow-water species extending along both west and south coasts:

   Dic calmani

3. Shallow-water warm temperate species from both south and east coasts:

   Diastylis algoae, Dic formosae, Leptostylis gilli

4. Shallow-water subtropical species from the east coast only:

   Dic platytelson

5. Deep-water species from 200 m and more:

   a) Cape species: Diastylis hexaceros, Leptostylis faurei, Makrokylindrus bicornis, Adiastylis aculeatus

   b) Natal species: Leptostylis macruroides, Adiastylis acanthodes, Makrokylindrus deinotelson, M. mundus, M. fragilis

   c) Species from both Natal and the Cape: Leptostylis attenuatus, Makrokylindrus spinifer, Vemakylindrus stebbingi

As in the Lampropidae (Day 1978b) evidence regarding the distribution of deep-water forms (i.e. those from depths greater than 200 m) is too scanty to merit discussion. The collection has been limited to two areas, one off the south-western Cape and one off Natal, so that faunistic boundaries cannot be defined. One species is known only from 550 m and one from 550-900 m; all the rest have only been found between 800 and 1 000 m. Since little material is available from 200 to about 500 m, and virtually nothing is known about the fauna below 1 300 m, it is not possible to estimate the depth limits of these species.

Not one of the species found in southern African waters has been recorded elsewhere. However the composition of the cumacean fauna further north is virtually unknown. There are no species common to southern Africa and tropical west Africa, but on the east coast, many deep-water species may be southern outliers of a tropical Indian Ocean fauna which is as yet unstudied.

Species diversity in the diastylids is low. 3 662 specimens of 16 species in 284 records were examined, giving figures of 14 individuals per record and a specimen:species ratio of 229:1. Thus the diastylids are much less diverse than the bodotriids which give figures of 7,5 individuals per record and 147,9 specimens per species. Comparison between the number of species of bodotriid and diastylid suggests that the bodotriids are more successful in shallow and the diastylids more successful in deeper waters.

	no. of specimens	no. of records	no. of species	individuals per record	specimens per species
Bodotriidae	4 596	607	31	7,5	147,9
Lampropidae	159	37	10	4,3	15,9
Ceratocumatidae	10	3	1	3,3	10,0
Gynodiastylidae	102	44	7	2,3	14,6
Diastylidae	3 662	284	16	12,9	228,9

Table 3. Comparison of diveristy and abundance of families of Cumacea in southern Africa.

A comparison with the other families so far examined (Table 3) suggests that the diastylids are the least diverse but the most abundant, with an average of 12,9 individuals per record. This high ratio is due largely to Diastylis algoae, which accounts for 2 739 specimens or almost 75% of the individuals in the family. D. algoae, together with Dic formosae (12%) and Leptostylis gilli (nearly 7%) account for almost 94% of the individuals, and without these the diversity is of the same order as that shown by the lampropids, ceratocumatids and gynodiastylids. Removal of the most common species in the bodotriids (Day 1978a) gives very similar figures.

In conclusion, it is found that the Diastylidae are second only to the Bodotriidae in number of individuals, although the Diastylidae are much less diverse.

ACKNOWLEDGEMENTS

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SOUTHERN AFRICAN CUMACEA

PART 5

ASPECTS OF CUMACEAN BIOLOGY

CONTENTS

FACTORS AFFECTING THE DISTRIBUTION OF CUMACEA

General Considerations

The factor most obviously correlated with the distribution of most Cumacea is depth (Jones 1969, J.A. Day 1978a). There is no reason to believe that it is depth *per se* which affects living animals, but temperature, as a depth-related parameter, may be the real limiting factor (J.A. Day 1978b). Thus the Cumacea in general are presumably stenothermal, with the possible exception of some of the diastylids which have much wider depth ranges than is common in the group (Day 1978c).

But apart from depth, there are likely to be other factors determining distribution, particularly of sympatric species. It is known, for example, that different feeding methods are employed in different families. It appears that diastylids (Dennell 1934, Zimmer 1932) and leuconids are filter feeders, bodotriids, lampropids and pseudocumatids rotate sand grains and scrape off the covering detritus, while the *Campylaspis* group of nannastacids is carnivorous. Thus, other factors being equal, the amount of organic matter in the substrate, and the size and degree of sorting of sand grains, could well be important in partitioning the environment. Presumably neither of these would have as direct an effect on the carnivores and on the members of the other groups, while the organic content would be important to both sand-scrapers and filter-feeders and the actual size of sand grains would be important for sand-scrapers.

It should be mentioned that the process of "filter-feeding" is unusual, and should really be classified as a type of detritivory. The process is said to entail the stirring up of the mud with the exopods of the third maxillipeds and the subsequent filtering of the organic matter from the inorganic fraction by the more anterior mouthparts. This is quite different from the usual process of filter-feeding by removing living and dead material from the water column. Thus, despite the classification of diastylids and the like as filter-feeders, the method they employ suggests that they would be almost as dependent on the organic content of the substrate as would the sand-scraping forms.

The only reports on the effect of organic content and particle size on the distribution of Cumacea are those of Corey (1970) and Vader and Wolff (1973). Corey found little correlation between organic content and abundance of Cumopsis goodsiri, Pseudocuma longicorne or Iphinoe trispinosa in Kames Bay, Scotland, but did find some correlation between abundance of all three species and particle size, although this was not a major limiting factor. She suggests that the thin layer of very fine silt and detritus on the surface in some areas may discourage animals from settling in places which would be quite adequate only a few millimetres below.

In the delta area of the Netherlands and the adjacent North Sea, Vader and Wolff (1973) found good correlation between particle size and abundance in several species. Bodotria scorpioides prefers fine sand (median ∅ values of 2,1 - 3,0) and mud, Pseudocuma longicorne prefers well-sorted medium and fine sands (median ∅ values 1,9 - 2,5), Diastylis rathkei medium and fine sands and D. bradyi medium to fine sands (median ∅ values 1,5 - 2,7). They generally found, however, that particle size alone is not responsible for the observed distribution patterns, suggesting that other, probably hydrographic, conditions may be involved. They did not analyse the organic content of the substrate.

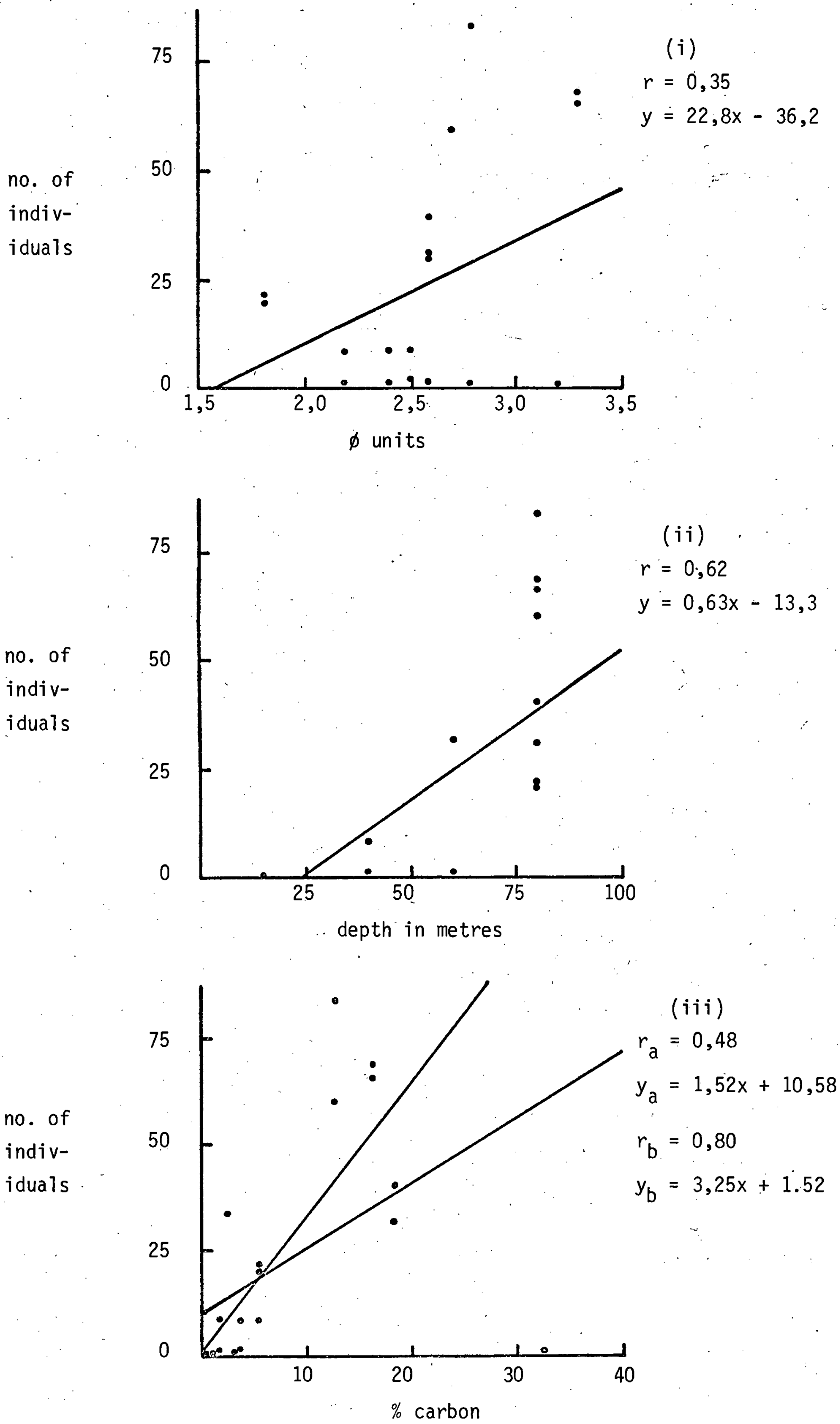
Cooper (1967) has briefly reported that in Wellington Harbour, New Zealand, diastylids are found in the finest sediments, leuconids in those of intermediate grain size and bodotriids in the coarser sediments. He has not analysed the relationship between abundance and organic content of the substrate.

Relationship between particle size, organic content, depth and abundance in False Bay

Full analyses of organic content and values for median particle size in ∅ units are available for all the samples taken on a transect in False Bay during 1967. The transect ran south-eastwards from Muizenberg, at the north-western corner of the bay, to the mouth; samples were taken at depths of 2, 4, 8, 15, 23, 40, 60, 80 and 100 m. Two grab samples were taken at each station and repeated at intervals of three months for a year, resulting in eight samples at each station. It so happens that there is strong positive correlation between depth and organic content in this particular area ($r = 0,83$, $P < 0,001$), although this is purely fortuitous. ϕ values vary randomly along the transect, with a maximum of 3,3 and a minimum of 0,9.

Sufficient specimens of Diastylis algoae and Iphinoe stebbingi were taken from the transect to allow numerical treatment of the data. Although a number of other species was taken, too few individuals are available to make analysis worthwhile.

Fig. 1 shows scatter-diagrams of number of individuals of I. stebbingi plotted against i) median particle size in ϕ units; ii) depth in metres from 0-80 m; iii) organic content of the sediment measured as percentage of organic carbon. Calculated regression lines have been drawn and show a significant positive correlation with abundance in each case. The strongest correlation ($r = 0,62$, $0,01 < p < 0,001$) is between abundance and depth, followed by that between abundance and organic content of the sediment ($r = 0,48$, $0,05 < p < 0,02$). There is least correlation between abundance and median particle size ($r = 0,35$, $0,05 < p < 0,1$), although correlation is still significant. In the case of organic content, removal of a single outlying point in the lower right-hand results in the strongest correlation of all ($r = 0,80$, $p < 0,001$). Since organic content of the substrate continues to increase with depth at 100 m, while no specimens of I. stebbingi were found at this depth, it can be assumed that the primary limiting factor is depth (and therefore probably temperature), while the second most important is organic content of the substrate. That the correlation with median particle size is less significant could also be due to the fact that not only the median ϕ value but also the degree of sorting of the sediment



(i)
r = 0,35
y = 22,8x - 36,2
no. of individuals
0
25
50
75
1,5
2,0
2,5
3,0
3,5
ø units
(ii)
r = 0,62
y = 0,63x - 13,3
no. of individuals
0
25
50
75
25
50
75
100
depth in metres
(iii)
ra = 0,48
ya = 1,52x + 10,58
rb = 0,80
yb = 3,25x + 1.52
no. of individuals
0
25
50
75
10
20
30
40
% carbon

may be of importance, and estimates of this factor are not available.

In the case of D. algoae, there is no correlation between abundance and organic content ($r = -0,10$, $p > 0,1$) or abundance and median ø value ($r = 0$), while correlation between abundance and depth to a depth of 80 m is positive at the 2% level ($r = 0,54$, $0,02 < p < 0,01$). There is no correlation using linear regression over the entire depth range because of the drop in numbers at 100 m. Since abundance of this species is not related to organic content or median ø value, some other depth-related parameter must be involved. It is suggested that once again temperature is the major limiting factor.

The positive correlation between abundance of I. stebbingi and particle size would be expected, because a sand-scraper would only be able to handle particles within a particular size-range. The lack of correlation in the case of D. algoae can be explained by the fact that, since it does not handle individual particles, grain size is probably of less importance. It should be stressed, however, that these data concern a limited range of particle sizes and particularly that information on sorting of the sediment is not available. Assuming D. algoae to be a filter-feeder which stirs up the substrate,it may be dependent on a certain amount of mud, which cannot be determined with the present data.

Since abundance of I. stebbingi is closely correlated with the organic content of the substrate and that of D. algoae is not at all, it may be assumed, regardless of the fact that organic content and depth are positively correlated, that the differences between the two species are real. I. stebbingi, being a sand-scraper, would require a high content of organic matter in the substrate wherever it occurred in abundance. In most types of filter-feeder, one would expect the two factors to be unrelated. This is certainly so in D. algoae, despite its presumed dependence on detritus. The actual method of feeding of this species requires investigation.

In conclusion, both species are positively correlated with depth down to 80 m, where numbers of both decline sharply. D. algoae has a slightly greater depth range, reaching 100 m, whereas I. stebbingi is not found below 80 m in False Bay. The distribution of I. stebbingi correlates with both organic content and median particle size of the substrate while that of D. algoae correlates with neither.

VERTICAL MIGRATION

General considerations

One of the few things that most biologists know about Cumacea is that adult males are commonly found in the plankton at night, and appear to swarm. It is generally assumed that they form "nuptial swarms", moving up from the bottom into the plankton, where they are carried away from their home grounds. When they finally descend again, they mate with females from a different part of the population (Barnes 1974), thus ensuring gene flow. Or, as Foxon (1936) has suggested, the males form a swarm "into which females can swim and so find a mate". But several workers on Cumacea, notably Foxon (1936) and Corey (1970), have suggested that, although nuptial swarms may occur, it is not only adult males which are found in the plankton, so that vertical migration may serve as a means of dispersal of the whole population.

It is evident that adult males are strikingly different from adult females and young individuals; these morphological differences should be reflected in their behaviour, and it certainly appears that adult males are functionally designed for swimming. And if their behaviour is different, it is necessary to take this into account when attempting to compare vertical migratory behaviour in adult males and other individuals. Further, in any comparison it is necessary to know the normal sex ratio found in benthic situations in order to determine whether swarms are genuinely composed of, or predominated by, adult males.

Sexual dimorphism

In all Cumacea there is some sexual dimorphism, and in most it is very obvious. The most striking difference is in ovigerous females, which carry their eggs in a large ventral brood-pouch or marsupium. This presumably leads to a reduction in mobility. In comparison, adult males are more slender and bear large, setose exopods on two or more thoracic limbs (nearly always larger and more numerous than in the female) and may also carry setose pleopods which aid in swimming. It has been shown by Foxon (1936) that cumaceans can swim by means of "rapid lateral flexures* of the abdomen", and that in Pseudocuma longicorne the adult male can swim about twice as far as non-ovigerous females, which in turn swim much faster than ovigerous females.

In adult males the first antenna frequently has a brush of sensory setae, and the flagellum of the second antenna is long and strongly setose at the base. Since these setae are absent from the female, it can be assumed that they are used by the male to detect the female. This in turn suggests that Foxon's (1936) idea of the females seeking out the males in the plankton is incorrect: from the point of view of functional anatomy, it is more likely to be the males which seek out the females. The elongated flagellum of the second antenna has been seen in some species to clasp the female during precopula and copulation (Zimmer 1941, Gnewuch and Croker 1973).

There are other, less obvious, differences between the sexes. The most significant of these from the point of view of vertical migration is that the eyes, when present at all, are usually much better developed in adult males, while in females they are usually smaller and may be absent.

Sculpturing of the exoskeleton may be quite different in adults, and in some, such as Iphinoe, there are protruding spines and nodules ventrally

*In all species in which I have observed swimming, the flexures appear to be dorsoventral.

on the thoracic somites in the male. In the male, too, the epimera of the abdominal somites may be produced ventrally, forming a groove to house the antennary flagella, while in others these may be housed in a pair of lateral grooves on the abdomen. The proportions and armature of the uropods and other appendages may also differ.

Thus the most significant differences between adult males and other individuals lie in sensory and locomotor abilities.

Sex ratios

With a differential locomotory ability in adult males and females, it is possible that, depending on the method of collection, adult males may be preferentially lost due to a combination of their superior swimming ability and better developed eyes, which together would allow increased avoiding behaviour. Thus any attempt to calculate sex ratios from benthic samples is likely to be biased in favour of females, while those derived from planktonic samples will almost certainly be biased in favour of males. However, since approximately equal numbers of males and females are found in benthic samples, these are likely to give a more accurate estimate of the actual sex ratios.

The following calculations have been made in an attempt to determine, not any exact figure, but a reasoned estimate of likely sex ratios. The calculations are based on all southern African species for which more than twenty individuals are known from benthic samples. Information from planktonic samples has been omitted. Average sex ratios have been determined because individual species vary somewhat and the data have not been rigorously collected. It should be noted that many species have only been collected at one time of the year, which could bias the data in favour of one sex or the other, depending on whether material was collected during the breeding season or not.

A number of points emerge from the figures shown in Table 1. Firstly, there is considerable variation in the sex ratios of individual species. But the ratios for shallow-water, deep-water and all species is between 1,4 and 1,6 when all individuals are considered, so that the predominance of females is not great.

Secondly, comparing this ratio with that calculated for adults only, there is a relative increase in the number of adult females. Thus a greater proportion of females is being caught, which in turn means that either there is a proportionally higher mortality in adult males or that they are being caught less often. I would suggest that the latter is true and is a reflection of their superior swimming and avoiding ability.

Thirdly, if this is true, there should be a smaller difference in deep-sea forms where eyes are absent and avoiding behaviour should consequently be reduced. In fact the difference in ratios calculated from adults and from total numbers is greater. This figure is based on a rather small number of individuals of only five species and must therefore be approached with caution. But it can be explained if males live for a shorter time in the deep sea, or if they mature more slowly than do the females.

In conclusion, it can be stated that the sex ratio of female:male is of the order of 2:1 for most species. This gives an approximation which can be used in discussing the data presented below.

Influence of light on vertical migration

General considerations

Fage (1923, 1933, 1945), Hale (1953), Macquart-Moulin (1972) and others have shown that Cumacea are photopositive. Macquart-Moulin does not state the sex of his experimental animals, but Hale notes that adult males comprised about 90% of the individuals he caught by means of a light-trap, and Fage states that the proportion of adult males is much higher when using an artificial light than under natural conditions.

	Ratio of ovigerous females:adult males		Ratio of all females: all males	
Shallow-water species (200 m)				
Cumopsis robusta	14,0		?	
Heterocuma africanum intermedium	1,5		3,0	
Austrocuma platyceps	4,3		5,3	
Bodotria elevata	1,0		2,0	
Bodotria falsinus	2,0		0,7	
Bodotria magna	1,6		1,1	
Bodotria montagui	2,5		1,6	
Bodotria nitida	4,0		1,9	
Bodotria vertebrata vertebrata	1,0		1,3	
Bodotria vertebrata semicarinata	1,7		1,4	
Bodotria serica	1,7		1,8	
Eocuma foveolatum	1,0		0,9	
Iphinoe dayi	2,4		1,2	
Iphinoe crassipes	1,9		1,4	
Iphinoe africana	1,1		0,9	
Iphinoe capensis	0,6		0,8	
Iphinoe fagei	1,0		1,2	
Iphinoe truncata	2,8		2,3	
Iphinoe stebbingi	2,3		1,5	
Iphinoe? zimmeri	4,5		1,5	
Dicoides siphonatus	1,4		1,3	
Diastylis algoae	2,8		1,9	
Dic formosae	1,9	Average =	1,2	Average =
Dic calmani	2,5	2,6	1,2	1,6
Intermediate species (ca 100-300 m)				
Leptostylis gilli	3,8		2,5	
Deep-water species				
Alticuma bellum	7,0		1,7	
Alticuma carinatum	5,0		1,6	
Bodotria tenuis	2,0		1,1	
Hemilamprops pellucidus	2,0	Average =	1,1	Average =
Adiastylis acanthodes	3,3	4,0	1,4	1,4
Overall average	2,3		1,5	

Table 1. Sex ratios of southern African Cumacea determined from benthic

In general, few Cumacea have been taken in daylight plankton hauls except in very shallow water, where it is difficult to assess whether they have actively moved into the plankton or whether they have been passively moved by the turbulence of the water. One of the few places where large numbers of individuals of all sizes and both sexes have been found in daylight plankton hauls has been off the coast of South West Africa (Jones 1955). Jones suggests that this is an unusual occurrence resulting from a deoxygenated "azoic" zone on the seafloor in this region, which requires benthic animals to move upwards into more oxygenated waters. (In support of this, there are records of the local rock lobster, Jasus lalandii, and other mobile organisms moving up onto beaches, apparently to escape deoxygenated water-masses which occasionally move close inshore (de Dekker 1970)).

Assuming, then, that the occurrence of large numbers of ovigerous females and immature animals described by Jones was due to unusual hydrographic conditions, most of the remaining records are of normal vertical migrations. But most of these were taken at night and the largest and best documented collections, those of Fage (1945) and Hale (1953) were obtained using light-traps with low-powered sources of artificial illumination.

Foxon (1936), finding some samples to contain too many ovigerous females, immature animals and mancas to be considered as nuptial swarms, suggested that vertical migration serves two purposes. Firstly, it would concentrate adult males for breeding purposes, and secondly it would serve to disperse both sexes, not necessarily at mating time. It has further been postulated (Foxon 1936, Corey 1970) that ovigerous females, at least in shallow waters, might rise to the surface while releasing their mancas so as to increase their chances of dispersal.

The first of these certainly appears to be possible, and the second is discussed in detail below. There is some evidence in favour of the third, in that a number of hauls have been reported in which mancas predominate (Gnewuch and Croker 1973).

The analysis by Corey (1970) of several species of Cumacea from Scotland (including Iphinoe trispinosa and Pseudocuma longicorne) is the only detailed study of vertical migration not using artificial illumination. She, too, found that the hauls were not always dominated by adult males and that "in January the immature animals of all species predominated". She did not further analyse the proportion of adult males in the samples.

Van der Baan and Holthuis (1972) have tabled the occurrence of Cumacea in plankton hauls in the North Sea, but have not distinguished sex or maturity of the animals. They did find, however, that almost all specimens were caught during hours of darkness and that the majority occurred during August to December. Their data were inadequate for further analysis and no general conclusions were drawn.

The problem of the presence of animals other than adult males in the plankton is complicated by the presumed differential attraction of adult males to artificial lights. No study has yet been designed to determine the effect of artificial and natural lighting on the composition of the cumacean fauna of the water column. I have been fortunate in being sent all the cumacean material from a series of samples collected on the Great Barrier Reef, Australia. The sampling programme was not designed with this problem in mind, but the material is nonetheless suitable for the purpose.

Analysis of light-trap samples from the Great Barrier Reef

Material was collected in shallow lagoons and adjacent areas on Heron Island over two periods a year apart. The sampling programme is not yet complete and final identifications will only be made when all material is available to me. But the data, even in preliminary form, are valuable. It is intended to publish a full account when the complete set of data are available.

Samples were taken, mainly using a light-trap of the type described by Hale (1953), on the substrate and at the surface, with or without an artificial light of low illumination, on moonlit and moonless nights. A few samples were taken during the day, both on the surface with plankton nets and from the substrate with push-nets, in order to determine the composition of the benthic fauna.

There is a large number of variables involved (time of tide, nature of substrate, currents and winds), but by pooling the data it is possible to see certain trends. Table 2 details the average number of individuals per sample under various conditions and Table 3 the sexual composition of the migrating population, giving percentages of adult males under each circumstance.

It should be noted that breeding data are not available for these species so that it is not possible to link the present information with seasonal activity; but all samples were taken in December/January so that they are comparable. Because of the small numbers found in the benthic samples, it has not been possible to determine sex ratios for this population. It is therefore further assumed that the sex ratios do not differ markedly in different parts of the world, so that the values determined above for southern African cumaceans is used in the final calculation.

From Table 2 it is clear that

i) There is a hundred-fold increase in the numbers of animals caught with an attracting light.

ii) Almost four times as many animals are caught at the bottom as on the surface, despite the fact that the water is shallow (5 m or less). Since most of the animals caught were adult males, this suggests that even they do not all migrate vertically at any one time.

	TRAP AT SURFACE			TRAP ON SUBSTRATE			TOTAL	
	number of individuals	number of samples	number of individuals per sample	number of individuals	number of samples	number of individuals per sample	number of individuals per sample	
FULL MOON								23,7
light on	21	6	3,5	561	12	46,8	32,2	
light off	5	2	2,5	6	5	1,2	1,8	
NO MOON								107,0
light on	326	6	54,3	3296	17	193,9	157,4	
light off	1	3	0,3	16	8	2,0	1,5	
TOTAL			20,8			92,3	71,2	

	Total number of individuals per sample
Light on	103,4
Light off	1,5

		Total number of individuals per sample
Trap at surface	: light on	28,9
	: light off	1,2
Trap on substrate	: light on	133,0
	: light off	1,7

Table 2. Abundance of individuals of all species caught under different lighting conditions

iii) Comparing numbers taken with the light off at the surface and on the substrate in the presence and absence of moonlight, a higher number is found at the surface in moonlight than in darkness, and a slightly lower number on the bottom in moonlight than in darkness. These numbers are so low that little can be deduced from them, but they do suggest that the tendency to migrate vertically may be initiated or controlled by moonlight, or may at least have a lunar periodicity.

iv) Interestingly, the average number of animals caught on moonlit nights, with or without artificial lighting, was about a quarter the number caught on moonless nights. And the number attracted to the artificial light on moonlit nights was only a fifth of the number attracted on moonless nights. This suggests both that their eyes become accommodated to a certain light intensity (so that light may be attractive for a shorter distance) and that - when the trap is on the substrate and there is no moon - more animals are caught because they are on the bottom and have not already moved into the surface layer. But when the trap is on the surface, more than ten times as many are attracted to the light source on moonless than on moonlit nights. This is somewhat more difficult to explain, but it may be that the mere position of the light vertically above acts as a reinforced stimulus, causing them to move to the particularly large "moon" above. Since the water was shallow, it is quite possible for them to rise from the substrate to the surface in the time the trap was down (5 minutes).

Sexual composition of the migrating population

In Table 3, the percentages of adult males are given, data for each set of relevant samples having been pooled. The few daylight samples collected with pushnets and plankton nets are included. Although not strictly comparable with the samples taken at night, they do give an indication of the composition of the fauna when on the substrate.

	DAY		NIGHT			
			Light on		Light off	
	surface n = 1 s = 4	substrate n = 65 s = 9	surface n = 370 s = 12	substrate n = 3868 s = 29	surface n = 31 s = 5	substrate n = 19 s = 13
% adult males	0	11	99	96	58	73
% not adult males	100	89	1	4	42	27

Table 3. Sexual composition of the migrating and non-migrating fauna.
n = number of individuals, s = number of samples

The percentage of animals other than adult males which is found in the substrate during the day indicates that their total numbers vastly exceed those of adult males, assuming that during the day all the individuals are on the bottom. The figure for adult males is probably unnaturally low, because they may be more efficient at avoiding capture. But this further serves to underline the very large numbers found in the plankton at night.

Considering the percentages of the two groups taken at night, lighted traps caught almost exclusively adult males, while a considerable proportion of the animals caught in unlit traps were not adult males.

These are the first data which go some way to proving that individuals other than adult males do indeed migrate vertically at night, simply because this is the first comparison between artificially attractive and non-attractive traps. It should be emphasised that the data are by no means conclusive because individual species have not been taken into account, so that the possibility of large numbers of adult males may in some cases be due to genuine "nuptial swarms".

Nevertheless it can be concluded that, at least under the conditions prevalent at the time of sampling, individuals other than adult males are found in the plankton at night, and may constitute more than 40% of the total.

The sex ratios appear to be greatly in favour of individuals other than adult males during the day in the benthos, but without adequate data for determining the actual ratios in the present situation, the value of about two ovigerous females to one adult male, as calculated above, will have to be used. Using this figure, there are about three times as many adult males as females in the plankton. This is not unduely high and certainly does not conform to the concept of "nuptial swarms" made up entirely of adult males, at least for the majority of species for most of the year.

The final conclusions to be drawn are that swarms of adult males appear to occur only when attracted by artificial light and that, under the conditions of natural light which normally prevail, large numbers of individuals other than adult males occur in the plankton, although adult males predominate. Moonlight has great influence on vertical migration.

BREEDING SEASONS

General considerations

The breeding seasons of a few species of cumaceans are known. Diastylis rathkei, Cumopsis goodsiri, Iphinoe trispinosa and Mancocuma stellifera are all reported to breed twice annually (Krüger 1940, Corey 1969, Gnewuch and Croker 1973), while Diastylid sculpta produces three generations annually (Corey 1976a) and Pseudocuma longicorne breeds throughout the year (Corey 1970). It has been shown (Corey 1976b) that the lifespan and productivity of Diastylis sculpta varies considerably depending on the time of year at which individuals are born: those born in spring and summer have a shorter lifespan and a higher productivity than those of the winter generation.

Breeding seasons in *Iphinoe stebbingi*, *Diastylis algoae* and *Cumopsis robusta*

Generally the data available for the present study were not collected with the view of population analysis, and any rigorous studies would require a great deal of additional material, the collection of which is outside the scope of the present study.

However it has been possible, by pooling all the available material, to determine the apparent breeding seasons of three common local species. The data have been collected over a number of years from different localities and with different gear so that the results cannot be considered definitive. For no species is there sufficient material from a single locality for each month of the year to allow a more rigorous study.

Several hundred specimens are known of both *Iphinoe stebbingi* and *Diastylis algoae*, two of the most common species on the southern African coasts, and sufficient samples have been taken over at least ten months of the year to allow analysis of their possible breeding seasons. *Iphinoe africana*, another very common species, cannot be considered because almost all samples containing this species have been collected during late summer; at this time of the year, many are breeding.

Figs 2 and 3 show, for *I. stebbingi* and *D. algoae* respectively, the percentage of adult males, ovigerous females, subadult males, immature females, immature males and juveniles (individuals too small to sex accurately) for each month of the year for whcih sufficient data are available. The number "n" is the total number of animals considered for each month. A number of inaccuracies may well be incorporated, since a species may not have the same breeding season on the warm south coast as on the cooler west coast, or in deeper and shallower water. Further, breeding seasons may

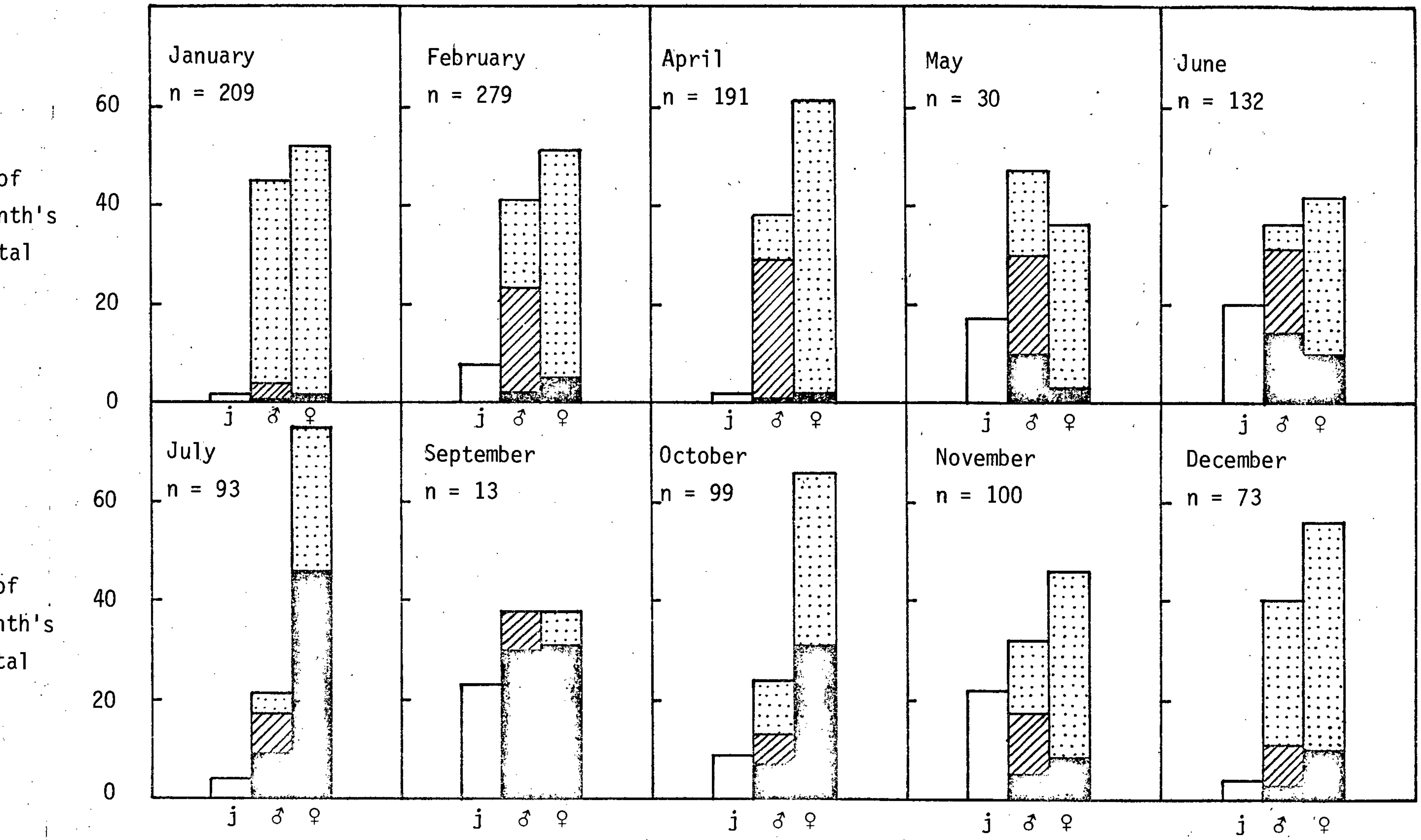


Fig. 2. Distribution by sex and maturity of I. stebbingi through the year. Clear areas = juveniles (j); black = adult males and females; hatching = subadult males; stippling = immature males and females. n = total number of animals analysed per month.

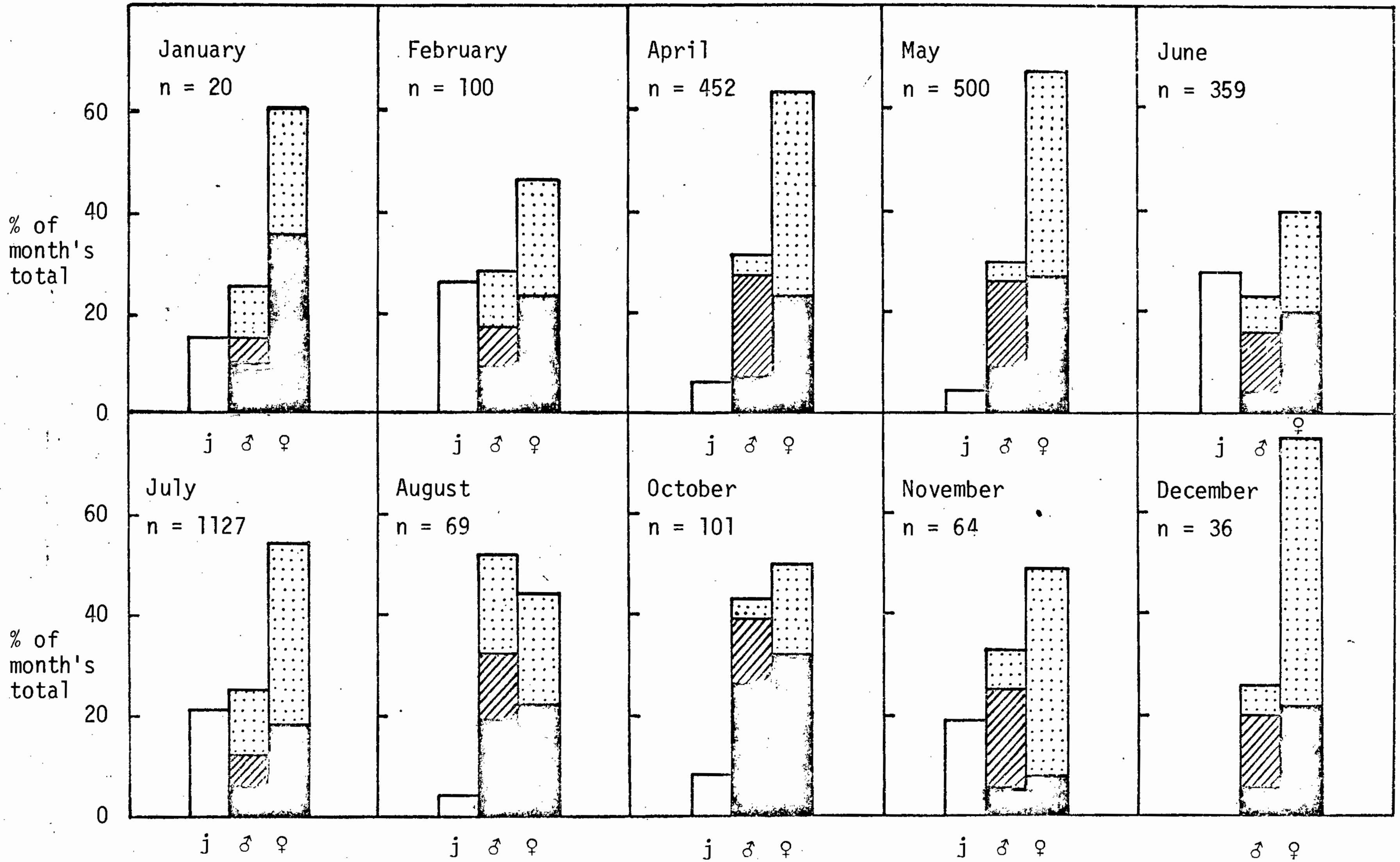


Fig. 3. Distribution by sex and maturity of <u>Diastylis algoae</u> through the year. Clear areas = juveniles (j); black = adult males and females; hatched = subadult males; stippled = immature amels and females. n = total number of animals analysed per month.

shift slightly from year to year depending on prevailing local conditions of temperature, nutrients and water movement.

In I. stebbingi (Fig. 2) the highest percentages of ovigerous females occur from July to October, indicating a single breeding season in late winter and early spring, although a few individuals may be breeding at any time of the year. The highest percentages of adult males slightly precede those of ovigerous females (except in September/October), as would be expected, since there would be a time-lag between mating and fertilization (with a predominance of adult males) and maturation of eggs and release of mancas (with a predominance of ovigerous females).

It is not possible to infer the length of gestation from the figures, but it has been shown that in Diastylis sculpta in Canada (Corey 1976b) the eggs are released after four to five weeks of development. If this were so in the present case then there should be a relationship between the percentage of ovigerous females of one month and the percentage of juveniles in the next. This is true from July to January but not from February to June. It is possible that in March there is a brief spurt in breeding, which would account for the high percentage of juveniles in May, but this is unlikely; the figures for May are suspect since they are based on only thirty individuals. It is more likely that the juveniles grow very much more rapidly in the warmer months so that by the following month the crop from the previous month's ovigerous females has already reached a degree of maturity at which they are no longer recognizable as juveniles.

The situation in D. algoae (Fig. 3) is far less clear. It appears from the rather uniform number of ovigerous females in all months that there is no single season, breeding occurring throughout the year. There is a slight decline in the number of ovigerous females and an increase in juveniles in February, June/July and November; more rigorous data may show that there are two or possible three periods of increased breeding activity annually for this species.

I have recently been provided with a number of specimens of Cumopsis robusta, which is being found in large numbers on many sandy beaches on the Cape Peninsula and further north. Surveys of a number of beaches by two graduate students have shown that this species occurs intertidally only from November to June. It is presumed that the individuals move offshore during the late winter months to avoid the very heavy surf resulting from the north-westerly winter gales (from June to September). The samples were not large enough to draw final conclusions, and the lack of material in winter is unfortunate, but it does appear that this species breeds at least throughout the period when it is found intertidally.

In summary, then, of the three species under discussion, one (Iphinoe stebbingi) has a single breeding season in spring, one (Diastylis algoae) appears to breed throughout the year and the third, Cumopsis robusta, breeds throughout the time that it occurs intertidally.

BIOGEOGRAPHY OF SOUTHERN AFRICAN CUMACEA

The world-wide distribution of Cumacea has been discussed in the papers dealing with the taxonomy of each family and will not be repeated here.

Links between the southern African cumacean fauna and that of other regions

The east coast of southern Africa forms the western edge of the Indo-west-Pacific Region (Eckman 1953) and therefore one might expect a strong link between the Cumacea of southern Africa and those of east Africa, India and even those of Australasia. But the most striking fact about the distribution of the group in southern Africa is the extremely high rate of endemism (89%). This agrees with the situation in other southern land-masses: Australia has 93% endemics, New Zealand between 80 and 90% and South America appears to have an entirely endemic cumacean fauna.

The high degree of endemism argues a very slowly-distributed group of animals with several evolutionary centres. And yet only five of the 28 genera known from southern Africa are endemic, suggesting that the rate of evolution is also very slow and that characters at the generic level are very stable.

With such a high rate of endemism there are few widely-distributed species available from which to draw conclusions about the affinities of the fauna. The nine species do show, however, that the closest links are with tropical west Africa (4 species) and the region between the Red Sea and India (3 species). Two species are known from the north-eastern Atlantic, two from eastern Africa and one each from the West Indies and the Southern Ocean. And yet, despite the generic links with the Indo-west-Pacific and the Southern Ocean, no species is common to southern Africa and Australasia or to southern Africa and the Subantarctic.

Thus it appears either that southern Africa is an evolutionary centre for species which have since become distributed both to the north-east (the western Indo-west-Pacific) and the north-west (central and north-eastern Atlantic), or that it is colonised from one or both of these sources. Since data is lacking from both of these areas, it is not possible to say which possibility is correct, although the first is backed up by the fact that Griffiths (1974) has also postulated that southern Africa is an evolutionary source of amphipods.

Examination of the genera found in southern African waters is of little help because most of them are cosmopolitan or circumtropical (nomenclature according to J.H. Day 1967). The list below details the distribution of all genera which have local representatives.

Cosmopolitan	9 genera
Circumtropical	5 "
Endemic	5 "
Atlantic Ocean	4 "
Indo-west-Pacific	2 "
Indian Ocean	1 genus
Atlantic and Antarctic	1 "
Southern Oceans	1 "
Atlantic and Indian Oceans	1 "

Again it appears that the main links are with warm-water faunas and in particular with those of the Atlantic and Indo-west-Pacific. There is little affinity with the cold-water fauna of the Subantarctic and Southern Oceans, which supports the hypothesis that temperature plays a very important role in the distribution of Cumacea, since as far as distance is concerned, one might expect there to be considerable linkage between the faunas of these two areas.

Finally, of the five endemic genera (all of which are monotypic), two are essentially estuarine, two occur intertidally and in very shallow waters and one is a deep-water genus. Throughout the world there are few species known from estuarine and intertidal areas so that it is not unexpected that species invading these areas in different parts of the world would have evolved independently. Since records from deep waters are scattered and obviously incomplete it would be premature to base conclusions on the existence of a single deep-water endemic genus.

In conclusion it can be stated that southern Africa appears to be an evolutionary centre with a high percentage of endemic species but showing some tenuous links with the fauna of the Atlantic and Indo-west-Pacific regions.

Faunistic provinces within southern Africa

General considerations

Hydrographically the coast of southern Africa can be divided into a warm-water subtropical region on the east coast (under the influence of the Mozambique Current), a region of intermediate temperatures on the south coast (under the influence of the Agulhas Current) and a cool-water region on the west coast (under the influence of the Benguela Current) (J.A. Day 1978a, Brown and Jarman 1978). The actual temperatures and the degree of fluctuation are dependent on depth, so that differences in faunistic provinces recognised by different authorities are largely due to the fact that they have used different depth limits in their analyses.

The earliest useful analysis of the faunistic provinces of the southern African coast was made by Stephenson (1944, 1948 and many more), working on the intertidal fauna of rocky shores. He recognised three provinces: an east coast province (tropical or subtropical) from Mozambique to 31°S 29°E; a south coast province (warm temperate) from 29°S 31°E to the Cape Peninsula and a west coast province (cool temperate) from the Cape Peninsula to the north of Walvis Bay. With slight modification, this was accepted by Eckman (1953).

Conditions are not as variable below the low-tide mark and later workers, analysing shallow-water benthic fauna, have come to slightly different conclusions. J.H. Day (1967), working on the polychaetes from 0 - 200 m, recognised four provinces: a Mozambique/Madagascar province extending as far south as Lorenco Marques (25°S), a Natal province extending to the mouth of the Bashee River (32°S), a Cape and South-West African province (sometimes known as the Namaqua Province) extending to about Cape Frio (18°S) and an Angola province with undefined northern limits. Griffiths (1974) working on amphipods and Millard (1978) on hydroids from 0 - 400 m have come to similar conclusions, although the exact limits of their provinces vary slightly, so that for both amphipods and hydroids, the boundary of the Natal and Cape/South West Africa provinces is given as 31^{o}S and the limits of the latter province are not defined. Griffiths further states that, when considering only shallow-water species, there is a break in the fauna in the region of the Cape Peninsula, although this is obscured in a consideration of the whole fauna. This agrees with Stephensons's conclusions and it can therefore be said that for shallow-water and intertidal species the Cape/South West Africa province can be divided into two, whereas these provinces are indistinguishable in deeper waters.

A point should be made here about nomenclature. It seems to be universally accepted that the Natal province should be called by that name, but the other provinces have been variously named. The traditional name for the province from Natal to South West Africa has been the "Cape" province, or sometimes the Cape/South West Africa province, and when a single province is recognised, these names are adequate. But when two provinces are recognised, they, too, have been variously named. It is suggested, following Briggs (1974), that the province on the south coast be named the Agulhas province, since it follows closely the limits of the Agulhas Current, while the province on the south-western coast be named the Namaqua province, "Namaqualand" being a long-accepted name for the central part of the western Cape.

Shallow-water faunistic provinces determined by cumacean distribution

Despite the great collecting effort over a large part of the coast of southern Africa, cumacean material is not available for those areas which are of most interest in determining provincial limits, namely from large parts of South West Africa, from the area in the vicinity of Cape Agulhas and from 28 to 29^{o}E off the eastern Cape Province. This is largely due to the fact that, at least in the latter areas, the shelf is very narrow and difficult to work and has few areas of sandy bottom. But in spite of these gaps it is possible to make some reasoned estimates of the probable limits of the provinces, even though no exact positions can be given. In fact, it is doubtful whether there are real, unmoving provincial boundaries in the sea, since currents fluctuate with season and wind conditions so that to draw lines of demarcation may be an attempt to oversimplify a dynamic system.

Since physical conditions are vastly more stable in the deep sea, it is unlikely that faunistic boundaries are continuous far offshore. In this work an arbitrary limit has therefore been set of species which occur for the most part at depths of less than 200 m. The situation for deep-water species is also less well-known and will be discussed briefly below.

Fig. 4 shows the eastern and northern limits of the 46 species of Cumacea known from depths of less than 200 m. The coastline has been straightened out and is shown along the bottom, with the east coast to the right and the west coast to the left. In the region of Cape Point, where the coastline begins to run east-west rather than north-south, samples from 33°S 17°E and 34°S 17°E have been pooled. Since hydrographic conditions in False Bay and Saldanha Bay are rather different from those prevailing on the adjacent open coasts, records of species which occur in these bays are marked with a cross. Where either bay is the limit of distribution, a dotted line indicates the intervening stretch of coast for which no records exist for that species. Dots indicate species found within an area of no more than one degree of latitude by one degree of longitude, although there may be more than one record for such an area.

Collecting has been intensive only between East London (33°S 27°E) and Lambert's Bay (32°S 17°E) so that it is not possible to determine provincial boundaries on the Natal coast with any accuracy. So, bearing in mind that the sudden drop in the number of species near East London may be artificially high due to decreased collecting effort, it is nonetheless true that ten south coast species are not found to the east of 25 - 27°S. A further ten Natal species only occur north-eastwards of 25°E, while five

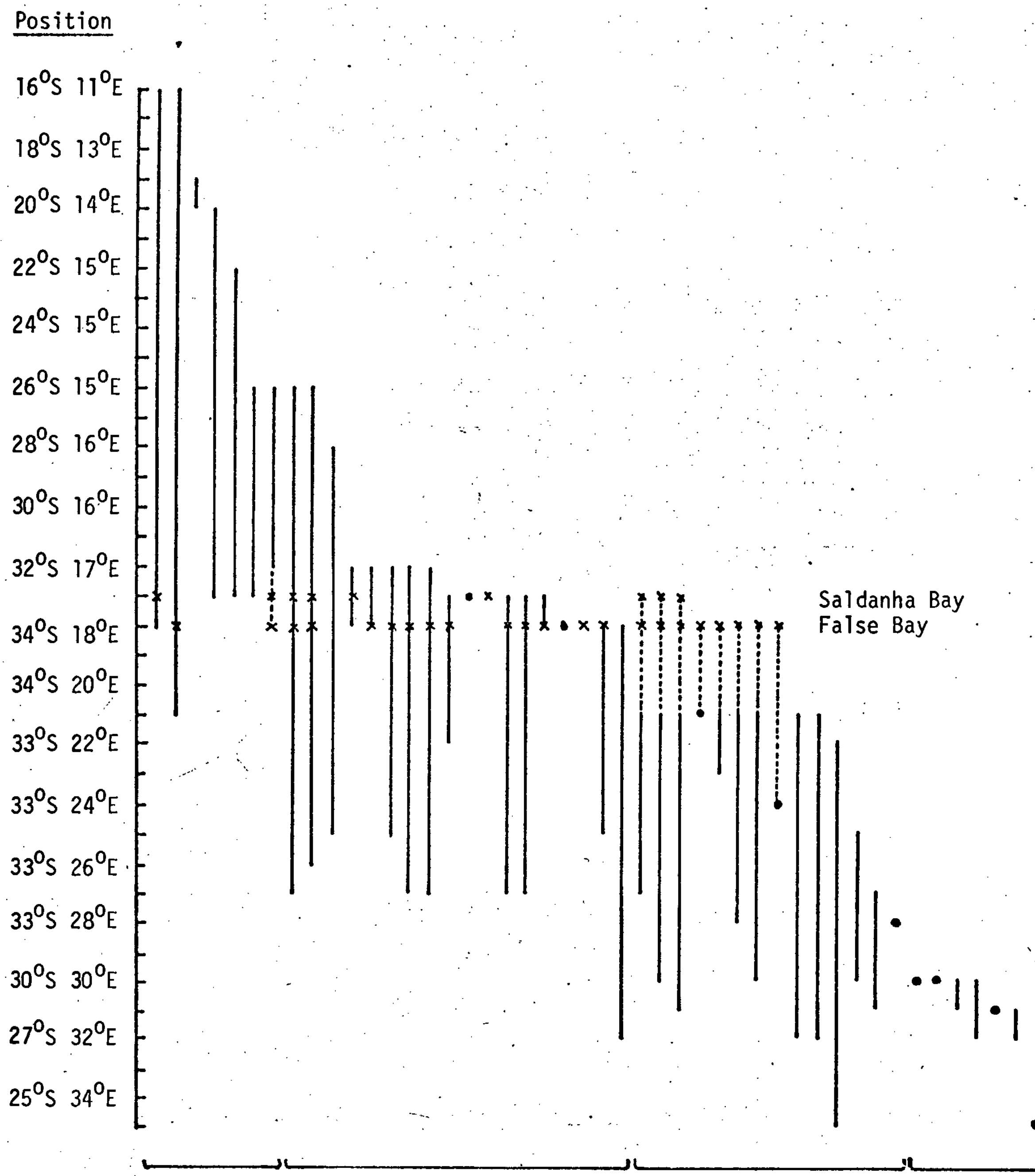


Fig. 4. Geographical limits of Cumacea from depths of less than 200 m. x = records from Saldanha Bay and False Bay; o = records from areas of no more than 1°latitude x 1° longitude.

species are found throughout this area and on either side. Thus within an area of overlap from about 25 - 30°E, there is a change in the fauna of 80%, strongly suggesting that there is a real provincial boundary within the area. This boundary can be assumed to lie between 27° and 30°E, since on the Natal coast there are a further seven species which do not occur at all south-west of 30°E.

It is therefore postulated that there is a subtropical Natal province with its south-western limit between 33°S 27°E and 30°S 30°E and its northern limit undetermined. This is more or less in agreement with the findings of other workers, as outlined above.

Although the fauna of the south and south-west coasts is well known, it is difficult to determine provincial boundaries within it because of the extensions of species into Saldanha Bay and False Bay. In the first part of the following account, records from these two areas have therefore been omitted.

Thirty-two species are known between Lambert's Bay (32°S 17°E) and Still Bay (34°S 22°E). Of these, only six occur in both areas. Fourteen are known from Still Bay but not from Lambert's Bay and eight are known from Lambert's Bay but not from Still Bay. Thus there is a change of 80% in the fauna between the two areas. It may therefore be assumed that there is another provincial boundary in the area.

Lack of information from the region of Cape Agulhas makes it difficult to predict what may happen there, but if we now include data from False Bay, the following emerges: 32 species occur in the area. For thirteen of these, the Cape Peninsula and adjacent areas form the western limit of distribution, and for five they form the south-eastern limit. Nine species extend beyond the Peninsula in both directions, while five are known only from False Bay and the immediate vicinity. Omitting the last group, it can be seen that only nine of the 27 species (66%) occur both to the north and to the east of the Peninsula. This in turn suggests that the provincial boundary occurs somewhere in the region of False Bay and the Cape Peninsula.

Thus there is a warm-temperate Agulhas province extending from the borders of the Natal province to the Cape Peninsula or vicinity, which in turn merges with a cool-temperate Namaqua province on the western Cape coast.

The northern limit of the Namaqua province cannot be determined becasue of the scanty information available, but there does not appear to be any change in the fauna as far north as 16^{o}S. Hydrographic conditions on the west coast change at roughly 18^{o}S (which is the northernmost limit of the cold Benguela Current) and one might expect a different group of species to appear at about this point. In fact, 16 or 17^{o}S appears to be the northernmost limit of any southern African species (apart from those which are found again in tropical west Africa), while three species unknown in southern Africa have been found on the coast of Angola north of 17^{o}S (Jones 1956). Thus despite the limited data, there is some slight evidence supporting the suggestions of previous workers that the northern boundary of the Namaqua province is between 16 and 18^{o}S.

The division of the Cape area into two provinces differs from the situation found by J.H. Day for polychaetes, Griffiths for amphipods and Millard for hydroids, each of whom recognises a single province. It is suggested that since Cumacea appear to be more temperature-sensitive than the three groups mentioned above, even slight differences in temperature between the south and west coasts would be sufficient to partition them. It should further be mentioned that, since the Cumacea are suggested to have a limited ability to disperse (J.A. Day 1978a), it may be extremes of temperature in a given area which limit their distribution. However, since their distribution ranges are rather narrow even in regions of apparently uniform temperature (such as the deep sea), they must be considered to be thoroughly stenothermal.

Deep-water species

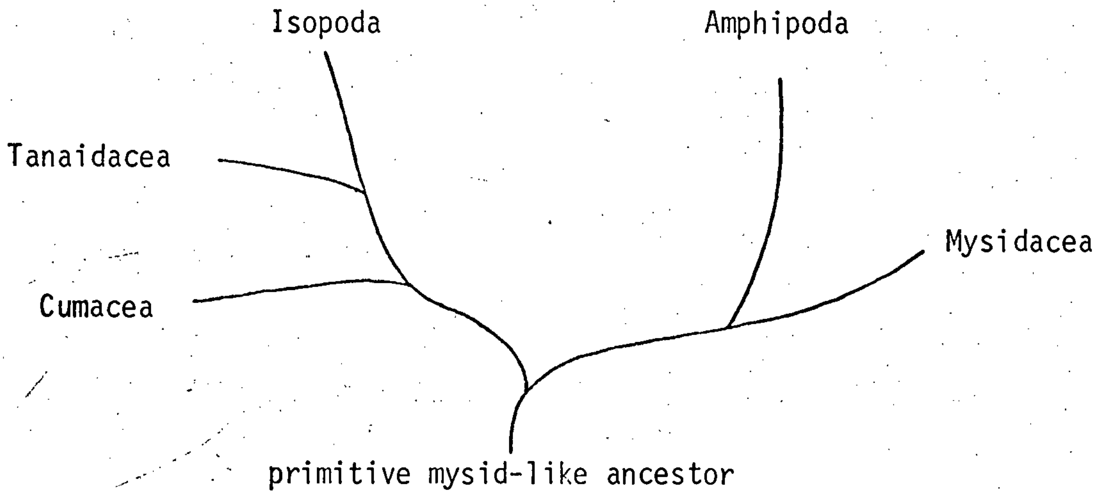
Collection of material from waters deeper than 200 m has been erratic. Although more than a third of the species from southern Africa occur almost exclusively below 200 m, they have all been collected from three areas, one between Lambert's Bay and the Cape Peninsula, one off Still Bay on the Agulhas Bank and one fairly wide area off northern Natal and the southern Mozambique Channel. Since the number of records for each species is small, it is not possible to determine any overall trends in the distribution of the deep-water species.

It is noteworthy, however, that fourteen of the twenty-nine species (nearly 50%) are common to both Natal and the area off the Cape Peninsula, while only seven (15%) of the forty-six shallow-water species are known from both areas, in spite of the fact that collecting has been more intensive in shallow waters. This again supports the suggestion that hydrographic conditions are much more uniform at depths below 200 m, so that provincial boundaries are indistinct and in fact may not exist at these depths.

EVOLUTION

Evolution within the Peracarida

The Cumacea, together with the Amphipoda, Isopoda, Tanaidacea, Mysidacea and Spelaeogriphacea, are peracaridean Malacostraca, being placed in this group because of the lacinia mobilis on the mandible and the presence of a ventral brood pouch or marsupium in the female, formed from the oostegites on the third to sixth pereionic appendages. It is difficult to hypothesise on the evolutionary relationships within the Peracarida because there are no extant forms intermediate between the orders, and even in the fossil record (Hessler 1969) there is no material of any value in elucidating the relationships between the orders. The fossil Order Anthracocaridacea, with six free thoracic somites, contains two genera, Anthracocaris from the Lower Carboniferous, which has the telson and the peduncle of the uropods not unlike those of some cumaceans, and Acadiocaris, which has mysid-like uropods and telson. It is not even certain that the order is a real grouping of like animals, as little else of their anatomy is evident. In the absence of adequate fossil evidence, the phylogeny within the Peracarida is accepted as being something as follows:



(modified after various authors)

Fig. 5. Peracaridean phylogeny.

A carapace is considered primitive and the mysids and amphipods to be close to each other, as are the tanaids, cumaceans and isopods.

Evolution within the Cumacea

There are no "doubtful cumaceans" - all either are, or are not, obvious members of the order. But within the group, phylogenetic relationships are difficult to visualise because of the mosaic of characters borne by many of the families.

The only known fossils belong to the genus Palaeocuma from the Upper Permian of Europe. They, too, are clearly Cumacea, and appear not very different from many nannastacans and bodotriids, with a slender abdomen and no free telson. But the best examples are visible only in dorsal view so that thoracic appendages are not visible.

It is generally accepted that a full complement of limbs is a primitive condition and that species with a reduced number of appendages are likely to be advanced. But in Cumacea the reduction of both pleopods and exopods on the thoracic limbs is much less pronounced in males than in females. This is presumably because an adult male requires one or the other for efficient swimming, so that the loss of one precludes the loss of the other. However in adult females there are no pleopods at all (with the possible exception of Archaeocuma) and the number of exopods is also reduced. Thus on evidence from females the Bodotriinae (with only two pairs of thoracic exopods) would appear to be the most advanced, whereas the males of this subfamily still carry a full complement of pleopods, and should therefore be considered fairly primitive.

The fusion of the telson with the last abdominal somite may also be taken as a sign of advancement, in which case the Bodotriidae, Leuconidae and Nannastacidae would be the most advanced. Lomakina (1968) has studied the number of pairs of hepatopancreatic diverticulae and reports that the number of pairs is lowest in these three families, a situation which she considers to be advanced.

Table 4 combines the information on all of the characters discussed above for each family. It is clear that, whichever groupings are used, it is necessary to postulate that the reduction of either the number of pairs of pleopods or of the telson has occurred more than once. Since the number of pairs of exopods on the thoracic limbs appears to be fluid, even within some genera, it is suggested that the occurrence and degree of development is dependent on functional requirements and is not a useful phylogenetic character. For example, in some of the more cumbersome gynodiastylids the thoracic exopods may be entirely absent in the female and greatly reduced in the male, which also lacks pleopods. These animals appear to be advanced

	number of pairs of exopods in the male	number of pairs of exopods in the female	number of pairs of pleopods in the male	number of pairs of hepatic diverticulae	development of telson
Diastylidae	5	2-3	(0-)2	4	+/+++
Lampropidae	5	2-3	0-3	4	++/+++
Pseudocumatidae	5	4	2	4	+
Leuconidae	3-5	3-4	0	2-4	-
Bodotriidae	2-5	2-5	(2-)5	1-2	-
Nannastacidae	5	3-4	0	1-2	-
Gynodiastylidae	3-5	0-3	0	?	+/++
Ceratocumatidae	3-5	2-4	4-5	?	+

Table 4. Familial characters of possible phylogenetic significance.

in many respects, but the reduction of <u>both</u> exopods <u>and</u> pleopods can be explained as a loss of non-functional parts in a poorly-mobile group. A theoretical phylogenetic tree is presented in Fig. 5 below.

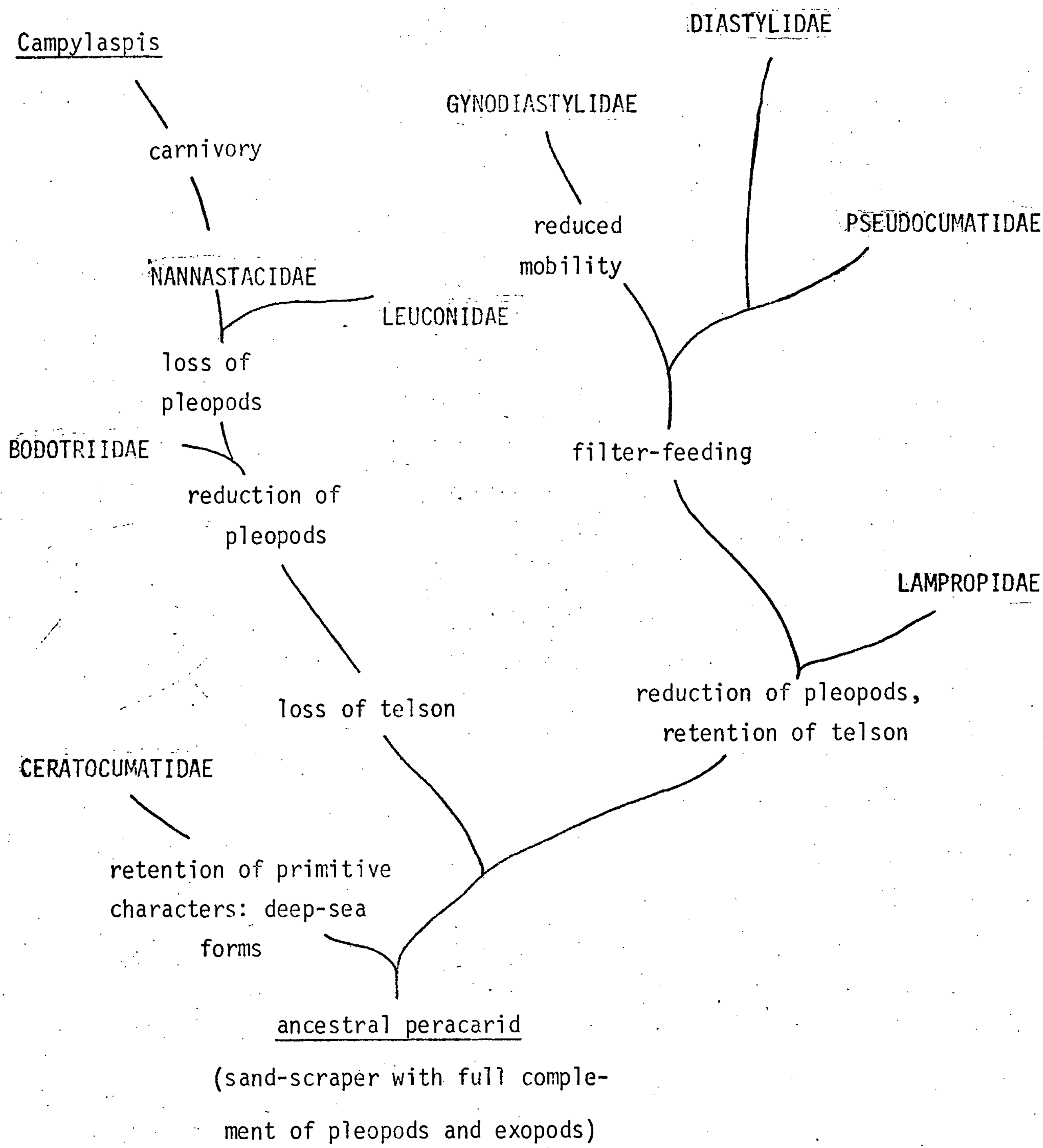


Figure 6. Proposed phylogeny of the Cumacea.

Thus it is postulated that the Nannastacidae, in particular the <u>Campylaspis</u>-group, the Bodotriidae and the Gynodiastylidae are the most advanced of the families, while the Lampropidae and Ceratocumatidae are nearest to the ancestral stock. If these last two families are indeed primitive, then the group as a whole may have evolved in similar conditions to those in which the ceratocumatids and lampropids are found today - in deep water, or possibly in cold, shallow waters. This in turn would go some way to explaining the rather narrow temperature ranges which appear to limit the distribution of modern cumaceans. In fact, it is only the three most advanced families which are found to any great extent in tropical waters.

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