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The systematics and ecology of a new genus of sand beach isopod (Sphaeromatidae) from Kenya

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(With 5 figures in the text)

Quantitative sampling of sand beaches at Watamu, Kenya, has revealed the presence of a new eubranchiate sphaeromatid isopod. A detailed description of this isopod is given together with details of its vertical distribution, ecology, and behaviour. ***Sphaeromopsis amathitis* gen. et sp. n.** appears to be herbivorous and is fossorial in habit prefering fairly exposed, coarse grained beaches, where it occurs most abundantly at the MLWN level. Comparison is made with eurydicid isopods from the same habitat.

Contents

Introduction

Members of the isopod family Sphaeromatidae occur frequently on rocky shores but only a few species are to be found associated with intertidal sand beaches, a habitat more commonly inhabited by cirolanid isopods such as *Eurydice* Leach (Jones, 1971). This may be related to the feeding habits of the Sphaeromatidae, most of which are usually herbivorous (Holdich, 1971), whilst the Cirolanidae tend to be carnivorous (Jones, 1968). Therefore the lack of easily obtainable plant material in sand beaches may be a limiting factor in the distribution of sphaeromatids.

During the University College of Bangor's marine biology expedition to Watamu (Kenya) in 1969, one of us (D.A.J.) made a quantitative survey of the fauna of sand beaches and inshore plankton. The object of this study was primarily to examine the ecology of eurydicid isopods (Jones, 1971), but in the course of sampling a large number of sphaeromatid isopods were also caught. Although a few sphaeromatid species have

been taken from sandy areas (see Menzies & Frankenberg, 1966; Menzies & Glynn, 1968; Schultz, 1969; Day, 1969 for reviews) so little detail has been given with regard to their ecology that it is difficult to ascertain whether or not they are permanent members of this habitat. *Sphaeroma teissieri* Bocquet and Lejuez (Bocquet & Lejuez, 1967) can probably be placed in this latter category and also *Exosphaeroma truncatitelson* Barnard. Brown (1964) has indicated that *E. truncatitelson*, a common constituent of sand beaches in South Africa, is a predator of other sand dwellers, although there seems little evidence for this (J. G. Field, pers. comm.).

The systematics of the Sphaeromatidae are in a state of extreme confusion (Monod, 1931; Menzies, 1954, 1962; Menzies & Glynn, 1968) mainly due to the fact that so many species have been formed without proper descriptions being published. Hansen (1905) divided his subfamily Sphaerominae, to which most sphaeromatids belong, into three groups based on the structure of the pleopods, and although a number of recently discovered genera are difficult to place in this division, Hansen's scheme is still the most workable for the majority. There are no records of sphaeromatid isopods from Kenya that we know of and the specimens found in the present study appear to be new to science, although records do exist for unidentified members of this sub-family from similar latitudes and habitats in other countries (e.g. Vohra, 1971).

Methods

Five sites (a–e) were sampled along the beach at Watamu Marine Park from fairly exposed to sheltered conditions (for details see Jones, 1971). At each site 7 equidistant stations were sampled along transects extending from 0 m chart datum to MHWS (+3·5 m). A 25 cm² quadrant was taken to a depth of 15 cm in the sand for each sample and all animals retained after washing through a 1 mm mesh sieve were preserved.

To investigate whether isopods present in the intertidal sand underwent a free-swimming phase, collections of animals, both intertidally and sublittorally, were made at night using a 45 W, 12 V spot lamp enclosed in a waterproof housing. These collections were standardized by fishing for 20 min on each occasion. Quantitative plankton tows were also taken at the water's edge at hourly intervals on both flood and ebb tides during the day. An investigation of possible spontaneous swimming activity in the sphaeromatids collected was made in the laboratory using a similar technique to that described for experiments on *Excirolana geniculata* Jones (Jones, 1971).

For detailed examination, appendages were mounted directly in CMC-S non-resinous stain-mountant (Turtox).

Systematics

Family Sphaeromatidae

Genus *Sphaeromopsis* gen. n.

Diagnosis. Sphaeromatidae in which both rami of the fourth and fifth pairs of pleopods bear prominent transverse folds (eubranchiate condition). Only the exopod of pleopod 5 biarticulate. Endopod of second male pleopod with appendix masculina. Sexual dimorphism otherwise not apparent. Articles of the maxillipedal palp each with a lobe on the inner margin. Exopods and endopods of uropods well developed. Pleotelson smoothly domed with non-emarginate, truncated posterior border. Lateral border of only one pleonite reaching lateral margin of the pleon. Pereonal segments 6 and 7, and the pleon, unarmed.

Sphaeromopsis amathitis gen. et sp. n.

(Figs 1–4)

Diagnosis. General body form ovate. Body surface smooth. Cephalon wider than long, without prominent rostral process or flange. First pereonal segment as long as cephalon and longer than other pereonites. Epimeral sutures clearly visible; epimera subequal, with those of pereonites 2 and 3 more pointed than the others. Pleon longer than first pereonite, pleonal sutures extending only a short distance into the midline from their origins, only one pleonite reaching lateral margin of pleon. Pleotelson dorsally domed and without bosses or keels, broadly truncate and not tapering to any marked degree, ventrally with prominent shelf, posterior margin not emarginate. Epistome with triangular apex and straight arms. Antennules and antennae of normal sphaeromatid type, peduncles not

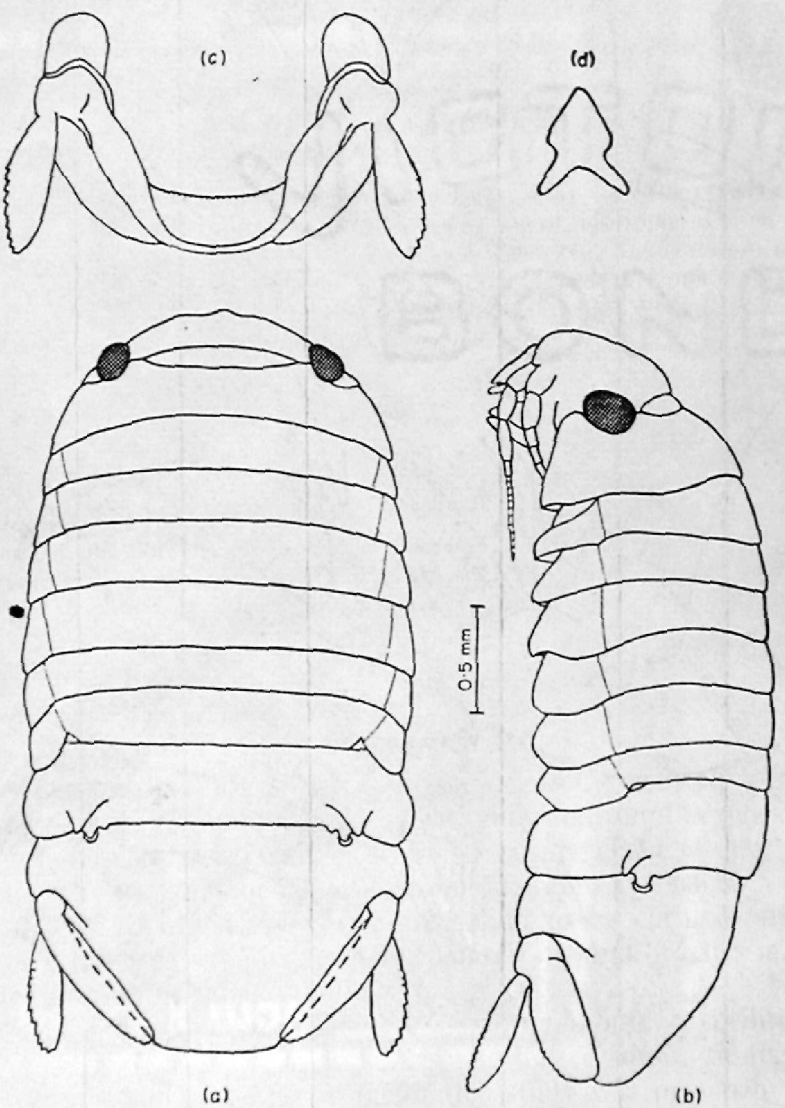

FIG. 1. *Sphaeromopsis amathitis* gen. et sp. n. Dorsal (a) and lateral (b) views of a male. (c) Ventral view of pleotelson showing shelf. (d) Epistome.

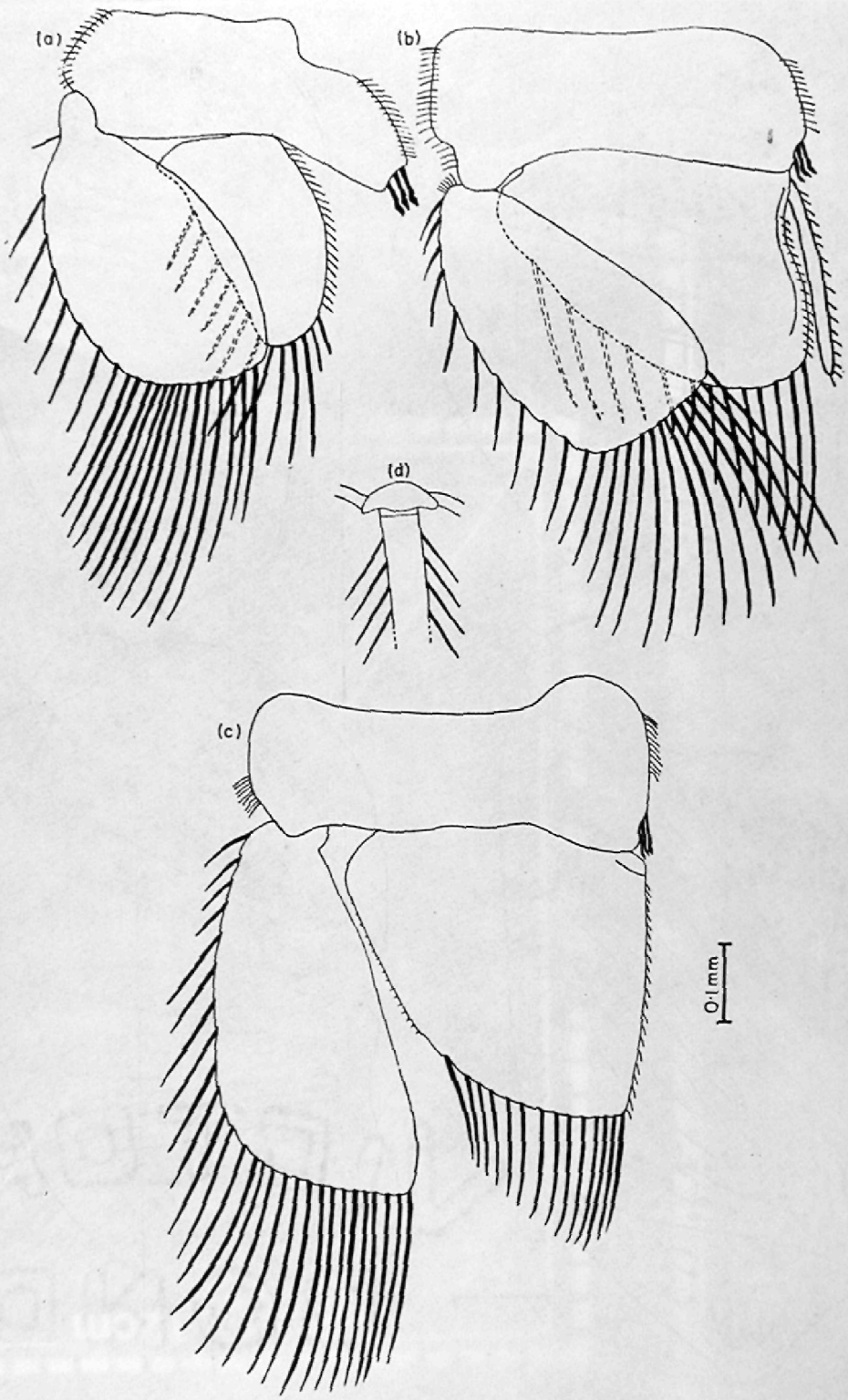

FIG. 3. *Sphaeromopsis amathitis* gen. et sp. n. (a)–(c) First to third pleopods of a male. (d) Detail of basal part of a plumose seta.

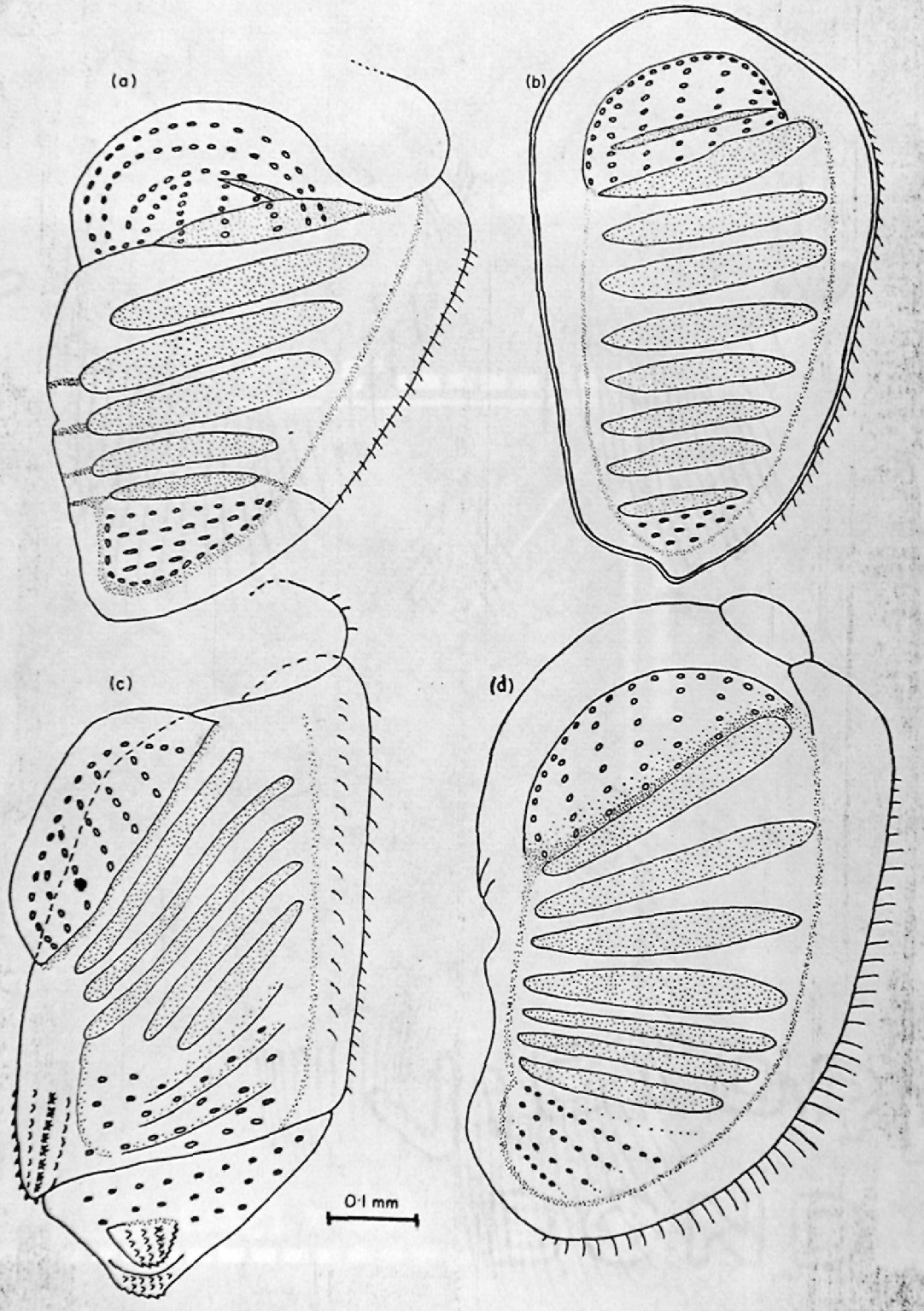

FIG. 4. *Sphaeromopsis amathitis* gen. et sp. n. (a)–(b) Exopod and endopod of fourth pleopod. (c)–(d) Exopod and endopod of fifth pleopod.

expanded, flagellar articles increasing in number with size (i.e. age). Mouthparts of normal sphaeromatid type; maxillipede with well marked lobes on articles of palp, endite with three prominent terminal spines and six well developed plumose setae. Pereopod 1 shorter than others, carpus reduced and of normal triangular shape. All pereopods with long relatively stout setae on the distal superior borders of the ischium and merus; plumose setae rare except on the distal borders of the carpus of pereopods 1 and 7. Penes well developed in male, each with a small distal seta. Exopod of first pleopod larger than the endopod, basis wide and projecting well beyond the insertion of the endopod, three stout coupling hooks on inferior border of basis. Endopod of pleopod 2 larger than exopod and with simple appendix masculina arising from the proximal inferior border, coupling hooks on basis less well developed than those on pleopod 1. Endopod of pleopod 3 larger than exopod, exopod unjointed. Both rami of pleopod 4 fleshy and with well developed respiratory folds and blood sinuses, superior borders with fine setae, exopod with signs of a slight articulation on the inferior distal border. Both rami of pleopod 5 fleshy and with well developed respiratory folds and blood sinues, however, the folds on the exopod are narrower and less well developed than those on the endopod; superior borders with fine setae; first proximal fold on the endopod bordered by a deep groove; exopod biarticulate and with a well developed lobe arising from the inferior proximal surface, two prominent tubercles covered in minute teeth occurring near the apex and another just above the point of articulation on the inferior border. Uropods not extending beyond the end of the pleotelson; endopod wider and more truncated than exopod, exopod with serrated apex and superior border and endopod with serrated apex.

Size. Varying from 1·4–3·2 mm in length. Adults of both sexes averaging 3 mm by 1·4 mm.

Colour. Sandy, usually scattered with dark red chromatophores. Individuals covered in chromatophores present but rare.

Sex. No sex ratio was observed in favour of either sex in the samples studied. No ovigerous females were encountered.

Habitat. Intertidal sand beaches of medium exposure, mainly at MLWN.

Type locality. Watamu Marine Park, Kenya.

Distribution. Known only from shores in the above locality.

Types. Holotype and paratypes deposited in the British Museum (Natural History) Nos. 1973:150:1 and 1973:151:17 respectively.

Ecology

Sand samples were taken from five transects at different localities in Watamu Marine Park. *S. amathitis* **gen. et sp. n.** was present in all five but seems to prefer the more exposed beaches where the mean particle diameter indicates fairly coarse sand (Table I). Where sand changed to mud at one station (Fig. 5) the sphaeromatids disappeared. Use of the χ^2 test shows that their distribution between these shores differs significantly from that which would have been expected if they were randomly distributed ($P<0{\cdot}001$). Although *S. amathitis* was found fairly high up on some beaches the preferred level appears to be around MLWN and no specimens were recorded at the lowest sampling station (MLWS) on any of the transects.

Besides a number of species of *Eurydice* and *Excirolana* (Jones, 1971) other common animals found inhabiting the same sands as *S. amathitis* were ostracods, mysids, amphipods, cumaceans, and foraminifera. In addition two other types of sphaeromatid isopod

TABLE I

Numbers of sphaeromatid isopods in beach transects taken at Watamu, and median particle diameter (mm) for each transect

(For map showing position of transects and profiles, see Jones, 1971)

Transects	a	b	c	d	e
Particle diameter	0·396	0·290	0·291–0·185	0·266–0·172	0·210
Total number sphaeromatids	65	125	123	29	11
Mean number per 25 cm²	9·3	18·0	17·5	4·1	1·6

were found in small numbers. These have yet to be identified and it is not known whether or not they were permanent members of the sand fauna.

Examination of the gut of a number of specimens of *S. amathitis* reveals that superficially at least this organ is similar to that found in typical herbivorous isopods (Holdich & Ratcliffe, 1970), and is unlike that found in carnivorous species (Jones, 1968). Examination of the gut contents supports the idea that *S. amathitis* is a herbivore. The gut contents usually consisted of fine sand grains, diatoms, and the remains of plant material. This latter source of potential food probably originates from *Cymodocea* plants washed up on the beaches from nearby localities (Jones, 1971).

Although a large number of *S. amathitis* were collected swimming to a light operated on the surface during the night at high tide over intertidal sand, no specimens were taken

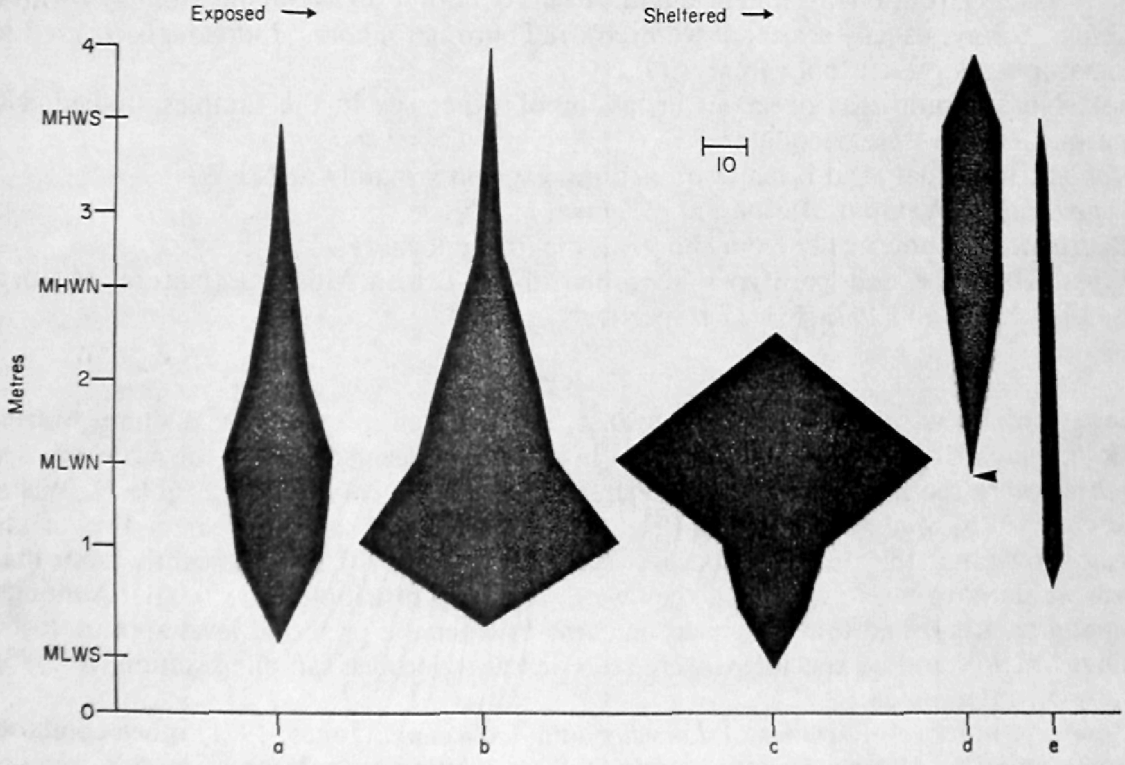

FIG. 5. Vertical zonation of *Sphaeromopsis amathitis* gen. et sp. n. at five localities (a–e) in Watamu Marine Park (see Jones, 1971). Solid arrow indicates sand changed to mud at this point.

when this light was moved to a position over sublittoral sand. Quantitative plankton tows taken intertidally at hourly intervals during the day and night also failed to collect *S. amathitis*.

Observations in the laboratory showed that this isopod, when placed on the surface of sand in an aquarium, promptly burrowed beneath the surface. Animals failed to reappear on the surface of the sand and experiments conducted over 60 hours indicate that *S. amathitis* does not exhibit any defined pattern of swimming activity, unlike some eurydicid isopods taken from the same beaches (Jones, 1971).

Discussion

Superficially the sphaeromatids found in the present study resemble some species of *Sphaeroma* (Lejuez, 1966), *Exosphaeroma truncatitelson* Barnard, 1940, and *Pseudosphaeroma mourei* Loyola e Silva, 1960. Examination of specimens of these isopods, however, has revealed differences in the structure of the pleopods. *Sphaeroma* spp. and *E. truncatitelson* definitely belong to the hemibranch Sphaerominae (Hansen, 1905) whilst our specimens are of a eubranchiate type. Monod (1931), and Menzies & Glynn (1968) have pointed out that Hansen's (1905) division of the Sphaerominae into three groups is difficult to apply to many genera. This is particularly so with regard to *Pseudosphaeroma* Chilton, 1909. Chilton placed this genus in the eubranchiate Sphaerominae but Monod (1931) did not consider that the structure of the pleopods fully warranted this and suggested that it be transferred to the hemibranchiate group. Loyola e Silva (1960), however, preferred to keep this genus in its original group and assigned a number of new species to it. One of these, *P. mourei*, strongly resembles our specimens from Kenya in many points. From Loyola e Silva's drawings the only apparent difference is the biarticulate nature of the exopod of the third pleopod. However, upon subsequent examination it was found that the rami of the fourth and fifth pleopods of *P. mourei* lacked definite respiratory folds. Menzies & Glynn (1968) have also remarked on this fact and have stated that the pleopods are almost of the platybranchiate type. The exact position of *P.* (?) *mourei* in Hansen's scheme is therefore uncertain at present. Two main features distinguish the present specimens from Kenya from the original diagnosis of *Pseudosphaeroma* (Chilton, 1909). These are the lack of sexual dimorphism and the definite eubranchiate nature of the fourth and fifth pairs of pleopods. As no other isopod so far described has these features in combination with a non-emarginate pleotelsonal border the authors consider that a new eubranchiate genus, *Sphaeromopsis*, should be erected in which to place them.

Intensive sampling has revealed the presence of eight species of eurydicid isopod occurring either intertidally or sublittorally in sand beaches of Watamu Marine Park (Jones, 1971). All these species, with the exception of *Pontogeloides affinis* Jones, swim up out of the sand to feed on plankton brought in on the flood tide. This predatory behaviour has been shown to be typical for other members of the family (Hansen, 1890; Richardson, 1905; Hale, 1925; Jones, 1968), and is usually controlled by an endogenous rhythm of swimming activity (Enright, 1965; Jones & Naylor, 1970; Jones, 1971).

In contrast *S. amathitis* appears to lead a fossorial existence, and experiments show the absence of any free-swimming phase in this sphaeromatid. In present studies animals could only be induced to leave the sand with the use of artificial light at night and were not taken above the sand under natural conditions. These features, together with investigations into the nature of the gut and its contents, indicate that *S. amathitis* in common

with other sphaeromatids is probably herbivorous, feeding primarily on diatoms within the sand or on plant detritus. The preference shown by *S. amathitis* for the lower part of medium to coarse sand beaches probably relates to the relatively well-oxygenated water-saturated nature of these sediments (Jansson, 1967).

Summary

A eubranchiate sphaeromatid isopod new to science has been recorded during quantitative sampling of sand beaches at Watamu Marine Park, Kenya. Although this sphaeromatid superficially resembles a number of other genera, the eubranchiate nature of the fourth and fifth pairs of pleopods in combination with the non-emarginate pleotelson, and absence of marked sexual dimorphism, clearly separates it from them.

Analysis of the habitat preferences indicate that this new sphaeromatid prefers the MLWN level of fairly exposed beaches composed of medium to coarse grained particles. No defined pattern of swimming activity was recorded and behavioural experiments indicate a fossorial existence for this isopod in contrast to the mode of life of most other isopods in the same beaches. Examination of gut morphology and contents indicate that this sphaeromatid is most probably a herbivore.

We would like to thank Dr J. G. Field and Dr J. Loyola e Silva for the provision of sphaeromatid specimens from South Africa and Brazil respectively. Part of this work was carried out during the Bangor/Watamu Expedition and we are grateful to the Royal Society, the Percy Sladen Memorial Trust, the Ministry of Overseas Development, the East African Wildlife Society, and many other organisations who provided financial support for this expedition.

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