MYSIDACEA OF THE MTENTU RIVER ESTUARY, TRANSKEI, SOUTH AFRICA

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ABSTRACT

The Mtentu River has a straight open tidal estuary flowing between steep grassy or indigenous forest-covered slopes. Total high-water surface area is about 0,3 km². The zooplankton was studied by periodic sampling over a period of thirteen months. Some physical characteristics of the estuary are presented. The seasonal and spacial distribution and relative importance of four species of mysid, is discussed. The most common mysid in the estuary was *Mesopodopsis africana*, although *Rhopalophthalmus terranatalis*, in view of its larger size, contributed more to the overall mass of mysids in the samples.

INTRODUCTION

The Mtentu River is situated 32 km south-west of Port Edward, on a relatively inaccessible, isolated section of the Pondoland coast. Although quite small, the river and its estuary are fairly typical of the area. The river has a catchment area of some 2 000 km². The estuary has a total length of about 3 km, a width of 50–150 m, and a depth (during this study) not exceeding 7 m. During the entire duration of the study, from February 1971 to March 1972, the estuary was tidal, with a constricted mouth about 30 m wide at its narrowest, and varying from 0,75 to 2 m in depth, at low spring tide. Spring tide rise was between 1,3 and 2 m.

Figure 1 shows a map of the estuary. Point A was the limit of the oyster-barnacle growth on the rock-faces flanking the river. At Point B the river was entirely fresh, with a sloping rocky bed and several rapids.

For the duration of the study, water-depth within the estuary was fairly constant. At Station 5, mean maximum depth at high spring tide was 4,37 m (range 3,23–5,77 m); at Station 4 mean maximum depth was 4,28 m (range 3,25–5,18 m) and at Station 2: 5,16 m (range 4,75–5,54 m).

Between Stations 4 and 5 the river bed had a basin-shaped profile, sloping steeply down from the spring-tide low-water level to a fairly flat channel floor. Above this basin were more gently sloping mudbanks about 10 m wide, bordered by mangrove (*Bruguiera gymnorhiza*) and hibiscus (*Hibiscus tiliaceus*) groves and honeycombed with *Upogebia africana* burrows. At Station 3 and on the north bank of Station 5 vertical cliffs dropped directly into the water, while at Station 2 a broad firm mud and sandbank (Figure 1) was exposed at low spring-tide, about 45 m wide at the Station 2 transect point. This bank was the only place where *Zostera* was evident in the estuary, but only a few strands were visible. From Station 3 upwards the estuary was flanked by high cliffs or steep grassy slopes. Above Station 6 thick forest covered the slopes.

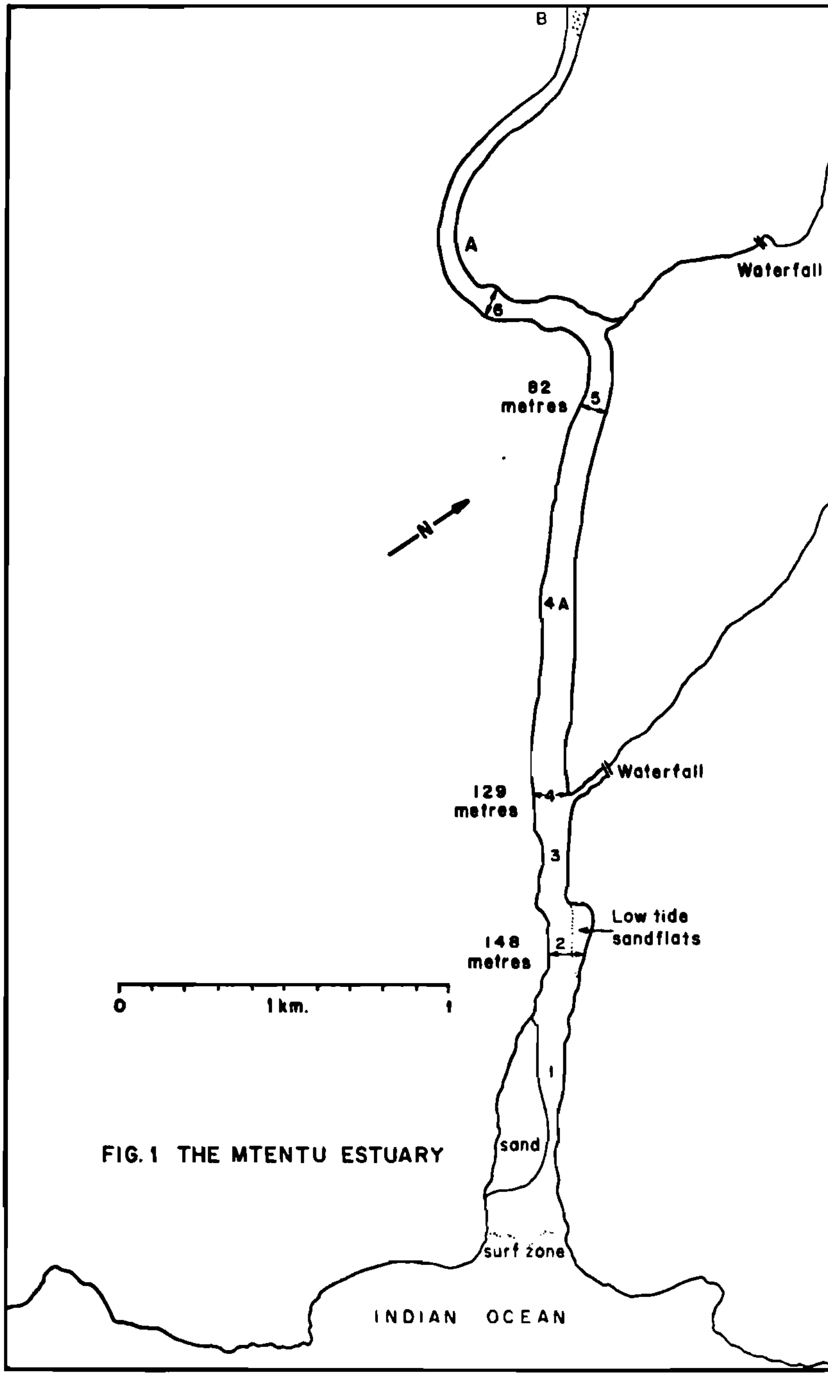
B
A
6
Waterfall
82
metres
5
N
4A
Waterfall
129
metres
4
3
Low tide
sandflats
148
metres
2
0
1 km.
1
1
FIG. 1 THE MTENTU ESTUARY
sand
surf zone
INDIAN OCEAN

FIGURE 1

METHODS

The estuary was visited at one- to two-monthly intervals. The sampling techniques used were of necessity simple, since the study was made privately. Two types of plankton net were used, namely an 'O'-net of 27,4 cm diameter and a 'D'-net, mounted on a metal sled, with a crossbar of 35,5 cm length and an arch of 20 cm maximum height. Both were constructed of bolting cloth with a 205μ aperture and 27,5 meshes per cm.

Quantitative samples were obtained by pulling the nets along fixed transects at Stations 5, 4 and 2 (Figure 1), the O-net just below the water surface, the D-net across the bottom. By measuring the width of the river at each transect point, and mapping the profile of the estuary bed, distance of travel of both the O-net and D-net could be calculated. With net mouth area known it was possible to calculate the theoretical volume of water filtered by the net, during transects at the different stations.

The river was always visited during spring-tides and quantitative samples were always taken at dusk, while there was still sufficient light to pinpoint sampling stations.

Since on this coast, spring-tide peak is about 1600h, tides were on or just past high, at the time of sampling. This eliminated the effects of tides and time of day on the quantitative samples collected.

Apart from the quantitative samples other random hauls were made at various points and at various times, especially after dark. Although not quantitative these samples were of value for qualitative studies and relative abundance within a sample, as well as for age-group studies of the mysid populations.

During transect sampling, water samples were collected with a 6 ℓ van Dorn bottle for surface and bottom temperature, salinity and dissolved oxygen determinations. The salinity was determined using a hydrometer, and dissolved oxygen by the Winkler method.

For data presented in Table 5, specimens were counted as adult, subadult and juvenile as follows: adult males of *Mesopodopsis* and *Gastrosaccus* had a fully developed genital appendage on the 8th thoracic appendage and a fully developed elongated third pleopod (fourth pleopod in *Mesopodopsis*). In *Rhopalophthalmus* the fully developed, elongated second pleopod was used to indicate maturity (extending to tip of last pleopod). In females, all with developing young in the pouch, or an empty but obviously adult pouch, were considered adult. Subadults were identified by only partially developed pleopods in males and pouches in females, with the presence of reduced genital appendages useful in males of *Gastrosaccus* and *Mesopodopsis*. Juveniles were all those without evidence of a tiny pouch, or developing pleopod or genital appendage.

RESULTS

Physical conditions in the estuary

Salinity and temperature data are presented in Figures 2 and 3. During all visits upper waters were found to have a lower salinity than bottom waters. This was also reflected by the water temperatures, where the underlying sea-water layers were cooler in summer and warmer in winter than the upper less saline layers. Salinities, even at Station 5, were consistently high in the bottom layers of water.

In order to establish whether the deeper saline waters retreated with the outgoing tide, samples of bottom water were collected at 1100h on 3 January 1972. These showed bottom salinities ranging from 34,8 to 35,3‰ between Stations 5 and 2, values practically identical to those recorded at high tide the same evening (Figure 2).

Oxygen levels in the estuary were at all times reasonably high to high. At Station 5 mean surface oxygen was 109,5% saturation, and 92,8% at the bottom. At Station 4 mean values of 111,7% at the surface and 93,0% on the bottom were recorded, and at Station 2: 98,3% on the surface and 83,8% at the bottom. These data were all collected in the late afternoon during each visit. Minimum percentage oxygen recorded was 49% on the bottom at Station 4 on 5 November 1971.

In view of the relative smallness of the system, the estuary was sensitive to rainfall in the river catchment, quickly responding to, and recovering from, local rains. For example, between the 19 and 21 August 1971, widespread rains fell, with 183 mm recorded at Mkambati, 10,5 km south-west of the estuary, on the coast. More than half of this rain fell on the 19th causing a strong flood in the river and considerably deepening the estuary mouth. Yet on 6 September, relatively high salinities were recorded on the surface, even at Station 5 (Figure 2) and the estuary was unusually clean.

This sensitivity of the system makes an assessment of the effect of salinities on faunal distribution difficult, since conditions recorded at the time of sampling were not necessarily representative of the conditions during which the sampled population developed. Rainfall data from Mkambati are therefore presented in Figure 4, to give an indication of fresh water inflow

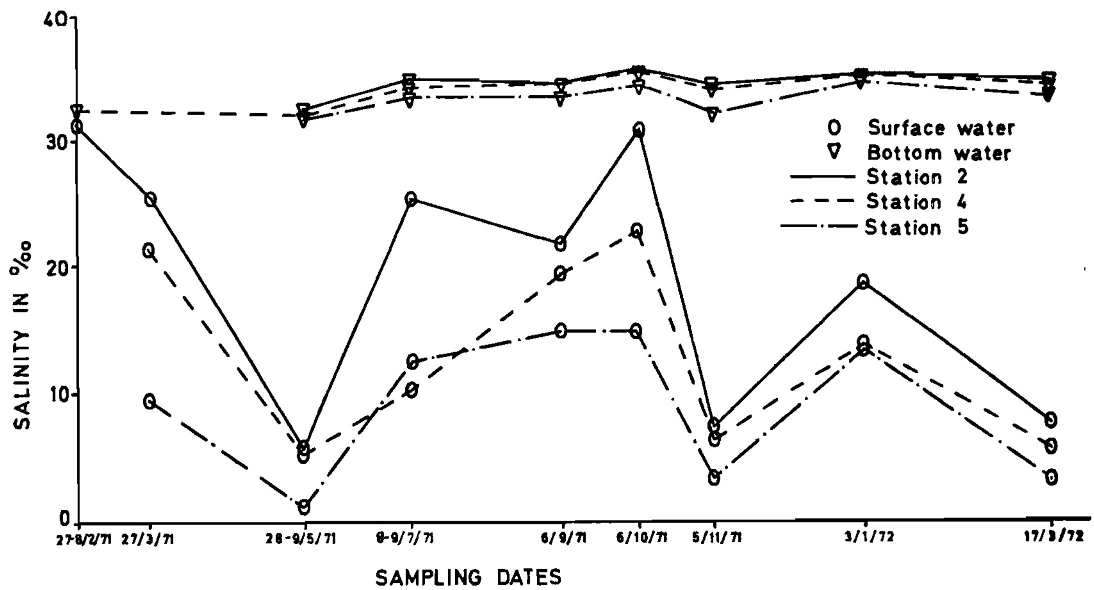

FIGURE 2

prior to each sampling period. The year 1971 was exceptionally wet in this area, with 1 367 mm recorded.

Mysid distribution and importance

Mysids in the samples were mainly represented by four species, namely *Rhopalophthalmus terranatalis* O. Tattersall, *Gastrosaccus brevifissura* O. Tattersall, *Mesopodopsis africana* O. Tattersall and *M. slabberi* van Beneden. During the September samplings four specimens of a *Siriella* species were collected. These are similar to *S. australis* W. Tattersall (1927), and appear to correspond to O. Tattersall's *Siriella* sp. nr. *australis* (O. S. Tattersall 1952:160–161). In addition, two juvenile specimens of a *Mysidopsis* sp. and a single male *Heteromysis* sp. were encountered in the samples.

At Station 6 a stony bed prevented the use of the sled net. This station was therefore poorly sampled for mysids. Apart from two samples taken after dark and one at dusk, mysids were not

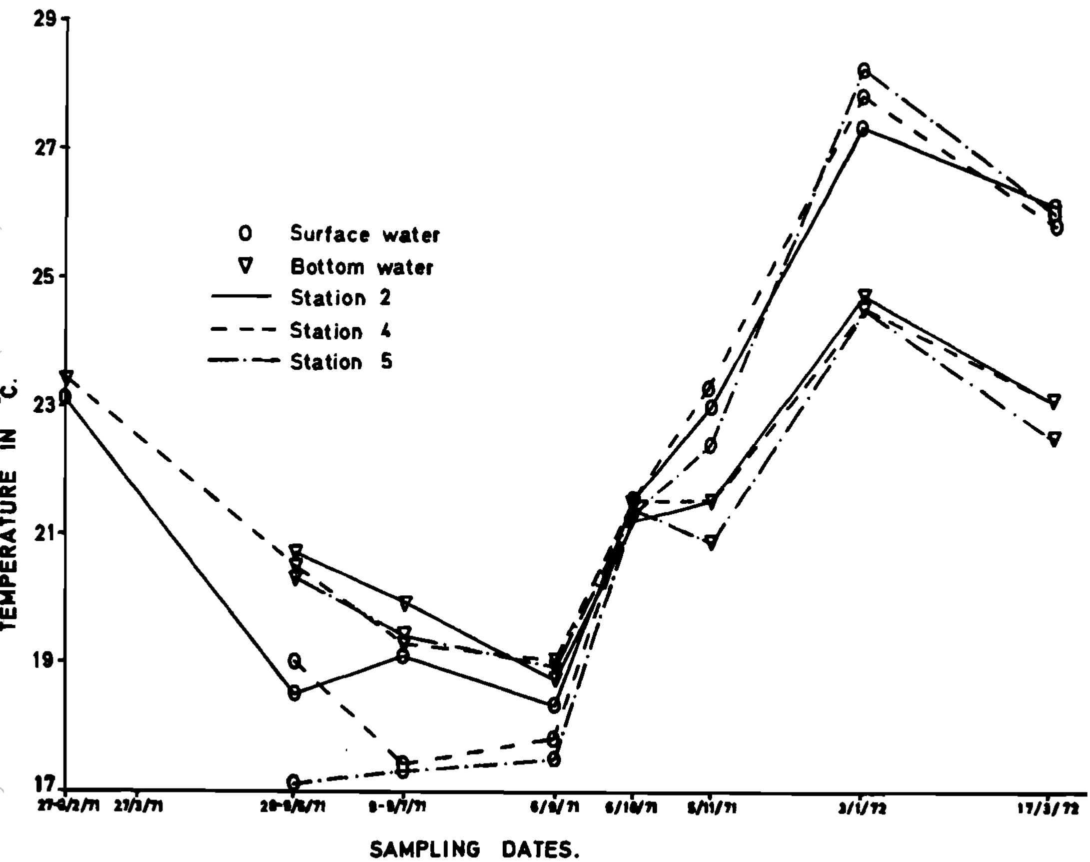

FIGURE 3

encountered in the O-net samples anywhere in the estuary. The data are therefore almost exclusively from D-net samples.

Mesopodopsis africana was the most frequently encountered mysid in the quantitative samples (Table 1) although a greater number of random hauls taken at Station 2 increased the total catch of *G. brevifissura* above that of *M. africana* (totals of Tables 1 and 2). Quantitative catches of *G. brevifissura* only just exceeded those of *R. terranatalis*, but the latter's total was greatly boosted by one sample (Table 1, Station 2, 17.3.1972).

Most of the samples indicated a dominance of *M. africana* over *G. brevifissura* upstream at Station 5, while the converse was often encountered at Station 2 (Table 2). It is apparent however that both these species were well represented throughout the estuary.

Of the four species of mysid common in the estuary, all except *G. brevifissura* are known to swarm (Tattersall 1952; Day *et al.* 1954), while many species of the genus *Gastrosaccus* are known to swarm. The occasional very high numbers of *G. brevifissura* collected during this study

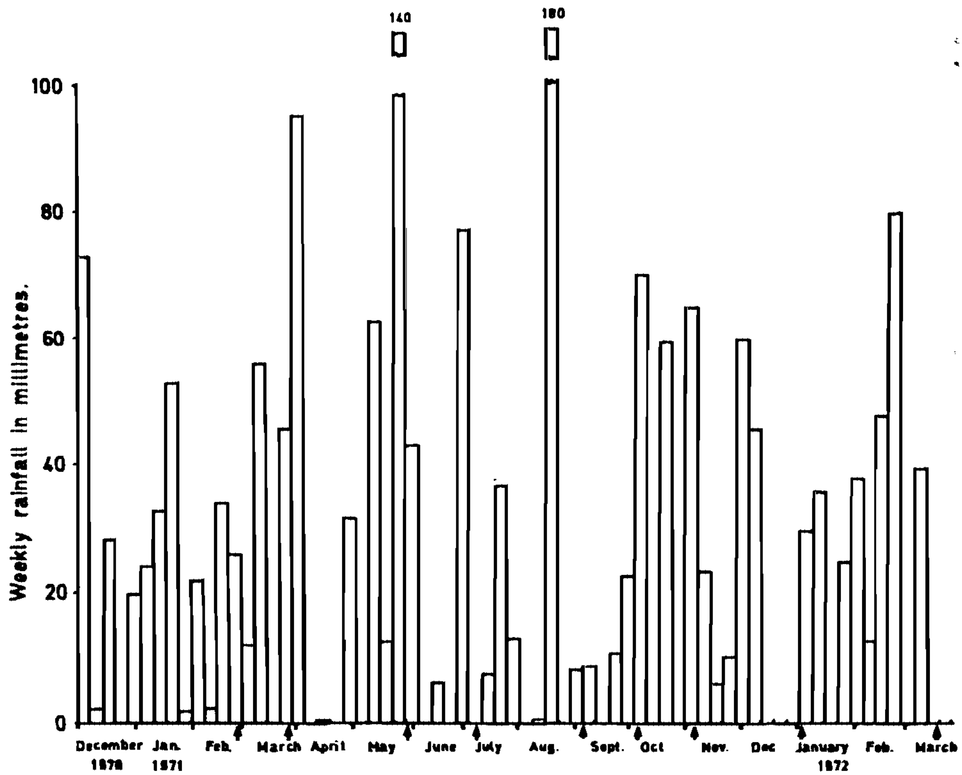

FIGURE 4

Weekly rainfall, Mkambati. December 1970–March 1972.

Arrows denote sampling visits.

TABLE 1

QUANTITATIVE D-NET TRANSECT DATA: MYSIDS

Values in brackets indicate density per m^3

Date	*Stn*	*Rhopalophthalmus terranatalis*	*Gastrosaccus brevifissura*	*Mesopodopsis africana*	*Mesopodopsis slabberi*
27. 3.71	5	0	0	3	0
27. 3.71	4	0	0	1 (0,11)	0
27. 3.71	2	0	0	0	0
28. 5.71	5	1 (0,17)	3 (0,51)	66 (11,31)	0
28. 5.71	4	0	2 (0,22)	6 (0,65)	0
28. 5.71	2	0	0	3 (0,28)	0
8. 7.71	5	0	0	10 (1,71)	0
8. 7.71	4	0	38 (4,09)	49 (5,28)	0
9. 7.71	2	0	0	3 (0,28)	0
5. 9.71	5	0	1 (0,17)	18 (3,08)	0
6. 9.71	5	14 (2,40)	9 (1,54)	19 (3,25)	0
6. 9.71	4	0	19 (2,05)	3 (0,32)	0
6. 9.71	2	0	6 (0,57)	2 (0,19)	0
6.10.71	5	3 (0,51)	1 (0,17)	48 (8,22)	1 (0,17)
6.10.71	4	1 (0,11)	3 (0,32)	30 (3,23)	0
6.10.71	2	0	120 (11,32)	15 (1,41)	
5.11.71	5	11 (1,88)	4 (0,69)	10 (1,71)	3 (0,51)
5.11.71	5*	15 (2,77)	74 (12,69)	10 (1,71)	9 (1,54)
5.11.71	4	24 (2,59)	1 (0,11)	30 (3,23)	2 (0,22)
5.11.71	2	55 (5,19)	21 (1,98)	16 (1,51)	7 (0,66)
3. 1.72	5	2 (0,34)	0	14 (2,40)	0
3. 1.72	4	0	0	18 (1,94)	0
3. 1.72	2	6 (0,57)	0	0	0
4. 1.72	2*	2 (0,19)	3 (0,28)	1 (0,09)	1 (0,09)
17. 3.72	5	5 (0,86)	0	15 (2,77)	2 (0,34)
17. 3.72	4	6 (0,65)	3 (0,32)	14 (1,51)	0
17. 3.72	2	149 (14,05)	7 (0,66)	31 (2,92)	0
Total		299 (32,28)	315 (37,69)	431 (59,62)	25 (3,53)

* Although comparable transect samples, these are not part of the normal three transects taken on each visit

(Tables 1 and 2), suggest that it also swarms. This swarming behaviour makes quantitative sampling difficult and therefore accumulated averages and not single samples are far more reliable in assessing relative abundance of the species encountered.

During early November conditions appeared very suitable for all four species, and all were well represented in the samples. From the results for that month (Tables 1 and 2) it would appear that swarms of the various species were scattered throughout the estuary. The D-net sample (Table 2) of 1900h, 5 November 1971, indicated the usual dominance of *G. brevifissura* over *M. africana* at Station 2, and this was also apparent in the transect data (Table 1). The other three November samples from Station 2, recorded in Table 2, were not comparable with the above, since they were taken in the morning on an outgoing to almost low tide. The complete dominance of *M. africana* in these morning samples as well as the relative abundance of *M. slabberi*, is interesting, indicating a general downstream movement of mysids on the outgoing tide. Both *R. terranatalis* and *G. brevifissura*, dominant in the evening high tide samples from Station 2, were almost completely absent, and must have moved towards Station 1. Underwater

TABLE 2

MYSID DATA FROM RANDOM HAULS

Date	*Stn*	*Net.*	*Time*	*R. terranatalis*	*G. brevifissura*	*M. africana*	*M. slabberi*
29. 5.71	3→1	D	1815h	0	34	0	0
8. 7.71	3→2	O	1800h	0	20	2	0
6.10.71	2	O	1900h	1	8	0	0
6.10.71	2	D	1930h	35	519	84	4
6.10.71	2	D	2000h	8	330	133	3
7.10.71	5	D	1715h	0	0	16	4
7.10.71	4	D	1745h	0	0	95	1
7.10.71	2	D	1815h	0	5	2	0
5.11.71	2	D	1000h	1	8	192	81
5.11.71	2	D	1900h	109	108	34	4
6.11.71	2	D on bank	0800h	0	1	62	6
6.11.71	2	D channel	0815h	26	0	277	20
4. 1.72	5	D	1930h	35	1	80	39
4. 1.72	4→3	D	1945h	76	15	16	11
4. 1.72	2	D	2000h	140	380	16	7
17. 3.72	3→2	D	1930h	52	0	3	1
Grand total tables 2 and 3*				782	1 744	1 443	206

* Biased by a larger number of samples from Stn. 2.

TABLE 3

MONTHLY (QUANTITATIVE AND TOTAL) AGE-GROUP DATA, PLUS COMPARATIVE BIOMASS ANALYSES, USING DATA FROM TABLE 4

Month	Quantitative & total	*R. terranatalis*				*G. brevifissura*				*M. africana*				*M. slabberti*			
		Ad.	*Sub-ad.*	*Juv.*	*QS*	*Ad.*	*Sub-ad.*	*Juv.*	*QS*	*Ad.*	*Sub-ad.*	*Juv.*	*QS*	*Ad.*	*Sub-ad.*	*Juv.*	*QS*
Mar. 1971	Q	—	—	—	—	—	—	—	—	3	1	—	386	—	—	—	—
	T	—	—	—	—	—	—	—	—	3	1	—	386	—	—	—	—
May 1971	Q	—	1	—	535	—	—	5	35	2	11	62	1 332	—	—	—	—
	T	—	1	—	535	3	8	28	1 752	2	11	64	1 358	—	—	—	—
Jul. 1971	Q	—	—	—	—	1	1	36	639	7	8	47	1 653	—	—	—	—
	T	—	—	—	—	2	1	55	1 080	8	8	48	1 784	—	—	—	—
Sept. 1971	Q	3	4	7	7 507	1	15	18	1 619	10	6	8	1 551	—	—	—	—
	T	3	4	7	7 507	1	15	21	1 640	10	9	25	1 851	—	—	—	—
Oct. 1971	Q	—	—	4	120	3	10	111	2 491	6	12	75	2 000	—	—	—	—
	T	31	6	11	56 829	41	53	893	23 066	55	50	319	11 983	—	1	12	—
Nov. 1971	Q	13	17	64	33 362	9	10	77	4 101	16	13	27	2 619	8	—	10	—
	T	37	63	141	101 538	19	31	167	9 470	84	78	469	18 121	34	15	83	—
Jan. 1972	Q	—	3	5	1 755	—	—	—	—	3	2	27	753	—	—	—	—
	T	23	100	138	97 177	—	2	397	2 937	37	11	100	5 972	10	18	30	—
Mar. 1972	Q	80	57	23	168 705	—	2	8	214	31	9	20	4 200	1	—	1	—
	T	102	75	35	216 513	—	2	8	214	34	9	20	4 557	2	—	1	—
Total	Q				211 984				9 099				14 494				
Total	T				480 099				40 159				46 012				

Ad. = Adult; Sub-ad. = Sub-adult; Juv. = Juvenile; Q = Quantitative; T = Total; S = Sub-total

TABLE 4

CONVERSION FACTORS FOR EQUATING NUMERICAL COUNTS WITH APPROXIMATE *Acartia* EQUIVALENTS (BY DRY WEIGHT 105 °C)

Species			*R. terranatalis*			*G. brevifissura*			*M. africana*		
Age group	*Acartia*	*P. hessei**	*Adult*	*Sub-adult*	*Juv.*	*Adult*	*Sub-adult*	*Juv.*	*Adult*	*Sub-adult*	*Juv.*
Conversion factor	1,0	4,0	1 719	535	30	308	79	7,0	119	29	12,5

* A 5 per cent egg-carrying population

observations at Station 2 did not reveal any abundance of burrows on the floor of the estuary, into which either of these two species might have moved. The difference between the 0800h and 0815h samples is probably largely due to the former being from the shallow water over the sand bank at Station 2, while the latter was taken in the channel.

No clear distribution pattern was discernible for *R. terranatalis*. Largest numbers were, however, always encountered at Station 2. The fourth important mysid, *M. slabberi*, was collected for the first time in the October samples. It appeared to have a distribution similar to that of *M. africana* within the estuary, but numbers were too few, and good catches too infrequent, to confirm this.

Both the juvenile and adult numbers of *G. brevifissura* reached their maximum in October–November (Table 3), indicating a single major brood. There were also juvenile peaks in July and January, indicating the possibility of three broods as was found by Grindley (personal communication) for this species in the Swartkops estuary, and by Hodge (1963), for *Gastrosaccus dakini*, in the Brisbane estuary. Two such peaks were noted for *R. terranatalis*, during November 1971 and March 1972. This species was however, not present in any great numbers during the first half of the study period. Although some peaks were observed in juveniles and adults of *M. africana*, this species maintained itself at a high level throughout the study period, indicating multiple broods. The closely related, larger *M. slabberi* was only present in four sets of samples with a peak in November. Unfortunately no samples were collected during December.

TABLE 5

PRINCIPAL MYSIDACEA IN SOUTH AFRICAN ESTUARIES, EXTRACTED FROM O. S. TATTERSALL (1952)

	PRINCIPAL SPECIES					
Estuary	*R. terranatalis*	*G. brevifissura*	*G. gordanae*	*Mesopodopsis africana*	*M. slabberi*	*Mysidopsis similis*
St. Lucia	—	8	20	346 + 'many'	—	—
Richards Bay	2	3	—	85	—	—
Umzimvubu	—	—	—	1	—	—
Umgazi	—	—	—	200–300	—	—
Haven lagoon	—	—	—	2	—	—
Umbanyana (Haven)	—	1	—	—	100 +	—
Bashee	—	—	—	—	2	—
Keiskama	—	16	—	79 + hundreds	—	—
Sundays	31	46	—	—	26 +hundreds	—
Knysna	14	—	—	1	—	—
Klein River	357	—	11	—	—	—
Langebaan	1	96	—	—	—	26
Berg River	present	—	—	—	—	—

DISCUSSION

During an extensive study of the ecology of South African estuaries, conducted by the Zoology Department of the University of Cape Town under the leadership of Professor J. H. Day, many Mysidacea were collected. The majority of these were identified and described by O. S. Tattersall (1952). In this paper, numbers of the different species collected from a number of estuaries were recorded. These are presented in Table 5. From this table it can be seen that the four most important species of mysid in the University of Cape Town collections, were the same four found to be important in the Mtentu estuary during the present study. Estuarine populations differed markedly from the offshore populations recorded by O. S. Tattersall (1962).

In the Swartkops estuary, Grindley (personal communication) found *G. brevifissura* to be more abundant in the upper estuary, although present throughout the year virtually throughout the estuary. This upper estuary dominance was opposite to what was apparently the case in the Mtentu estuary. It was also apparent that during the period of study in the Swartkops estuary (1967/68), *G. brevifissura* was the dominant mysid, with *Mesopodopsis africana* more sporadic and scattered in its representation in the estuary (Grindley personal communication). The data indicated the sensitivity of both species to salinity drops within the estuary, due to heavy rains in the catchment. This may have a bearing on the present study since the year during which the Mtentu estuary was studied was unusually wet, affecting mysid populations in the estuary. It is possible that this resulted in generally suppressed mysid populations.

The wide range of feeding habits of mysids, coupled with their medium size, makes them important links in the estuarine food web since they utilize various grades of material and provide food for a wide range of fish (Green 1968). It is of interest to note that Ivanov (1972) and other workers have recorded the importance of mysids in freshwater fish production, and Ivanov found that addition of the freshwater mysids *Mesomysis kowalevskyi* and *Limnomysis benedeni* to seasonal fish ponds increased fish production (carp, grass carp and *Hypophthalmichthys* spp.) by 150–200 kg/ha (20%).

In the final analysis, the importance of the mysids to the estuary lies in their contribution to the volume of zooplankton standing crop. No assessment was made of the plankton volume of quantitative samples in this study. However, by dry weight (104°C) conversion factors were calculated for equating, approximately, the biomass contribution of each species to the total sample (Tables 4 and 5). From these it was apparent that, together with two species of calanoid copepod, namely *Pseudodiaptomus hessei* and *Acartia* (*Acartiella*) *natalensis* (Connell & Grindley in press), mysids contributed most significantly to the zooplankton standing crop. A summary of the data is given in Table 6. Amongst the mysids themselves *R. terranatalis* was the major contributor, followed by *M. africana* and *G. brevifissura* (Table 3). Due to a lack of specimens conversion factors for *M. slabberi* were not calculated, but it was evident from some of the present samples and from the data of O. S. Tattersall (1952) that this species was of major importance.

There are few quantitative studies recorded in the literature in which the contribution of mysids to the zooplankton biomass of estuaries has been recorded. Cronin *et al.* (1962) found that the zooplankton of Delaware estuary, sampled over a two-year period, was dominated by an amphipod *Gammarus fasciatus*, contributing 54% by volume, while *Acartia tonsa* contributed 22%. Two species of *Eurytemora* (another calanoid copepod) contributed 7% by volume and the mysid *Neomysis americana* 6%.

Haertel & Osterberg (1967), studying the Columbia River estuary, found that the zooplankton of brackish marine waters was dominated numerically by the calanoid copepods *Acartia clausi*, *A. longiremis* and *Pseudocalanus minutus*, with other calanoid and cyclopoid copepods and the cladoceran *Evadne nordmanni* seasonally abundant. Yet one of the most important food sources for fish in this zone of the estuary, evidenced by stomach contents of fishes, was the mysid *Archaeomysis grebnitzkii*. However, suspended sand near the bottom in this part of the estuary prevented the use of a plankton net near the bottom where this mysid was possibly abundant. In analyses of stomach contents of various fish, data were supplied on an average per volume basis, and six groups were important. These were Copepoda, Amphipoda, Mysidacea, Decapoda, Polychaeta and fish. Mysidacea were apparently more abundant in the stomach contents than encountered in plankton samples, possibly indicating selective feeding. Four species of mysid were recorded in plankton samples but only seasonal presence/absence data were provided (Haertel & Osterberg 1967). It is apparent from the above that although not particularly abundant numerically, mysids played an important role as a food source for the many fish species using the Columbia River estuary as a nursery ground.

Samples taken during the present study indicated that mysids were common in the Mtentu estuary and dominant contributors to zooplankton biomass. Data collected from quantitative samples and corrected for biomass contribution are given in Table 6, showing mysid contribution compared with that of *P. hessei* and *A. natalensis*. It is probable therefore that they are of importance as a food source in the Mtentu estuary, and in other tidal east coast estuaries of South Africa as well. A list of fish species dependent to a greater or lesser degree upon estuaries, especially

TABLE 6

THE BIOMASS CORRECTED CONTRIBUTIONS TO THE QUANTITATIVE SAMPLES OF THE THREE IMPORTANT COMPONENTS OF THE ZOOPLANKTON IN THE MTENTU ESTUARY

Sampling date	*Acartia natalensis*	*Pseudodiaptomus hessei**	*Mysidacea**
27. 3.71	57 303	12 012	386
28. 5.71	7 693	3 500	1 902
8–9.7.71	56 160	191 120	2 292
6. 9.71	128	13 512	10 677
6.10.71	6 851	435 720	4 611
5.11.71	3 129	83 992	40 082
3. 1.72	564 300	19 032	2 508
17. 3.72	3 540	100 720	173 119
Total	699 104	859 608	235 577

* Data from Table 5.

as a relatively safe, rich nursery ground which the juveniles invade each year, is given by Heydorn (1973). Although little is known of the specific feeding habits of these juveniles in the estuary, evidence from other studies of selective feeding on low mysid populations, adds substance to the probable importance of mysids in South African east-coast estuaries where they contribute to a greater extent to the standing crop of zooplankton.

ACKNOWLEDGEMENTS

The author is grateful to the Director of the National Institute for Water Research for permission to publish this paper, and to Mr. Hyde, Secretary for Agriculture and Forestry of the Transkeian Government, for permission to collect samples of plankton and fish from the estuary.

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