Euryhaline zooplankton of the Sundays estuary and notes on trophic relationships

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The euryhaline component of the zooplankton in the Sundays River estuary was sampled monthly at 10 stations from August 1979 to April 1981. In deeper regions surface and near-bottom samples were taken (Stations 1 – 7) using WP2 nets. Shallow (< 2,0 m) stations were sampled in surface waters only. Water temperature ranged between 14 – 27 °C. A full salinity gradient was present and salinity stratification was well developed. *Acartia longipatella* was most abundant during winter and spring (maximum 73 300 m^{-3}) in the lower estuary. The interaction of temperature and salinity as factors regulating temporal and spatial distribution was evident, these factors also interacting in the water column owing to stratification. The pioneer copepod species, *Pseudodiaptomus hessei*, attained high abundance following floods or increased river inflow. Three species of mysid shrimps were common in the plankton in summer, each species showing clear zones of maximum distribution. Zooplankton standing stock (dry mass) ranged from < 10 mg m^{-3} to 1 450 mg m^{-3} in surface samples and < 10 mg m^{-3} to 8 275 mg m^{-3} in bottom samples. Contribution of mysids to standing stock was rarely less than 70% and often exceeded 90%. Differences in standing stock between surface and bottom samples were owing to behavioural differences between the zooplankton species, particularly the mysids. Behavioural adaptations play an important role in the retention of the indigenous zooplankton in the estuary. Aspects of trophic relationships are discussed and demonstrate the significance of the zooplankton in the transfer of energy to higher trophic levels in this estuary.

S. Afr. J. Zool. 1982, 17: 151 – 163

Die euryhalienkomponent van die soöplankton in die Sondagsgetyrivier is maandeliks gemonster by 10 stasies gedurende die periode Augustus 1979 tot April 1981. Oppervlakte- en bodemmonsters (Stasies 1 – 7) is in die dieper gedeeltes geneem met WP2-nette. Slegs die oppervlaktewater is gemonster in die vlakker (< 2,0 m) gebiede. Watertemperatuur het gewissel tussen 14 – 27 °C. 'n Volledige soutgehaltegradiënt was teenwoordig en soutgehaltestratifikasie was goed ontwikkel. *Acartia longipatella* was die volopste gedurende die winter en lente (maksimum 73 300 m^{-3}) in die laer getyrivier. Die interaksie van temperatuur en soutgehalte as reguleringsfaktore vir temporale en ruimtelike verspreiding, is duidelik. Hierdie faktore funksioneer ook in die waterkolom as gevolg van stratifikasie. Die pionier-Copepoda-spesie, *Pseudodiaptomus hessei* was baie volop na vloede of toenemende afloop van die rivier. Drie Mysidacea-spesies was volop gedurende die somer in die plankton. Elke spesie toon duidelike sones van maksimale distribusie. Die biomassa (droë massa) van die soöplankton varieer van < 10 mg m^{-3} tot 1 450 mg m^{-3} in oppervlaktemonsters en van < 10 mg m^{-3} tot 8 275 mg m^{-3} in bodemmonsters. Die bydrae van die Mysidacea-spesies tot die biomassa was selde minder as 70% en dikwels meer as 90%. Verskille in biomassa tussen oppervlakte-en bodemmonsters was die gevolg van die gedragsverskille tussen die soöplankton-spesies, in besonder die Mysidacea. Gedragsaanpassings speel 'n belangrike rol in die behoud van die inheemse soöplankton in die getyrivier. Aspekte van die trofiese verwantskappe word bespreek wat die rol van die soöplankton in die energie-oordrag na hoër trofiese vlakke in hierdie getyrivier toelig.

S.-Afr. Tydskr. Dierk. 1982, 17: 151 – 163

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Received 31 March 1982; accepted 30 June 1982

Recent studies on the nocturnal distribution of estuarine zooplankton relative to tidal currents in the Sundays River estuary demonstrated that zooplankton was behaviourally active, rather than passive as generally conceived and not equably distributed in the water column. Patterns of behaviour varied between species and even between different age classes within a species (Wooldridge & Erasmus 1980). In addition, an exceptionally high zooplankton standing stock was present, owing largely to mysid shrimps. Previous work on estuarine zooplankton in southern Africa has shown that although mysids may be numerically abundant at times, they are usually dominated by copepods (Grindley 1981). This is the case in the neighbouring Swartkops estuary, where much of the earlier work was done (Grindley 1970, 1974, 1981; Connell *et al.* 1976; Wooldridge & Melville-Smith 1979; Melville-Smith & Baird 1980).

The complex patterns of zooplankton behaviour and the prominence of mysids in the Sundays estuary resulted in the present study and forms part of a wider investigation on the dynamics and role of zooplankton in eastern Cape estuaries. Because they are not sampled efficiently, mysids are often overlooked. Thus particular attention was directed towards sampling methodology during the present programme. Other aspects investigated include the effects of river discharge and aspects of trophic relationships.

Little data are available on zooplankton in this estuary, the only published work being that of Wooldridge & Melville-Smith (1979). Until recently, the estuary was regarded as supporting an impoverished fauna (see Day 1981).

Study area and Methods

Description of the estuary and sampling sites

The Sundays River estuary is incised in a broad plain which represents a thick accumulation of silt during the late Cainozoic period (Ruddock 1968). Near the sea the silt deposits pass beneath a broad accumulation of dune sand. On the western side and bordering the estuary these dunes attain a width of 3 km; on the eastern side dune sand is only evident near the mouth. Further eastwards these coastal dunes rapidly increase in width and stretch for a further 43 km around Algoa bay.

The estuary is 21 km in length and may be described as channel-like along its entire length. No extensive sand- or mud-flats are present, except near the narrow mouth where numerous sandbanks are exposed at low tide. Just inside the mouth the estuary is 800 m in width but decreases to 350 m within 1 km and to 180 m within 2 km. It becomes progressively narrower upstream and at the upper limit of tidal influence it is about 20 m in width. Further upstream the river passes through a region of intensive cultivation which probably contributes to the generally high nutrient levels (particularly nitrate) recorded in the estuary (Watling 1981). Tidal exchange is dynamic and relatively strong tidal currents occur (Wooldridge & Erasmus 1980). Tidal range at spring tide is about 1,5 m near the mouth and *ca.* 0,75 m near the head of the estuary.

Above the mouth the banks of the estuary are steep and are often vertical for long distances above the high water level. In places they may exceed 10 m in height. The intertidal zone is narrow and is mostly less than 5 – 6 m in width.

Ten sampling stations were chosen from the mouth to the upper limit of tidal influence (Figure 1). The depth at LWST varied from 2 m at Station 1, to 6 m at Station 2, 3 – 4 m at Stations 3 – 4 and 4 – 6 m at Stations 5 – 7. Above Station 7 the estuary is shallow and is generally less than 2 m in depth.

During the period of study the intertidal zone below Station 7 was devoid of macrophyte vegetation. Subtidally, small patches of eel-grass *Zostera capensis* were located in the blind arm of the estuary adjacent to Station 1.

Benthic algae (*Bryopsis* sp. or *Derbesia* sp.) were conspicuous in the intertidal zone between Stations 5 – 8. Above this region a dense but narrow band of *Phragmites australis* occurs along the western shore extending well beyond Station 10. In the uppermost regions patches of *Potamogeton pectinatus* also occur.

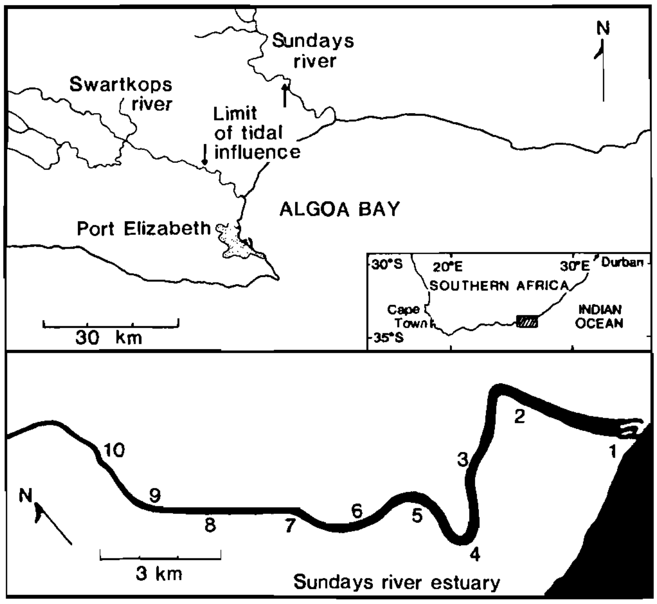

Figure 1 Map of the Sundays River estuary and location of the sampling stations.

Sampling methods

Monthly samples taken at 10 stations (Figure 1) continued over 21 months beginning in late winter of 1979 (August) and terminating in early autumn 1981 (April).

Two WP2 plankton nets (57-cm diameter and mesh of 190 μm aperture size) were used simultaneously at Stations 1 – 7. Each net was connected to a 1-m boom fixed on either side of the bow of a flat-bottomed boat; one net sampled just below the water surface and the other between midwater and the substrate. The net sampling bottom waters was held at the required depth using a pole operated by a worker on the boat. Each net was fitted with a Kahlsico 005 WA 130 flowmeter (equidistant from the centre and rim) so that all data are quantified. The shallow upper region of the estuary (Stations 8 – 10) made it impracticable to sample bottom waters.

Sampling commenced about half an hour after dark beginning in the uppermost reaches and when the ebb tide was well progressed. Lower stations were occupied around low slack water, the series taking about 2 h to complete. During sampling an oblique course was followed across the channel of the estuary and this allowed for variation in lateral distribution patterns of the organisms.

Nets were towed for a maximum of 3 min at approximately 2 – 3 knots. Flowmeter readings were then noted. At each station, surface and bottom temperature and salinity data were recorded.

Laboratory methods

Zooplankton composition and abundance (numbers m^{-3}) for each level and at each station were determined by subsampling. The number of subsamples varied between three and five in the case of mysid shrimps and one to three in the case of other organisms including eggs and larvae of the clupeid, *Gilchristella aestuarius*.

The copepod *Pseudodiaptomus hessei* was divided into a number of classes: mature males, ovigerous females, nonovigerous females and juveniles. Nauplii larvae are excluded since this component was not efficiently sampled due to aperture size of the mesh used.

Mysids were examined under a stereo microscope fitted with an eyepiece micrometer, measured (anterior tip of carapace to posterior tip of telson, excluding spines) and separated into seven classes which relate to the degree of sexual maturity. These classes are based on those described by Mauchline (1967, 1973):

(i) Juveniles — secondary sexual characteristics not developed
(ii) Immature males
(iii) Immature females
(iv) Females with developing young in the brood pouch, separated into 'eyeless' and 'eyed' larvae
(v) Females with rounded embryos
(vi) Females with empty marsupia; young released
(vii) Mature males

The number of larvae in marsupia of all brooding females in subsamples was also recorded.

Dry mass (60 °C for 24 h) of different stages of copepods was determined by batch weighing and converted to standing stock per m^3.

Mysid standing stock was calculated after determining the relationship between mass and length, obtained by regressing $\log_{10}$ (dry mass) on $\log_{10}$ (length). Mass of a developing larva from brooding females was obtained by the same method used for copepods.

Total mysid standing stock for each of the species at surface and near-bottom for each station was derived by the following method: the length of each individual in subsamples for each class (mature males; females with empty marsupia, with rounded embryos, with well-developed embryos; immature males and females, and juveniles) was entered into a Burroughs B6800 computer. Using the specific regression equation, the calculated mass of the individual was raised to a value which represented the individual as a fraction of the total number of animals m^{-3} for that class. All data were summed, including details pertaining to brood mass and expressed as total standing stock in mg m^{-3}.

Aspects of trophic relationships were also investigated and were largely directed towards the dominant mysid species, *Rhopalophthalmus terranatalis* and the most common fish species taken in plankton tows, *Gilchristella aestuarius*. The data represent food consumed during early evening and do not take into account variation which may occur during a 24-h period.

Specimens used for gut content analysis were randomly taken from samples collected during different seasons and from different regions of the estuary. In the case of mysids the gut contents of animals from the various size classes was extruded on to a glass slide and examined under 40 × magnification. Fish were grouped into size classes — in the case of *Gilchristella aestuarius* four classes, (15 – 30 mm total length (TL); 31 – 45 mm TL; 46 – 60 mm TL and > 60 mm TL), were recognized. The frequency of occurrence of each food item in each size class was then expressed as a percentage contribution. These data are not presented quantitatively, but are used to establish feeding patterns at the time of sampling.

Results

Results are presented for every month of study for different regions in the estuary, the stations in each region grouped as follows: Station 1, Stations 2 – 3, Stations 4 – 5, Stations 6 – 7 and Stations 8 – 10. Data represent the mean for the particular group of Stations at each level (surface and near-bottom).

Temperature

Recorded temperatures (Figure 2) revealed relatively small changes (generally less than 2 °C) between surface and bottom waters. Maximum water temperatures (> 26 °C) were recorded in mid- to late-summer (January – March). Thereafter a marked drop was evident with lowest temperatures around 14 °C in June-July. A temperature gradient was evident during the summer, with cooler temperatures nearer the mouth associated with the modifying influence of the sea.

Salinity

Flooding or increased freshwater inflow was frequently evident during the period of study and accounted for large changes in salinity between sampling occasions as well as significant differences in salinity between surface and bottom waters (Figure 3). These vertical differences were most prominent in the deeper parts of the estuary between Stations 2 and 7.

Flooding occurred in mid-July 1979, two weeks prior to the commencement of the programme and resulted in vertical differences > 20‰ in the middle estuary.

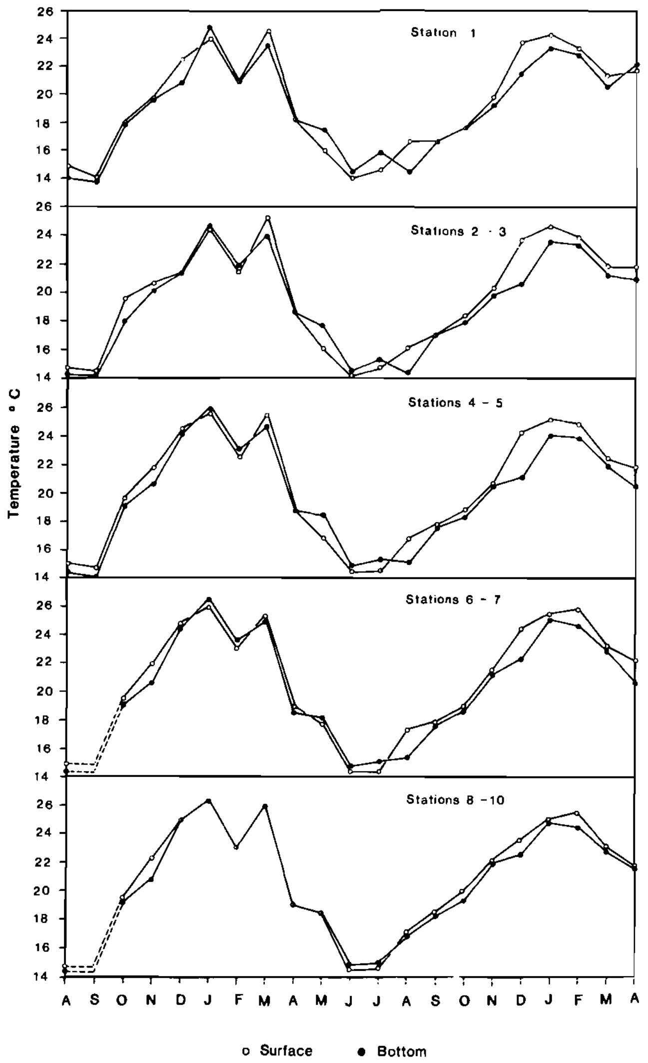

Figure 2 Recorded temperatures (°C) in surface and bottom waters for different regions in the Sundays River estuary. Sampling monthly from August 1979 to April 1981.

Flooding again occurred in mid-August and in September 1979 accounted for recorded salinities of less than 5‰ above Station 4. A period of recovery followed with bottom salinities in November below Station 5 reaching 25 – 30 ‰. Recovery of surface salinities was considerably slower and resulted in vertical differences of up to 20‰ in the middle estuary. At the uppermost stations (8 – 10) both surface and bottom salinity remained below 5‰.

Strong freshwater inflow and vertical mixing in December 1979 resulted in a sharp decrease in bottom salinity in the middle regions, eg. from 21‰ (Nov.) to 2,5‰ (Dec.) at Stations 6 – 7.

Salinity stratification increased during the early part of 1980 and differences of 15 – 20‰ were recorded in March (Stations 4 – 5) and in April (Stations 6 – 7). In June differences had increased to *ca.* 12‰ at the uppermost stations, with a value of 20‰ recorded in bottom waters.

During the following late winter and spring months the salinity above Station 2 decreased near the bottom. Low salinities were most marked at the uppermost stations.

Flooding occurred in December and resulted in a sharp decrease in surface salinity throughout the estuary. At Station 1 a reading of 13‰ was recorded, decreasing pro-

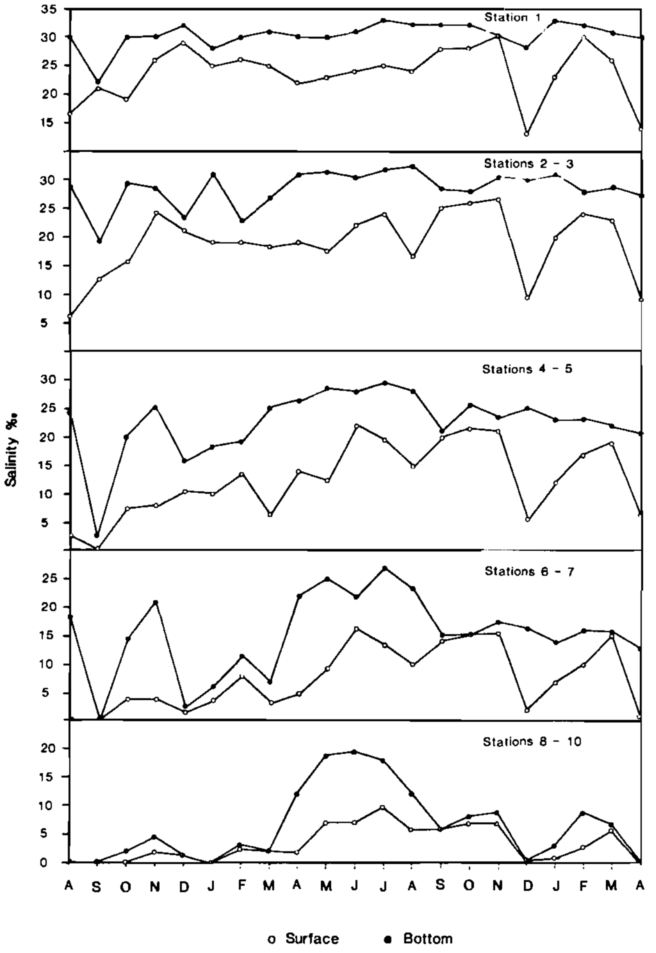

Figure 3 Recorded salinity (‰) in surface and bottom waters for different regions in the Sundays River estuary. Sampling monthly from August 1979 to April 1981.

gressively up the estuary (<2‰ at Stations 8 – 10). Except for these upper stations, bottom waters were only slightly affected and remained around 30 – 35‰ below Station 3, around 25‰ at Stations 4 – 5 and around 15‰ at Stations 6 – 7.

Surface salinity increased markedly during early 1981. Flooding again occurred in April, the final month of sampling and values were similar to those recorded in December at corresponding stations.

Distribution of the copepods

Succession of *Acartia longipatella* and *A. natalensis* (Figure 4) reflected the pattern previously described for eastern Cape estuaries (Wooldridge & Melville Smith 1979; Baird *et al.* 1981), although *A. natalensis* does not become well established in the Sundays estuary. It was present during the second summer only, appearing in February samples at Stations 6 – 7 and spreading downstream. Maximum numbers (1 063 m^{-3}) were recorded in March at Station 5.

A. longipatella was numerically the most abundant copepod in the estuary. Following the floods in August 1979, *A. longipatella* appeared in the plankton in October. Accession started at Stations 2 – 3 and reached maximum abundance of 18 100 (surface sample) and 18 700 m^{-3} (bottom sample) in January at Station 1. It was not recorded above Station 5 during this time. Thereafter numbers decreased during the remaining parts of the summer and only began increasing again with the approach of autumn.

Above Station 6, *A. longipatella* was present only during the cooler months (April – November). Highest numbers in this region were recorded in September (30 700 m^{-3} at Station 6). Towards the mouth *A. longipatella* became increasingly more abundant and was present during summer and winter. Highest numbers however, were recorded during spring and early summer; 57 500 m^{-3} in bottom waters in November at Station 3 and 73 300 m^{-3} in bottom waters in December at Station 1. On the latter occasion *A. longipatella* was not recorded in surface samples in any region of the estuary. Thereafter numbers declined at all stations with highest abundance generally occurring in bottom waters.

Pseudodiaptomus hessei (Figure 4) was numerically the second most important copepod and was present during all seasons in the estuary. Severe flooding in July and in August 1979 resulted in their apparent absence from the system until October when numbers began to increase rapidly. The recovery was most marked at Stations 4 – 7 and by November numbers had increased to 15 400 m^{-3}

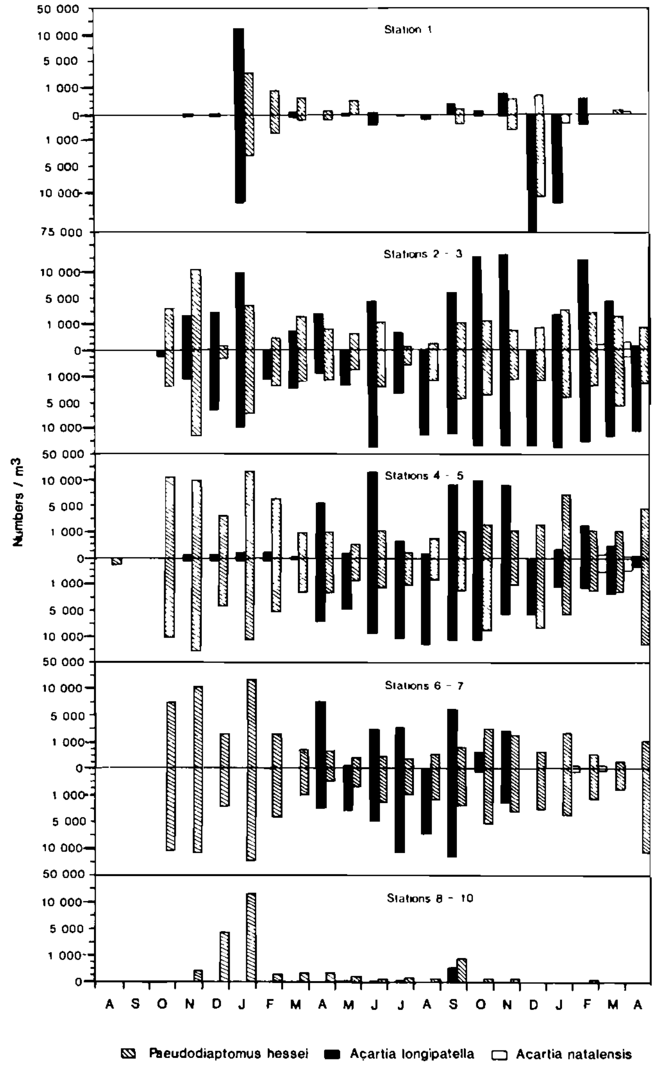

Figure 4 Abundance (m^{-3}) of *Pseudodiaptomus hessei, Acartia longipatella* and *A. natalensis* in surface and bottom waters for different regions in the Sundays River estuary. Sampling monthly from August 1979 to April 1981.

(surface sample) and 27 200 m^{-3} (bottom sample) at Station 4. By December numbers had decreased to less than 6 000 m^{-3} at all stations. Numbers again increased and in January maximums of 22 800 m^{-3} (surface) and 30 300 m^{-3} (bottom) at Station 6 were recorded. Thereafter numbers declined throughout the estuary and generally remained below 2 500 m^{-3} until the following spring. In October 3 300 m^{-3} (surface) and 13 800 m^{-3} (bottom) were recorded at Station 5. Numbers declined in November (less than 4 500 m^{-3} at any station) but increased in December to 1 800 m^{-3} and 15 500 m^{-3} (surface and bottom sample respectively) at Station 5 and 13 000 m^{-3} and 8 900 m^{-3} in January at Station 4. Numbers declined in February and March with a maximum of 6 800 m^{-3} in bottom waters at Station 2, but had increased markedly by the time stations were occupied in April. For example, 33 500 m^{-3} were recorded in bottom samples at Station 5 (5 500 m^{-3} in surface sample) and 22 500 m^{-3} at Station 6 respectively (2 100 m^{-3} in surface sample).

Distribution of the mysids

Three species of mysid shrimps were common in the estuary and showed clear patterns of temporal and spatial distribution (Figure 5). *Gastrosaccus brevifissura* was only occasionally present above Station 4, exceeding 10 m^{-3} once only (29 m^{-3} in September 1980; bottom sample at Station 5). It was most abundant during the late spring and mid-summer at Station 1, attaining 1 350 m^{-3} in November 1979 in the surface sample and 500 m^{-3} in the bottom sample. During the autumn and winter months it was generally absent in the plankton.

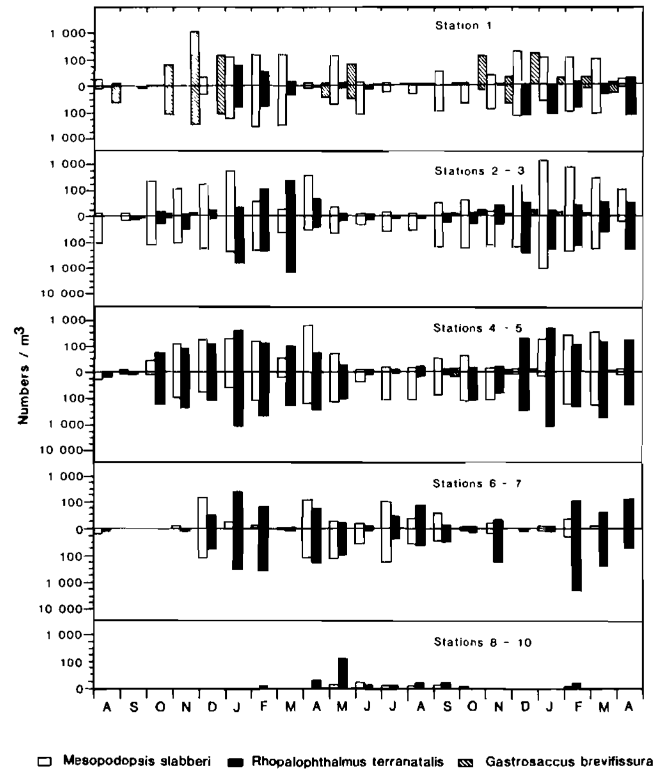

Figure 5 Abundance (m^{-3}) of *Gastrosaccus brevifissura, Mesopodopsis slabberi* and *Rhopalophthalmus terranatalis* in surface and bottom waters for different regions in the Sundays River estuary. Sampling monthly from August 1979 to April 1981.

Mesopodopsis slabberi was present throughout the estuary during all seasons, but was most abundant during spring and summer and at Stations 2 – 3 (Figure 5). Following flooding in July and August 1979, low numbers were recorded, particularly in surface samples. In October, numbers increased to 550 m^{-3} and 270 m^{-3} (surface and bottom respectively) at Station 2. Their abundance increased generally during spring and summer with a maximum of 1 100 m^{-3} (surface) and 650 (bottom) in January at Station 2 and in April between Stations 3 – 5. On the latter occasion the respective values in surface and bottom samples were: at Station 3, 850 m^{-3} and 100 m^{-3}; at Station 4, 550 m^{-3} and 150 m^{-3}; at Station 5, 950 m^{-3} and 325 m^{-3}. Numbers declined during winter with a maximum in July at Station 6 (100 m^{-3} and 300 m^{-3} in the surface and bottom samples respectively).

The recorded pattern was repeated during the following spring and summer with a maximum in January at Stations 2 and 3; 650 m^{-3} (surface) and 1 200 m^{-3} (bottom) at Station 2 while at Station 3 the values were 1 900 m^{-3} and 900 m^{-3} (surface and bottom). In February 1 200 m^{-3} and 450 m^{-3} organisms were recorded in surface and bottom samples at Station 3.

Rhopalophthalmus terranatalis, the largest mysid encountered in southern African estuaries, was extremely abundant in the Sundays. The seasonal pattern was similar to that of *M. slabberi* but highest densities generally occurred higher up the estuary at Stations 4 – 5 (Figure 5).

Relatively low numbers were recorded in the initial stages of the project following flooding, but numbers increased rapidly from October at Station 5 and particularly in bottom waters (surface sample, 100 m^{-3} and bottom sample, 300 m^{-3}). By November numbers had increased to 100 m^{-3} (surface sample) and 500 m^{-3} (bottom sample) at the same station. High densities were recorded in Janaury at Station 3 (surface sample, 6 m^{-3} and bottom sample, 1 200 m^{-3}), at Station 5 (surface sample, 750 m^{-3} and bottom sample 2 075 m^{-3}) and at Station 6 (surface sample, 675 m^{-3} and bottom sample, 1 000 m^{-3}). Peak numbers were recorded in March at Station 2 (surface sample, 500 m^{-3} and bottom sample 4 100 m^{-3}) followed by a rapid decline towards the end of summer. Throughout the cooler months (May to September) numbers did not exceed 150 m^{-3} in any sample.

The pattern was repeated during the subsequent spring and summer. Population numbers had increased to 300 m^{-3} (surface sample) and 2 000 m^{-3} (bottom sample) in January 1981 and peaked in February at Station 6 (surface sample 175 m^{-3} and bottom sample 2 700 m^{-3}) and at Station 7 (surface sample 50 m^{-3} and bottom sample 3 500 m^{-3}). In April numbers did not exceed 475 m^{-3} in any sample.

Distribution of eggs and larvae of *Gilchristella aestuarius*

Data pertaining to the distribution of eggs and larvae of *Gilchristella aestuarius* in the estuary are given in Figure 6. These were present in the plankton from October through April with the highest numbers during the early to mid-summer months. During the first summer a maximum of 1 800 eggs m^{-3} and 2 250 larvae m^{-3} were recorded in November at Station 7 in the bottom sample; corresponding values in surface waters were zero and 100

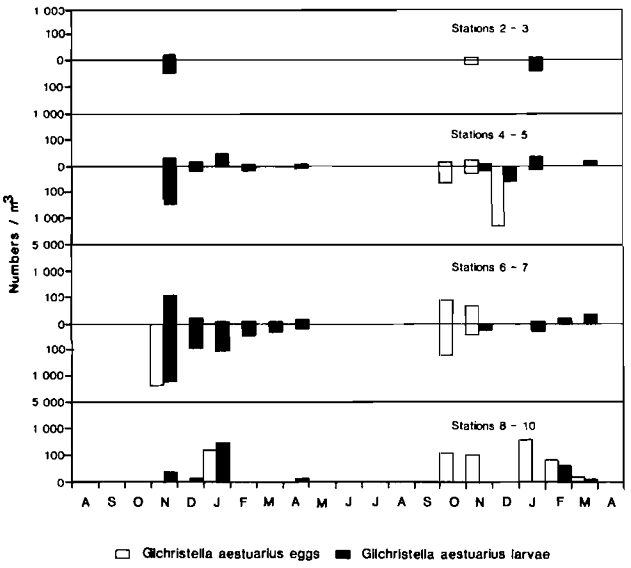

Figure 6 Abundance (m^{-3}) of eggs and larvae of *Gilchristella aestuarius* in surface and bottom waters for different regions in the Sundays River estuary. Sampling monthly from August 1979 to April 1981.

m^{-3} respectively. During the remaining summer months eggs were recorded on one occasion only above Station 7. Larvae, however, were more generally recorded and usually in greater abundance in bottom waters.

In the spring and summer of 1980 – 81 *Gilchristella* eggs were more regularly taken in the plankton, particularly at the upper stations. Highest numbers were recorded in December near the bottom at Station 5 (3 500 m^{-3}). No eggs were taken in surface samples. In January 1 200 eggs m^{-3} were recorded at Station 10. Larvae were less abundant in the plankton compared to the previous season and did not exceed 150 m^{-3} (Station 9 in February).

Zooplankton standing stock

Contribution of copepods to zooplankton standing stock was calculated from data presented in Table 1. Mysid standing stock was calculated from the relationships between length and mass of the different species and are given below.

The relationship between length and mass for *Gastrosaccus brevifissura* was:

$\log_{10}$ Mass (mg) = 3,15 $\log_{10}$ L (mm) − 2,8258,
$r = 0{,}97$; $P < 0{,}005$ and $n = 51$.

For *Mesopodopsis slabberi* the relationship was:

$\log_{10}$ Mass (mg) = 2,87 $\log_{10}$ L (mm) − 2,7846,
$r = 0{,}99$; $P < 0{,}005$ and $n = 57$,

and for *Rhopalophthalmus terranatalis:*

$\log_{10}$ Mass (mg) = 2,81 $\log_{10}$ L (mm) − 2,6975,
$r = 0{,}99$; $P < 0{,}005$ and $n = 61$.

Copepod and mysid standing stock in surface and bottom waters are given in Figures 7 and 8 respectively. These data are summarized in Figure 9 which records mean standing stock for the two groups in the water column as well as their total contribution. Tabulated data refer to different regions in the estuary while data given below refer to specific stations.

Of the copepods *Pseudodiaptomus hessei* was the most important contributor, the peaks closely following on

Table 1 Dry mass (μg) of single individual copepod zooplankters used to calculate total copepod standing stock

Species	Mass in μg	S.D.
Acartia natalensis	1,65	0,40
Acartia longipatella	3,45	0,43
Nauplii larvae	0,24	0,11
Oithona spp.	0,74	0,16
Pseudodiaptomus hessei		
Mature males	8,43	0,97
Ovigerous females	22,48	0,96
Non-ovigerous females	16,39	1,52
Juveniles (late copepodid stages)	5,70	2,26
Tortanus capensis	35,15	3,46

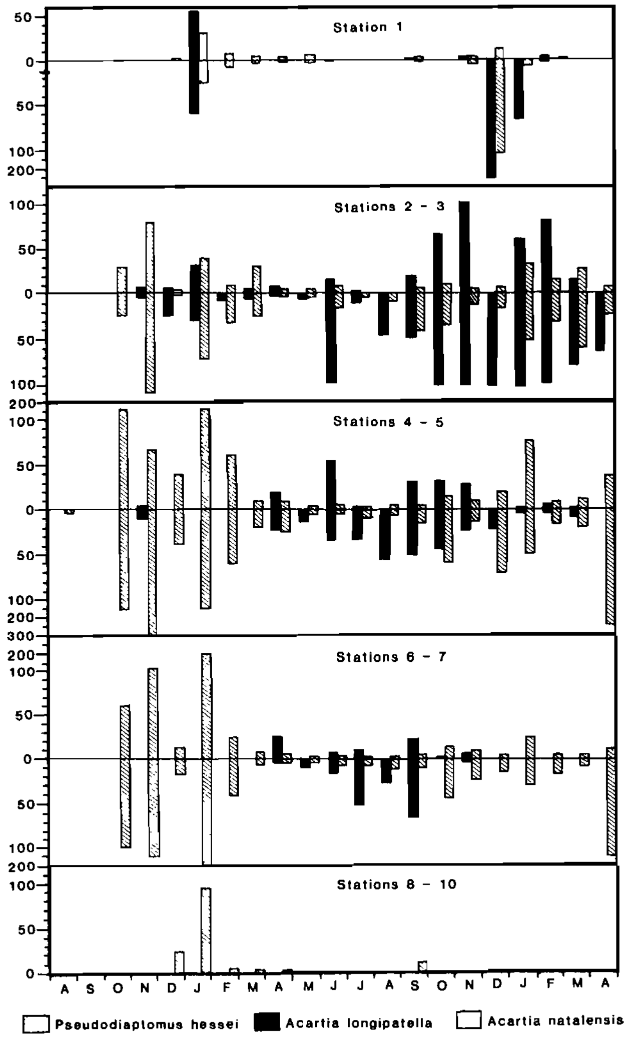

Figure 7 Copepods standing stock (dry mass) from August 1979 to April 1981 in different regions of the Sundays River estuary. Data for surface and near-bottom sample in mg m^{-3} of water. Minimum standing stock indicated: 1,0 mg.

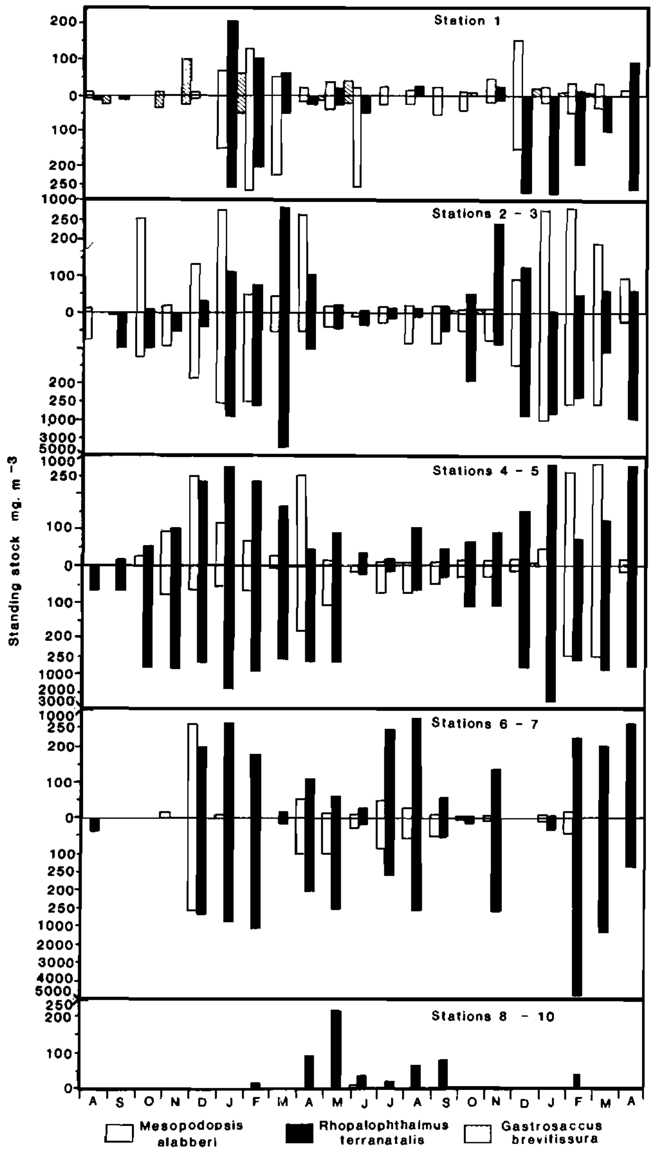

Figure 8 Mysid standing stock (dry mass) from August 1979 to April 1981 in different regions of the Sundays River estuary. Data for surface and near-bottom sample in mg m^{-3} of water. Minimum standing stock indicated: 1,0 mg.

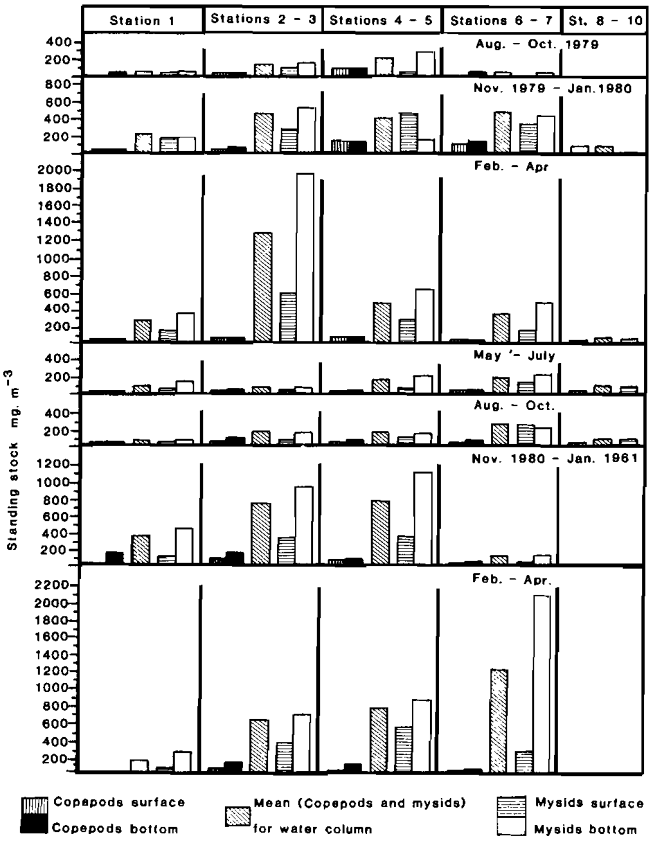

Figure 9 Contribution of copepods and mysids to zooplankton standing stock (mg m^{-3}) in surface and near-bottom waters in different regions of the Sundays River estuary. The sums of the respective standing stock means (copepods + mysids) are also given and represent the mean standing stock for the water column. Original data are from Figures 7 and 8 grouped at three-monthly intervals beginning August – November 1979 (late winter – spring) and terminating February – April 1981 (mid-summer – early autumn).

floods or increased river discharge into the estuary. For example maximums of 328 mg m^{-3} and 312 mg m^{-3} were recorded in November 1979 in bottom waters at Station 5 and 4 respectively. Corresponding surface values were 13 and 121 mg m^{-3}. In January 281 mg m^{-3} was recorded in bottom waters at Station 6 (247 mg m^{-3} in surface sample). A relatively low standing stock was recorded for this species during the winter months, but increased in the following spring and summer (11 mg m^{-3} in surface sample and 117 mg m^{-3} in bottom sample at Station 1 in December). A high standing stock was again recorded in April when 400 mg m^{-3} was recorded near the bottom at Station 5 (surface 51 mg m^{-3}) and at Station 6, 24 mg m^{-3} near the bottom.

The only other important contributor to copepod standing stock was *Acartia longipatella,* which attained a maximum of 253 mg m^{-3} in bottom waters at Station 1 in December 1980. No *A. longipatella* were present in surface waters at this time. Standing stock of this species exceeded 150 mg m^{-3} on a few occasions only, for example in June 1980 at Station 2 (28 mg m^{-3} at the surface and 155 mg m^{-3} near the bottom), in October at Station 3 (108 mg m^{-3} at the surface and 151 mg m^{-3} near the bottom), in November at Station 3 (133 mg m^{-3} at the surface and 199 mg m^{-3} near the bottom), in January 1981 at Station 2 (89 mg m^{-3} at the surface and 213 mg m^{-3} near the bottom) and in February at Station 3 (128 mg m^{-3} at the surface and 170 mg m^{-3} near the bottom).

Mysids contributed substantially to zooplankton standing stock and reflected spatial, temporal and vertical patterns of distribution. *Gastrosaccus brevifissura* was only important near the mouth obtaining a maximum of 100 mg m^{-3} in November 1979 at Station 1 in surface waters (22 mg m^{-3} in bottom sample).

Mesopodopsis slabberi was important during the summer months and high standing stock figures were regularly recorded. For example, 438 mg m^{-3} in October in surface waters and 224 mg m^{-3} near the bottom at Station 1; in December 776 mg m^{-3} in surface waters at Station 6 (bottom sample 618 mg m^{-3}). In January 1980 a biomass of 1 056 mg m^{-3} was recorded at Station 2 near the surface (bottom sample 442 mg m^{-3}) and in April at Station 3, 589 mg m^{-3} was recorded from the surface and 85 mg m^{-3} from the bottom sample.

A similar pattern was recorded during the following spring and summer, with a standing stock in January of

1 103 mg m^{-3} in bottom waters at Station 2 (surface 276 mg m^{-3}) and in February at Station 3, 1 117 mg m^{-3} in surface sample and 630 mg m^{-3} near the bottom.

Standing stock of *Rhopalophthalmus terranatalis* was also highest during the summer months and exceeded 1 000 mg m^{-3} on a number of occasions. Maximum values were predominantly recorded in bottom waters — for example in November 1979, 1 028 mg m^{-3} at Station 5 (surface 121 mg m^{-3}). In January 1980, 2 732 mg m^{-3} was recorded at the same station (surface 820 mg m^{-3}) and at Station 6, 1 061 mg m^{-3} near the bottom and 492 mg m^{-3} at the surface. Peak biomass of 8 150 mg m^{-3} was recorded in March at Station 2 (surface 1 430 mg m^{-3}). Standing stock was relatively low during the winter months and did not exceed 500 mg m^{-3}, except in August at Station 7 in surface waters when a value of 715 mg m^{-3} was recorded (bottom 381 mg m^{-3}).

Standing stock of *R. terranatalis* increased during the following summer months, following the pattern previously recorded. A maximum value of 6 729 mg m^{-3} was obtained in February at Station 7 in bottom waters. The surface value was 84 mg m^{-3}. Standing stock decreased throughout the estuary during the remaining sampling period and in April maximum standing stock recorded was 1 163 mg m^{-3} at Station 7 in bottom waters (surface 77 mg m^{-3}).

Trophic relationships

Analysis of the gut of *R. terranatalis* indicates an omnivorous diet, consisting of copepods, mysids, phytoplankton, plant debris and detritus. Following flooding in July-August 1979, *R. terranatalis* fed almost exclusively on fragmented plant debris and detritus — the plant material present as a dense layer above the bottom. By December *Pseudodiaptomus hessei* was well established in the estuary and, together with juvenile *Mesopodopsis slabberi,* formed the dominant food items of adult *R. terranatalis.* Phytoplankton blooms were visually evident by this time and although all classes of *R. terranatalis* fed on phytoplankton, it only formed a significant proportion in the diet of juvenile and immature animals. Traces of phytoplankton were still observed in March when it formed an important component in the diet of smaller animals only. *R. terranatalis* is a summer breeder, and during the winter months it fed almost exclusively on copepods, the dominant species being *Acartia longipatella* followed by *Pseudodiaptomus hessei.*

Phytoplankton blooms were again evident during the summer months in 1981 and the pattern of feeding was similar to that recorded during the corresponding period in the previous summer.

Gilchristella aestuarius was often taken in relatively high numbers (> 250 per station or *ca.* 10 m^{-3}). Analysis of stomach contents emphasized the importance of zooplankton in the diet of this species; the food items recorded clearly mirror the availability of prey species in different parts of the estuary and during different seasons. These data are summarized in Table 2.

Low abundance of zooplankton in the estuary following flooding in July and August 1979 is reflected in a higher proportion of detritus consumed in comparison to other food items. As the zooplankton re-established itself, it became increasingly more important in the diet. In late spring (October – November) *Pseudodiaptomus hessei* was abundant between Stations 4 and 7 and was the most important food item taken by all classes of *Gilchristella aestuarius* in this region. At this time large *Gilchristella* (> 60 mm TL) fed mainly on *Gastrosaccus brevifissura* and fish eggs (species unknown) at Station 1 and *Mesopodopsis slabberi* at Stations 2 – 3.

Above Station 7, *G. aestuarius* was not as common in plankton net samples (n = 60) compared to Stations 6 – 7 (n = 1 150) during the period August – November following the floods. At these upper stations detritus was the most common food item identified.

Thereafter (December – February) *P. hessei* was abundant throughout the estuary and was by far the main food item taken by all classes of *G. aestuarius* at all stations. Mysids were also important in the diet of larger *Gilchristella;* at lower stations *M. slabberi* were commonly recorded while higher up the estuary *Rhopalophthalmus terranatalis* was more common. These feeding patterns correspond to the respective regions of maximum distribution

Table 2 Summary of the dominant food items recorded in stomachs of *Gilchristella aestuarius* during different seasons and in different regions of the estuary. Data for August 1979 to September 1980

Season	Station				
	1	2 – 3	4 – 5	6 – 7	8 – 10
Aug. – Sept. 1979	Detritus				
Oct. – Nov.	*Gastrosaccus brevifissura*	*Mesopodopsis slabberi*	*Pseudodiaptomus hessei*		Detritus
Dec. 1979 – Feb. 1980	*P. hessei*				
	M. slabberi		*Rhopalophthalmus terranatalis*		
			Other food items: *Corophium triaenonyx, Gilchristella* larvae, Isopods, Zoea larvae.		
March – Aug.	*Acartia longipatella & P. hessei*				Diverse diet
	M. slabberi				
Sept. 1980	*A. longipatella*		*P. hessei*		*P. hessei* Ostracods, Harpacticoids, Cladocerans

for the two species of mysids. Other prey items included *Corophium triaenonyx,* larvae of *Gilchristella,* isopods and zoea larvae. In the upper regions (Stations 8 – 10) insects were also important.

P. hessei declined in abundance towards the end of summer and became less significant in the diet of *G. aestuarius.* In contrast *Acartia longipatella* was more frequently recorded, particularly between Stations 2 and 7. At these stations *M. slabberi* were also regularly taken. At Stations 8 – 10 the diet was more diverse, with ostracods, harpacticoid copepods and cladocerans also being consumed.

P. hessei increased in abundance in the following spring and again became the most important food item in fish stomachs collected between Stations 4 and 7. At lower stations (2 and 3) it was preceded by *A. longipatella* in importance. During the remainder of the summer the pattern followed that recorded during the previous summer period.

Discussion

River discharge and influence on copepod distribution and abundance

Periodic flooding or increased freshwater discharge was a prominent feature of the Sundays River estuary during the period of study. Flooding is effective in scouring the estuary, particularly the lower region which abuts a north-easterly moving dune field along a broad front, and is important in the recurrent removal of encroaching dune sand. During a period of low rainfall prior to 1960, aerial photographs indicated that the dunes had advanced 35 – 40 m into the estuary between Stations 1 and 2, a distance of approximately 3 km. Further, exposed sandbanks extended an additional 500 m from the mouth. The channel-like estuary is scoured during flooding and the cyclic process begins again.

These unstable conditions probably contribute largely to the dearth of marginal and subtidal macrophytes in the middle and lower estuary, although, on occasion, isolated patches of *Zostera capensis* have been recorded (Forbes 1968). During the present study isolated clumps of *Zostera* were only present in the sheltered arm near the mouth.

Vertical salinity stratification was also well developed and had a major influence on temporal and spatial patterns of copepod succession already described for eastern Cape estuaries (Wooldridge & Melville-Smith 1979, Baird, *et al.* 1981). *Acartia natalensis* does not become well established in the estuary and appeared briefly during the latter part of the study and in the upper regions only. *A. longipatella* was most abundant in the winter and spring months, particularly at the lower stations. The interaction of temperature and salinity as regulating factors of spatial and temporal distribution patterns was clearly evident, but stratification also influenced the interaction of these two factors in a vertical plane.

In the upper estuary (Stations 6 and 7) where salinity was relatively low, *A. longipatella* was only present during the cooler months, April to November. At Stations 4 and 5 their presence extended into warmer months, although abundance was low. Salinity was relatively high at Stations 2 and 3 and in this region maximum abundance was recorded during the spring months. As summer temperatures increased, *A. longipatella* declined in abundance and this was most marked in surface samples where salinities were lower relative to the bottom. Increased freshwater inflow in December 1980 resulted in a sharp decrease in surface salinity and *A. longipatella* was only recorded in bottom samples in regions of the estuary where it was recorded. Similarly in the following April, *A. longipatella* was restricted principally to bottom waters. If these surface samples at Stations 1 – 3 are compared to winter samples at Stations 6 – 7, it can be seen that although salinities are similar, *A. longipatella* was only recorded when temperatures were relatively low, i.e. in winter. In February 1981, differences in surface and bottom salinity were comparatively small at Stations 1 – 3, and this is reflected in greater numbers of *A. longipatella* in surface samples at this time. Thus the presence of *A. longipatella* in summer surface samples in stratified estuaries need not reflect their abundance in the water column. In summer, salinity differentially modifies the effects of increasing temperature — the higher the salinity, the greater the temperature necessary to exclude *A. longipatella.*

The pioneer species *Pseudodiaptomus hessei* (Wooldridge & Melville-Smith 1979) responded to flooding or an increase in river discharge through marked increases in population density. If loss due to flushing of the estuary was severe the recovery of *P. hessei* was relatively slow. For example, in 1979 peak abundance was recorded 2 – 3 months after flooding in August. During this time *P. hessei* was the only copepod recorded in significant numbers above Station 4.

Less severe river discharge results in bottom waters remaining relatively unaffected, the less saline water flowing seawards above it. Considerable decreases in surface salinity were recorded on a number of occasions, these effects resulting in significant increases in *P. hessei* abundance within short periods of time. For example, highest numbers of *P. hessei* recorded during the period of study followed one month after increased river inflow in December 1979. Parallel results were obtained in early spring of 1980 (September – October). In December – January and in April 1981 increases in *P. hessei* abundance were recorded after sharp drops in surface salinity. Similar results have been recorded for the Swartkops and other east-coast estuaries (Wooldridge & Melville-Smith 1979) and for *P. stuhlmanni* in Richards Bay (Grindley & Wooldridge 1974).

Mysid distribution and zooplankton standing stock

Mysid shrimps were abundant in the Sundays, although their general range seldom extended into regions where the salinity fell below 10 – 15‰. Spatially, zones of maximum distribution could be distinguished for each of the three species with *Gastrosaccus brevifissura* near the mouth, *Mesopodopsis slabberi* at Stations 2 and 3 and *Rhopalophthalmus terranatalis* higher up the estuary.

The prominence of mysids in the zooplankton can be clearly seen with regard to standing stock. In comparison to copepods, their contribution was rarely less than 70% of the total and in most cases exceeded 90% even during winter months when abundance was relatively low. Total standing stock varied from < 10 mg m^{-3} after flooding to a maximum of 1 450 mg m^{-3} in surface and 8 275 mg m^{-3} in bottom samples. These values are the highest so far recorded for an estuary in southern Africa. Grindley (1981) gives the recorded range of zooplankton standing stock for *ca.* 95 estuaries along the southern African coast. The highest value was 1 200 mg m^{-3} (dry mass) for the Mgazana estuary on the east coast (Wooldridge 1977). For the south coast region the range fell between 1,0 and 112,7 mg m^{-3}. These latter figures also approximate the range for the majority of estuaries along the entire coastline.

Grindley (1981) emphasized temporal and spatial variations which may occur in the zooplankton. Present data accentuates such variations, and further emphasizes differences between levels in the water column. The distribution of *M. slabberi* and *R. terranatalis* in relation to tidal currents (Wooldridge & Erasmus 1980) showed that the latter species does not undergo a general migration into surface waters irrespective of the state of the tide. This is in contrast to *M. slabberi* which was, for example, abundant in surface samples around slack water.

These differences in behavioural patterns were again evident in the present sutdy; *M. slabberi* was often the most important species in samples collected near the surface (sampling commenced when the ebb tide was well progressed — lower stations occupied around low slack water) while in bottom waters, zooplankton was dominated by *R. terranatalis*. This species was also responsible for the exceptionally high zooplankton standing stock recorded in the estuary (Figure 9). Although the biology of *R. terranatalis* is now known in detail, it is still to be published.

The data so far presented emphasize the importance of well-designed sampling methodology. Since the 1950s, the zooplankton of southern African estuaries has been sampled by workers using a diversity of sampling gear. With regard to the larger zooplankters, conical nets were probably the most often used and range from 12,5 cm (Clarke Bumpus sampler) to 57 cm in diameter. The samples were usually collected in surface waters only. Sampling efficiency will vary with regard to the zooplankton species and the type of net used. For example, tests carried out in the surface waters of the Sundays River estuary indicated that a 40 cm conical net (124 μm mesh aperture) caught on average 30 – 35% of the total number of adult *M. slabberi* and *R. terranatalis* in samples taken simultaneously with a WP2 net (57 cm diameter and 190 μm mesh aperture). Corresponding values for juvenile and immature animals was 60 – 70%.

Although the avoidance of samplers by mysids is documented in the literature (Clutter & Anraku 1968), the use of WP2 nets was practical and their efficiency considered acceptable for the group since small fish such as *Gilchristella aestuarius* were regularly taken, sometimes in relatively high numbers. In contrast, these nets did not sample small zooplankters efficiently. For example mesh aperture size was too coarse for the sampling of nauplius larvae of *Pseudodiaptomus hessei*. In addition to variability due to gear used, vertical differences in distribution occur. Such vertical patterns of distribution may be influenced *inter alia* by tidal currents (Wooldridge & Erasmus 1980), by differences in behaviour between species or between age classes within a species, or through salinity stratification. The influence of salinity stratification may also change differentially according to seasonal changes in temperature. This is shown by *Acartia longipatella*. Surface samples therefore, need not necessarily reflect the composition, abundance and standing stock of the zooplankton in the water column. Although mysid shrimps may be an important component in some estuaries only, it is suggested that they have not generally been efficiently sampled in the past and their relative importance in eastern Cape estuaries, and possibly in southern African estuaries in general, has been underestimated. The complex pattern of behaviour of plankton populations is an aspect which warrants greater attention by workers (Hamner & Hauri 1981).

Tidal exchange has been suggested as the single most important factor controlling the distribution of estuarine plankton (Grindley 1981). Ultimate survival depends on population reproduction rates and the exchange rate of the water. A high reproductive rate may replace that component lost by way of the net seaward transport (Ketchum 1954; Barlow 1955) as well as through other causes. Thus, in Richards Bay, the estuarine zooplankton can only survive in the estuary where the rate of tidal replacement is not too great (Grindley & Wooldridge 1974).

Behavioural adaptations are also important in aiding the retention of indigenous zooplankton in an estuary (Naylor 1976). In the Sundays, tidal current velocities exceeding 50 cm s^{-1} have been recorded 8 km from the mouth (Wooldridge & Erasmus 1980). Water current velocities varied with depth as well as across the axis of the estuary. By avoiding faster-flowing currents on the ebb tide (vertical and/or lateral redistribution, depending on the species), animals were able to reduce the possibility of being flushed from the system. Thus despite its dynamic nature high population densities become established. Similarly, in the Mgazana estuary, zooplankton densities attain high levels (Wooldridge 1977) yet tidal exchange is considerable (Branch & Grindley 1979). Equating high zooplankton densities with sluggish water movement should not be applied generally since behavioural adaptations may be significant in aiding the retention of estuarine zooplankton. In both the Sundays and Mgazana estuaries, salinity stratification was established in the water column and is in contrast to Richards Bay which for the most part, was less than 1 m in depth (Grindley & Wooldridge 1974). Salinity stratification was also well established in Msikaba estuary (Wooldridge 1976) and *Pseudodiaptomus hessei* was recorded in maximum numbers close to the mouth.

When river flow increases during floods which are, however, not strong enough to disrupt stratification, for example in December 1980 and in April 1981 in the Sundays estuary, zooplankters avoid surface waters entirely and remain near the bottom to avoid being flushed from the estuary. Such a mechanism has already been suggested by Lance (1962) and Grindley (1964). At such times marked increases in *P. hessei* population density are recorded within relatively short periods, while at other times, when the estuary is severely scoured and most of the estuarine plankton is swept out, the recovery of the pioneer *P. hessei* is extended and peaks in population density are recorded some months after flooding (e.g. in August – November 1979). Ultimately however, increased river discharge results in an increase in the population density of *P. hessei*.

Trophic relationships

Although data are not yet available on the lower levels of the food web in the Sundays estuary, some comments on trophic relationships may be made with regard to the zooplankton. These are summarized in Table 3. The mysid shrimp, *Rhopalophthalmus terranatalis* and the clupeid, *Gilchristella aestuarius*, were abundant and important omnivores in the estuary. Zooplankton represented a major component in their diet, the composition varying in relation to the size of the predator and prey availability. The data on *G. aestuarius* probably closely reflects the feeding habits. In Lake St Lucia, feeding was recorded during daylight hours only and reached a peak in late afternoon which corresponded to the start of the diel vertical migration cycle of *Pseudodiaptomus stuhlmanni* (Blaber 1979).

Table 3 Summary of food items identified in mysids and fish taken in zooplankton nets in the Sundays River estuary

Species	Food consumed
Mysid species	
Gastrosaccus brevifissura	Detritus, phytoplankton.
Mesopodopsis slabberi juveniles	Detritus, phytoplankton.
Mesopodopsis slabberi adults	Detritus, phytoplankton, *Pseudodiaptomus hessei*, *Acartia longipatella*, *Acartia natalensis*.
Rhopalophthalmus terranatalis juveniles	Detritus, phytoplankton, *Pseudodiaptomus hessei*, *Acartia longipatella*, *Acartia natalensis*, *Mesopodopsis slabberi* juveniles.
Rhopalophthalmus terranatalis adults	Detritus, phytoplankton, *Pseudodiaptomus hessei*, *Acartia longipatella*, *Acartia natalensis*, *Mesopodopsis slabberi* (adults and juveniles) *Gilchristella aestuarius* larvae.
Fish species	
Gilchristella aestuarius	*Pseudodiaptomus hessei*, *Acartia longipatella*, *Acartia natalensis*, *Mesopodopsis slabberi* (adults and juveniles) *Rhopalophthalmus terranatalis* (adults and juveniles) *Gastrosaccus brevifissura*, *Corophium triaenonyx*, Zoea larvae.
Hemiramphus sp.	*Acartia longipatella*, *Acartia natalensis*, *Gilchristella aestuarius* eggs.
Heteromycteris capensis and *Solea bleekeri*	Ostracods, *Pseudodiaptomus hessei*, *Rhopalophthalmus terranatalis* (juveniles).
Argyrosomus hololepidotus	*Pseudodiaptomus hessei*, *Mesopodopsis slabberi* (adults and juveniles), *Rhopalophthalmus terranatalis*.
Monodactylus falciformis	*Pseudodiaptomus hessei*, benthic copepods.
Ambassis sp.	*Pseudodiaptomus hessei*, *Mesopodopsis slabberi* (adults and juveniles).
Pomadasys commersonni	*Pseudodiaptomus hessei*, *Mesopodopsis slabberi*, (adults and juveniles), *Rhopalophthalmus terranatalis* (adults and juveniles).
Lithognathus lithognathus	*Pseudodiaptomus hessei*, *Corophium triaenonyx*, benthic copepods, ostracods.
Rhabdosargus holubi	*Pseudodiaptomus hessei*, *Acartia longipatella*, *Acartia natalensis*, *Mesopodopsis slabberi* (adults and juveniles), *Corophium triaenonyx*.
Juvenile mullet	*Pseudodiaptomus hessei*, *Acartia longipatella*, *Acartia natalensis*, *Mesopodopsis slabberi* (adults and juveniles), *Corophium triaenonyx*, ostracods, Zoea larvae, detritus, phytoplankton.
Goby spp.	*Pseudodiaptomus hessei*.

R. terranatalis cultured in the laboratory feed readily on crustaceans such as *Artemia salina*, *Pseudodiaptomus hessei* and juvenile *Mesopodopsis slabberi*. In an aquarium tank *M. slabberi* newly released from the brood pouch are rapidly seized and devoured. Predation upon adult *M. slabberi* was sometimes successful, but in most cases the potential victim escaped by rapidly darting away. The predation of *R. terranatalis* upon other zooplankters in the estuary probably plays an important role in forming the observed patterns of spatial distribution, particularly with regard to *M. slabberi*. *R. terranatalis* swims with the ventral side uppermost, the endopods and setae of the thoracic appendages forming a cone. Capture is effected when the predator darts forward and closes the cone over the prey and against the thorax. The prey is then manipulated towards the mouthparts and devoured.

The diet of other fish species taken in plankton nets also contained a high proportion of zooplankton. The predators include *Heteromycteris capensis*, *Solea bleekeri*, *Argyrosomus hololepidotus*, *Monodactylus falciformis*, *Ambassis* sp., *Pomadasys commersonni*, *Lithognathus lithognathus*, *Rhabdosargus holubi*, juvenile mullet and goby species. Less frequently recorded were juvenile *Etrumeus teres*, *Hemiramphus far*, *Pomadasys olivaceum* and *Rhabdosargus globiceps*. Prey items identified were predominantly *P. hessei, A. longipatella, M. slabberi, R. terranatalis, Corophium triaenonyx, Grandidierella lignorum* and zoea larvae. Other items present include species of copepods, ostracods, detritus and phytoplankton. In the goby and *Argyrosomus hololepidotus* specimens examined, the prey was almost exclusively *P. hessei.*

Juvenile mullet were sometimes present in high numbers. For example, in February 1980, 450 specimens were taken at Station 8 (modal range 16 – 22 mm TL). As juveniles increased in size, changes in feeding habits were apparent. This reflected the pattern described by Blaber & Whitfield (1977). Other fish species identified in samples include *Elops machnata, Hyporhamphus knysnaensis, Syngnathus acus, Lichia amia, Lithognathus mormyrus* and *Hepsetia breviceps.* These were not feeding around the time of capture.

Although phytoplankton blooms were present in the summer months, data are not complete to establish its significance in the food web. In the species investigated, it formed a component in the diet only, although schools of mullet (*Liza richardsoni* ?) were sometimes observed feeding at the surface on phytoplankton patches. No clear response in the form of marked increases in zooplankton population densities were apparent in the data following the appearance of a phytoplankton bloom. The pattern was further complicated by the appearance of dinoflagellate blooms in the estuary below Station 6 – 7 in both summers investigated. Mysids generally avoided dinoflagellate patches, while other zooplankters were present in relatively low numbers.

Benthic macrofauna, such as *Callianassa kraussii* and *Upogebia africana* are important food items for estuarine fish, although in the Sundays, total biomass of these anomurans is relatively low. This is probably largely owing to the channel-like nature of the estuary and hence the limited area available for colonization. This is in contrast to the adjacent Swartkops estuary where extensive sand and mudbanks are present. Consequently, *Pomadasys commersonni* is relatively unimportant in the Sundays (Marais 1981) compared to the Swartkops estuary (Marais & Baird 1980) where this fish dominated anglers' and gill net catches and which was shown to feed largely on *U. africana* (Van der Westhuizen & Marais 1981). Despite the relatively low biomass of benthic macrofauna the fish fauna attains 57% higher biomass levels than in the Swartkops and is largely due to the kob, *Argyrosomus hololepidotus* and the sea catfish, *Tachysurus feliceps* with regard to mass and numbers respectively (Marais 1981). Apart from their scavenging mode of feeding, sea catfish consume mysids, crabs and small fish while the main prey items of kob smaller than 40 cm were mysids, *Gilchristella aestuarius* and juvenile mullet (Marais 1981), all of which are abundant in the Sundays estuary.

Zooplankton has been shown to be an important component in the diet of filter-feeding teleosts in St Lucia (Blaber 1979) although Whitfield (1980) has shown the opposite to be the case in the Mhlanga estuary. Zooplankton densities and standing stock attain high levels in the Sundays and the fish fauna is also abundant (Marais 1981). Present data suggests that in this estuary the transfer of energy to higher trophic levels is largely via the zooplankton in the water column.

Acknowledgements

We are indebted to the Department of Environmental Affairs for funding this project and to colleagues and friends who assisted on numerous occasions. In particular we thank Lynnath Beckley and Francois Talbot for their efficient help in the field and Deo Winter for help with the computer program.

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