A note on the diet and feeding selectivity of juvenile riverbream, *Acanthopagrus berda* (Forskal, 1775), in a subtropical mangrove creek

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The diet and food selectivity of juvenile (< 100 mm S.L.) *Acanthopagrus berda* were investigated in Beachwood creek, north of Durban. Fish and benthic samples were taken from November 1986 to September 1987. The diet of juvenile *A. berda* was varied but crustaceans, mainly amphipods, were the dominant prey item. Ivlev's (1961) electivity index revealed a positive selection for amphipods, tanaids and fish scales.

Die dieet en voedselseleksie van vingerling (< 100 mm S.L.) *Acanthopagrus berda* is in Beachwoodspruit, noord van Durban, ondersoek. Vis- en bentiese monsters is vanaf November 1986 tot September 1987 geneem. Die dieet van vingerling *A. berda* was uiteenlopend van aard, maar skaaldiere, hoofsaaklik amfipoda, was die oorheersende prooi-items. Ivlev (1961) se keuse-indeks het 'n positiewe seleksie van amfipoda, tanaïede en visskubbe aangedui.

The riverbream, *Acanthopagrus berda* is abundant and widespread in the tropical Indo-Pacific (Smith & Heemstra 1986). They are plentiful in Mozambique and have been recorded as far south as Knysna in the Cape. The juveniles, however, are distinctly subtropical and are almost entirely restricted to Natal (Wallace & van der Elst 1975). *A. berda* is one of 22 fish species which depends on estuaries during the juvenile phase of its life cycle (Wallace, Kok, Beckley, Bennet, Blaber & Whitfield 1984). It has been suggested that the steady degradation of these habitats has affected the abundance of this species (Begg 1978; van der Elst 1988). The Mgeni estuary however, is one system where *A. berda* were found to be relatively abundant (Begg 1984a). This note describes the diet and feeding selectivity of juvenile *A. berda* in a mangrove creek in the Mgeni estuary.

Study site

The Mgeni estuary (29°48'S / 31°02'E) is situated 5 km north of the centre of Durban. Near the mouth, on the northern bank of the system, is a stand of mangroves through which a tidal creek enters the estuary. Beachwood creek is 3 km long and runs in a northerly direction at right angles to the estuary (Figure 1). The entrance of the creek is tidal and the depth may range from 15 cm to 125 cm (Begg 1978).

Materials and Methods

Juvenile *A. berda* (< 100 mm standard length (S.L.)) were sampled monthly from November 1986 to September 1987 with the exception of December 1986. The study was terminated in October 1987 following severe fluvial floods during which the study site was severely eroded.

A. berda were sampled using a manually operated 1 m wide beam trawl as described by Begg (1984b). Trawling was conducted at low tide, since reduced water levels concentrated the fish, increasing their susceptability to capture (Begg 1984b). All specimens collected were immediately preserved in 10% formalin for laboratory analysis.

To determine the selectivity of *A. berda*, the benthic community was sampled using an Ekman-Birge grab (sample area: 210 cm^2 to a maximum depth of 22 cm) mounted on a pole. Each sample consisted of five random grabs taken at the sample site (Figure 1); these were only taken if fish capture was successful. The five grab samples were placed in a 20 l plastic bucket, a 10% formalin solution containing the vital dye phloxine was then added to the sample, and the sample stirred. This caused the living organisms to float to the surface. The suspension was then poured through a 0,25 mm mesh sieve. This process was

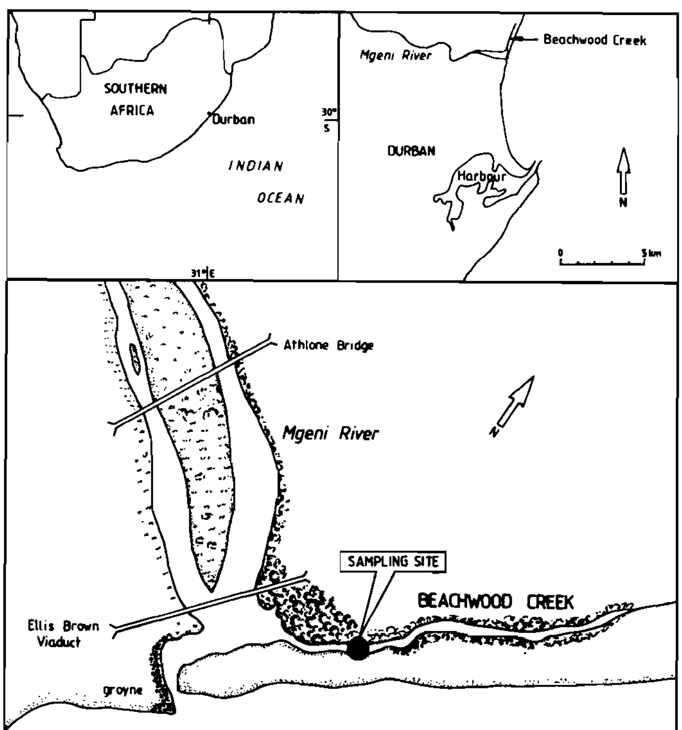

Figure 1 Location of the study area indicating the sample site in Beachwood creek.

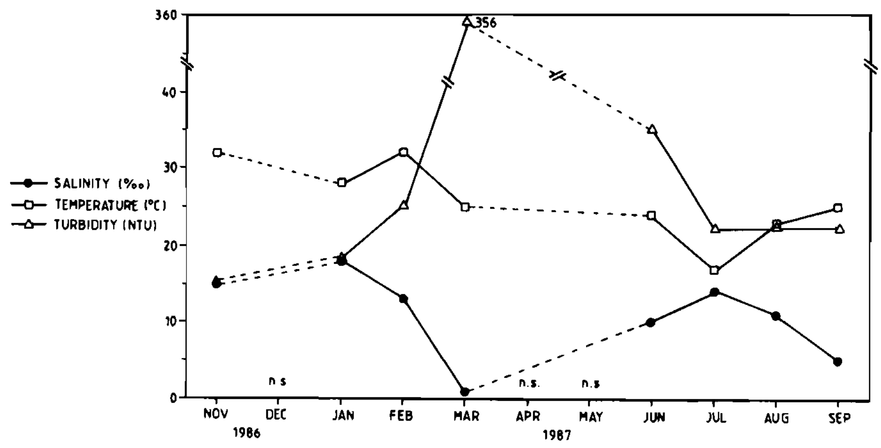

Figure 2 Salinity, temperature and turbidity data from Beachwood creek, November 1986–September 1987 (n.s. = no sample taken).

repeated until no further organisms were present in the supernatant. The remaining sediment was then visually sorted for bivalves and gastropods. The contents of the sieve and those organisms collected in the sediment were preserved in 70% ethanol for laboratory analysis.

Surface temperature and salinity measurements were taken after each successful sampling trip using a Y.S.I. model 33 S-C-T meter. Water samples were also taken for turbidity measurements in the laboratory. Turbidities were measured in Nephelometric Turbidity Units (NTU) using a Hach Portalab Turbidimeter.

In the laboratory, each fish was measured to the nearest 0,1 mm standard length (S.L.), using vernier slide calipers, prior to removal of the stomach. Stomach contents of the fish were analysed using the following methods:

(i) Frequency of occurrence: The number of stomachs in which each prey item occurred was recorded and expressed as a percentage of the total number of stomachs examined.

(ii) Numerical occurrence: The number of individuals of each food type in all stomachs was expressed as a percentage of the total number recorded.

(iii) The 'points' method (Ricker 1968): the percentage fullness of a stomach was assessed, food items were sorted into species groups and points were then allocated to each group according to the proportion they represented in relation to the other groups present, and the fullness of the stomach. The maximum total points which could be allocated was 100 for a full stomach. This method gives an approximate volumetric analysis of diet.

Benthic samples were decanted into a large perspex counting tray and all the organisms identified to class and where possible, to family level and counted. The selectivity of *A. berda* for certain prey items was calculated using Ivlev's (1961) electivity index (E):

$$E = \frac{r-p}{r+p}$$

where r is the proportion of a species in a food sample and p is the proportion of a species available. This index ranges from + 1 for a positive selection to − 1 for a negative selection.

Results

Temperature followed a seasonal pattern reaching a maximum of 32°C in November 1986 and February 1987 and a minimum of 17°C in July 1987 (Figure 2). Salinity and turbidity readings were variable. Begg (1978) noted that at low tide Beachwood creek carries water which is almost fresh, this may account for the relatively low salinities (max. 18‰) recorded during this study. The lowest salinity (1‰) and highest turbidity (356 NTU) were recorded in March 1987 (Figure 2).

The most abundant benthic taxa sampled over the study period were polychaetes, these contributed 88% to the total benthos. Crustaceans, mainly amphipods, isopods and tanaids contributed over 9% to the total (Table 1). Seasonal variations in the benthic community could not be firmly established over the short and interrupted study period.

Length frequency histograms (Figure 3) indicate that two annual recruitments of *A. berda* were sampled. The first group sampled between November 1986 and March 1987, consisted of a few relatively large specimens (mean monthly abundance 11,25; mean monthly length > 40 mm S.L.). A second group, sampled from June to September 1987, comprised fry and small juveniles (mean monthly abundance 36,25; mean monthly length < 30 mm S.L.). It is noteworthy that despite intensive sampling, no specimens were caught during April and May 1987.

Important food items in the November–March group included amphipods and crustacean remains. Unidentified remains, algal material and fish scales were also consumed. It should be noted here that owing to the initial difficulty in identifying the stomach contents, amphipods and tanaids were pooled for the frequency of occurrence analysis of the November–March sample. The June–September group consumed amphipods, crustacean remains, polychaetes and unidentified remains. Algal material, fish scales and ostracods were also present in their diet (Table 2).

Amphipods, tanaids and fish scales were positively selected for throughout the study period in both populations (Table 3).

Table 1 Density (n) and per cent contribution (%) of the major benthic groups present in Beachwood creek, November 1986–September 1987 (n = density in numbers m^{-2}; n.s. = no sample taken)

	November		December		January		February		March		April		May		June		July		August		September		Total	
Benthos	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Annelids																								
Polychaeta																								
Sabellidae	1539,20	36,9			515,04	3,4	1181,04	15,3	204,24	3,8					10993,44	61,0	12254,40	41,8	16747,68	59,5	7050,72	41,9	6310,72	40,5
Nereidae	2072,00	49,6			11242,08	74,4	4981,68	64,6	3303,60	61,9					6002,88	33,3	15584,40	53,2	8880,00	31,5	7183,92	42,7	7406,32	47,5
Oligochaeta					745,92	4,9	444,00	5,8	452,88	8,5													205,35	1,3
Arthropoda																								
Copepoda																								
Ostracoda			n.s.		44,40	0,3	8,88	0,1	8,88	0,2	n.s.		n.s.										7,77	>0,1
Isopoda																								
Anthuridae	118,40	2,8			577,20	3,8	763,68	9,9	284,16	5,3					479,52	2,7	603,84	2,1	559,44	2,0	1260,96	7,5	580,90	3,7
Amphipoda	103,60	2,5			1580,64	10,5	133,20	1,7	168,72	3,2					124,32	0,7	559,44	1,9	1065,60	3,8	1047,84	6,2	597,92	3,8
Tanaidacea	59,20	1,4			195,36	1,3	88,80	1,2	150,96	2,8					461,76	2,6	222,00	0,8	888,00	3,2	266,40	1,6	291,56	1,9
Cumacea	29,60	0,7			177,60	1,2	53,28	0,7	8,88	0,2							62,16	0,2	26,64	0,1	17,76	0,1	46,99	0,3
Mollusca																								
Gastropoda	177,60	4,3			8,88	0,1	17,76	0,2	8,88	0,2													26,64	0,2
Fish scales	74,00	1,8			17,76	0,1	35,52	0,5	745,92	14,0					26,64	0,1					8,88	0,1	113,59	0,7

Table 2 Diet of juvenile (< 100 mm S.L.) *Acanthopagrus berda* from Beachwood creek, November 1986–September 1987 (%F = frequency of occurrence; %N = numerical occurrence; %P = 'points'; *n* = number of specimens; * = Tanaidacea and Amphipoda were pooled)

	November			December			January			February			March		
Food item	%F	%N	%P	%F	%N	%P	%F	%N	%P	%F	%N	%P	%F	%N	%P
Annelida															
Polychaeta															
Sabellidae															
Nereidae															
Oligochaeta															
Arthropoda															
Copepoda	3,2	0,2													
Ostracoda	22,6	4,2					25,0	0,8							
Isopoda															
Anthuridae															
Amphipoda	83,9	54,3	9,0				100,0	73,3	23,0	100,0	78,5	6,0	28,6	14,3	14,3
Tanaidacea	*	10,1	1,6				*	6,4	2,0	*	10,7	1,3			
Cumacea															
Mollusca															
Gastropoda	3,2	0,2					25,0	0,8	1,3						
Sand	51,6	16,3	0,3				25,0	6,4	1,3						
Fish scales	51,6	14,1	1,4				25,0	11,4		33,3	10,7	1,0	57,1	85,7	21,4
Crustacean remains	87,1		31,6				100,0		62,5	100,0		49,3	71,4		54,3
Unidentified remains	16,1		5,8							66,7		30,0	14,3		10,0
Algal material	64,5		18,1				25,0		1,3				57,1		32,1
		n = 31			n.s.			*n* = 4			*n* = 3			*n* = 7	

	April			May			June			July			August			September		
Food item	%F	%N	%P	%F	%N	%P	%F	%N	%P	%F	%N	%P	%F	%N	%P	%F	%N	%P
Annelida																		
Polychaeta																		
Sabellidae							66,6	59,2	8,3	16,6	6,4	1,7	32,8	27,0	4,9	10,0	1,5	0,3
Nereidae							22,2	3,1	1,8	4,2	1,3	1,7	6,3	1,3	1,5	6,6	1,0	0,3
Oligochaeta																		
Arthropoda																		
Copepoda																		
Ostracoda							3,7	2,6	0,0	12,5	34,6	1,0				6,6	1,5	0,0
Isopoda																		
Anthuridae																		
Amphipoda							70,4	15,3	5,0	45,8	16,6	3,5	59,4	28,3	10,2	86,6	49,0	16,7
Tanaidacea							3,7	7,6	3,6	4,2	10,3	2,8	53,1	27,6	4,1	46,6	10,2	2,3
Cumacea																		
Mollusca																		
Gastropoda																		
Sand							3,7	1,0	0,0	37,5	25,6	1,9				13,3	9,7	0,2
Fish scales							11,1	7,1	0,8	16,6	5,1	0,5	31,3	18,2	1,6	46,6	27,2	2,5
Crustacean remains							3,7		0,4	37,5		10,5	48,4		17,0	90,0		37,6
Unidentified remains							100,0		72,6	66,6		23,9	85,9		23,9	46,6		14,6
Algal material										25,0		5,8	4,7		1,4	20,0		5,3
		n = 0			*n* = 0			*n* = 27			*n* = 24			*n* = 64			*n* = 30	

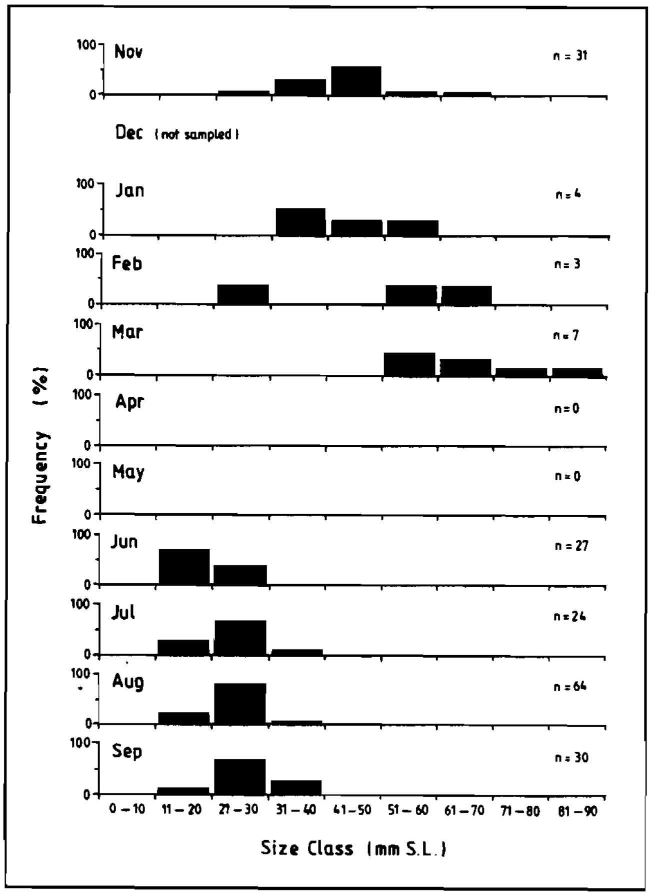

Figure 3 Length frequency histogram of juvenile (< 100 mm S.L.) *Acanthopagrus berda* from Beachwood creek, November 1986–September 1987 (*n* = number of specimens).

Table 3 Selectivity of *Acanthopagrus berda* (< 100 mm S.L.) for food and potential food in Beachwood creek, November 1986–September 1987 (positive value = positive selection; negative value = negative selection)

Food item	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Annelida											
Polychaeta											
Sabellidae	–1,0		–1,0	–1,0	–1,0			–0,2	–0,8	–0,4	–0,9
Nereidae	–1,0		–1,0	–1,0	–1,0			–0,8	–1,0	–0,9	–1,0
Oligochaeta			–1,0	–1,0	–1,0						
Arthropoda											
Copepoda	1,0										
Ostracoda	1,0		0,5	–1,0	–1,0			1,0	1,0		1,0
Isopoda											
Anthuridae	–1,0		–1,0	–1,0	–1,0			–1,0	–1,0	–1,0	–1,0
Amphipoda	0,9		1,0	1,0	0,7			0,9	0,8	0,8	0,8
Tanaidacea	0,8		0,7	0,8	–1,0			0,6	0,9	0,8	0,7
Cumacea	–1,0		–1,0	–1,0	–1,0				–1,0	–1,0	–1,0
Mollusca											
Gastropoda	–0,9		0,9	–1,0	–1,0						
Fish scales	0,8		1,0	0,9	0,7			1,0	1,0	1,0	1,0

Discussion

Two annual recruitments of *Acanthopagrus berda* were represented in this study. The first group, sampled from November to March 1987, comprised large juveniles (> 40 mm S.L.) and the second group, sampled from June 1987 to September 1987, consisted of fry and small juveniles (< 30 mm S.L.) (Figure 3). Adult *A. berda* are thought to spawn at sea during the winter (May–August) (Wallace 1975), with migration into estuaries probably taking place at a very small size (20–30 mm total length (T.L.)) (Wallace & van der Elst 1975; Kyle 1986). This corresponds with the appearance and size class of the July–September sample and emphasizes the nursery function of estuaries and their backwaters. Kyle (1986) found that, in the Kosi system, only specimens of 40 mm T.L. and over were found away from the protective reed margins of the channels thus further emphasizing the nursery function of these sheltered habitats. This behaviour may have accounted for the apparent disappearance of *A. berda* in the creek during April and May where the larger November–March sample (mean monthly length > 40 mm S.L.) presumably moved into the more open waters of the estuary. Furthermore although not complete, the data in Figure 2 indicate that high turbidities and/or low salinities may have influenced their departure from the creek. This seems unlikely, however, since *A. berda* can tolerate low salinities (van der Elst 1988; Whitfield, Blaber & Cyrus 1981) and appears to be turbidity indifferent (Cyrus & Blaber 1987a; 1987b). Another explanation for their apparent disappearance is that these larger, swifter individuals may have been undersampled owing to net avoidance.

The diet of *A. berda* has been described as wide, feeding on a variety of bottom invertebrates (Fischer & Bianchi 1984; van der Elst 1988). Beumer (1978) recorded teleosts, invertebrates and plant material in the stomachs of *A. berda*. He found that crustaceans formed the major invertebrate component and that teleosts were found in all the specimens sampled. Predation on small fish was found to be very important to *A. berda* in the Kosi system (Kyle 1986). Day, Blaber & Wallace (1981) noted that specimens of *A. berda* from 20–60 mm fed on zooplankton, mainly amphipods, chironomid larvae, tanaids and small crabs, and from 60–120 mm the main food included amphipods, bivalves, gastropods, gobies and weed.

The occurrence of sand particles in the stomachs and the types of organisims consumed (amphipods, tanaids, crustacean remains and algal material) indicate that juvenile *A. berda* in Beachwood creek are benthic feeders. Crustaceans (amphipods and tanaids) were the dominant food of the November–March sample. The June–September sample had a more diverse diet with crustaceans, unidentified remains and polychaetes being the main food items. *A. berda* have sharp, pointed incisors which seize and retain food items, whilst broad, powerful molars crush the food. Smaller specimens, however, do not have well-developed molars and the foliacious structure of their gill-rakers is efficient in retaining smaller food items (Beumer 1978). This may account for the occurrence of polychaetes, unidentified remains and ostracods in the stomachs of the smaller July–September group and the predominantly crustacean diet of the November–March group.

Studies in Durban Bay (Day & Morgans 1956) found that up to 50 mm the diet of *Acanthopagrus berda* consisted of planktonic copepods and amphipods and from 50–100 mm specimens contained amphipods, polychaetes and bivalves. Cyrus & Blaber (1983) reported a comparable change in the diet of *Gerres* fry (< 40mm S.L.) during the early stages of growth where copepods were dominant in individuals smaller than 16 mm S.L., while those more than 35 mm S.L. showed an increase in the number of food types taken and a decrease in importance of copepods. Differences in feeding structures, relative to fish length may therefore help reduce intraspecific competition between new recruits and growing juveniles of *A. berda*. Although *A. berda* is not a shoaling species, they have been found in loose groups of a few individuals and in mixed shoals with *Rhabdosarus* spp. (Kyle 1986). The possible reduction of intraspecific competition in *Gerres* by 'loose association' shoaling during feeding (Cyrus & Blaber 1984a; 1984b), may also apply to *A. berda*. The possible departure of the larger November–March individuals from the creek prior to the arrival of the July–September group suggests that some resource segregation takes place as the food in the sheltered creek is available to be utilized by new recruits thus reducing intraspecific competition. However, the possibility of these larger individuals avoiding capture in the creek must not be overlooked.

Polychaetes were the most abundant benthic taxa sampled in this study and accounted for 88% of the total benthos (Table 1). *A. berda*, however, exhibited a preference for crustaceans and positively selected amphipods and tanaids (Table 3). The high selectivity for fish scales and erratic occurrence of ostracods may be due to these items being poorly sampled in the benthos as, when a grab is taken, the uppermost layers in which the micro-fauna lives is swept aside thus eliminating or underestimating the abundance these organisms in the sample (Schnoerbel 1970). A number of other fish such as *P. commersonnii*, *Gerres* and *Rhabdosargus sarba* also feed on benthic invertebrates and polychaetes are the single most important food item taken by *Gerres* (Cyrus & Blaber 1983; 1984a). It is possible therefore that some resource partitioning is employed to reduce interspecific competition with other major benthic feeding fish.

Cyrus & Blaber (1983) found that food availability and habitat (marine, estuarine or mangrove) are the most important factors affecting the type of food taken by different *Gerres* species. The same might apply to *A. berda* whose diet demonstrates what Blaber (1984), referring to *Rhabdosargus*, described as ...'the opportunistic and flexible feeding ecology necessary for living in estuaries'.

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