Stomach content analysis of the sea barbel, *Galeichthyes feliceps* (Valenciennes in C & V), from the Swartvlei system, southern Cape

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The diet of the sea barbel, *Galeichthyes feliceps*, in the Swartvlei estuarine system was investigated during the period April 1979 to March 1980. The stomachs of 393 specimens (TL 13,5 to 46,0 cm) were examined. The sea barbel appears to be a bottom feeder with the crown crab, *Hymenosoma orbiculare*, forming its main prey throughout the system. Unidentified pieces of fish and the tube-dwelling amphipod, *Grandidierella lignorum*, were respectively the second and third most important food items. The feeding habits of most adult male sea barbel were markedly affected by the breeding season, since during this time they were carrying developing eggs in their mouths and apparently did not feed.

S. Afr. J. Zool. 1985, 20: 33–37

Die dieet van die seebaber, *Galeichthyes feliceps*, in die Swartvlei-riviermondsisteem is gedurende die periode April 1979 tot Maart 1980 ondersoek. Die pense van 393 eksemplare (TL 13,5 tot 46,0 cm) is ondersoek. Die seebaber skyn 'n bodemvoeder te wees met die kroonkrap, *Hymenosoma orbiculare*, as vernaamste prooi dwarsdeur die sisteem. Ongeïdentifiseerde stukkies vis en die buisbewonende Amphipoda, *Grandidierella lignorum*, was onderskeidelik die tweede en derde belangrikste voedselitems. Die voedingsgewoontes van die meeste volwasse seebabermannetjies is sterk deur die broeiseisoen beïnvloed, aangesien hulle gedurende daardie tyd ontwikkelende eiers in hul bekke gedra het en blykbaar nie geëet het nie.

S.Afr. Tydskr. Dierk. 1985, 20: 33–37

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Received 2 April 1984; accepted 29 August 1984

The sea barbel, *Galeichthyes feliceps*, occurs around the South African coast (Smith 1965) and has been reported in estuaries from the Transkei (Van der Elst 1981) to the Bot River estuary on the south-western Cape coast (Ratte 1977). It is usually fairly numerous in eastern and southern Cape estuaries, and is often the most or second most abundant fish species collected during gill-net surveys (Van Wyk 1976; Marais 1981, 1983a, 1983b; Ratte 1982).

During the period April 1979 to March 1980 the composition of the diet of *G. feliceps* was investigated in the Swartvlei system, a southern Cape estuarine system that has an unstable mouth which closes periodically owing to sand-bar formation. This study forms part of a project on the feeding habits of estuarine fish species and their role in the food-web in the Wilderness Lakes complex (Coetzee 1981, 1982a, 1982b).

Material and Methods

G. feliceps specimens for this study were collected simultaneously with specimens for a study on *Lichia amia* (Coetzee 1982b), but over a shorter period, namely 12 months as opposed to 22 months. The same sampling equipment, stations and procedures were used. Catches were made with six 100 m long gill-nets with stretched mesh sizes of 41; 51; 61; 86; 111 and 146 mm respectively, which were tied together and set once a month at each of three stations in the Swartvlei system (Figure 1). The station positions were selected to represent the lower, middle and upper reaches of this estuarine system. The nets were left overnight (approximately 16h00 to

Figure 1 The Swartvlei estuarine system with sampling localities (Stations 1, 2 and 3) indicated.

08h00) at each station. The collected fish were measured and their stomachs were removed and preserved in formalin (approximately 10%).

The contents of each stomach were separated into species or groups, which were then weighed to calculate the percentage of the total stomach content formed by the various food items. The occurrence and dominance methods of stomach content analysis (Hynes 1950) were also applied. Afterwards the results for each station were combined to ascertain the composition of the diet of *G. feliceps* in the lower, middle and upper reaches of the Swartvlei system, and finally the results for all three stations were combined to obtain the overall composition of the diet.

Results

A total of 395 *G. feliceps* was collected from April 1979 to March 1980, and the stomach contents of 393 were examined. The majority (53,2%) were caught in spring (September to November), followed by 22,8% in summer (December to February), 12,4% in winter (June to August) and 11,6% in autumn (March to May) (Figure 2). The mouth of the Swartvlei system was, however, closed from 4 May to 27 July 1979, which would have influenced the movement of the sea barbel to and from the sea.

Total lengths (TL) of the examined specimens ranged from 13,5 to 46,0 cm with a peak between 35 and 45 cm and a secondary peak between 15 and 25 cm (Figure 3). Mean lengths were 39,2 cm (n = 136, S.D. = 5,2) at Station 1, 27,9 cm (n = 152, S.D. = 10,3) at Station 2 and 29,3 cm (n = 105, S.D. = 6,8) at Station 3. An analysis of variance indicated significant differences between the mean total

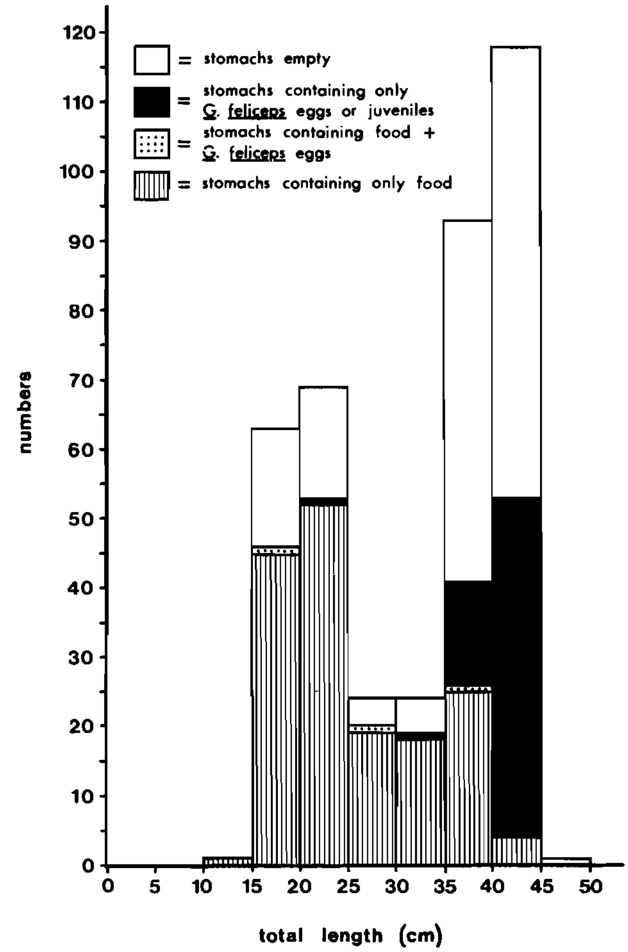

Figure 3 Length distribution and stomach contents of 393 *Galeichthyes feliceps* collected in the Swartvlei system from April 1979 to February 1980.

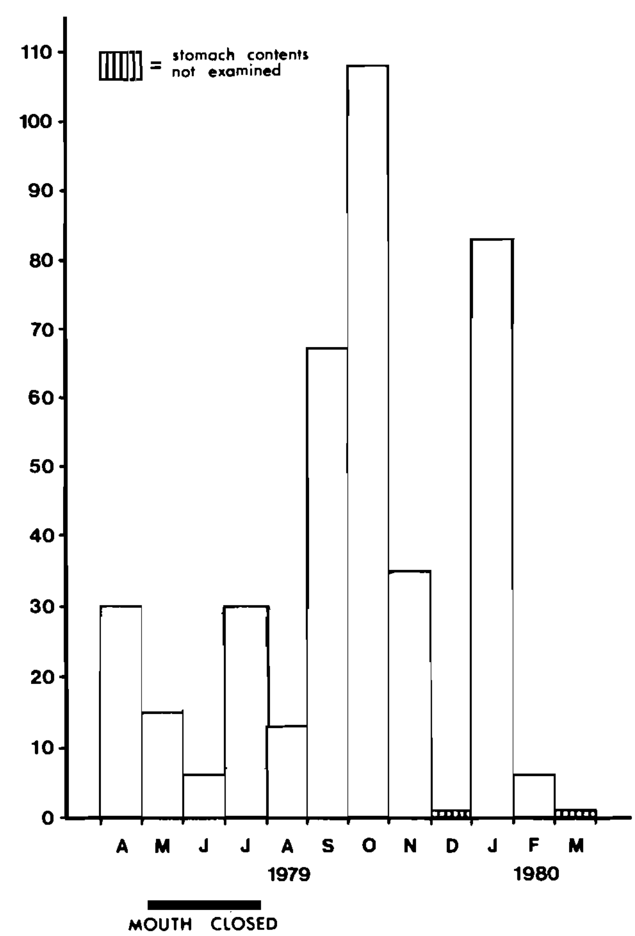

Figure 2 Monthly catches of *Galeichthyes feliceps* in the Swartvlei system from April 1979 to March 1980.

lengths for the different stations. Applying the least significant difference test procedure (Steel & Torrie 1960), significant differences were obtained between lengths for Stations 1 and 2 ($P < 0{,}001$) and Stations 1 and 3 ($P < 0{,}001$), but not between Stations 2 and 3 ($P > 0{,}05$). The higher mean length at Station 1 can be ascribed to the fact that 91,1% of the sea barbel caught at this station were adult males over 35 cm in length.

Of the 393 stomachs examined, 40,7% were empty, 41,2% contained only food items, 17,3% (all from male specimens collected between October 1979 and January 1980) contained only developing *G. feliceps* eggs or juveniles, and 0,8% (one juvenile and two adult male specimens) contained food items as well as *G. feliceps* eggs. In the latter case the eggs formed the major component (> 80%) of the stomach content.

G. feliceps eggs were the most abundant items (73,8% of the total content and 74% occurrence) in the stomachs of specimens collected at Station 1, the second most abundant (15,5% of the total content and 15% occurrence) at Station 2, and the fourth most abundant (9,9% of the total content and 10% occurrence) at Station 3. Since it is known that male *G. feliceps* carry the developing eggs in their mouths after spawning (Smith 1965; Van der Elst 1981; Day, Blaber & Wallace 1981) and swallow at least some of them in times of stress (Smith 1965), it was assumed that these eggs were accidentally swallowed while the fish were struggling to free themselves from the gill-nets. Eggs were therefore not regarded as food items and not included in Table 1. Similarly, four *G. feliceps* juveniles (TL 4,6 to 5,0 cm) that were the only

Table 1 Composition of the diet of 165 *Galeichthyes feliceps* collected in the Swartvlei system over the period April 1979 to March 1980 (*n* = number of stomachs, c = composition, o = occurrence, d = dominance, p = present, but mean < 0,05%). The length ranges of *G. feliceps* which ingested each food item are given in the last column

	Station 1 (*n* = 14)			Station 2 (*n* = 71)			Station 3 (*n* = 80)			Overall diet			Length ranges of
	%c	%o	%d	%c	%o	%d	%c	%o	%d	%c	%o	%d	*G. feliceps* (cm)
Algae				p	6	0	1,2	24	1	0,6	14	1	17,2–36,1
Submerged aquatic macrophytes	2,4	21	0	1,7	55	1	0,5	58	0	1,1	54	1	16,4–43,1
Nemertea	6,8	7	7							0,6	1	1	43,3
Nematoda				p	3	0				p	1	0	21,7
Polychaeta	0,8	21	0	p	1	0				0,1	2	0	16,4–40,7
Crustacea													
Ostracoda							p	8	0	p	4	0	20,4–35,8
Isopoda													
Cirolana spp. (including *C. fluviatilis*)				2,2	21	1	1,4	38	0	1,6	27	1	17,2–38,1
Cyathura estuaria				2,0	20	1	12,6	71	14	7,0	43	7	16,4–36,4
Exosphaeroma hylecoetes				1,2	27	0	0,3	23	0	0,7	22	0	16,4–35,8
Pseudosphaeroma barnardi				p	4	0	0,2	11	0	0,1	7	0	19,1–39,2
Unidentified isopods							p	1	0	p	1	0	30,3
Amphipoda													
Corophium triaenonyx	4,8	14	7	4,9	42	3	4,5	56	4	4,7	47	4	13,5–36,3
Grandidierella lignorum	0,2	14	0	12,5	61	14	3,9	36	4	7,2	45	8	16,4–38,3
Melita zeylanica				3,5	32	3	4,5	61	1	3,7	44	2	17,2–36,4
Talitridae							p	1	0	p	1	0	29,5
Unidentified amphipods				p	4	0				p	2	0	20,6–28,3
Mysidacea													
Rhopalophthalmus terranatalis							0,6	10	0	0,3	5	0	20,8–35,2
Tanaidacea													
Apseudes digitalis				p	1	0	0,6	23	0	0,3	12	0	19,7–32,7
Macrura													
Alpheus crassimanus	7,1	7	7							0,6	1	1	38,4
Palaemon pacificus	7,9	14	7	0,6	3	0				0,9	2	1	17,9–37,6
Anomura													
Callianassa kraussi	1,6	14	0	15,5	28	15				6,8	13	7	13,5–43,3
Brachyura													
Hymenosoma orbiculare	15,2	21	14	32,2	65	35	53,5	93	63	41,1	75	47	16,4–39,2
Unidentified decapod pieces	6,0	21	7	0,8	4	0				0,9	4	1	16,1–43,3
Insecta													
Chironomidae larvae				1,3	13	1	0,1	24	0	0,6	17	1	17,1–39,2
Chironomidae pupae				p	6	0	p	3	0	p	4	0	18,8–33,1
Odonata nymphs							2,3	23	1	1,1	11	1	20,4–39,2
Terrestrial insects				p	6	0	0,1	4	0	p	4	0	18,8–36,2
Unidentified larvae and pupae				p	1	0	p	5	0	p	3	0	17,5–36,3
Mollusca													
Gastropoda				p	3	0				p	1	0	17,5–19,9
Lamellibranchiata													
Musculus virgiliae				p	4	0	0,1	13	0	0,1	8	0	16,6–36,3
Cephalopoda	7,1	7	7							0,6	1	1	42,7
Echinodermata													
Holothuroidea	5,2	7	7							0,4	1	1	40,7
Tunicata													
Ascidiacea	14,2	21	14							1,2	2	1	36,8–40,7
Osteichthyes													
Fish eggs (not *G. feliceps*)				0,1	1	0				p	1	0	17,9
Unidentified fish larvae				p	1	0				p	1	0	39,0
Clinidae				7,7	10	8				3,3	4	4	17,9–39,0
Gobioidea	7,1	7	7	2,7	3	3	1,5	3	1	2,5	3	2	16,1–35,8
Unidentified pieces of fish	13,5	21	14	9,2	25	11	13,3	38	13	11,6	31	12	16,4–40,7
Unidentified material				0,1	1	0	p	3	0	p	2	0	18,6–33,1

items found in the stomachs of three males (TL 41,0 to 42,7 cm) collected at Stations 1 and 2 in January 1980, were not regarded as food items, since young sea barbel seek shelter in the mouths of the males for some time after hatching (Smith 1965).

The crown crab, *Hymenosoma orbiculare*, was the most important component of the diet of sea barbel at all three stations. It constituted 15,2% of the diet at Station 1, 32,2% at Station 2 and 53,5% at Station 3 (Table 1). The second and third most important food items at Station 1 were ascidians (14,2% of the total content) and unidentified pieces of fish (13,5% of the total content). At Station 2 these were respectively the burrowing sandprawn, *Callianassa kraussi* (15,5% of the total content), and the tube-dwelling amphipod, *Grandidierella lignorum* (12,5% of the total content). Although the latter formed a smaller percentage of the stomach contents from Station 2 than the sandprawn, it occurred in more than twice the number of stomachs (61% occurrence as compared to 28%). Three other food items also had a higher frequency of occurrence than the sandprawn, namely submerged aquatic macrophytes (55%) and two amphipods, *Corophium triaenonyx* (42%) and *Melita zeylanica* (32%).

In the upper reaches of the system at Station 3, unidentified pieces of fish formed the second most important food item (13,3% of the total content) and the isopod, *Cyathura estuaria,* the third (12,6% of the total content). However, *C. estuaria* occurred in 71% of the stomachs and was the dominant food item in 14% of these, as opposed to the unidentified pieces of fish which only occurred in 38% of the stomachs and were dominant in 13%. Other food items with a higher frequency of occurrence than unidentified pieces of fish were *Melita zeylanica* (61%), submerged aquatic macrophytes (58%) and *Corophium triaenonyx* (56%).

Overall, 41,1% of the food items consumed by *Galeichthyes feliceps* in the Swartvlei system consisted of *Hymenosoma orbiculare.* This crab occurred in 75% of the stomachs that contained food and was the dominant food item in 47% of these. It was ingested by specimens ranging from 16,4 to 39,2 cm in length. Unidentified pieces of fish formed the second most important food item (11,6% of the total content), followed by *Grandidierella lignorum* (7,2%). The former occurred in 31% and the latter in 45% of the stomachs. Submerged aquatic macrophytes, however, had the highest frequency of occurrence after *H. orbiculare* (54%). These macrophytes, as well as algae, were probably incidentally ingested when the sea barbel captured its prey. This would also be the case with the sand particles which formed a small proportion of the stomach content of some specimens. However, in contrast with the sand particles, this plant material with its associated periphyton (Howard-Williams & Allanson 1978) may have some nutritional value for the sea barbel and was therefore included in Table 1.

Discussion

Generally the diet of *G. feliceps* in the Swartvlei system agrees with what is known for other South African estuarine systems, which is given by Day *et al.* (1981) as mainly *Upogebia* and *Hymenosoma* (also the most important component in the Swartvlei system), as well as amphipods, gobies and small crabs. In certain eastern Cape estuaries the sea barbel is described as a scavenger which also consumes mysids, crabs, small fish and the mudprawn, *Upogebia africana* (Marais 1981), whereas along the coast of southern Africa it favours crayfish, although its diet also includes small fish and crabs (Van der Elst 1981). It appears therefore that *G. feliceps* feeds mainly on crustaceans and fish. Support for this is given by the present study where its diet consisted of 75,9% crustaceans and 17,4% fish by weight.

G. feliceps consumed predominantly benthic organisms in the Swartvlei system, which points to bottom-feeding habits. This is substantiated by Van der Elst (1981) who states that the sea barbel feeds exclusively on the bottom where its barbels are used to 'feel out' prey.

The diet for the different stations would depend on the availability and distribution of specific food items in the system. For example, marine organisms such as cephalopods, holothurians and ascidians were only found in stomachs of sea barbel caught at Station 1 near the mouth of the system. *H. orbiculare,* on the other hand, occurred in stomach contents from all three stations. This crab is common in the sea and in estuaries around southern Africa wherever the bottom consists of muddy sand (Day 1981). It also forms part of the relict estuarine fauna of Lake Sibaya, a freshwater lake of estuarine origin on the Kwazulu coast (Allanson, Hill, Boltt & Schultz 1966). It is interesting that *H. orbiculare* is also the main prey of a freshwater barbel, the sharptooth catfish, *Clarias gariepinus,* in this lake (Bruton 1979).

G. feliceps breeds both in the sea and in estuaries (Day *et al.* 1981), and although its reproduction fell outside the scope of this study, it did have a marked influence on the feeding habits of adult male sea barbel from October to January. During this period a relatively large number of adult males over 35 cm in total length (92,3% of the catches) were obtained from Station 1 near the mouth of the Swartvlei system. Of these 120 males, the stomachs of all except three specimens caught in October 1979 (TL 39,6 to 43,1 cm), were either completely empty (71 stomachs) or contained only developing *G. feliceps* eggs (46 stomachs). This suggests that male sea barbel carrying eggs in their mouths did not feed, which could explain the large proportion of empty male stomachs during this period as compared to the rest of the year. Just as some of the eggs were accidentally swallowed, many could have been lost during the efforts of the males to escape from the gill-nets.

Acknowledgements

We wish to thank the Director of the Cape Department of Nature and Environmental Conservation for permission to publish the results of this study. We are also grateful to Mr D.J. Hanekom for collecting the sea barbel stomachs and Mr M.S. de Klerk who gave technical assistance in the laboratory.

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