Fish community structures in *Zostera* and non-*Zostera* regions of the Kromme estuary, St Francis Bay

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Comparative seine netting for fish was performed quarterly during 1981 in the *Zostera* and non-*Zostera* regions of the upper middle reaches of the Kromme estuary. Twenty-four fish and three crustacean species were recorded. The catches were dominated by the following species: *Liza dumerili, Glossogobius giurus* and *Gilchristella aestuarius* (Pisces). Only two fish species (*Monodactylus falciformes* and *Rhabdosargus holubi*) were recorded in significantly ($P<0{,}05$; $P<0{,}05$ respectively) higher numbers in the *Zostera* than in the non-*Zostera* regions and community analyses (comparing numbers, species richness and diversity) revealed no significant ($P>0{,}05$) differences between the catches from the two regions. These results are contrary to findings of most other researchers and possible reasons for these differences are discussed.

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Die visgemeenskappe van *Zostera*- en non-*Zostera*-gebiede is gedurende 1981 kwartaalliks met treknette in die bo-middelgebied van die Krommegetyrivier gemonster. Die vangste is oorheers deur die aanwesigheid van die volgende visspesies: *Liza dumerili, Glossogobius giurus* en *Gilchristella aestuarius* (Pisces). Slegs twee visspesies (*Monodactylus aestuarius* en *Rhabdosargus holubi*) was in betekenisvol ($P<0{,}05$; $P<0{,}05$ onderskeidelik) hoër getalle aanwesig in *Zostera* as in non-*Zostera*-gebiede. Gemeenskapanalises (in terme van getalle, spesiesdiversiteit en -rykheid) dui geen betekenisvolle ($P>0{,}05$) verskille tussen die twee gebiede aan nie. Hierdie resultate is in teenstelling met die bevindings van ander navorsers en die moontlike redes vir hierdie verskille word bespreek.

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Eelgrass often provides food or protection for a variety of fish species (Adams 1976a) and its function in this respect has been extensively studied in coastal areas of America and Japan (see Carr & Adams 1973 and Kikuchi 1980 for reviews). Studies by Millard & Harrison (1954), Talbot (1955), Wallace & van der Elst (1975), Blaber (1977), Branch & Grindley (1979) and Beckley (1983) in South African estuaries suggested that eelgrass beds serve as nursery grounds for juvenile fish by having larger and more diverse populations than the surrounding non-vegetated regions. This study was designed to sample the fish populations found in the *Zostera* beds as well as in the non-*Zostera* regions in close proximity to vegetated areas. The aims were, firstly, to compare the numerical abundance and species diversity of fish communities in vegetated and non-vegetated areas and secondly, to comment on the role of *Zostera capensis* Setchell as shelter and food for juvenile fish in South African estuaries.

Study area

The Kromme estuary, situated at 34°09′S/24°51′E and approximately 55 km west of Port Elizabeth, was chosen for this study because of the presence of extensive *Zostera* growth (*ca* 14 ha) in the estuary. The estuary has a tidal range of approximately 13,7 km (Figure 1). It is relatively narrow in the upper and middle reaches, (*ca* 120 m wide) and confined between rocky or muddy banks, which are usually at least 0,5 m high. The banks on either side flatten out in the lower reaches where large intertidal sand banks are found. Sampling was performed in the upper middle reaches, as the largest inter- and subtidal eelgrass beds (*ca* 8 ha) occur here. Also, the substrates inside and outside the *Zostera capensis* beds were similar, namely a mixture of fine mud and shale.

Large epipsammic mats of *Chaetomorpha* were recorded in both the *Zostera* and non-*Zostera* areas of sites 2–4 (Figure 1), while odd tufts of *Codium* and *Gracilaria* were present throughout the year.

Material and Methods

Secchi-disc, surface-temperature and salinity readings were taken monthly from May 1980 to September 1981 in the main channel opposite sites 1 and 4N (Figure 1) and the mean values for the two sites are presented. Seine netting was performed quarterly (January, March, June and September 1981) at eight sites; four in the *Zostera* and four in the non-*Zostera* regions in the upper middle reaches of the estuary (Figure 1). At the beginning of the flood tide a 10 m long seine net, 2,5 m high and with a stretched mesh of 2 mm, was laid by hand in a

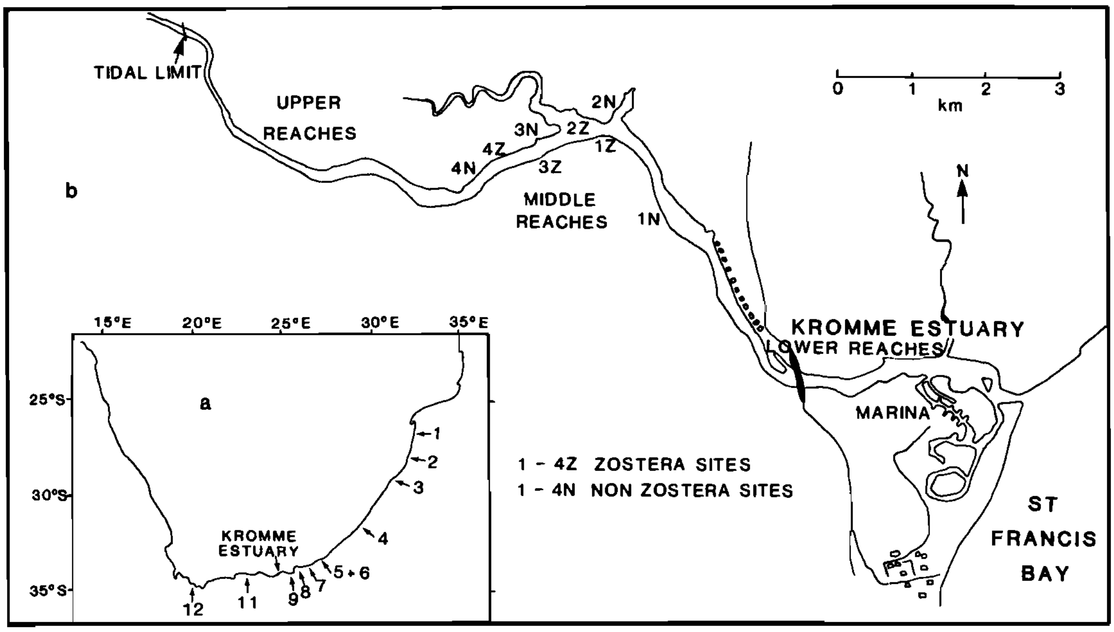

Figure 1 (a) Map of Southern Africa showing geographical position of estuaries mentioned in text (1 = Kosi Bay, 2 = St Lucia, 3 = Mlanga estuary, 4 = Mngazana estuary, 5 & 6 = West Kleinemond and Kasouga estuaries, 7 = Sundays estuary, 8 = Swartkops estuary, 9 = Gamtoos estuary, 11 = Swartvlei estuary, 12 = Klein River estuary). (b) The Kromme estuary showing sampling sites.

semi-circle. Each haul covered an area of approximately 30 m^2. The catch was analysed for species and the number of fish per species, and the standard length (SL) of the specimens was measured in mm. The very small mullet (SL < 30 mm) were difficult to identify and were grouped as Mugilidae.

Similarity and community analyses were performed on the results for all samples taken in the *Zostera* and non-*Zostera* regions over the entire sampling period. For similarity analyses the method of Bray & Curtis (1957) was used on the log of the numbers ($n + 1$) and a dendrogram was constructed, using group averages. In the community analyses the following indices were used:

(i) Species richness (R), where $R = S - 1/\log_e N$ (Margalef 1958), S = number of species and N = numbers;

(ii) Shannon-Weaver index of general diversity (H) where $H = \Sigma P_i \log_e P_i$ (Southwood 1978) and P_i is the proportion of the importance value of the i th species to the total of importance values;

(iii) Index of evenness (E) where $E = H/\log_e S$ (Pielou 1966), H is the Shannon-Weaver index and S is the number of individuals.

In March and June the dominant species in the *Zostera* beds were selected for stomach analyses. The stomachs were dissected and the food items identified using a stereomicroscope. They were divided into broad categories, such as molluscs and annelids, before being analysed in terms of the numerical and dominance methods (see Ricker 1971). The results of stomach-content analyses of this survey were compared with previous studies in other South African estuaries.

Results

The surface temperature and secchi-disc reading, recorded in the main channel of the middle reaches ranged from 13 – 27 °C and 1,3 – 0,1 m respectively, while the salinity values, which were normally about 33‰, dropped to 1‰ in June and September 1981 during floods (Figure 2).

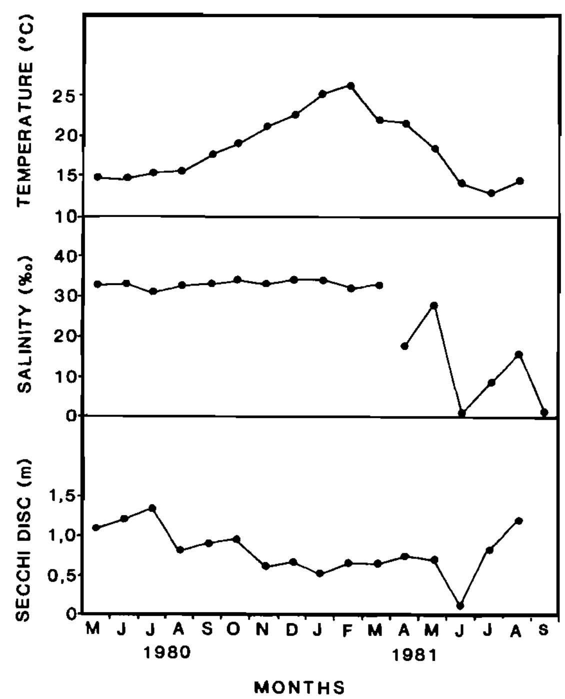

Figure 2 Monthly secchi-disc, surface salinity and temperature readings recorded in the upper middle reaches of the Kromme estuary.

Table 1 lists the species composition recorded at the different sites over the entire sampling period. A total of 24 fish species was netted. Seven species, namely *Caffrogobius multifasciatus* (Smith), *Gilchristella aestuarius* (Gilchrist), *Glossogobius giurus* (Hamilton-Buchanan), *Hepsetia breviceps* (Cuvier), *Liza dumerili* (Steindachner), *Liza richardsoni* (Smith) and *Rhabdosargus holubi* (Steindachner), were recorded at all sites. Three species of the family Sparidae, *Diplodus cervinus* (Valenciennes), *Lithognathus lithognathus* (Cuvier) and *Spondyliosoma emarginatum* (Cuvier) were recorded at only one sampling site and then always in non-*Zostera* regions. The most dominant species in terms of numbers were *L. dumerili*, *G. giurus*, *G. aestuarius* and *R. holubi*, representing 62, 14, 11 and 3% of the total catch respectively. Although certain species were caught in higher numbers in the *Zostera* than in the non-*Zostera* regions (Table 1), this trend was only significant for

Table 1 Total numbers caught in seine netting at the various sites in the *Zostera* and non-*Zostera* regions over the entire sampling period (January 1980 – September 1981). The numbers of fish from *Zostera* and non-*Zostera* areas are statistically compared in the last column (^{a} = $P < 0{,}05$, ^{b} = $P < 0{,}01$)

	Site 1		Site 2		Site 3		Site 4		Total		
	Zostera *n*	Non-*Zostera* *n*	*Zostera* *n*	Non-*Zostera* *n*	*Zostera* *n*	Non-*Zostera* *n*	*Zostera* *n*	Non-*Zostera* *n*	*Zostera* *n*	Non-*Zostera* *n*	Comparison value from *t*-test
Clinus superciliosus	6	–	1	–	–	1	1	–	8	1	1,17
Caffrogobius multifaciatus	48	17	84	34	53	40	31	43	216	131	1,55
Diplodus cervinus	–	1	–	–	–	–	–	–	–	1	1,00
Diplodus sargus	–	1	–	2	8	–	–	–	8	3	0,55
Gilchristella aestuarius	31	257	15	33	85	215	14	27	145	532	−1,90
Glossogobius giurus	286	221	433	117	308	482	507	80	1534	910	1,18
Hepsetia breviceps	19	69	6	168	150	1	58	16	233	253	−0,08
Heteromycetes capensis	20	19	–	16	–	1	–	2	20	36	1,16
Lichia amia	–	–	4	–	–	–	1	–	4	–	1,32
Lithognathus lithognathus	–	–	–	–	–	–	–	1	–	1	1,00
Liza dumerili	501	1001	16	1398	128	15	85	172	730	2586	−1,40
Liza richardsoni	3	8	–	–	–	–	2	–	8	8	0,00
Liza tricuspidens	6	8	–	–	–	–	2	–	8	8	0,00
Monodactylus falciformes	14	–	7	1	32	4	27	1	80	6	3,57^a
Mugil cephalus	53	25	15	1	6	12	9	3	83	30	1,47
Myxus capensis	3	–	–	–	–	–	–	1	3	1	0,58
Pomadasys commersonni	–	–	1	1	–	–	–	–	1	1	0,00
Pomadasys olivaceum	–	7	–	3	2	1	1	–	3	11	1,04
Psammogobius knysnaensis	–	9	32	32	146	5	30	115	225	161	0,25
Rhabdosargus holubi	103	48	35	13	199	26	152	73	489	160	2,54^a
Solea bleekeri	1	5	7	–	6	–	–	–	14	5	0,87
Spondyliosoma emarginatum	–	–	–	–	–	–	–	2	–	2	−1,00
Syngnathus acus	4	2	7	2	–	4	3	–	14	8	0,77
Tachysurus feliceps	–	–	1	–	–	–	8	–	9	–	1,17

two fish species, namely *Monodactylus falciformis* (Lacepede) ($P<0{,}05$) and *Rhabdosargus holubi* ($P<0{,}05$). There was no significant ($P>0{,}05$) pattern in the reverse situation, although *Gilchristella aestuarius, Liza dumerili, Liza richardsoni* and *Pomadasys olivaceum* (Day) were netted primarily in the non-*Zostera* regions (Table 1). The reduced salinities (*ca* 1‰) recorded in June and September 1981 did not significantly ($P>0{,}05$) affect the total number of fish species caught (Table 3).

The population structure and approximate size at sexual maturity of the various species netted in the *Zostera* and non-*Zostera* regions are given in Table 2. The size composition of the catches in the two regions was similar and virtually all the specimens of the various species netted were juveniles. However, adult forms of *Clinus superciliosus* (Linnaeus), *Psammogobius knysnaensis* and *Syngnathus acus* were recorded.

Fish from *Zostera* and non-*Zostera* regions did not always group separately from each other in the similarity analysis (Figure 3). Community analyses, which included the number of species caught and the indices of species diversity and richness of the catches from the two areas, showed no significant (P 0,05) difference, thus indicating that the composition of the catches from the two regions was similar.

Most of the fish analysed appeared to feed primarily on zoobenthos or zooplankton. In a few instances (less than 10% of the samples) small fragments of *Zostera* were found in the stomach contents of *C. multifasciatus* and *R. holubi* and the eelgrass often appeared to have been consumed accidently (Table 4). The results from other studies similarly indicated

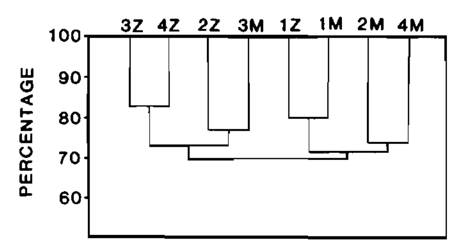

Figure 3 Dendrogram showing the similarity between the various seine-netting sites on a group average basis.

that few of the fish species found in *Zostera* beds of the Kromme were herbivorous (Table 4).

Discussion

The number of fish species netted in the *Zostera capensis* beds of the upper middle reaches of the Kromme estuary was low (20) compared to that (39) recorded by Beckley (1983) in the lower reaches of the Swartkops estuary (33°52'S/25°38'E) (Figure 1). In the samples from the Swartkops estuary, however, many of the fish occurred in very low numbers and 97% of the catch consisted of only 10 species namely, *Hepsetia breviceps* (Cuvier) (46%); four species of mullet *Mugil cephalus, L. dumerili, L. richardsoni* and *L. tricuspidens* (Smith) (together 20%); *R. holubi* (12%); *G. aestuarius* (9%); *Diplodus sargus* (6,5%) and two species of the Gobidae, *P. knysnaensis* and *C. multifasciatus* (together 3,5%). All the above species, with the exception of *D. sargus*, were domi-

Table 2 The approximate standard length (mm) and range, within which about 90% of population fell, is given for the various species netted, as well as the approximate size at sexual maturity and breeding location as taken from the literature ([a] = maximum size)

	Zostera		Non-*Zostera*		Size at		
	Median mm	Range mm	Median mm	Range mm	maturity mm	Site of breeding	Reference
Clinus superciliosus	82	64–93	79	79	65	estuaries/sea	Day *et al.* 1981.
Caffrogobius multifasciatus	43	23–63	44	23–66	150[a]	estuaries	Smith 1965, Beckley 1984.
Diplodus cervinus	–	–	55	55	250	sea	Van der Elst 1981.
Diplodus sargus	37	22–43	38	35–40	150	sea	Day *et al.* 1981.
Gilchristella aestuarius	30,5	18–36	31	19–37	145	estuaries	Talbot 1982.
Glossogobius giurus	31	20–47	27	16–44	55	estuaries	Day *et al.* 1981.
Hepsetia breviceps	30	19–41	27	13–44	70	sea	Beckley 1983
Heteromycetes capensis	29,5	22–41	32	25–41	150[a]	sea	Smith 1965.
Lichia amia	35	30–39	–	–	550	sea	Day *et al.* 1981.
Lithognathus lithognathus	15	15	–	–	550	sea	Day *et al.* 1981.
Liza dumerili	32	16–47	33	10–59	140–170	sea	Marais 1976.
Liza richardsoni	34	27–88	59	36–70	220–250	sea	Marais 1976.
Liza tricuspidens	60	50–90	59	52–67	470	sea	Van der Elst 1981.
Monodactylus falciformes	21,5	11–33	15	15	150	sea	Van der Elst 1981.
Mugil cephalus	25	19–70	29	16–32	450	sea	Day *et al.* 1981.
Myxus capensis	35	33–38	28	28		sea	
Pomadasys commersonni	65	65	96	96	370	sea	Wallace 1975.
Pomadasys olivaceum	60	53–65	61	43–80	150	sea	Day *et al.* 1981.
Psammogobius knysnaensis	39	16–60	24	16–38	65[a]	estuaries	Day *et al.* 1981; Beckley 1984.
Rhabdosargus holubi	20	14–55	24	14–63	150	sea	Day *et al.* 1981.
Solea bleekeri	63	60–67	35	25–62	100	estuaries/sea	Day *et al.* 1981; Beckley 1984.
Spondyliosoma emarginatum	–	–	20	19–22	220	sea	Van der Elst 1981.
Syngnathus acus	120	56–193	145	115–170	130	estuaries	Day *et al.* 1981.
Tachysurus feliceps	51	40–43	–	–	280	estuaries/sea	Marais (pers. comm.).

Table 3 The number of individuals and species of fish as well as the indices of species richness, (Shannons) diversity and evenness (calculated from numbers) recorded from the combined results of all sites in the *Zostera* and non-*Zostera* regions respectively, on the various sampling dates are given and the values from the two regions are compared

	January 1981		March 1981		June 1981		September 1981						
	Zostera	Non-*Zostera*	*Zostera*	Non-*Zostera*	*Zostera*	Non-*Zostera*	*Zostera*	Non-*Zostera*	*Zostera*		Non-*Zostera*		Comparison value from *t*-test
	All sites	All sites	All sites	All sites	All sites	All sites	All sites	All sites	Mean	S.D.	Mean	S.D.	($P < 0{,}05$)
Number of individuals	788	518	636	2 384	1 891	952	524	1 118	960	630	1 234	802	–0,56
Number of species	13	17	13	14	12	11	13	13	12,8	0,5	13,8	2,5	0,78
Species richness	1,80	2,56	1,86	1,67	1,46	1,46	1,92	1,71	1,76	0,21	1,85	0,49	0,34
Shannons diversity	3,81	4,25	3,82	3,90	3,58	3,46	3,70	3,70	3,73	0,11	3,83	0,33	0,58
Evenness	1,44	1,44	1,44	1,44	1,44	1,44	1,44	1,44	1,44	–	1,44	–	–

nant species in the Kromme estuary surveys and as a group, together with *Glossogobius giurus*, formed 96% of the total fish catch (Table 1). The major differences between the results from the Swartkops and Kromme estuaries were the relative numbers of *D. sargus* and *G. giurus*. This would appear to be a result of the positioning of the sampling sites within the two estuaries, as well as the low salinities experienced in June and September during this survey. *D. sargus* is primarily an inshore marine species (van der Elst 1981) and although the juveniles often seek shelter in estuaries (Day, Blaber & Wallace 1981) they would presumably remain in the stable salinity environment of the lower reaches. Winter (1979) recorded a marked reduction in their numbers in the Swartkops estuary after floods. The reverse situation appears to hold for *Glossogobius giurus*. Malan (1979) found this species exclusively in the upper reaches of the Swartkops estuary and was therefore absent from the catches of Beckley (1983) while it was abundant in those of this survey (Table 1). Adams (1976b) also found that the estuarine fish communities associated with *Zostera marina* beds in North Carolina were characterized by a low species diversity, but high number per species.

The population structure of the various fish species netted in the *Zostera* and non-*Zostera* regions of the Kromme estuary were similar and virtually all the specimens caught were juvenile or immature forms (Table 2). It was only in the case of *Clinus superciliosus*, *Psammogobius knysnaensis* and *Syngnathus acus* where adult forms were recorded. These three species together with *Caffrogobius multifasciatus*, *Gilchristella aestuarius*,

Table 4 Results of stomach analysis of some of the fish caught in the *Zostera* beds, using (a) the numerical and (b) the dominance methods (number of full stomachs analysed given by figure in brackets)

Species	Algae	Macrophytes *Zostera*	Zooplankton Copepods + Ostracods	Macrurans	Zoobenthos: Isopods + Amphipods + Tanaidaceans + Cumaceans	Zoobenthos: Anomurans + Brachyurans	Zoobenthos: Molluscs	Zoobenthos: Annelids	Insects
C. multifasciatus (33)									
(a) numerical	4	4	13	1	62	15	–	–	–
(b) dominance	9	9	9	3	49	30	–	–	–
G. giurus (21)									
(a) numerical	–	–	26	11	61	2	–	–	–
(b) dominance	–	–	14	24	62	5	–	–	–
H. breviceps (5)									
(a) numerical	–	–	–	–	–	–	–	–	100
(b) dominance	–	–	–	–	–	–	–	–	100
M. falciformes (19)									
(a) numerical	–	–	79	1	20	–	–	–	–
(b) dominance	–	–	84	5	58	–	–	–	–
P. knysnaensis (28)									
(a) numerical	1	–	26	–	67	–	–	6	–
(b) dominance	4	–	29	–	82	–	–	18	–
R. holubi (28)									
(a) numerical	76[a]	10	–	–	–	7	7	–	–
(b) dominance	89[a]	11	–	–	–	7	7	–	–
S. acus (2)									
(a) numerical	–	–	–	100	–	–	–	–	–
(b) dominance	–	–	–	100	–	–	–	–	–

[a]Mainly *Chaetomorpha* sp. *Cladophora* sp.

Glossogobius guirus, Solea bleekeri and *Tachysurus feliceps* were also the only species caught which apparently breed in the estuary. The rest appear to spawn at sea (Table 2). The seasonal breeding cycles of these fish and the occurrence of the juveniles in the Swartkops and Sundays estuaries have been reported by Beckley (1983, 1984).

Similarity analyses revealed no significant difference ($P>0{,}05$) between the number of individuals, species or in the indices of diversity and species richness of the catches from the *Zostera* and non-*Zostera* regions (Table 3). This was contrary to the findings of most researchers in Southern Africa. Millard & Harrison (1954), Wallace & van der Elst (1975) and Beckley (1983), seine netting in Richards Bay, St Lucia and Swartkops estuary respectively, recorded a greater fish diversity and number in the *Zostera* than in the non-*Zostera* regions. regions.

However, it was felt that other factors, beside the presence or absence of *Zostera* might have influenced the above results. In Beckley's (1983) study of the Swartkops estuary, for example, all the *Zostera* stations sampled were in sheltered muddy creeks, while samples in the non-*Zostera* regions were taken in the more turbulent sandy regions, bordering the main channel of the estuary. Thus substrate and current strength rather than the presence of *Zostera* might have influenced those results. In fact Winter (1979), seine netting close to the non-*Zostera* site of Beckley (1983), recorded much lower numbers of fish per haul, than he did for two other non-*Zostera* stations in the same estuary.

Quantitative netting for juvenile fish over a variety of substrates in the Mngazana estuary (31°42'S/29°25'E) was performed by Branch & Grindley (1979). The species diversity and abundance recorded in those *Zostera* beds was at least four times greater than in any other area sampled. The water in the Mngazana estuary is remarkably clear, especially in the mouth area, where the secchi-disc readings ranged from about 0,5 to 3,5 m (Branch & Grindley 1979) and the importance of *Zostera* as shelter may have been accentuated. Day & Grindley (1981) have cited certain phenomena which tend to indicate that a suspended silt load may be advantageous in limiting predation. Similarly, Blaber & Blaber (1980) suggest that juvenile fish in Moreton Bay are attracted to shallow turbid waters. Gill-net catches in the channel-like Sundays (33°43'S/25°51'E) and Gamtoos (33°59'S/26°57'E) estuaries, both of which had limited *Zostera* beds of less than 0,5 ha (Marais 1981; Marais pers. comm.) and turbid waters (secchi-disc reading of about 0,3 m and 0,5 m respectively) (Day 1981; Marais 1983b), were larger than those in the Swartkops and Kromme estuaries, which had large *Zostera* beds (*ca* 1 and 14 ha respectively). (Bate G.C. pers. comm.; Hanekom 1982) and clear water (secchi-disc reading of about 1,3 and 0,8 respectively) McLachlan (1972) and Figure 2. The number of species netted in the above estuaries was 26, 22, 21 and 23 respectively, while the catch per unit effort in terms of mass was 33, 21, 13 and 18 kg/haul and 23, 43, 25 and 27 in numbers/haul respectively (Marais 1981, 1983a, 1983b; Marais & Baird 1980). Although the gill-nets tend to be selective for fairly large fish the above results would suggest that *Zostera* beds are not a prerequisite for the presence of large and diverse fish populations in estuaries. In estuaries with clear water, however, submerged macrophytes probably provide essential shelter for the smaller fish, but the importance of this shelter may be reduced with increasing turbidity.

Most of the dominant fish species recorded in the *Zostera* beds of the Kromme and Swartkops estuaries apparently feed primarily on zoobenthos, zooplankton or benthic floc and only a few on macrophytic plants and algae (Table 4). Organisms occurring near or on the water/substrate/plant interface are collectively grouped as zoobenthos; it is also accepted that some may become planktonic after dark. The juveniles of the latter fish species (*Rhabdosargus globiceps, R. holubi, Salpa salpa, Diplodus sargus* and *D. cervinus*) were all tentatively studied by Talbot (1955) in the Klein River estuary (34°25′S/19°18′E) and found to be omnivorous. They cropped plants such as *Zostera capensis, Ruppia maritina* and filamentous algae (mainly *Enteromorpha* spp.) as well as feeding on small crustaceans, polychaetes and molluscs. Of the above species, *R. globiceps*, was the only fish extensively worked on by Talbot (1955) and his results showed that the plant material grazed consisted primarily of filamentous algae (*ca* 40% of total diet), while only small amounts of *Zostera* were taken (*ca* 6% of total diet). Although juveniles of *R. globiceps* frequent estuaries, they are found primarily in the cool waters of, or close to the west coast of southern Africa (van der Elst 1981) and were thus recorded in low numbers and as absent in the Swartkops (Beckley 1983) and Kromme estuaries respectively (Table 1).

R. holubi, which is found in warmer waters than *R. globiceps* (van der Elst 1981), constituted approximately 3 and 12% (by numbers) of the respective catches in the *Zostera* beds of the Kromme and Swartkops estuaries (Table 1; Beckley 1983). This fish species was recorded almost exclusively in the vegetated regions (*Potamogeton* and filamentous algal beds) of the Swartvlei lake (34°00′S/28°48′E) by Whitfield (1982) and was netted in significantly higher numbers in the *Zostera* than in the non-*Zostera* regions of the Kromme estuary (Table 1). Studies by Blaber (1974) on the diet of juvenile *R. holubi* in the West Kleinemond (33°33′S/27°02′E) and Kasouga (33°39′S/26°44′E) estuaries revealed a predominance of the grass *Ruppia spiralis* in stomach contents. The latter apparently passes through the alimentary canal unaltered, but is stripped of epiphytic diatoms. In the Kromme estuary, where *R. spiralis* is replaced by *Z. capensis*, juvenile *R. holubi* appeared to graze mainly (*ca* 80%) on filamentous algae (such as *Chaetomorpha* and *Cladophora*) rather than on *Z. capensis*. Similarly, the stomach content of *R. holubi* in the Swartvlei estuary apparently consisted almost exclusively of filamentous algae and diatoms associated with the *Zostera* and *Ruppia* beds (Whitfield 1982). It would thus seem that *Zostera* might not be extensively grazed by this fish species.

The other fishes, *Diplodus sargus, D. cervinus* and *Salpa salpa*, which apparently feed on eelgrass (see above) are primarily marine species, with only the juvenile forms tending to be found in estuaries (see Day *et al.* 1981; van der Elst 1981; Beckley 1983, 1984). Except for *D. sargus* the numbers entering the east Cape estuaries appear to be small (see Winter 1979; Marais & Baird 1980; Baird, Marais & Wooldridge 1981; Marais 1981, 1983a, 1983b; Beckley 1983, 1984) and although they are apparently omnivorous (Talbot 1955; van der Elst 1981), their intake of *Z. capensis* is not known.

Monodactylus falciformes was caught in significantly ($P < 0,05$) higher numbers in *Zostera* than in the non-*Zostera* regions of the Kromme estuary, but the numbers netted were relatively small (Table 1). It was also listed as infrequent in the *Zostera* beds of the lower reaches of the Swartkops estuary by Beckley (1983). Large numbers of juvenile *M. falciformes* were, however, recorded in the *Potamogeton* beds, found in the reduced salinities at the head of the Sundays estuary and in the Swartvlei lake (Beckley 1984; Whitfield 1982), suggesting that *M. falciformes* prefer low salinities and are therefore probably not abundant in *Zostera* beds. Although *M. falciformes* did not graze on plant material, but fed primarily on isopods and bivalves, the senescence of the *Potamogeton* beds in the littoral zone of the Swartvlei lake resulted in a significant ($P < 0,05$) decrease in their numbers and a change in diet (Whitfield 1982). This suggested that the *Potamogeton* beds supplied an important habitat or food source for this species.

Carr & Adams (1973) working in Florida stated that the most conspicuous feature of a seagrass bed is the large standing crop of seagrass algae and associated epiphytic algae, yet so few fish species, either adults of juveniles are herbivorous. This seems to be the general finding in the temperate regions (Ogden 1980). However, Whitfield (1982) has shown that the food chain in both the Mhlanga and Swartvlei systems in Southern Africa is based on detritus. *Zostera* may be an important source of detrital food and this aspect should be investigated in future studies.

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