Seasonal abundance, distribution and catch per unit effort of fishes in the Krom estuary, South Africa

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Seasonal abundance, distribution and catch per unit effort were determined by means of gill-nets for fishes in the Krom estuary. The leervis *Lichia amia*, which was more abundant during the summer than the winter months, predominated in the catches, followed by the sea-catfish *Tachysurus feliceps*, which breeds in the estuary. The mean catch per unit effort for the estuary was 17,5 kg which is more than in the Swartkops estuary (13,1 kg) but less than in the Sundays (20,5 kg) and Gamtoos (33,3 kg) estuaries. Catch composition in the marina canals was similar to that of the estuary proper. The estuarine water is well mixed with a high salinity throughout the estuary when floods do not occur.

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Seisoenale verspreiding, voorkeurgebied en vangs per eenheid poging is deur middel van kiefnette bepaal vir die visse van die Krom-getyrivier. Vangste is oorheers deur die leervis *Lichia amia*, wat veral in groter getalle gedurende die somer voorgekom het. Seebarbers *Tachysurus feliceps*, wat in die getyrivier broei, het die tweede meeste voorgekom. Die gemiddelde vangs per eenheid poging vir die getyrivier was 17,5 kg. Dit is meer as die Swartkops- (13,1 kg) maar minder as die Sondags- (20,5 kg) en Gamtoos- (33,3 kg) getyriviere. Die samestelling van vangste in die mensgemaakte strandmeer, in die toegangskanaal tot die marina-kanaalstelsel, was soortgelyk aan dié van die getyrivier. Die water van die getyrivier is goed vermeng met 'n relatief hoë soutgehalte wanneer vloede nie voorkom nie.

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Little work has been published to date on the biotic and abiotic features of the Krom estuary in the Eastern Cape Province. Hecht (1973) briefly described the estuary in an unpublished thesis and more recently Baird, Marais & Wooldridge (1981) reported on the influence of the marina canal system on the ecology of the estuary. Day (1981) included a note on the ecology of the estuary and Hanekom (1982) has completed a comprehensive ecological study on the *Zostera* beds of this estuary.

The aim of the present study was to obtain information on the larger fishes of the Krom estuary from gill-net catches. By comparing the results with those obtained in other Eastern Cape estuaries such as the Swartkops, Sundays and Gamtoos it is hoped to gain a better understanding of the many factors that determine fish abundance in estuaries. Knowledge of the animal and plant communities in the estuary would also allow an evaluation of the effects of a second water supply dam in particular, as well as the recently completed road bridge and marina canal system, on the viability of the estuary in future. At the moment no industrial pollution occurs in the estuary and it is regarded by Day (1981) as a marine-dominated estuary with a rich fauna.

Description of estuary

The Krom River originates in the Tsitsikamma mountains, flows through the Langkloof and eventually down a series of rapids. Sea water penetrates to approximately 14 km from the estuarine mouth. The water of the main tributary, the Dwars River, is impounded by the Churchill dam approximately 55 km west of the mouth (Figure 1). A second dam, the Elandsjacht, is under construction closer to the sea.

The narrow, upper part of the estuary (± 2,5 km) is bounded on either side by rocky cliffs but nearer to the sea the estuary broadens and the slopes on either side become less steep. Below the confluence of the Krom and Geelhoutboom Rivers (approximately 8 km from the mouth) the flood plain is wide particularly on the south bank.

On the south bank, intertidal mud-flats not wider than 20 m and covered by typical salt marsh vegetation extend to about 4,5 km from the mouth (Hecht 1973). The mudflats give way to a small sandy area which stretches downstream for approximately 0,5 km before changing to mud-

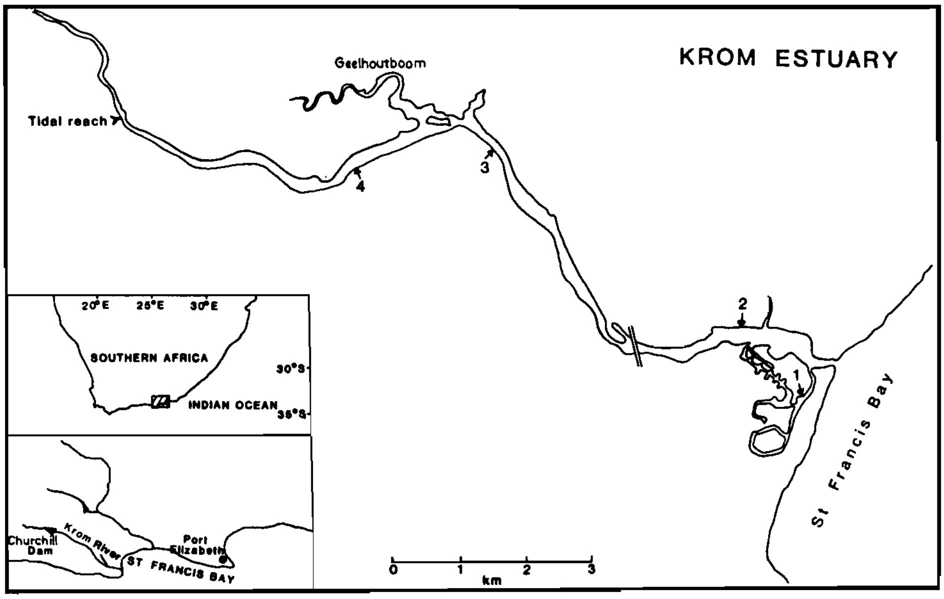

Figure 1 Geographical position of Krom estuary and position of sampling sites.

flats again. The intertidal zone changes rather abruptly from a muddy substrate to shalestone, extending to 2 km from the mouth. The last 2 km of the intertidal area to the mouth on the south bank consist of a sandy substrate.

The rocky slope of the north bank is covered by dense bush and, with the exception of a few areas where it is interrupted by small muddy and sandy banks, reaches down to the water's edge until about 7,5 km from the mouth. A narrow mud-flat, not exceeding 7 m in width and containing much shalestone, extends further downstream until shalestone completely dominates the intertidal zone to approximately 3,6 km from the mouth. The shalestone then suddenly changes into the only extensive mud-flat of the Krom estuary (1,8 km long and 1,5 km wide at its widest point). The mud-flat continues to about 2 km from the mouth where the bank reverts to shalestone again. At about 0,75 km from the mouth it changes to a clean sandy substrate.

Methods

Catch per unit effort (CPUE) of fish in the Krom estuary was obtained by means of gill-nets. Each net consisted of five 10-m sections, 3 m deep with stretched mesh sizes of 55; 70; 85; 110 and 145 mm covering an area of 150 m^2. The nets were set for 12-h periods (from dusk till dawn) across the estuary during week days when boat traffic was minimal. Exactly the same method was employed by Marais & Baird (1980) in the Swartkops estuary and Marais (1981, 1983) in the Sundays and Gamtoos estuaries respectively.

Nets were set in the marina canal system (Station 1, Figure 1), the lower reaches (Station 2), the middle reaches (Station 3) and the upper reaches (Station 4). The division of the estuary is according to Hecht (1973).

A number of catches were made at irregular intervals at Stations 1, 2 and 4 from February 1977 to October 1979 and at monthly intervals from November 1979 to November 1980. Monthly netting at Station 3 commenced in December 1979 but could not be carried out during March, April and May 1980 because of a delay in the replacement of a stolen net.

Salinity of surface and bottom water was measured by a refractometer in the morning prior to lifting of the nets at each station. Temperature of surface and bottom water was measured with a mercury thermometer accurate to 0,1 °C. Water turbidity was measured on three occasions at all sampling stations using a secchi disc, 20 cm in diameter. Water depth was also recorded on these occasions.

Results

Mean (when sampling took place on more than one occasion) monthly water temperature and salinity at Stations 1 – 4 (Figures 2 – 5 respectively) show that the estuarine water is well mixed, as surface and bottom temperatures and salinities differed very little. Highest temperatures were recorded during the summer months January – March and the lowest during the winter months May – August.

Salinity at Stations 1 – 3 was high throughout the year and never dropped below 30°/‰ (Figures 2 – 4). At Station 4 this occurred on four occasions (Figure 5). Lowest salinity values were recorded during the winter months when evaporation rate is lowest. As in the case of temperature little difference was found between surface and bottom water salinity.

Light penetration at three of the four stations was very good. The mean secchi-disc recordings were: Station 1: 1,6 m; Station 2: 1,8 m; Station 3: 0,85 m and Station 4: 1,1 m. Mean water depths, measured at mid-tide, were: Station 1: 2 m; Station 2: 2,1 m; Station 3: 3,5 m and Station 4: 3m.

CPUE expressed in terms of number and mass of fish caught per gill-net at the different catch positions is given in Table 1. In terms of numbers and mass the most dominant species was the leervis *Lichia amia*, followed by the sea-catfish *Tachysurus feliceps*. These two species contributed more than 50% of the total mass of fish caught. The family Mugilidae was third numerically, followed by

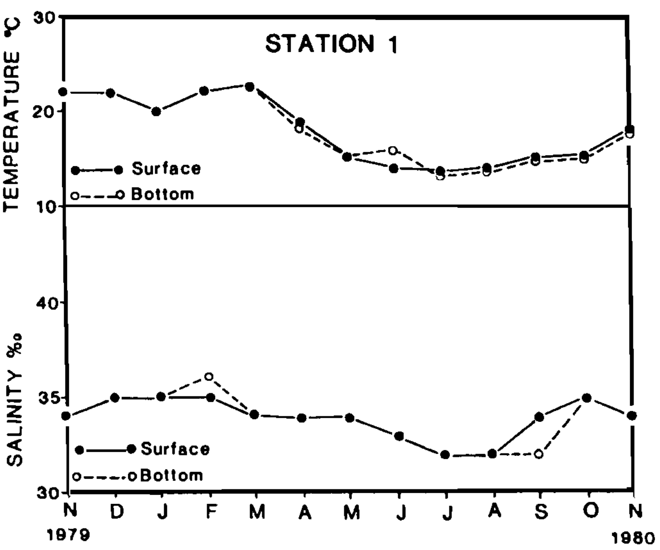

Figure 2 Surface and bottom water temperature and salinity values recorded at Station 1 in the marina lagoon.

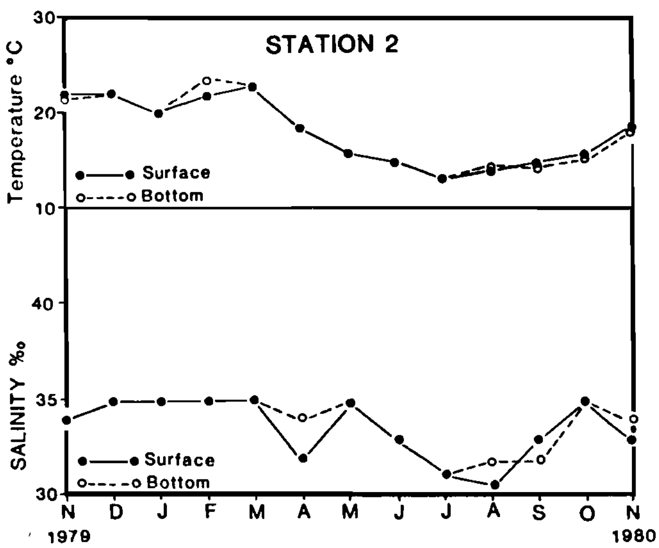

Figure 3 Surface and bottom water temperature and salinity values recorded at Station 2 in the mouth region of the Krom estuary.

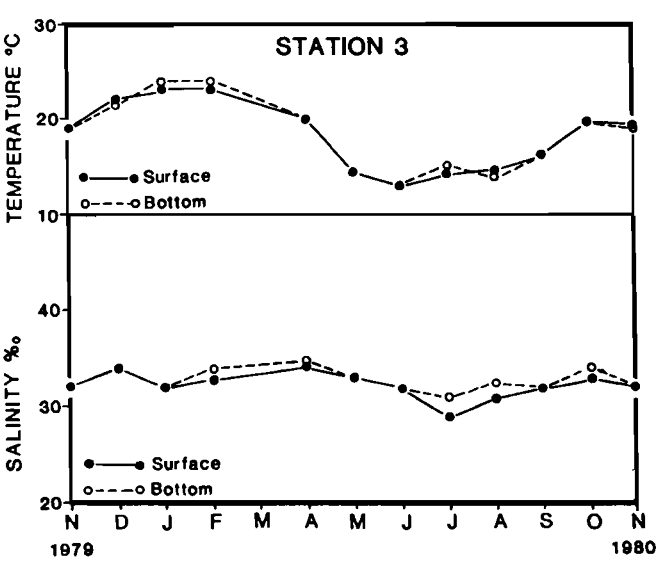

Figure 4 Surface and bottom water temperature and salinity values recorded at Station 3 in the middle reaches of the Krom estuary.

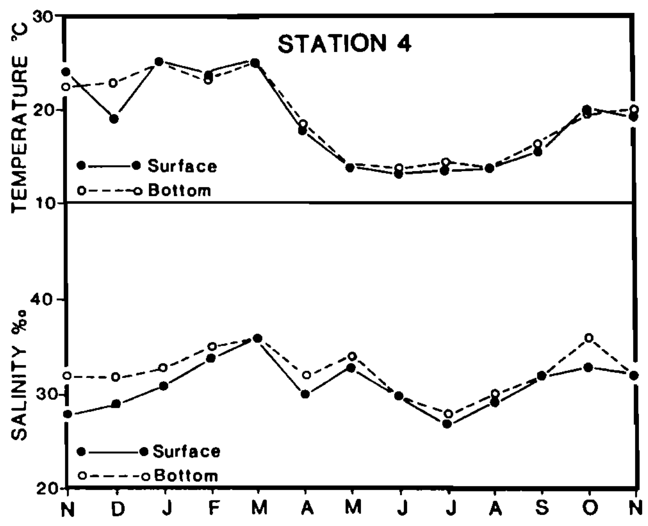

Figure 5 Surface and bottom water temperature values recorded at Station 4 in the upper reaches of the Krom estuary.

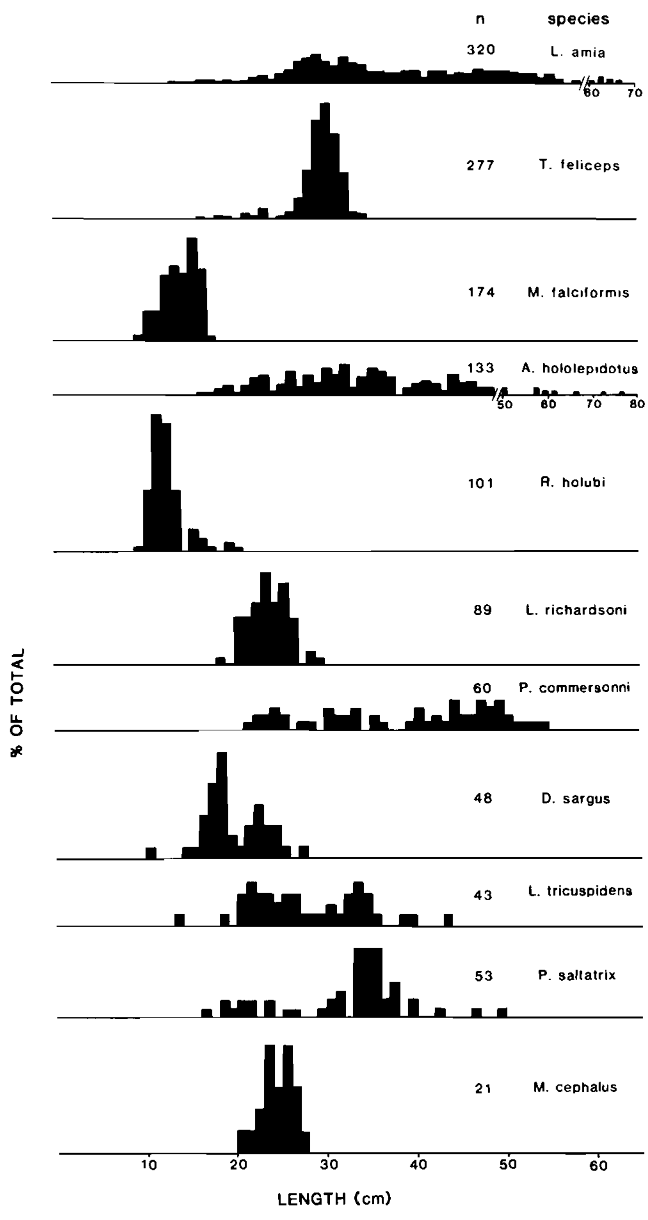

Figure 6 Size frequency distribution of 11 most abundant species caught by means of gill-nets in the Krom estuary.

Table 1 CPUE (number and mass) of fish caught per gill-net at four localities in the Krom estuary. Total number and mass, mean number and mass per net as well as mean individual body mass are also given for fish caught in the estuary itself (Stations 2 – 4)

	Station 1 16[a]		Station 2 20[a]		Station 3 9[a]		Station 4 16[a]		Total 45[a]		Mean		Mean mass
Species	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n* per net	mass (g) per net	(g) per indiv.
Lichia amia	0,2	162	8,5	7895	2,8	2319	7,6	7267	317	295035	6,9	6414	931
Tachysurus feliceps	1,2	583	7,8	3983	3,9	1853	4,2	2042	259	129030	5,6	2805	498
Liza richardsoni	0,8	197	2,1	610	0,4	135	1,9	486	76	21193	1,7	461	279
Liza tricuspidens	0,3	298	1,7	653			0,4	178	40	15901	0,9	346	398
Mugil cephalus	0,1	18	0,5	179	0,4	188	0,4	164	20	7889	0,4	172	394
Liza dumerili	0,1	23					0,4	70	6	1124	0,1	24	187
Valamugil buchanani							0,1	117	1	1869	0,02	41	1869
Mugilidae	1,3	535	4,2	1442	0,9	323	3,3	1014	143	47976	3,1	1043	335
Monodactylus falciformis	2,1	273	2,9	1074	5,0	806	2,4	268	141	33020	3,1	718	234
Rhabdosargus holubi	0,6	49	4,1	373	0,2	39	0,4	40	91	8447	2,0	184	93
Argyrosomus hololepidotus	3,3	2261	0,7	212	3,4	4013	2,3	2606	81	82061	1,8	1784	1013
Pomadasys commersonni	0,6	641	0,9	1003	0,8	1265	1,7	2610	51	73220	1,1	1591	1436
Myliobatus aquila	1,5	954	1,1	932	1,2	1110	0	437	46	35513	1,0	774	774
Pomatomus saltatrix	0,6	217	1,6	1068	0,2	175	0,6	451	43	30145	0,9	655	701
Diplodus sargus	0,1	13	2,1	721					41	14421	0,9	314	351
Elops machnata			0,1	196	0,3	711	0,1	477	6	17940	0,1	390	2990
Dasyatus brevicaudatus			0,1	186			0,3	1903	5	34200	0,1	743	6840
Sarpa salpa			0,2	25					4	493	0,1	11	123
Pomadasys olivaceum			0,1	7					2	133	0,04	3	67
Rhinobatos annulatus					0,1	144			1	1297	0,02	28	1297
Acanthopagrus berda			0,1	20					1	408	0,02	9	408
Lithognathus lithognathus	0,3	65					0,1	10	1	159	0,02	3	159
Aetobatus narinari	0,1	281											
Diplodus cervinus	0,1	4											
	11,8	6038	34,2	19139	18,9	12758	23,8	19125	1233	803598	26,8	17470	652

[a]No. of nets

the Cape moony *Monodactylus falciformis*, the Cape stumpnose *Rhabdosargus holubi* and the kob *Argyrosomus hololepidotus*. In terms of mass, however, *A. hololepidotus* was third, followed by the spotted grunter *Pomadasys commersonni*.

Stations 2 and 4 both yielded a mean catch of 19 kg per net although 10 more fish were caught per net in the mouth area (Station 2) than in the upper reaches (Station 4). The middle reaches yielded a mean catch of 12,7 kg and Station 1 in the marina lagoon a mean catch of only 6 kg. Apart from lower numbers and mass of leervis and sea-catfish, catch composition at the entrance to the marina canal system (Figure 1) was similar to that at the other stations (Table 1).

Largest mean body mass was registered for short-tail stingray, *Dasyatus brevicaudatus* (6,8 kg), the tenpounder *Elops machnata* (3 kg), one specimen of blue-tail mullet, *Valamugil buchanani* (1,9 kg) and *P. commersonni* (1,4 kg). Species with the lowest mean body mass were the gorrie *Pomadasys olivaceum* (67 g), Cape moony (93 g) and the strepie *Sarpa salpa* (123 g).

Table 2 shows that CPUE during the winter and spring months (from May – October) was considerably lower than during the summer months (November – April).

Size frequency distribution histograms (Figure 6) show that in large species such as *A. hololepidotus, L. amia, P. commersonni* and elf *Pomatomus saltatrix* an extended size range was caught by the nets (Figure 6). On the other hand, the smaller species such as *R. holubi, M. falciformis, T. feliceps* and the mullets *Mugil cephalus* and *Liza richardsoni* occurred over a restricted size range.

Discussion

The water temperature of the Krom estuary reflects the temperate climate of the area; it ranged from 13 °C to 25 °C. In general, values were very similar to those recorded in the Swartkops estuary (McLachlan & Grindley 1974; Marais & Baird 1980) and the Sundays estuary (Marais 1981).

Salinity was generally high at three of the four stations with only four recorded values of below 30°/₀₀ in the upper reaches. Salinity values in the Swartkops estuary are also high throughout the estuary when floods do not occur (McLachlan & Grindley 1974) but over an extended period, values are lower near the head of the Krom estuary than in the Swartkops estuary (Marais 1976). Although the present study was performed during a 'normal' period with no floods, floods do occasionally occur and may have a drastic effect on salinity. Such floods occurred during 1972 (Hecht

Table 2 Mean numbers and mass of fish caught per gill-net at four localities in the Krom estuary

	January 7[a]		February 4[a]		March 3[a]		April 3[a]		May 8[a]		June 4[a]		July 4[a]		August 4[a]		September 4[a]		October 6[a]		November 10[a]		December 4[a]	
Species	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)	*n*	mass (g)
Lichia amia	5,1	7357	4,8	2917	10,0	6409	13,3	6623	0,6	278	0,8	366	8,2	3193							9,3	13857	15,3	14204
Tachysurus feliceps	4,9	2356	5,5	1996	0,3	152	2,6	1333	3,6	1440	1,8	966	1,0	458	0,5	322	3,3	2034	5,0	2625	9,1	4946	9,3	4393
Liza richardsoni	1,0	289	1,5	428					1,4	385	0,5	143	2,0	442	0,5	127	1,0	230	3,8	1189	1,1	278	1,5	405
Liza tricuspidens	0,3	75			0,3	160	0,3	73	3,5	1405			0,3	465			0,3	67	0,2	25	0,4	316	1,3	683
Mugil cephalus	0,9	288	2,3	828	0,3	123			0,3	85	0,3	81			0,3	151			0,2	73	0,1	44		
Liza dumerili	0,1	25			1,3	365	2,0	436	0,1	25											0,2	36	0,8	146
Valamugil buchanani												.									0,1	187		
Mugilidae	2,3	677	3,8	1256	1,9	648	2,3	509	5,3	1900	0,8	224	2,3	907	0,8	278	1,3	297	4,2	1287	1,9	861	3,6	1234
Monodactylus falciformes	0,4	49	0,5	33	4,3	596	7,3	913	2,1	271	8,0	1356	6,8	845	4,3	774	5,5	849	1,0	133	0,5	48	2,0	279
Rhabdosargus holubi	0,4	88	1,3	148	1,0	58	0,7	44	6,9	552	0,3	18					0,3	14	4,5	413	0,4	37	0,3	83
Argyrosomus hololepidotus	2,0	1192	3,3	1665	4,7	4112	2,3	1545	1,8	924	2,5	2857	1,5	1826	1,0	1840	0,8	563	0,7	738	2,8	3399	4,0	3482
Pomadasys commersonni	0,7	470	1,0	1628	1,5	4757	0,7	907	0,1	239	1,8	964			0,3	138			2,5	3210	1,1	1862	2,0	3134
Myliobatus aquila	0,3	329	0,5	157	5,3	2227	3,3	1543	0,4	182	1,3	477	0,3	116	0,5	107	2,5	2762	0,5	1405	1,0	795	1,5	1240
Pomatomus saltatrix	0,7	418	0,5	64	0,7	713	1,3	1019	0,3	120	0,3	88	0,5	296	1,0	698	3,8	2708	1,2	811	0,4	128	1,3	951
Diplodus sargus	0,1	23			0,3	15			0,3	85	1,3	361			2,8	956	4,0	1510	0,2	31			1,5	626
Elops machnata	0,1	436			0,3	1167													0,2	688	0,1	391	0,5	838
Dasyatus brevicaudatus			1,0	5000	0,7	3483																	0,3	938
Sarpa salpa																					0,3	36		
Pomadasys olivaceum							0,3	19	0,1	10														
Rhinobatos annulatus																	0,3	324						
Acanthopagrus berda																					0,1	41		
Lithognathus lithognathus							0,3	83	0,1	27		81					0,3	64			0,1	16		
Aetobatus narinari																							0,1	450
Diplodus cervinus							0,3	18																
	17,0	13395	22,2	14864	31,0	24337	34,7	14556	21,6	6028	19,2	7758	20,6	7641	11,2	5113	22,1	11125	20,0	10041	27,2	26867	40,6	31402

[a]No. of nets

1973), July and August 1979 and again during March and June 1981 (Hanekom 1982). The last flood reduced salinity to 3°/‰ at the surface and 7°/‰ at the bottom near the mouth of the estuary (W. Emmerson, pers. comm.).

Dissolved oxygen concentration (ml $O_2 l^{-1}$) and pH measured by Hecht (1973) and Hanekom (1982) ranged between 3,7 – 5,9 and 7,6 – 8,2. These values did not differ much from other Eastern Cape estuaries (Erasmus, Watling, Emmerson & Reddering 1980; Emmerson 1981).

Mean secchi-disc readings of more than 1 m (Stations 1, 2 & 4) are in accordance with the recordings of Hecht (1973) but higher than those found by Hanekom (1982). Hanekom's lower values can probably be ascribed to the flood conditions which existed during an extended period in 1981. Secchi-disc recordings in Swartkops estuary by McLachlan (1972) were also more than 1 m throughout the estuary. The relatively low value of 0,85 m, found at Station 3 just below the junction of the Geelhoutsboom and the Krom was to be expected since Hanekom (1982) found that water in the Geelhoutsboom was considerably more turbid than in the Krom itself.

Compared to the other three Eastern Cape estuaries (Swartkops, Sundays and Great Fish) which were monitored by Erasmus *et al.* 1980 and Emmerson 1981, the nutrient load of the Krom estuary is low and was less than 50% of that found in the above-mentioned estuaries. Hanekom (1982) concluded that this could be because of the absence of agricultural development along the banks of the Krom River in contrast to extensive agricultural practices in the catchment areas of other estuaries.

Table 1 shows that 317 (26%) of the 1 233 fish caught in the Krom estuary (excluding Station 1) were leervis, which constituted 37% in terms of mass. The second most abundant fish was the sea-catfish (21%). Catch composition in the Swartkops estuary which is also a relatively short shallow estuary with extensive mud-flats, sandbanks, salt marshes and *Zostera* beds differs markedly from that found in the Krom estuary. Marais & Baird (1980) reported that in the Swartkops estuary, mullet constitute 42% of the total number of fish gill-netted compared to only 12% in the Krom estuary, whilst spotted grunter contributed 17% numerically and 29% by mass in the Swartkops estuary but only 4 and 9% respectively in the Krom estuary.

A number of possible reasons for these major differences in catch composition can be offered. The most probable reason is that there is relatively less muddy substrate available for benthic feeders such as mullet and spotted grunter in the Krom estuary. Because of the extensive areas covered by shalestone (Hecht 1973) there is also an absence of shallow muddy creeks in the Krom estuary in comparison to the Swartkops estuary (McLachlan & Grindley 1974). A muddy substrate is a prerequisite for *Upogebia africana*, the burrowing mud-prawn, which is the most important food item in the diet of *P. commersonni* in Swartkops estuary (van der Westhuizen & Marais 1977). Benthic diatoms are important food items of mullet species occurring in Swartkops estuary (Masson & Marais 1975).

Secondly, the complete absence of pollution in the Krom estuary (Hecht 1973; Hanekom 1982) could have an effect on fish abundance and catch composition. In Swartkops, sewage and industrial and thermal pollution occur (McLachlan 1972; Marais 1976). Marais (1976) mentioned that spotted grunters congregate in the warmer water of the outlet channel of the Swartkops power station. For this reason angling is prohibited in the channel and adjoining estuary. In addition, the 'higher proportion of nitrogenous material than would be expected in unpolluted waters . . .' from water sampled near the tidal limit (Macnae 1957) in the Swartkops estuary, could be advantageous to a group of fishes like the mullet which feed directly from the first trophic level (Hiat 1944).

Gill-net catches in Transkei (Marais & Prinsloo 1981) revealed that the catch composition of the Nquabara estuary is comparable to that of the Krom estuary. Mean catch (mass) from the mouth, middle and upper regions was 19,4 kg, the composition of which was as follows: leervis contributed 31% numerically (44% by mass), kob was the second most abundant species and contributed 26% (12% in terms of mass), sea-catfish were not found in Transkei estuaries, and mullet contributed 17% (10% in terms of mass). Light penetration throughout the Nquabara estuary was high with a slightly reversed salinity gradient during November 1979. It thus appears that leervis have a preference for clear water, normally associated with high salinity in estuaries. Clear water could be advantageous to a 'group one' predator (Whitfield & Blaber 1978) that makes use of high speed to catch prey. Lower leervis catches at Station 3 in the Krom estuary where turbidity was highest (secchi disc: 0,85 m), support this suggestion. Why more leervis were not caught in Swartkops estuary which also has clear water and a high salinity is unclear.

Largest numbers of sea-catfish occurred in the mouth region (Station 2) of the Krom estuary (Table 1). They breed in this area, as females in a pre-spawning condition with a gonadosomatic index (GSI) of 14 and males with up to 70 eggs or young in their mouths were caught here. They have also been observed to breed in the Swartkops, Sundays and Gamtoos estuaries.

Rhabdosargus holubi and *Diplodus sargus* (blacktail) also occurred in greater numbers near the estuary mouth. Kob and Cape moony were found in largest numbers at Station 3. Mullet, contrary to expectations, occurred in lower numbers in the more turbid water of Station 3 than at the other stations. Lower numbers of mullet, leervis and sea-catfish are primarily responsible for the lower CPUE at Station 3.

In general, CPUE in the Krom estuary (mean 17,5 kg) was higher than in the Swartkops estuary (13,1 kg: Marais & Baird 1980), but lower than in the Sundays (20,5 kg: Marais 1981) and Gamtoos (33,3 kg: Marais 1983) estuaries. Species composition at Station 1 in the marina lagoon did not differ markedly from that of the other three stations in the open estuary. This substantiates the conclusion of Baird *et al.* (1981) which was based on a limited amount of information. However, considerably less fish (Table 1) were caught in this area, in particular fewer leervis and sea-catfish. This is probably owing to the limited size of the canals.

Mean monthly catches show a definite seasonal pattern for *Lichia amia*. During the cooler months (May – October) with the exception of July, leervis all but disappeared from the estuary only to reappear in November. Reduced numbers over the same period were also found in the Swartkops (Marais & Baird 1980), Sundays (Marais 1981) and Gamtoos (Marais 1983) estuaries. Wallace (1976) mentioned that leervis show a north-easterly shift in their distribution during the cooler months of the year when they become plentiful in the Natal inshore zone. Biden (1930) also mentions that longshore migration is associated with a change in temperature in this species whereas off-shore migrations can take place during the spawning season. Day, Blaber & Wallace (1981) state that leervis migrate up the coast to Natal with the 'Sardine Run' and return to the Cape in October and November.

The regular occurrence of kob in the nets does not indicate a seasonal migration pattern as suggested by Wallace (1976).

The Cape moony increased in numbers from March to September while reduced numbers occurred from October to February. This seasonality is probably the result of seaward spawning migrations since females with developing gonads (GSI = 6) were found during November and December while males and females caught in March appeared to be in a post-spawning condition. This is in agreement with Melville-Smith (1978) who found that 78% of larva recruitment into Swartkops estuary occurred from December to February. Lasiak (1982) showed increased GSI for male and female *M. falciformis* caught in the surf-zone at Port Elizabeth from September to January as well as an increase in numbers during this period.

Size distribution histograms of fish caught in the Krom estuary showed the same general pattern as that found for fish from Swartkops, Sundays and Gamtoos. Mean body mass of leervis caught in the Krom estuary (931 g) was nearly double the mass of those from the Swartkops (502 g) but smaller than the mass of those from the Sundays (1 228 g) estuary. Spotted grunters (1 436 g) were heavier in the Krom estuary than in any of the other three estuaries. Mean kob mass (1 013 g) was intermediate between that of the Sundays (2 009 g) and that of Swartkops estuary (628 g: Marais & Baird 1980; Marais 1981, 1983).

In conclusion the present study has shown that the large-fish component (i.e. those caught by gill-net) is more abundant in the Krom estuary than in Swartkops estuary which also has a high salinity throughout but where different forms of pollution are prevalent. However, the Krom estuary is poorer in larger fish than both the Sundays and Gamtoos estuaries which are channel-like with turbid water and a pronounced salinity gradient from head to mouth.

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