

Inshore small-mesh trawling survey of the Cape south coast. Part 2. Occurrence of estuarine-associated fishes

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Marine inshore trawl catches of 12 species of estuarine-associated fishes are reported together with their depth and length distributions. Underwater observations of four additional species, made during 122 SCUBA dives over rocky substrates, are also recorded. Species include *Rhabdosargus holubi*, *R. globiceps*, *Pomadasys commersonii*, *Argyrosomus hololepidotus*, *Pomatomus saltatrix*, *Galeichthys* sp. and *Sarpa salpa*. The data are related to published accounts of the occurrence of juveniles of estuarine-associated and inshore species in the Cape south coast region. This revealed three ecologically distinct groups of inshore fishes: typically marine species that only use marine inshore nursery grounds; an intermediate group that uses mainly marine inshore nurseries plus estuarine nurseries to a limited extent; and a specialized group that is dependent on estuarine nurseries. Possible reasons for this dependence on estuaries are suggested.

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Treilnetvangste in die kuswaters van 12 visspesies wat met getyrviere geassosieer is, is aangeteken asook hul diepte- en lengteverspreidings. Verder is onderwaterwaarnemings van 'n verdere vier spesies gedurende 122 SCUBA-duike oor rotsagtige bodems gemaak. Spesies sluit in *Rhabdosargus holubi*, *R. globiceps*, *Pomadasys commersonii*, *Argyrosomus hololepidotus*, *Pomatomus saltatrix*, *Galeichthys* sp. en *Sarpa salpa*. Hierdie data word in verband gebring met gepubliseerde gewens oor die voorkoms van jongvisse van getyrvier-geassosieerde en kuswaterspesies in die Suid-Kaapse kuststreek. Drie duidelike ekologies onderskeibare groepe kuswatervisse is gevind; tipiese mariene spesies wat slegs mariene kuswaters gebruik as grootwoordgebiede; 'n intermediaire groep wat hoofsaaklik mariene kuswater as grootwoordgebiede gebruik maar ook, in 'n mindere mate, getyrvier-grootwoordgebiede; en 'n gespesialiseerde groep wat afhanklik is van getyrviere as grootwoordgebiede. Moontlike verklarings vir die afhanklikheid van laasgenoemde groep van getyrviere word voorgestel.

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Many studies have been made of the fish fauna of Cape south coast estuaries and consequently the occurrence of both juveniles and adults in these calm, food-rich areas is well known. The fish fauna has received particular attention in the Sundays, Swartkops, Gamtoos, Kromme, Swartvlei and Knysna estuaries (Winter 1979; Marais & Baird 1980a, 1980b; Melville-Smith & Baird 1980; Melville-Smith 1981; Marais 1981, 1982, 1983a, 1983b; Beckley, L.E. 1983, unpubl.; Kok, H.M. 1982, unpubl.). The fish fauna of the sandy beach surf zone (Lasiak 1981, 1982, 1983a, 1983b) and the tidal pools on rocky shores (Beckley, L.E. 1983, unpubl.) along the south coast have also been investigated and the occurrence of estuarine-associated fishes in these parts of the inshore environment is thus known.

In this study we report the catches of estuarine-associated marine fishes trawled by the R.V. *Thomas B. Davie* on soft substrata in the Cape south coast inshore environment between Algoa Bay (34°S/26°E) and St Sebastian Bay (34°S/22°E). The occurrence of estuarine-associated fishes recorded during SCUBA diving surveys on subtidal rocky substrata in Algoa Bay, along the coast west of Cape Recife and in the Tsitsikamma Coastal National Park, is also reported in this paper.

Methods

Trawling

Trawling was conducted along the Cape south coast in bays close to estuary mouths (mainly Algoa Bay, St Francis Bay, Plettenberg Bay and Mossel Bay) as well as on the open coast. Sampling covered a wide depth range of 4.5 – 97 m but was most intensive in depths of 8 – 40 m. The substrata ranged from coarse silt to coarse sand (Wentworth scale; King 1972) but included shell grits, mixed rock and calcareous reef. Details of the fishing gear, catches and stations are given in Wallace, Kok, Buxton & Bennett (1984).

Diving

Diving observations covered areas inaccessible to trawling and included high and low profile reefs and adjacent sands. Observations on the occurrence of estuarine-associated fishes were made by M.J. Smale and C.D. Buxton of the Port Elizabeth Museum as part of a study on the inshore reef fishes of Algoa Bay and the Tsitsikamma Coastal National Park. Data were obtained from belt transects, 30 m in length, in which fish species and approximate sizes and numbers within 5 m of the transect line were recorded on underwater slates. Estimates of fish size were confirmed by occasional spearing, and rotenone fish collections were also made. Careful note was taken of fish

in areas not suitable for transects such as high relief reefs and in turbid water (Secchi < 2 m) and three night dives were also completed in Algoa Bay. These data were supplemented with observations by L.E. Beckley on the occurrence of estuarine-associated fishes over rocky substrata and inshore seaweed beds in Algoa Bay and its adjacent coast. In total, data were available from 122 SCUBA dives along the Cape south coast in depths of 1–32 m.

Results

Trawling

A total of 80 teleost species and 27 elasmobranch species was trawled along the Cape south coast. Reference to the previously mentioned studies on the fishes of Cape south coast estuaries revealed that only 12 of the trawled teleost species commonly occur in estuaries. These 12 species constituted 21% of the total trawled catch. The elasmobranchs do not occur in the estuaries except as occasional vagrants in the mouth region. The catch data for the 12 teleost species is given in Figure 1.

Sea catfish (*Galeichthys* sp.), elf (*Pomatomus saltatrix*) and kob (*Argyrosomus hololepidotus*) numerically constituted 98% of the estuarine-associated catch and their percentage frequency of occurrence in trawls was high. The Cape stumpnose (*Rhabdosargus holubi*), the white stumpnose (*Rhabdosargus globiceps*) and the strepie (*Sarpa salpa*), although occurring in low numbers in the trawls, showed higher frequencies of occurrence than the remaining minor components of the estuarine-associated catch.

Length-frequency distributions for the 12 estuarine-associated species are given in Figure 1. The catch of *Galeichthys* sp. included embryos of 25+ mm which fell from the mouths of brooding adults, juveniles of which the 50–75

mm size class was particularly abundant and adult specimens of which the largest was 477 mm (details given in Part 4 of this series: Buxton, Smale, Wallace & Cockroft 1984). The catch of *P. saltatrix* comprised only juveniles with a length range of 32–267 mm and a modal length of 125–175 mm. Although *A. hololepidotus* of 41–1 590 mm were captured most were juveniles of 100–200 mm (details on these two species are given in Part 3: Smale 1984). The *R. holubi* specimens were 112–219 mm and most were subadults of 150–200 mm. The *R. globiceps* catch consisted of juveniles and subadults of 71–187 mm, and the *Solea bleekeri* catch of subadults and adults of 77–141 mm. *Sarpa salpa* and *Diplodus sargus capensis* (blacktail) catches were represented by juveniles, subadults and adults whilst the limited numbers of *Atherina breviceps* (Cape silverside), *Pomadasys commersonii* (spotted grunter) and *Syngnathus acus* (pipefish) were all adults. The single *Heteromycteris capensis* (Cape sole) was a juvenile of 50 mm.

In terms of depth distribution most of the estuarine-associated fish showed highest frequency of occurrence in depths of 10–30 m, with only *Galeichthys* sp. and *A. hololepidotus* occurring at depths > 50 m.

Diving

Ten species of fish associated with estuaries were encountered during dives and details of frequency of occurrence, approximate numbers and lengths of specimens are given in Table 1.

S. salpa and *D. sargus capensis* were the most abundant species with juveniles, subadults and adults occurring frequently over shallow rocky substrata. *R. holubi* subadults and adults were observed on 52 dives but in low numbers ($\bar{x} = 5,4$ per dive). Mullet >200 mm including *Liza richardsoni*, *Liza*

Species	Total catch	%F	CPUE
<i>Argyrosomus hololepidotus</i>	5512	44.9	41.7
<i>Atherina breviceps</i>	3	2.5	0.1
<i>Diplodus sargus capensis</i>	21	5.1	0.3
<i>Galeichthys</i> spp.	11277	80.5	87.0
<i>Heteromycteris capensis</i>	1	0.8	0.1
<i>Pomadasys commersonii</i>	6	1.7	0.1
<i>Pomatomus saltatrix</i>	6623	53.4	53.4
<i>Rhabdosargus globiceps</i>	98	17.8	0.8
<i>Rhabdosargus holubi</i>	114	20.3	1.0
<i>Sarpa salpa</i>	104	3.4	1.9
<i>Solea bleekeri</i>	67	8.5	0.7
<i>Syngnathus acus</i>	4	3.4	0.1

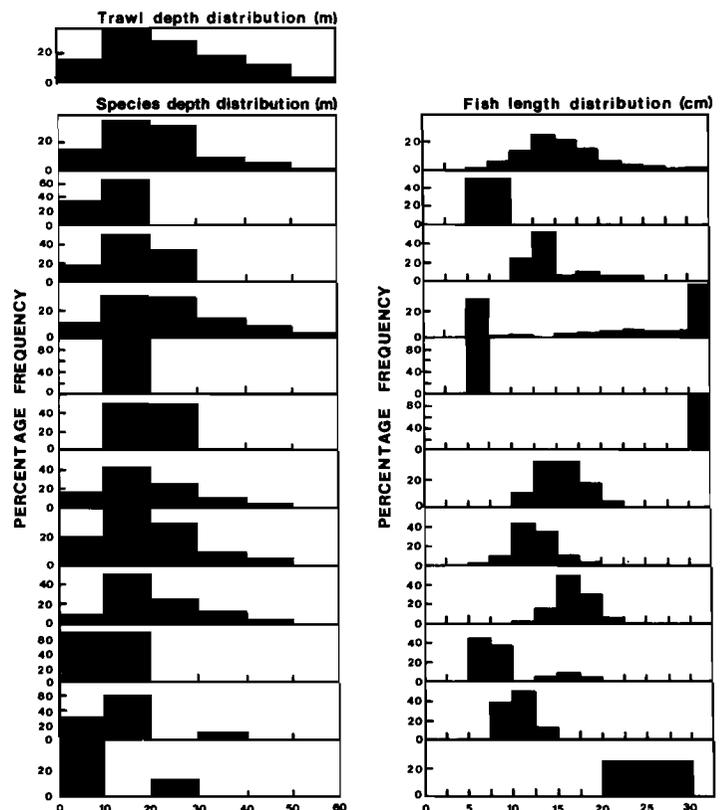


Figure 1 Catches of estuarine-associated fishes taken in 118 trawl stations on the Cape south coast. Catch per 10-min trawl (CPUE) calculated as [total no. specimens/total trawling effort (min)] \times 10 within the depth range at which the species was represented. %F is percentage frequency of occurrence.

Table 1a Summary of diving observations of estuarine-associated fishes in the marine inshore environment, Cape south coast, February 1979 – May 1982

Species	Frequency observed	No. specimens	Total length (mm)	Comments
<i>Diplodus sargus capensis</i>	57 dives (47%)	At least 1 000: $\bar{x} = 18 +$ fish/dive on which species observed	20 – 350	Juveniles, subadults and adults
<i>Galeichthys</i> sp.	3 dives (2,5%)			Adults
<i>Lichia amia</i>	3 dives (2,5%)	Numerous	$\pm 1\ 000$	Adults
Mugilidae including <i>Liza richardsoni</i> , <i>Liza tricuspidens</i> and <i>Mugil cephalus</i>	12 dives (10%)	$\pm 230 - 300$	200 +	No juveniles; subadults and adults
<i>Pomatomus saltatrix</i>	2 dives (1,6%)	± 40	± 325	Adults
<i>Rhabdosargus holubi</i>	52 dives (43%)	± 282 : $\bar{x} = 5,4$ fish/dive on which species observed	125 – 350	No juveniles; subadults and adults, length classes not abundant in estuaries
<i>Rhabdosargus globiceps</i>	2 dives (4,6%)	6	200 – 225	No juveniles, only subadults larger than specimens in estuaries
<i>Sarpa salpa</i>	44 dives (36%)	At least 3 000: $\bar{x} = 68 +$ fish/dive on which species observed	40 – 250	Juveniles, subadults and adults

Table 1b Details of dives undertaken

Areas	No. of dives	Substrates	Total duration	Depth range (m)	Visibility range (m)
Algoa Bay	58				
Cape Recife westwards	23	Mainly reef, some adjacent sand	80 h 40 min	1 – 32	1 – 20
Tsitsikamma Coastal National Park	41				
Total	122				
Mean			40 min	13	7

tricuspidens and *Mugil cephalus* were observed in small shoals on 12 occasions. Adult *P. saltatrix*, *Lichia amia* (leervis) and *Galeichthys* sp., and subadult *R. globiceps*, were infrequently observed.

Discussion

The main objective of the trawling and diving surveys along the Cape south coast was to establish whether estuarine-associated fishes utilize the inshore marine environment as a nursery area for juveniles. To discuss the results of the surveys in terms of this objective it is necessary to examine the available information on the biology of the 16 estuarine-associated species recorded. Table 2 summarizes the relevant information with regard to size at sexual maturity, spawning area, and recorded distribution of juveniles along the Cape south coast. Juveniles of all 16 species have been captured in South coast estuaries but juveniles of species such as *R. holubi*, *M. cephalus*, *L. tricuspidens* and *L. richardsoni* are far more abundant in estuaries than those of *Galeichthys* sp., *A. hololepidotus*

and *P. saltatrix*.

The large trawled catches of juveniles of *Galeichthys* sp., *A. hololepidotus* and *P. saltatrix* identify the shallow marine environment as a major nursery area for these species (Buxton *et al.* 1984; Smale 1984). Similarly, the abundance of juvenile *D. sargus capensis* and *S. salpa* on subtidal reefs, in tidal pools and the sandy beach surf zone indicates that the shallow marine environment is the major nursery area for these species as well. *Galeichthys* sp. and *A. hololepidotus* juveniles, when they occur in estuaries, are able to penetrate to the upper reaches implying tolerance of the variable salinity, turbidity and temperature of these areas. *P. saltatrix*, *D. sargus capensis* and *S. salpa* juveniles differ in preferring the lower reaches of the estuaries where conditions are less variable.

Juvenile *R. globiceps* occur in Cape south coast estuaries but were also caught in the trawls and off sandy beaches. Therefore it appears that this species is not entirely dependent on estuarine nursery areas. On the other hand, *R. holubi* appears to be much more dependent on estuaries, for although

Table 2 Summary of available information on aspects of the biology of 16 species of estuarine-associated teleosts

Species	Size at maturity (mm)	Spawning area	Distribution of juveniles in S. Cape
<i>Argyrosomus hololepidotus</i>	750 ^a	Cape inshore ^a	Estuaries ^{bcddefgh} ; Surf zone ⁱ
<i>Atherina breviceps</i>	50 ⁱ	Cape inshore ⁱ	Estuaries ^{bghi} ; Surf zone ⁱ
<i>Diplodus sargus capensis</i>	160 ^k	Cape & Natal inshore ^{ik}	Estuaries ^{bghi} ; Surf zone ⁱ ; Tidal pools ^{mn}
<i>Galeichthys</i> sp.	300 ^o	Cape estuary mouths ^e	Estuaries ^{bcddefgh} ; Tidal pools ^a
<i>Heteromycteris capensis</i>	100 ⁱ	Cape inshore ⁱ	Estuaries ^{bghi}
<i>Lichia amia</i>	600 ^a	Natal inshore ^a	Estuaries ^{bghp} ; Surf zone ⁱ
<i>Liza richardsoni</i>	200 ^a	Cape inshore ^q	Estuaries ^{bghi} ; Surf zone ⁱ ; Tidal pools ⁿ
<i>Liza tricuspidens</i>	450 ^f	Natal inshore ^f	Estuaries ^{bghi} ; Surf zone ⁱ ; Tidal pools ⁿ
<i>Mugil cephalus</i>	450 ^f	Natal inshore ^f	Estuaries ^{bghi}
<i>Pomadasys commersonii</i>	400 ^f	Natal inshore ^f	Estuaries ^{bgh}
<i>Pomatomus saltatrix</i>	250 ^s	Natal inshore ^s	Estuaries ^{bhp} ; Surf zone ⁱ
<i>Rhabdosargus globiceps</i>	220 ^t	Cape inshore ^t	Estuaries ^{bghi} ; Surf zone ⁱ
<i>Rhabdosargus holubi</i>	200 ^a	Cape & Natal inshore ^a	Estuaries ^{bghi} ; Tidal pools ^{mn}
<i>Sarpa salpa</i>	160 ^k	Natal inshore ^k	Estuaries ^{bhi} ; Surf zone ⁱ ; Tidal pools ^m
<i>Solea bleekeri</i>	90 ^a	Cape & Natal inshore ^u	Estuaries ^{bghi}
<i>Syngnathus acus</i>	120 ^u	Cape estuaries ^u	Estuaries ^{bghi}

^avan der Elst 1981; ^bWinter 1979; ^cMarais & Baird 1980b; ^dMarais 1981; ^eMarais 1983a; ^fMarais 1983b; ^gBeckley 1984; ^hKok, H.M. 1982, unpublished; ⁱLasiak 1982; ^jBeckley 1983; ^kJoubert 1981; ^lLasiak 1983a; ^mChristensen 1978; ⁿBeckley, L.E., unpublished; ^oMarais, J.F.K. 1983, unpublished; ^pSmale & Kok 1983; ^qLasiak 1983b; ^rWallace 1975; ^svan der Elst 1976; ^tTalbot 1955; ^uDay, Blaber & Wallace 1981.

a few juveniles have been captured in tidal pools, none was caught by trawling and beach seine-netting or observed by diving. This applies to another endemic sparid, *Lithognathus lithognathus* (white steenbras) whose juveniles were not found in the trawling and diving surveys or the beach seine-net catches (Lasiak 1982) but which are abundant in Cape south coast estuaries (Talbot 1955; Winter 1979; Beckley 1984; Kok, H.M. 1982, unpubl.). Similarly, juvenile *P. commersonii* (spotted grunter) were absent from all sampled areas except estuaries, and this species is considered to be dependent on south coast estuaries during the juvenile phase of its life cycle. Available information suggests that this is also true for the two species of sole sampled in this survey, *H. capensis* and *S. bleekeri*, *S. acus* (pipefish), *M. cephalus* (mullet), and probably also *L. amia* (leervis) because small juveniles have not been recorded at sea. Juveniles of *A. breviceps* (Cape silverside) and *L. tricuspidens* (mullet) show a preference for estuaries but have also been captured inshore. Conversely, juvenile *L. richardsoni* (mullet) prefer the inshore zone although they do occur in estuaries.

The results of the trawling and diving surveys have provided new insight into the ecological separation of congeneric species, arising from the ability to utilize estuaries as nurseries. For example, juveniles of *L. lithognathus* are abundant in estuaries but absent from the shallow marine environment where juveniles of the closely related *Lithognathus mormyrus* (sand steenbras) abound (Lasiak 1983a; Buxton *et al.* 1984). Similarly, juvenile *P. commersonii* (spotted grunter) occur in estuaries whilst juvenile *Pomadasys olivaceum* (piggy) are very abundant in the shallow marine environment (Lasiak 1983a; Buxton *et al.* 1984). It is remarkable how little distributional overlap occurs between the juvenile populations of these congeneric pairs and intensive trawling at distances of as little as 500 m from the mouths of estuaries failed to reveal the presence of juveniles of the estuarine-dependent species.

The picture that emerges reflects three ecologically distinct groups of inshore fishes. The first and largest group only utilizes marine nursery areas and includes species such as *L. mormyrus* and *P. olivaceum*. The second is an intermediate group that mainly uses inshore nurseries but also uses estuaries to a limited extent. It includes *A. hololepidotus*, *Galeichthys* sp., *R. globiceps*, *P. saltatrix*, *D. sargus capensis* and *S. salpa*. The third is a specialized group whose juveniles are dependent on estuaries and are adapted to cope with the environmental variability typical of these areas, thereby benefiting from protection from marine predators and competitors, as well as from the abundant food in estuaries. Species include *R. holubi*, *L. lithognathus*, *P. commersonii*, *S. bleekeri*, *H. capensis* and *M. cephalus*.

The restriction to estuaries of this ecologically specialized group is probably attributable to the marked differences between the South African estuarine and inshore environments. As Blaber (1981) has pointed out, calm 'estuarine' conditions with high turbidities and reduced salinities do not penetrate out to sea along the South African coast, in marked contrast to many parts of the shallow Indo-Pacific. Consequently, Indo-Pacific species whose juveniles are adapted to these conditions are restricted to estuaries in South Africa (eg. *P. commersonii*). South African endemics such as *R. holubi* and *L. lithognathus* probably became estuarine-dependent in the course of speciation under the conditions peculiar to the South African region.

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