The ichthyoplankton assemblage of the Algoa Bay nearshore region in relation to coastal zone utilization by juvenile fish

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The nearshore ichthyoplankton of Algoa Bay was sampled at six stations over a two-year period between 1980 and 1982. Larvae of 26 families of teleosts were identified with Gobiidae constituting 48,0%, Engraulidae 26,7% and Clupeidae 12,1% of all larvae sampled. *Caffrogobius* spp., *Engraulis capensis* and *Etrumeus teres* were the dominant species. Representatives of families such as Sparidae and Mugilidae which numerically dominate juvenile nursery areas in Algoa Bay were not abundant in the nearshore ichthyoplankton. The various taxa occurring in the ichthyoplankton are discussed in terms of distribution of adults and juveniles, breeding biology and available information on early life history. The paucity of larvae of coastal species with pelagic eggs is highlighted and, with reference to the findings of other workers and local oceanographic conditions, a possible spawning strategy is suggested.
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Die igtioplankton van Algoabaai is by ses stasies langs die kus vanaf 1980 tot 1982 gemonster. Larwes van 26 families van Teleostei is geïdentifiseer en, van die aantal larwes wat gevang is, het Gobiidae 48,0%, Engraulidae 26,7% en Clupeidae 12,1% van die totaal uitgemaak. *Caffrogobius* spp., *Engraulis capensis* en *Etrumeus teres* was die oorheersende spesies. Verteenwoordigers van families soos Sparidae en Mugilidae, wat numeries die jongviskweekgebiede in Algoabaai oorheers, was nie volop in die igtioplankton nie. Die verskillende spesies van vislarwes wat in die igtioplankton verteenwoordig is, word in terme van die verspreiding van volwassenes en kleintjies, die teelbiologie en die beskikbare inligting oor vroeë lewensloop bespreek. Die skaarsheid van larwes van kusspesies met pelagiese eiers het duidelik geword en met verwysing na plaaslike oseanografiese toestande word 'n moontlike kuitskietpatroon voorgestel.
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Fish species utilizing coastal nursery areas such as estuaries generally spawn in the sea and, on completion of larval development, the early juveniles migrate into the nursery areas (Gunter 1967; Clark 1974). Clark, Smith, Kendall & Fahay (1969) have reported on an extensive grid of offshore stations along the east coast of the United States which was regularly sampled to locate larvae of species abundant as juveniles in the estuaries of the Middle Atlantic Bight. Numerous publications, including Kendall (1972), Richards & Kendall (1973), Fahay (1974), Kendall & Reintjes (1975) and Kendall & Walford (1979) have resulted from this survey, and spawning times and seasons were identified for many species. Along the coast of southern Africa, juvenile fish are also abundant in coastal nursery areas such as estuaries and surf zones (Wallace & van der Elst 1975; Day, Blaber & Wallace 1981; Lasiak 1981). The present study of the ichthyoplankton of Algoa Bay was aimed at investigating the availability of larvae to recruit into such coastal nursery areas from the nearshore region.

Marine ichthyoplankton research in southern Africa dates from Gilchrist (1903, 1904) but, in general, has been concentrated on the early life histories of commercially important species on the west and south-west coasts [see Shannon & Field (in press) for a review]. Ichthyoplankton research along the east coast has been neglected except for a few cruises to locate eggs and larvae of pilchard *Sardinops ocellata* and anchovy *Engraulis capensis* (Anders 1975; Shelton & Kriel 1980). The present study is the first to characterize and quantify a marine ichthyoplankton assemblage in the East Cape, although the fish larvae occurring in the Swartkops, Sundays and Kromme estuaries have been investigated (Melville-Smith 1978, 1981; Melville-Smith & Baird 1980; Melville-Smith, Baird & Wooldridge 1981; Wooldridge & Bailey 1982; Beckley 1985a).

Materials and Methods

Six stations were selected for the ichthyoplankton study in Algoa Bay. These stations were located in water of 5 – 7 m depth, just behind the breaker line off, respectively, Sundays Beach, Sundays estuary mouth, Coega Beach, Swartkops estuary mouth, King's Beach and Bird Rock (Figure 1). Over a two-year period from January 1980 to January 1982, eleven series of samples were taken at each of the six stations at intervals of approximately two months. Sampling commenced at Sundays Beach just after dark and the series was usually completed at either King's Beach or Bird Rock before 23h00. Sampling took place after dark to coincide with the requirements of a concurrent project on mysid distribution.

A large conical net with a diameter of 1,5 m, length of

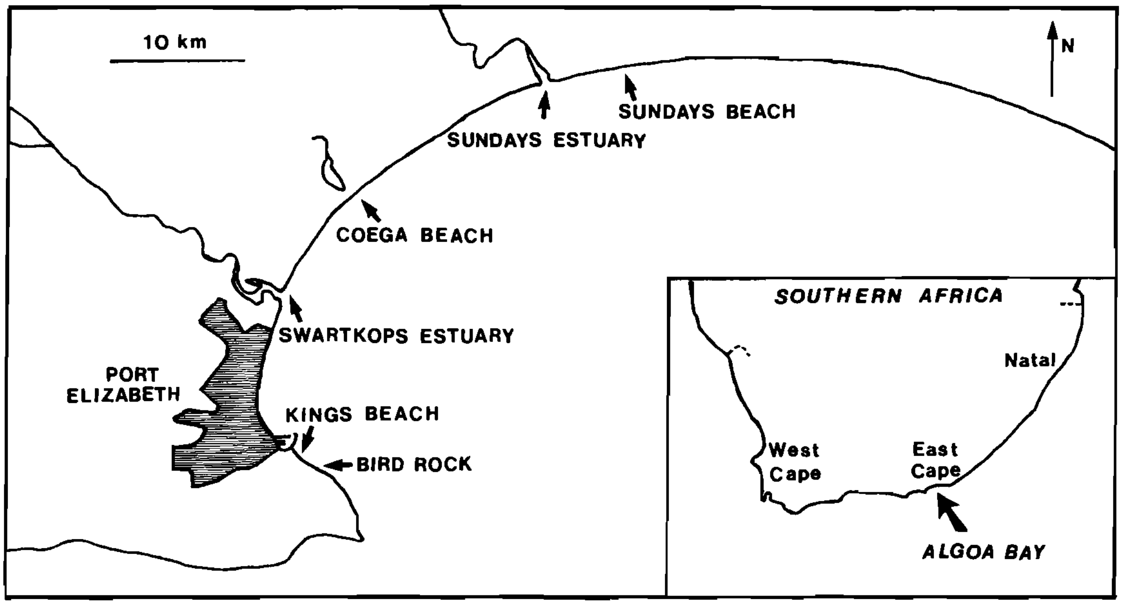

Figure 1 A map of Algoa Bay showing the six sampling stations in the nearshore ichthyoplankton survey.

6,5 m and a mesh aperture of 500 μm was used. A rope between the net and a large inflatable buoy allowed for the maximum sampling depth to be regulated. The gear was towed at about 2 knots behind a 6-m ski-boat. Each tow sampled the water column from about 1 m above the bottom to the surface. A Kahlisco 005WA130 flowmeter attached off-centre in the mouth of the net was used to quantify the volume of water sampled. Sampling time at each station varied from 3 – 7 min and during each tow an average of 330 m^3 of water was sampled. Sea-surface temperature was measured at each station with a thermometer accurate to 0,1°C.

The zooplankton samples were transferred from the net to plastic containers and immediately preserved with formaldehyde in seawater (5% v/v). In the laboratory, fish larvae in the samples were separated from the rest of the zooplankton (chiefly mysids, copepods and chaetognaths) with the aid of a stereomicroscope. The fish larvae were identified and the standard length of each larva was measured using a stereomicroscope and a micrometer accurate to 0,1 mm.

Results

Mean sea-surface temperatures for the six stations during the study period varied between 14,7°C and 22,9°C with maxima in summer. These are shown with the monthly means of temperatures measured daily at Humewood Beach in Algoa Bay in Figure 2. Also shown in Figure 2 are the mean ichthyoplankton densities for each sampling series and summer density peaks are evident. Spatial and temporal variation in density of ichthyoplankton during the two-year survey is given in Table 1. Densities varied from 1 to 562 larvae per 100 m^3. The station off the Swartkops estuary mouth characteristically had a higher density of ichthyoplankton ($\bar{x}$ = 207 larvae per 100 m^3) than the other stations which had mean densities of 39 to 93 larvae per 100 m^3.

Twenty-six families of teleosts were identified from the ichthyoplankton samples and Figure 3 indicates that numerically the family Gobiidae dominated the nearshore ichthyoplankton of Algoa Bay, constituting 48,0% of the total number of larvae captured. Engraulidae constituted 26,7%, Clupeidae 12,1%, Blenniidae 4,0%, Sciaenidae 2,4%, Sparidae 1,5%, Soleidae 1,5%, and the other 15 families 2,3%. Only 0,8% of all the larvae sampled were unidentifiable.

The numbers of each species captured, size range and mean length are given in Table 2. Thirty species were identified but

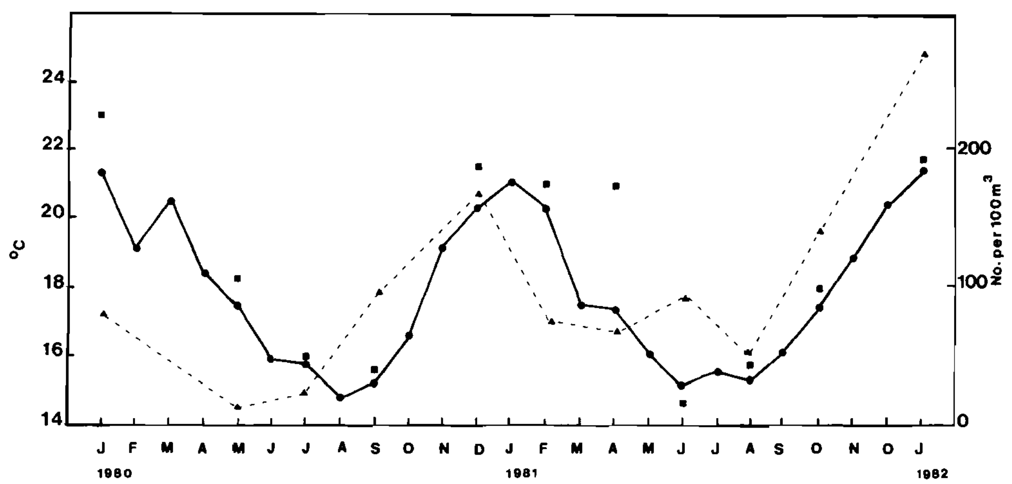

Figure 2 Mean monthly sea-surface temperature in Algoa Bay during the sampling period (●——●) with mean temperatures recorded during each sampling series superimposed (■). Ichthyoplankton density for each sampling series is given as the mean for the six stations (▲—·—·—▲).

Table 1 Spatial and temporal variation in density of fish larvae per 100 m³ at the six stations in the Algoa Bay nearshore region for the 11 sampling series in the study period (n.s. = no sample; l.n. = lost net)

Date of Series	Sundays Beach	Sundays Estuary	Coega Beach	Swartkops Estuary	King's Beach	Bird Rock	Series mean
22 Jan 1980	n.s.	n.s.	28	62	35	191	79
10 May 1980	8	20	16	1	8	20	12
28 July 1980	6	11	26	15	65	21	24
30 Sept 1980	46	82	163	8	109	170	96
3 Dec 1980	2	299	199	l.n.	l.n.	l.n.	167
10 Feb 1981	25	6	29	170	105	112	75
15 April 1981	27	46	48	261	8	4	66
17 June 1981	6	66	38	416	7	30	94
25 Aug 1981	124	20	21	29	12	85	49
27 Oct 1981	72	21	73	542	87	44	140
5 Jan 1982	71	81	380	562	341	196	272
Station mean	39	65	93	207	78	87	

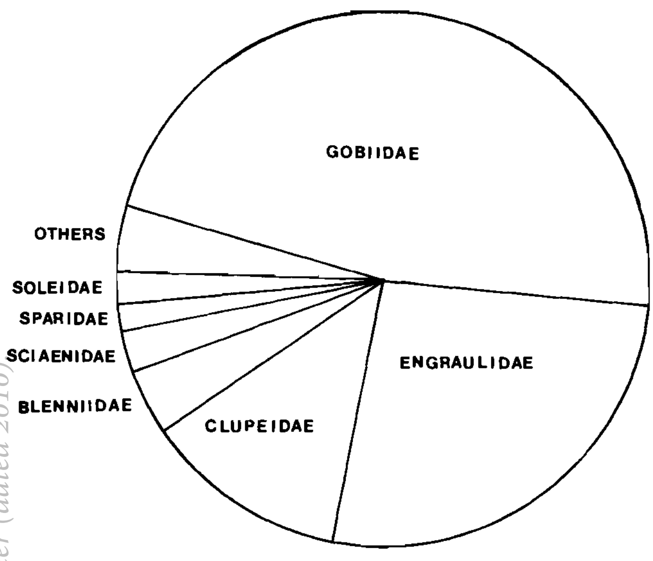

Figure 3 Pie-diagram showing the proportions which various fish families contributed to the total catch of larvae.

within the families Sparidae, Mugilidae, Clinidae and the genus *Caffrogobius* the absence of adequate descriptions of larvae and the diversity of species in Algoa Bay precluded identification to species level. Size-frequency histograms for the most abundant taxa are given in Figure 4. The majority of larvae had mean standard lengths < 10 mm. The clupeid larvae, however, were much larger with mean lengths of 21,5 mm and 23,9 mm for *Etrumeus teres* and *Sardinops ocellata*, respectively.

The average densities of the various taxa of larvae at each sampling date were calculated from total number of each species captured in a particular sampling series, divided by the total volume of water sampled in a series, and are given in Table 3. Of the numerically dominant taxa, *Caffrogobius* spp. larvae occurred throughout the year but, proportionally, they contributed a greater percentage to the ichthyoplankton density during winter (Figure 5). *Engraulis capensis* showed distinct density maxima in summer when this species contributed 41 – 59% of the ichthyoplankton (see January 1980,

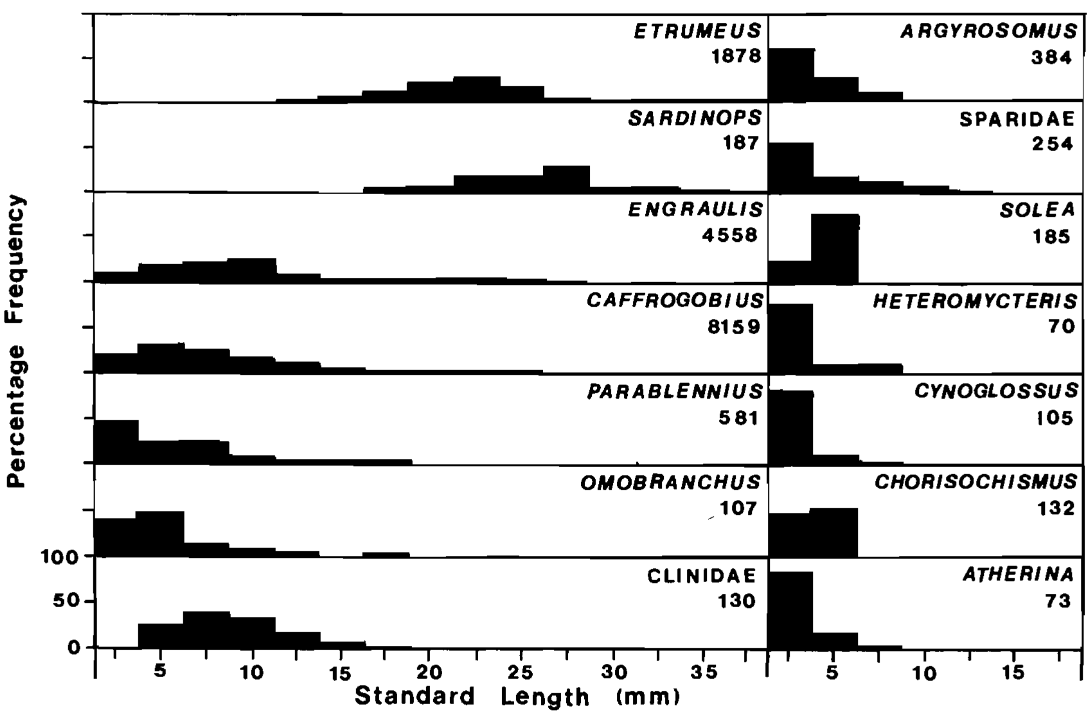

Figure 4 Size-frequency histograms for the dominant taxa of larvae occurring in the Algoa Bay ichthyoplankton.

Table 2 Species composition, total catch, size range and mean size of fish larvae captured in the Algoa Bay nearshore region during the study period

Family	Species	Total catch	Size range (mm)	Mean (mm)	*SD* (mm)
Elopidae	*Elops machnata*	2	31,9–37,4	34,7	3,9
Clupeidae	*Etrumeus teres*	1 878	2,3–37,0	21,5	4,3
	Sardinops ocellata	187	3,4–36,4	23,9	6,4
Engraulidae	*Engraulis capensis*	4 558	2,4–45,4	10,0	5,9
	? *Stolephorus* sp.	21	13,2–31,9	22,5	4,8
Synodontidae	? *Synodus indicus*	1	7,4	7,4	–
Exocoetidae	*Hemirhampus far*	1	8,8	8,8	–
Gadidae	*Gaidropsaurus capensis*	6	1,8–2,7	2,2	0,4
Ophidiidae	*Xiphiurus capensis*	7	2,8–4,1	3,5	0,4
Bothidae	*Arnoglossus capensis*	5	2,8–5,0	3,9	0,8
Soleidae	*Austroglossus pectoralis*	3	2,2–2,7	2,4	0,3
	Heteromycteris capensis	70	1,4–8,8	3,4	1,7
	Solea bleekeri	185	1,7–5,3	4,1	0,8
	Synaptura marginata	4	2,6–3,2	3,0	0,3
Cynoglossidae	*Cynoglossus capensis*	105	1,5–9,6	3,2	1,3
Syngnathidae	*Syngnathus acus*	4	8,4–14,7	11,3	3.4
Carangidae	*Trachurus capensis*	11	2,0–25,5	5,2	6,8
Pomatomidae	*Pomatomus saltatrix*	2	24,4–39,8	32,1	10,9
Sciaenidae	*Argyrosomus hololepidotus*	384	2,0–10,0	3,9	1,8
	Umbrina capensis	18	2,3–7,6	4,3	2,0
Pomadasyidae	*Pomadasys olivaceum*	8	8,8–64,9	24,0	20,3
Sparidae	Unidentified spp.	254	1,8–11,3	4,6	2,5
	Sarpa salpa	7	15,8–36,5	19,1	7,7
Mugilidae	Unidentified spp.	9	2,0–19,4	8,0	6,7
Atherinidae	*Atherina breviceps*	73	4,7–9,8	5,8	0,8
Gobiidae	*Psammogobius knysnaensis*	58	2,1–7,0	3,9	1,5
	Caffrogobius spp.	8 159	1,7–25,2	7,3	3,5
Blenniidae	*Omobranchus woodi*	107	2,7–17,1	5,1	2,5
	Parablennius cornutus	581	2,0–17,5	5,4	2,8
Clinidae	Unidentified spp.	130	4,3–17,0	8,5	2,6
Scorpaenidae	*Coccotropsis gymnoderma*	2	2,4–4,7	3,6	1,6
Congiopodidae	*Congiopodus spinifer*	2	3,5–4,1	3,8	0,4
Triglidae	*Trigla capensis*	5	2,6–3,9	3,4	0,5
Gobiesocidae	? *Chorisochismus dentex*	132	1,5–6,1	4,1	1,1
Tetradontidae	*Amblyrhyncotes honckenii*	16	2,1–92,3	9,8	22,1
Unidentified larvae		139	1,5–5,2	2,5	0,8
Total		17 134	1,5–92,3		

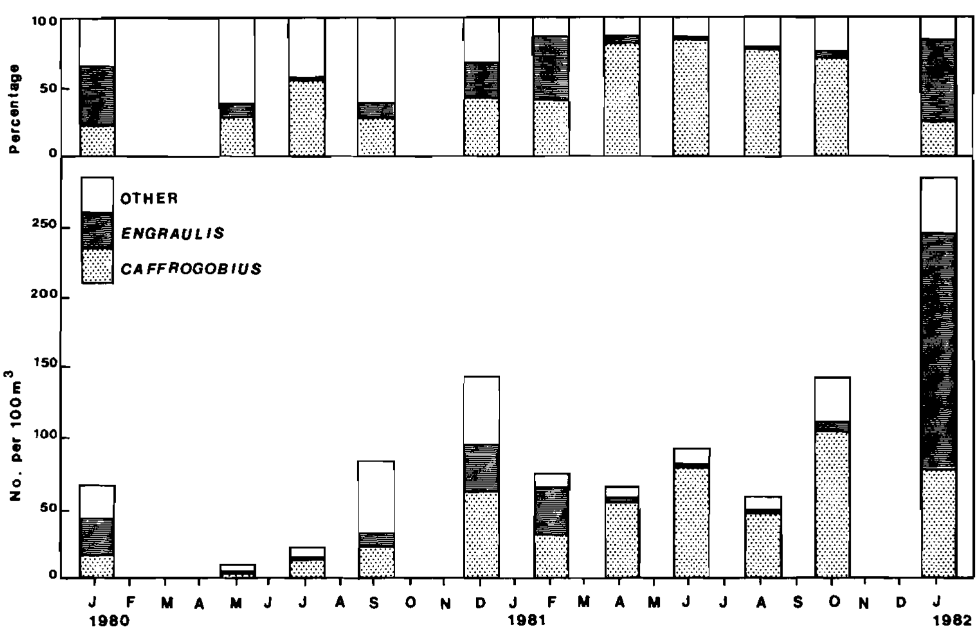

Figure 5 Numerical and percentage contributions of *Caffrogobius* spp. and *Engraulis capensis* to the ichthyoplankton assemblage of the nearshore region of Algoa Bay.

Table 3 Averaged densities (larvae per 100 m^3) for each species in the nearshore ichthyoplankton for each sampling series (+ indicates < 0,1 larva per 100 m^3)

Species	01/80	05/80	07/80	09/80	12/80	02/81	04/81	06/81	08/81	10/81	01/82
Elops machnata								+	+		
Etrumeus teres	0,5	0,9	0,3	44,1	34,8	1,4	1,1	5,8	6,2	12,4	1,6
Sardinops ocellata	+	+	+	1,8	10,3			+	0,1	+	0,1
Engraulis capensis	26,9	1,1	0,3	8,5	34,7	34,0	4,0	0,5	0,6	6,6	169,0
? *Stolephorus* sp.	0,5			0,6							
? *Synodus indicus*								+			
Hemiramphus far											+
Gaidropsaurus capensis			0,1	+					0,1		
Xiphiurus capensis		+		0,2							
Arnoglossus capensis											0,3
Austroglossus pectoralis									0,2		
Heteromycteris capensis	0,2	0,4	0,2	+		0,5	0,6	0,7	0,3	0,2	0,8
Solea bleekeri	5,6	+	+		0,1	1,3	0,3	+	+	+	3,2
Synaptura marginata	+					0,2					+
Cynoglossus capensis	0,7	1,4	+			0,4	0,1	+	0,1	0,2	1,9
Syngnathus acus									0,2		+
Trachurus capensis	+	+	+	0,1		0,3		0,1			
Pomatomus saltatrix					0,1						
Argyrosomus hololepidotus	2,4	2,5	0,2	0,1		0,5	4,0		0,2	0,7	9,7
Umbrina capensis	0,2			+		0,5		+		+	0,4
Pomadasys olivaceum	+			+	0,2			0,2			
Sparidae spp.	1,4	0,2	0,3	1,3	+	0,9	0,2	0,6	0,3	1,8	8,0
Sarpa salpa		+		+					0,3		
Mugilidae spp.	0,1	+									0,3
Atherina breviceps	3,8					0,2	+				
Psammogobius knysnaensis	0,6	+	0,5	0,2	0,4	0,3			0,2	0,3	0,7
Caffrogobius spp.	15,1	2,9	11,7	22,4	60,3	30,8	53,8	78,6	46,9	104,2	78,1
Omobranchus woodi	3,4				0,2	0,5				0,4	1,8
Parablennius cornutus	1,4	0,5	6,9	1,3			1,5	4,4	1,3	11,8	2,5
Clinidae spp.	0,6	+	0,4	1,9	1,4	1,1	+	0,3	0,3	0,1	1,6
Coccotropsis gymnoderma											0,1
Congiopodus spinifer				0,1		0,3					
Trigla capensis			0,1						0,3		+
? *Chorisochismus dentex*	0,6					0,2		0,3	0,3	3,6	2,8
Amblyrhynchotes honckenii	+				0,2				+	+	0,2
Unidentified larvae	1,8	0,3	0,2	0,3		2,1	0,1	0,1	1,2		2,3
Total	65,9	10,6	21,4	83,1	142,7	75,3	64,7	91,9	59,3	142,6	285,6

February 1981 and January 1982 in Figure 5). Densities of *Etrumeus teres* and *Sardinops ocellata* larvae were also greatest during summer and were particularly high during summer 1981. No definite seasonal trends in larval density were evident in the case of Sparidae, *Argyrosomus hololepidotus, Parablennius cornutus, Heteromycteris capensis* or *Cynoglossus capensis. Solea bleekeri* larvae were more abundant in summer than winter.

Discussion

The dominant taxa of ichthyoplankton occurring in the nearshore region of Algoa Bay are discussed below in terms of distribution of adults and juveniles, breeding biology and available information on early life history. An overview relating the findings of this study to those of other workers and local oceanographic conditions concludes the discussion.

Gobiidae

The gobiid genus *Caffrogobius* is ubiquitous in the East Cape where four species are known to be abundant. *Caffrogobius multifasciatus* occurs predominantly in estuaries (Beckley 1983a, 1984a), *Caffrogobius caffer* and *Caffrogobius saldanha* in tidal pools (Beckley 1985b; 1985c) and *Caffrogobius agulhensis* subtidally (Beckley 1984b). Another two species, *Caffrogobius natalensis* and *Caffrogobius nudiceps* are also known from the East Cape but the former is rare and the latter is more common in the West Cape (Smith 1960).

Gobies produce demersal eggs with adhesive threads or pedestals (Breder & Rosen 1966) and Gilchrist (1916) has described the demersal eggs of *Caffrogobius nudiceps*. Beckley (1985a) found that extremely high numbers (up to 15 per m^3) of very small, 2–3 mm SL, *Caffrogobius multifasciatus* larvae were flushed out of the Swartkops estuary at ebb tide and this may account for the high densities of goby larvae found off the Swartkops estuary mouth during the present survey. It must be stressed, however, that the *Caffrogobius multifasciatus* larvae were identified by inference (*Caffrogobius agulhensis, Caffrogobius caffer* and *Caffrogobius saldanha* have not been recorded in the Swartkops estuary) and distinguishing features between the larvae of the various *Caffrogobius* species are unknown. It is interesting to note that O'Toole (1974) found the pelagic goby *Sufflogobius bibartus* to dominate the offshore ichthyoplankton of South West Africa, contributing 67% of the total fish larvae captured.

Engraulidae

The larvae of the commercially exploited *Engraulis capensis* showed clear summer peaks of abundance in the nearshore plankton of Algoa Bay. Though Anders (1975) recorded anchovy eggs and larvae on the east coast of South Africa, research effort on anchovy larvae has been concentrated in South West Africa (O'Toole 1977; Badenhorst & Boyd 1980) and in the south-western Cape (Shelton & Kriel 1980; Shelton & Hutchings 1981, 1982; Shelton 1984). In the latter area, Shelton & Hutchings (1982) delineated the spawning time of anchovy as between October and January, with spawning maxima restricted to a 200 km inshore zone between Cape Point (34°50'S/18°32'E) and Cape Infanta (34°27'S/20°51'E).

In laboratory rearing experiments on anchovy, King, Robertson & Shelton (1978) found time of hatching to decrease from 108 h to 21 h as temperature was raised from 12° to 23°C. They found size at hatching to range from 2,4 mm to 3,2 mm though Badenhorst & Boyd (1980) have recorded anchovy larvae of under 2 mm in formaldehyde preserved samples. Although no eggs were recorded in the present survey, the occurrence of newly hatched larvae (from 2,0 mm SL) in the nearshore plankton of Algoa Bay and the rapid rate of development of eggs in water > 20°C — comparable to the temperatures which occur in Algoa Bay in summer (Figure 2) — suggest spawning of *Engraulis capensis* in Algoa Bay.

Because of increasing evidence of anchovy abundance east of Cape Agulhas (34°50'S/20°00'E) from ichthyoplankton data (Beckley 1983b) and studies of the diets of predatory fish and seabirds (Hecht 1976; Smale 1983; Randall 1983; Batchelor & Ross 1984) the Sea Fisheries Research Institute extended anchovy surveys as far east as East London (33°01'S/27°55'E) in 1983 and 1984. During these surveys, Algoa Bay was the only area east of Cape Agulhas where anchovy eggs were found near the coast (P.A. Shelton pers. comm.). Investigation into chlorophyll distribution in southern African waters (Shannon, Hutchings, Bailey & Shelton 1984) has established the presence of a plume of high chlorophyll extending southwards from East London into Algoa Bay, and they have proposed this as a possible food supply for anchovy in the region.

Clupeidae

Larvae of the clupeid *Etrumeus teres* occurred throughout the sampling period but showed greatest densities in spring and early summer. Davies, Newman & Shelton (1981) from work in the south-western Cape, found *Etrumeus teres* to have protracted spawning which was most intense from August to October. They found highest densities of eggs in offshore waters. The prevalence of large larvae (Figure 3) with a mean length of 21,5 mm in the Algoa Bay nearshore region implies either offshore spawning in the East Cape as well, or, immigration of larvae spawned to the west.

Sardinops ocellata larvae, the most thoroughly described fish larvae from the coast of southern Africa (Brownell 1979), were abundant in the ichthyoplankton of Algoa Bay during the summer of 1980, but only occurred in low numbers in 1981. The majority of larvae were large ($\bar{x}$ = 23,9 mm) corresponding to an age of nearly two months (Boyd & Badenhorst 1981) and, therefore, were probably not spawned in Algoa Bay. Davies, Newman & Shelton (1981) indicated that during 1977/1978 the highest densities of *Sardinops ocellata* eggs were found south of Cape Agulhas from October to February, whereas earlier studies in the 1960s, before overfishing of pilchard had occurred, recorded greatest densities off St Helena Bay (32°45'S/18°05'E) on the west coast (Crawford 1981). Anders (1975) located a pilchard spawning area on the east coast though the seasonal occurrence of *Sardinops ocellata* along the Natal coast ('the sardine run') is not considered a spawning migration (Baird 1971). The recent (1983/1984) Sea Fisheries Institute surveys from the south-western Cape to East London failed to capture any significant concentrations of pilchard eggs or larvae (P.A. Shelton pers. comm.). It appears that with the collapse of the pilchard stock, the occurrence and distribution of *Sardinops ocellata* eggs and larvae along the coast of southern Africa is highly variable.

Blenniidae

Two species of Blenniidae contributed 4,0% to the total nearshore ichthyoplankton sampled in Algoa Bay. *Parablennius cornutus* occurs both intertidally and subtidally on rocky shores from Doring Bay (31°50'S/18°17'E) to Durban (29°51'S/31°01'E) (Penrith & Penrith 1972). Eyberg (1984) determined that the spawning period of *Parablennius cornutus* in Natal was from May to November and noted that larvae on hatching from benthic eggs had a mean length of 3,5 mm. In the present study, larvae of this species were recorded on all sampling dates except December 1980 and February 1981, suggesting a similar long breeding season in the East Cape. Large larvae of this species were also very abundant in the ichthyoplankton in the mouth of the Swartkops estuary in October 1980 (Beckley 1985a). The second species of blenniid, *Omobranchus woodi*, is mainly estuarine in occurrence and is distributed from Knysna (34°03'S/23°03'E) to Kosi Bay (26°53'S/32°58'E) (Penrith & Penrith 1972). The distinct seasonal occurrence of the larvae in the present study coincides well with the summer peaks of abundance (up to 15 per m^3) recorded by Melville-Smith (1978) in the Swartkops estuary. *Omobranchus woodi* larvae were found at all six stations in Algoa Bay and were also found on the ebb tide in the ichthyoplankton in the mouth of the Swartkops estuary (Beckley 1985a).

Sciaenidae

Sciaenid larvae of the species *Argyrosomus hololepidotus* and *Umbrina capensis* constituted 2,4% of the total number of fish larvae captured in the nearshore region of Algoa Bay. The *Argyrosomus hololepidotus* larvae were small ($\bar{x}$ = 3,9 mm) and were most abundant in summer and autumn. Smale (1983) regards Algoa Bay as a major breeding area for *Argyrosomus hololepidotus* and suggests that this species migrates from other areas of the coast to the East Cape to spawn. Smale (1984) has identified the shallow (0 – 9 m) soft substratum areas of Algoa Bay as a major nursery area for this species and Beckley (1984b) has captured small juveniles (from 13 mm TL) in shallow-water trawling off the Swartkops estuary mouth. The few *Umbrina capensis* larvae captured were also small ($\bar{x}$ = 4,3 mm) and, although Lasiak (1982) has recorded juveniles and ripe adults from the surf zone of Algoa Bay, little is known of the biology of this species.

Sparidae

The family Sparidae in southern Africa is represented by 42 species (Smith 1975) of which 50% are endemic. Twenty-five sparid species are regularly captured in the East Cape and though the larvae of a few have been described (Gilchrist 1903, 1916; Ranzi 1933; Brownell 1979) most South African species are undescribed. Coastal nursery habitats are extensively utilized by sparids in the East Cape with juveniles of *Rhabdo-*

sargus holubi, Lithognathus lithognathus and *Diplodus sargus* abundant in estuaries (Beckley 1983a, 1984a), juveniles of *Lithognathus mormyrus, Diplodus sargus, Sarpa salpa* and *Rhabdosargus globiceps* abundant in sheltered sandy beach surf zones (Lasiak 1981, 1982), juveniles of *Sparodon durbanensis, Diplodus sargus* and *Diplodus cervinus* abundant in tidal pools (Beckley 1985b, 1985c) and juveniles of *Chrysoblephus laticeps, Chrysoblephus cristiceps, Boopsoidea inornata, Sarpa salpa, Spondyliosoma emarginatum* and *Pachymetopon aeneum* abundant on shallow subtidal reefs (Beckley in prep.). The paucity of sparid larvae (only 1,5% of total nearshore ichthyoplankton) in relation to the abundance of juveniles is difficult to account for as ripe adults of numerous species have been recorded in the East Cape [see van der Elst (1981) for summaries of available information on breeding biology of common South African sparids]. Sparids produce pelagic eggs (Breder & Rosen 1966) though *Spondyliosoma emarginatum* has benthic eggs (van Bruggen 1965). Spawning and development of larvae away from the nearshore region are offered as possible explanations for the low numbers of larvae in the present survey. On the other hand, more sparid species may be discovered to undergo breeding migrations to Natal waters, similar to that described for *Sarpa salpa* by Joubert (1981).

Pleuronectiformes

The larvae of three families of flatfishes, namely Bothidae, Soleidae and Cynoglossidae were captured in the nearshore ichthyoplankton of Algoa Bay with the latter two families more abundant and together constituting 2,1% of the total number of larvae sampled. *Solea bleekeri* spawns in both estuaries and the sea (Day, Blaber & Wallace 1981) and in the present survey larvae of this species were more abundant in summer than winter. This corresponds with the January/February peak of larval abundance recorded by Melville-Smith (1978) in the Swartkops estuary. *Heteromycteris capensis*, although also occurring in estuaries, breeds in the sea (Melville-Smith 1978; Brownell 1979) and Lasiak (1982) has recorded ripe specimens throughout the year in the surf zone. *Cynoglossus capensis* occurs subtidally over soft substrata in Algoa Bay (Wallace, Kok, Buxton & Bennett 1984; Beckley 1984b) but very little is known of the biology of this species.

Other taxa

The Gobiesocid larvae captured in the nearshore plankton are believed to be those of *Chorisochismus dentex* for although Gilchrist's (1916) description of larvae of this species (based on larvae hatched from eggs dredged in False Bay) is poor, the pigmentation pattern described fits that of the Algoa Bay larvae. *Chorisochismus dentex* is common in tidal pools and subtidally in the East Cape (Beckley 1985b). The family Clinidae is represented by at least 15 species along East Cape rocky shores. *Clinus superciliosus*, the most common species, is viviparous and prepartum embryos attain a length of 20 mm (Veith 1979) so it is concluded that the small clinid larvae captured in the present survey are probably those of a smaller species such as *Blennioclinus stella*.

The remainder of the larvae captured in the nearshore ichthyoplankton of Algoa Bay only occurred in very low numbers. Of these, *Atherina breviceps, Pomadasys olivaceum* and mullet are associated with coastal nursery areas, in particular, sheltered sandy beach surf zones and estuaries (Lasiak 1982; Beckley 1983a, 1984a). Melville-Smith (1978) recorded peak numbers of *Atherina breviceps* larvae entering the Swartkops estuary during January, whilst Beckley (1983a) found juveniles to be extremely abundant in the lower reaches of the estuary in late summer. Lasiak (1982) recorded ripe *Atherina breviceps* in the surf zone from August to December. Bennett (in prep.) has found the eggs to be demersal, with long sticky threads, but the spawning location of this species in Algoa Bay has yet to be identified.

Juveniles of *Pomadasys olivaceum* are one of the dominant species occurring off sandy beaches in Algoa Bay (Lasiak 1982) and van der Elst (1981) states that this species spawns year round in deep water. Juvenile mullet, in particular *Liza dumerili* and *Liza richardsoni*, are extremely abundant in East Cape estuaries (Beckley 1983a, 1984a) and van der Horst & Erasmus (1981) and Lasiak (1983) have concluded that these two species spawn in the inshore marine environment. The extremely low numbers of *Pomadasys olivaceum* and mullet larvae captured in the nearshore region indicates that the larvae probably develop away from the coast and only migrate inshore to nursery habitats as post-larvae capable of swimming.

Concluding Overview

The ichthyoplankton of the nearshore region of Algoa Bay can be divided into three categories based on distribution of the adults and types of eggs they produce. The first category comprises larvae of pelagic species with pelagic eggs and includes the families Engraulidae and Clupeidae. The second category comprises larvae of coastal species with benthic eggs and includes the families Gobiidae, Blenniidae, Gobiesocidae and Atherinidae. The family Clinidae, with its many viviparous species, can, in effect, be included in this category as well. The third category comprises larvae of coastal species with pelagic eggs and includes the families Sparidae, Sciaenidae, Pomadasyidae, Mugilidae and Soleidae. Species belonging to these families are abundant as juveniles in coastal habitats but were found in relatively low numbers in the nearshore ichthyoplankton survey.

Ruple (1984) investigating the occurrence of larval fish off the Mississippi coast, used sampling stations in the outer surf zone which correspond directly with the Algoa Bay study in terms of depth and distance from the shore. Eighteen of the 28 families of larvae he recorded were common to the Algoa Bay inshore ichthyoplankton. As was the case in Algoa Bay, Ruple (1984) found low numbers of larvae of the species utilizing the surf zone as juveniles. Similarly, Miller (1974) and Leis & Miller (1976) found that families which dominated the reef ichthyofauna of Hawaii were virtually absent in the inshore ichthyoplankton around the islands.

Johannes (1978) reviewed reproductive strategies of coastal fish in tropical areas and indicated that many coastal species migrate offshore to spawn in order to avoid predation on the eggs and larvae by filter-feeding benthos and zooplankton-eating reef fish. Leis & Miller (1976) investigating offshore distribution patterns of fish larvae at stations ranging from 0,5 to 12 km off the islands of Hawaii, found that larvae of reef species with demersal eggs decreased in abundance with distance offshore, but larvae of reef fish with pelagic eggs increased in abundance with distance offshore. They describe how some families, e.g. Chaetodontidae, have developed prolonged and elaborate pelagic larval stages which result in large post-larvae capable of swimming long distances back to the coast. In Algoa Bay, however, recruitment of early juveniles of sparids, sciaenids, pomadasyids and mugilids to various coastal habitats occurs at lengths of 10–20 mm (Lasiak 1982; Beckley 1983a, 1984a, 1985a,b) indicating relatively short larval phases. Johannes (1978) and Sale (1980) in their reviews covering the early life history of coastal reef fish suggest, as did Leis & Miller (1976), that for most larvae without lengthy larval phases, current eddies and gyres must prevent larvae from being lost to the coastal populations.

Along the east coast of southern Africa, the strong Agulhas current flows in a south-westerly direction along the edge of the continental shelf (Harris 1978) but movement of inshore shelf surface water is largely longshore under the influence of local winds (J. Lutjeharms, pers. comm.). In Algoa Bay there is evidence for cyclonic within-bay circulation (Harris 1978) whereas the long sandy beaches which dominate the shoreline are characterized by surf circulation cells extending at least 500 m offshore (McLachlan & Bate 1985). In the present study samples were collected within 500 m of the shore and relatively few larvae of coastal species with pelagic eggs were encountered. It is suggested that these coastal species spawn outside the surf circulation cells to avoid retention of the eggs and larvae in the nearshore region and exposure to the numerous nearshore filter feeders and zooplankton predators. Outside the surf circulation cells the larvae could become entrained in the cyclonic within-bay circulation and on completion of larval development juveniles would not have to actively swim great distances to recruit to coastal nursery habitats. An investigation of the ichthyoplankton occurring further offshore would, however, be necessary to confirm this suggestion.

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