South African Journal of Marine Science
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tams19

Catch composition of the commercial beach-seine fishery in False Bay, South Africa

S. J. Lamberth , B. A. Bennett & B. M. Clark

Published online: 08 Apr 2010.

S. Afr. J. mar. Sci. 14: 69–78
1994

CATCH COMPOSITION OF THE COMMERCIAL BEACH-SEINE FISHERY IN FALSE BAY, SOUTH AFRICA

S. J. LAMBERTH, B. A. BENNETT* and B. M. CLARK**

A total of 726 447 fish, representing 66 species from 39 families, was recorded in 311 commercial beach-seine hauls made in False Bay between January 1991 and December 1992. Numerically, *Liza richardsonii* was the most important species, providing 86% of the total catch. The remainder of the catch included 13 teleost species, which shore-anglers regard as angling species and hence not a legitimate target of the beach-seine fishery. The landed proportion of this by-catch was dominated by *Seriola lalandi*, *Pomatomus saltatrix*, *Lithognathus lithognathus*, *Argyrosomus hololepidotus* and *Umbrina canariensis*. The reporting of catches by beach-seine fishermen differed in accuracy between species. Accuracy ranged from <1% (*Dichistius capensis*) to 89% (*L. richardsonii*).

Altesaam 726 447 visse, wat 66 spesies uit 39 families verteenwoordig, is in 311 kommersiële strandnettrekke in Valsbaai tussen Januarie 1991 en Desember 1992 aangeteken. Getalsgewys was *Liza richardsonii* die belangrikste spesie en het 86% van die totale vangs verskaf. Die res van die vangs het 13 beenvisspesies ingesluit wat strandhengelaars as hengelspesies beskou en dus nie as 'n geoorloofde teiken vir die strandnetvissery nie. Die deel van hierdie newevangs wat aan wal gebring is, is deur *Seriola lalandi*, *Pomatomus saltatrix*, *Lithognathus lithognathus*, *Argyrosomus hololepidotus* en *Umbrina canariensis* oorheers. Die juistheid van die verslagdoening oor vangste deur strandnetvissers het van spesie tot spesie verskil. Akkuraatheid het tussen <1% (*Dichistius capensis*) en 89% (*L. richardsonii*) gewissel.

Beach-seining has been a contentious issue in the Cape for at least 100 years. Clashes between anglers and net fishermen occurred as long ago as 1883 (Gilchrist and Williams 1910) and complaints about the catching of immature and spawning fish were recorded in 1898 (Gilchrist 1899). The increased popularity of recreational shore- and boat-angling over the past 50 years (Van der Elst 1989, Bennett 1991), combined with the recent emergence of various conservation groups, has resulted in steadily increasing conflict between these interest groups and beach-seine fishermen (Penney 1991, Lamberth and Bennett 1993).

Anglers' catches in False Bay have declined substantially in recent years (Bennett 1991) and the groups opposed to beach-seining claim that these declines are directly attributable to exploitation by the seine fishery. Of particular concern to the angling/conservation lobby are what they consider to be excessively large catches of adults and juveniles of "angling" species such as *Pomatomus saltatrix*, *Seriola lalandi* and *Lithognathus lithognathus*. Cartilaginous species, increasingly important in competition angling, are also regarded as being under threat (V. Taylor, Western Province Rock and Surf Angling Association, pers. comm.).

Management responded to these concerns by restricting beach-seine permits solely to the capture of *Liza richardsonii* and *Callorhinchus capensis*, except in False Bay where species such as *S. lalandi* and *L. lithognathus* are claimed as traditional and legitimate targets by seine fishermen (Wiley 1985). In order to reduce catches of angling species in False Bay, management imposed a number of gear, area and time restrictions on the beach-seine fishery. The seine fishermen in turn complained that some of the new restrictions were too harsh and that, as a consequence, many of them would have to terminate their operations. Groups opposed to seine-netting maintained that the new regulations were easy to circumvent and that the concession to catch angling species was open to abuse. Additional claims were that reporting of beach-seine catches, although compulsory, was not accurate and that this fishery caught a disproportionate quantity of angling species relative to the recreational and commercial linefisheries. Management, under increasing pressure to curtail beach-seine activities, initiated an investigation into this fishery in 1991 in order to resolve the controversy surrounding it.

In this paper, the species and size composition of beach-seine catches monitored over a two-year period in False Bay are described. The total annual catch is estimated and used to gauge the impacts of the fishery on the respective species. The accuracy of beach-seine catch reports are assessed and catches are compared and discussed relative to those of the commercial line

* Department of Zoology and Marine Biology Research Institute, University of Cape Town, Private Bag, Rondebosch 7700, South Africa
Manuscript received: November 1993

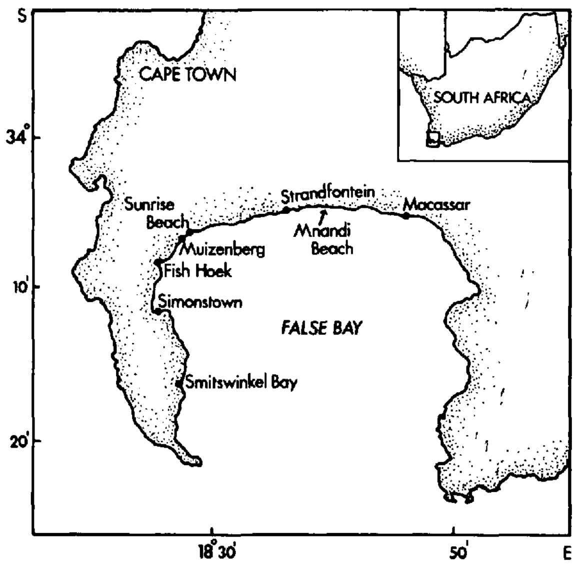

Fig. 1: Map of False Bay showing the localities at which beach-seine fishermen operate and some other places mentioned in text

and recreational angling fisheries.

METHODS

False Bay, which is approximately 1 080 km^2 in extent (Fig. 1) and the largest true bay in South Africa, has been described in detail by Day (1970) and Spargo (1991). Beach-seine fishermen are, however, able to operate only from sandy shores, so including much of the northern shore and a few small sandy beaches on the rocky eastern and western shores of the Bay. The operations of each permit-holder are, nevertheless, restricted to specific areas or beaches. In all, approximately 10 km of the 116 km False Bay coastline are worked by beach-seine fishermen.

The commercial beach-seine nets monitored in this study were 275 m long, 5 m deep, and with stretched mesh sizes that ranged from the legal minimum of 44 to 90 mm. Each net had a central bag approximately 5 m wide by 10 m long. Hauling ropes are restricted by law to 600 m long and the net was set at any distance between 50 and 600 m offshore. The nets were rowed out into the surf on a boat 3–5 m long, leaving the end of the trailing rope on the shore. The net was then shot around a shoal of fish or a likely area for occurrence of fish and the leading rope brought back to shore. The net was hauled beachwards by a crew of approximately 14 persons, with the ends being drawn together as it approached the shore.

Seven beach-seine permit-holders operate in False Bay. One operator at Simonstown was inactive throughout the study period and catches at Smitswinkel Bay (see Fig. 1) were not monitored directly because of time and distance constraints. The five remaining operators were monitored intensively.

Commercial beach-seine activities were monitored between January 1991 and December 1992 on almost every day that weather permitted seining to take place. Locality, date, time and total catch of all fish and invertebrates in each haul were recorded. As much as possible of the catch of each species was measured, except for large catches, from which a representative subsample of no fewer than 120 fish was taken. The numbers and species discarded on each occasion were noted.

Beach-seine permit-holders submit monthly reports in which their daily hauls and catches are recorded. In order to assess the accuracy of these catch records, monitored beach-seine hauls were compared individually, where possible, with those reported in written catch returns. Monitored and reported catches of individual species were compared separately using the paired-sample *t*-test (Zar 1984). The monthly total catches of each permit-holder according to their written returns were also compared to those on the Sea Fisheries Research Institute (SFRI) database.

Mean annual catch of the beach-seine fishery was calculated after reported catches from 1985 to 1992 were corrected for under-reporting. Because most beach-seine and angling catches were reported numerically, it was decided to compare them with those of the commercial linefishery by number rather than by mass. Mean annual commercial lineboat catches were converted into numbers of fish directly from catch masses reported to the SFRI. These catch masses were not verified, but for the purpose of this study were assumed to be accurate. Angler numbers were obtained from random counts made during the 1991/1992 monitoring period. Annual shore-angling effort was estimated by multiplying the mean number of anglers along the False Bay coastline at any one time by six hours, the mean daily amount of time spent fishing by each angler (Bennett 1993a). Annual catch was calculated by multiplying this total effort by the annual catch per unit effort of each species determined from angling club records (Bennett *et al.* 1994).

RESULTS

During the study period, 311 commercial hauls were monitored, an average of almost one every two

Table I: Summary of information on species composition, abundance, number retained, and size and length at maturity of fish caught in 311 beach-seine hauls between January 1991 and December 1992

Taxon			Number caught	Percentage of total catch	Frequency of occurrence (%)	Number retained	Size range† (cm)	Length at maturity (cm)	Percentage immature
OSTEICHTHYES									
Ariidae	*Galeichthys feliceps*	Sea catfish	194	0,027	19,3	34	16–45	31,5[a]	62
Atherinidae	*Atherina breviceps*	Cape silverside	3 121	0,430	12,5	0	8–13	4,3[b]	0
Carangidae	*Decapterus macrosoma*	Slender scad	1	<0,001	0,3	0	17		
	*Lichia amia**	Leervis	214	0,029	6,8	0	10–101	60[c]	22
	*Seriola lalandi**	Yellowtail	7 641	1,052	6,8	7 641	34–110	70[d]	10
	Trachurus trachurus capensis	Horse mackerel	13 903	1,914	17,0	10 942	8–29	20[e]	18
Clinidae	*Clinus agilis*	Agile klipvis	32	0,004	0,6	0	3–7	4,5[f]	19
	Clinus latipennis	False Bay klipvis	13	0,002	3,2	0	8–16	4,5[f]	0
	Clinus superciliosus	Super klipvis	5	0,001	0,6	0	5–8	6,5[g]	20
Clupeidae	*Sardinops sagax*	Pilchard	7 407	1,020	12,2	7 407	13–28	21[h]	<0,1
Dichistidae	*Dichistius capensis*	Galjoen	40	0,006	7,7	0	14–45	31[i]	45
Cynoglossidae	*Cynoglossus capensis*	Sand tonguefish	20	0,003	2,6	0	17–26		
Diodontidae	*Lophodiodon calori*	Fourbar porcupine fish	1	<0,001	0,3	0	10		
Elopidae	*Elops machnata**	King springer	3	<0,001	0,3	3	95–100		
Engraulidae	*Engraulis capensis*	Cape anchovy	70	0,010	1,3	0	6–12	9[j]	10
Gobiesocidae	Undescribed ?	Suckerfish	1	<0,001	0,3	0	1		
Haemulidae	*Pomadasys commersonnii**	Spotted grunter	43	0,006	2,9	39	39–61	36[k]	0
Kuhliidae	*Kuhlia mugil*	Barred flagtail	1	<0,001	0,3	0	16		
Monacanthidae	*Aluterus monoceros*	Unicorn leatherjacket	2	<0,001	0,6	0	12–22		
	Cantherhines pardalis	Honeycomb filefish	2	<0,001	0,6	0	8–12		
	Stephanolepis auratus	Porky	1	<0,001	0,3	0	10		
Mugilidae	*Liza richardsonii*	Harder	628 125	86,465	85,9	619 769	4–30	23[l]	2
	Mugil cephalus	Springer	26	0,004	4,5	26	35–55	34[m]	0
Parascorpididae	*Parascorpis typus*	Jutjaw	1	<0,001	0,3	0	10		
Pomatomidae	*Pomatomus saltatrix**	Elf	17 264	2,376	62,1	6 832	5–85	24[n]	55
Sciaenidae	*Argyrosomus hololepidotus**	Kob	3 610	0,497	45,7	2 264	9–157	34[o]	11
	*Atractoscion aequidens**	Geelbek	1	<0,001	0,3	0	27	59[p]	100
	*Umbrina canariensis**	Belman	1 396	0,192	21,9	1 143	7–75	30[q]	3,6
Scombridae	*Scomber japonicus*	Chub mackerel	1	<0,001	0,3	1	30	47[r]	100
Soleidae	*Austroglossus microlepis*	West coast sole	1	<0,001	0,3	1	47		
	Heteromycteris capensis	Cape sole	5	0,001	1,6	0	12–16	4,5[q]	0
	Solea bleekeri	Blackhand sole	51	0,007	8,4	0	12–20	10[s]	0
	Solea fulvomarginata	Lemon sole	3	<0,001	1,0	1	15–30		
Sparidae	*Diplodus sargus capensis**	Dassie	1 772	0,244	33,4	1 396	12–56	18[t]	1
	*Lithognathus lithognathus**	White steenbras	4 258	0,586	56,6	2 768	13–108	65[u]	44
	Lithognathus mormyrus	Sand steenbras	39	0,005	3,2	1	9–36	19[v]	18
	Pterogymnus laniarius	Panga	2	<0,001	0,3	0	25–28	28[w]	50
	*Rhabdosargus globiceps**	White stumpnose	11 203	1,542	68,8	648	3–49	31[x]	95
	*Rhabdosargus holubi**	Cape stumpnose	39	0,005	3,2	4	8–32	18[g]	22
	Sarpa salpa	Strepie	8 192	1,128	7,1	8 135	16–32	18[t]	0
	Spondyliosoma emarginatum	Steentjie	132	0,018	2,9	100	12–26	22[c]	87
Sphyraenidae	*Sphyraena acutipinnis*	Sharpfin barracuda	2	<0,001	0,6	0	10–18		
Stromateoidae	*Stromateus fiatola*	Blue butterfish	273	0,038	8,7	199	12–50		

(Continued over)

Table I (continued)

Taxon			Number caught	Percentage of total catch	Frequency of occurrence (%)	Number retained	Size range† (cm)	Length at maturity (cm)	Percentage immature
Syngnathidae	*Syngnathus acus*	Pipefish	6	0,001	1,0	0	12–19	12,5[b]	20
Tetraodontidae	*Amblyrhynchotes honckenii*	Blaasop	6 806	0,937	64,6	0	5–21	8[g]	0,2
Triglidae	*Chelidonichthys capensis*	Cape gurnard	143	0,020	6,8	30	7–44	30,5[y]	79
Zeidae	*Zeus capensis*	Cape Dory	12	0,002	1,3	0	12–24		
CHONDRICHTHYES									
Callorhinchidae	*Callorhinchus capensis*	St Joseph	1 640	0,226	40,2	646	12–101	58[z]	34
Carcharhinidae	*Carcharhinus brachyurus*	Bronze whaler	100	0,014	15,1	0	48–305	200[aa]	95
Dasyatidae	*Dasyatis brevicaudata*	Shorttail stingray	3	<0,001	1,0	0	46–200		
	Dasyatis chrysonota	Blue stingray	1 073	0,148	29,6	0	15–80	58[ab]	92
	Gymnura natalensis	Diamond ray	18	0,002	4,5	18	106–180	100[ab]	0
Lamnidae	*Carcharodon carcharias*	Great white shark	1	<0,001	0,3	0	195	240[aa]	100
Myliobatidae	*Myliobatis aquila*	Bullray	1 524	0,210	35,0	0	14–116	54[ab]	92
	Pteromylaeus bovinus	Duckbill ray	4	0,001	1,3	0	50–114	120[ab]	100
Narkidae	*Narke capensis*	Onefin electric ray	6	0,001	1,9	0	6–17		
Odontaspididae	*Carcharias taurus*	Spotted ragged tooth	2	<0,001	0,3	0	176–197	220[aa]	100
Rajidae	*Raja alba*	Spearnose skate	18	0,002	2,6	0	20–45	90[ac]	100
	Raja miraletus	Twineye skate	1	<0,001	0,3	0	28,5	45[ac]	100
	Raja cf. *clavata*	Biscuit skate	56	0,008	7,1	23	8–70	80[ac]	100
Rhinobatidae	*Rhinobatos annulatus*	Lesser guitarfish	4 607	0,634	73,3	0	15–95	70[ad]	89
Scyliorhinidae	*Halaelurus natalensis*	Tiger catshark	1	<0,001	0,3	0	46	42[aa]	0
	Haploblepharus edwardsii	Puffadder shyshark	9	0,001	1,0	0	30–58	41[aa]	33
	Poroderma africanum	Pyjama shark	3	<0,001	0,6	0	48–80	58[aa]	66
Torpedinidae	*Torpedo fuscomaculata*	Electric ray	1	<0,001	0,3	0	40		
Triakidae	*Mustelus mustelus*	Houndshark	1 299	0,179	36,3	0	21–160	70[aa]	49
	Triakis megalopterus	Spotted gully shark	4	0,001	1,0	0	140–180	140[aa]	0

* Angling species
† Total length, but dorsal width in the case of skates and rays
a. Tilney (1990); b. Bennett (1989), c. Van der Elst (1988); d. Penney *et al.* (1989); e. Geldenhuys (1973); f. K. Prochazka, University of Cape Town, pers. comm.; g. Day *et al.* (1981); h. Davies (1956)[1]; i. Bennett and Griffiths (1986); j. Armstrong and Thomas (1989); k. Winter (1979)[1]; l. De Villiers (1987)[2]; m. Whitfield and Blaber (1978); n. Van der Elst (1976); o. Griffiths and Hecht (1993); p. Van der Elst and Adkin (1991); q. Pers. obs.; r. Baird (1977)[1]; s. Wallace (1975); t. Joubert (1981b); u. Bennett (1993b); v. Lasiak (1982)[1]; w. Hecht (1976); x. Talbot (1955)[1]; y. Hecht (1977); z. Freer and Griffiths (1993)[2]; aa. Compagno (1984); ab. Wallace (1967a); ac. Wallace (1967b); ad. Wallace (1967c)
Superscripts 1 and 2 indicate measurement corrected to total length from standard and fork lengths respectively

days. From interviews with seine fishermen it was estimated that a total of approximately 1 000 beach-seine hauls were made in False Bay during the two-year period of the study.

The species composition, frequency of occurrence and abundance of adult and juvenile fish caught in all the hauls observed are summarized in Table I. A total of 726 447 fish, representing 66 species from 39 families, was caught. Of these, 670 071 individuals of 26 species were retained and 56 376 (8,4%) were released. *Liza richardsonii* was by far the most numerous species, accounting for 86,5% of the total numerical catch. The 13 teleosts that could be considered to be angling species were represented by 47 484 individuals and provided 6,5% of the catch. Of the 22 738 angling fish retained, *Seriola lalandi* (7 641), *Pomatomus saltatrix* (6 832), *Lithognathus lithognathus* (2 768), *Argyrosomus hololepidotus* (2 264) and *Umbrina canariensis* (1 143) were numerically the most important. The 46 724 immature fish that were caught constituted 6,4% of the catch, but only 5 511 of these (0,76% of the total catch) were retained. In all, 687 cartilaginous fish were retained, 94% of which were *Callorhinchus capensis*.

Of the species caught, including those targetted (Table I), 26 were kept and 40 were discarded. *Seriola lalandi*, *Trachurus trachurus capensis*, *Sardinops sagax* and *Sarpa salpa* were represented by infrequent large catches (>50 specimens per haul) and occurred in less than 20% of the hauls. Landed catches of angling species, notably *P. saltatrix*, *A. hololepidotus*, *U. canariensis*, *Diplodus sargus* and *Rhabdosargus globiceps*, were small (<50 specimens per haul) but frequent, occurring in >20% of all hauls. *L. lithognathus* was characterized by both infrequent large, and frequent small, catches. *L. richardsonii* was the only species of which frequent large catches were made.

Size frequency distributions of the 10 most abundant "angling" species are shown in Figure 2. The catch of *R. globiceps* was dominated (95%) by immature individuals. Large *R. globiceps* (>30 cm) were only taken in hauls made directly after sunrise. Catches of *S. lalandi*, *D. sargus*, *A. hololepidotus*, *Pomadasys commersonnii* and *U. canariensis* were predominantly (≥90%) adult fish. The size distributions of *P. saltatrix* and *L. lithognathus* both showed a bimodal pattern. For *P. saltatrix*, fish <20 cm, although not fully selected for by the mesh, were well represented, as were legal-sized fish of >30 cm. In the case of *L. lithognathus*, large (70+ cm) individuals were caught at Simonstown and Macassar Beach, whereas small (<40 cm) fish were caught almost exclusively in the Muizenberg-Strandfontein area (Fig. 1). *L. lithognathus* in the 40–60 cm size range were most often observed in early morning hauls at Sunrise Beach (Fig. 1). With the exception of *Callorhinchus capensis* and *Mustelus mustelus*, the cartilaginous catch was dominated by immature fish (Fig. 3).

A total of 253 of the monitored beach-seine catches was matched up with those submitted in written catch returns from January 1991 to December 1992. There was no significant difference between monitored and reported versions of *L. richardsonii* catches ($p(|t| \geq 0{,}33) > 0{,}05$). However, catches of *S. lalandi* ($p((|t| \geq 2{,}223) < 0{,}05$), *P. saltatrix* ($p((|t| \geq 2{,}955) < 0{,}005$), *L. lithognathus* ($p((|t| \geq 2{,}493) < 0{,}02$), *A. hololepidotus* ($p((|t| \geq 2{,}500) < 0{,}02$), *R. globiceps* ($p((|t| \geq 4{,}294) < 0{,}001$), *D. sargus* ($p((|t| \geq 3{,}263) < 0{,}002$) and *U. canariensis* ($p((|t| \geq 2{,}218) < 0{,}05$) were all significantly greater than those reported in catch returns. Reporting of angling fish (Table II) ranged from <1% (*Dichistius capensis*) to 59% (*U. canariensis*) of the true catch of each species, but 89% of the *L. richardsonii* catch was reported. For the beach-seine fishery, the degree of under-reporting of the most abundant angling species was assumed to have been constant for the years 1985 - 1992. The under-reporting factors obtained from the catches monitored in 1991 and 1992 were used to correct the SFRI returns for the years 1985-1992 and the mean annual catch was calculated over this eight-year period (Table III).

In all, 176 counts were made of anglers along the False Bay coastline during this study. Numbers peaked at high tide and three hours before and after sunset. Anglers were often concentrated at nodes of activity (easily accessible and popular sites), especially on the northern shore of False Bay. The highest count of anglers was 6 000 recorded during a run of *P. saltatrix* within the area bounded by Strandfontein Pavilion and Mnandi Beach. Peak angling activity, excluding weekends, did not coincide with peak beach-seine activity. It is estimated that there was a daily average of 451 shore-anglers along the False Bay coastline, each of whom fished for an average of six hours per day. This amounts to a total of 2 706 angler-hours expended per day or 987 690 angler-hours expended per year in False Bay. Angler numbers concurred with estimates made by Van Herwerden *et al.* (1989). The six-hour angler-day observed in this study is similar to that of five hours for anglers on the Natal coast (Joubert 1981a). The average annual angling catches are summarized in Table III.

In total, the beach-seine, commercial line and recreational shore-angling fisheries were calculated to account for 14, 60 and 26% of the catch of important "angling" species respectively (Table III). The beach-seine fishery was responsible for 77% of the annual catch of *S. lalandi* and 40% of the *L. lithognathus* catch. Most *P. saltatrix* (48%), *R. globiceps* (84%) and *A. hololepidotus* (79%) were caught by commercial

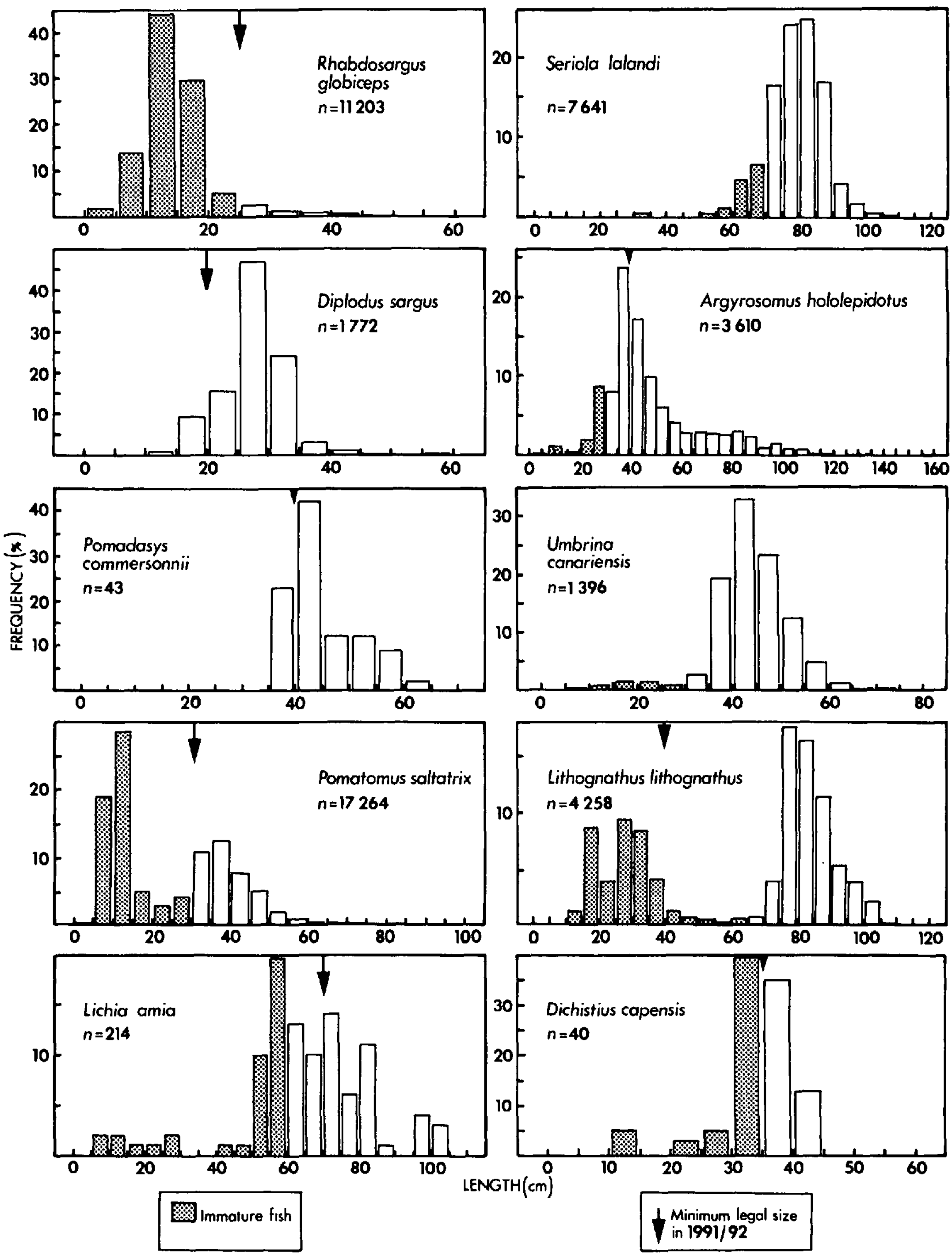

Fig. 2: Size frequency distributions for the 10 most abundant angling species caught in 311 commercial beach-seine hauls between January 1991 and December 1992

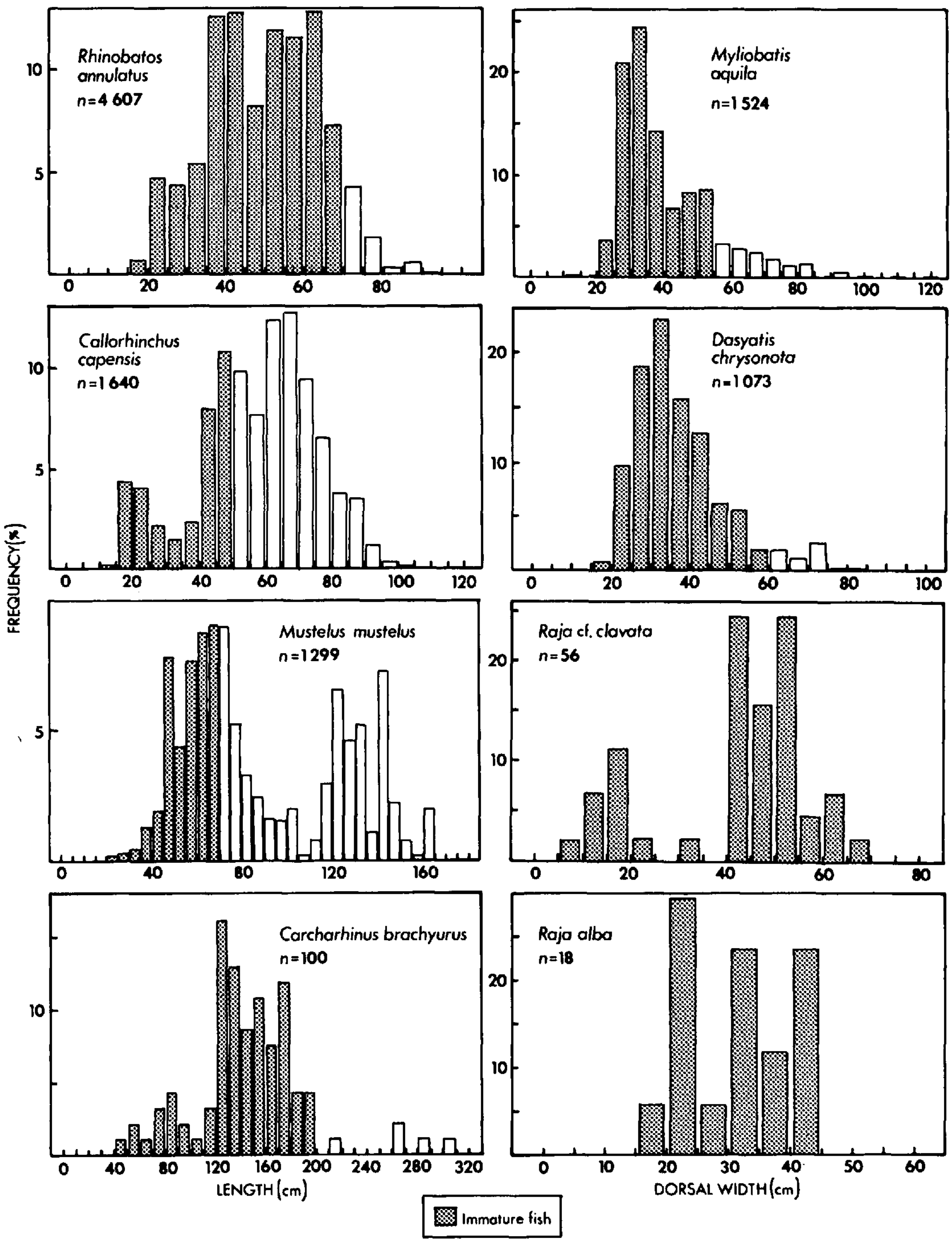

Fig. 3: Size frequency distributions for the 10 most abundant cartilaginous species caught in 311 commercial beach-seine hauls between January 1991 and December 1992

Table II: Landed beach-seine catches (numbers) in False Bay for the years 1991 and 1992 calculated from monitored hauls and according to submitted catch returns and SFRI catch summaries

Species	Monitored hauls		Submitted returns		SFRI summaries		% of catch reported
	1991	1992	1991	1992	1991	1992	
Seriola lalandi	23 364	24 442	13 298	10 620	13 084	10 999	50
Pomatomus saltatrix	8 322	2 937	3 510	1 305	3 412	1 351	43
Lithognathus lithognathus	1 067	4 388	705	2 246	320	2 457	43
Argyrosomus hololepidotus	1 356	2 348	785	1 251	705	1 080	49
Rhabdosargus globiceps	1 450	1 017	44	70	29	61	4
Diplodus sargus	959	1 484	389	377	355	371	31
Umbrina canariensis	1 420	137	867	82	866	78	59
Dichistius capensis	50	50	2	0	0	0	0
Liza richardsonii	1 215 761	1 174 705	1 168 446	963 275	1 154 973	986 752	89
Other species	213 550	19 333	8 348	1 059	4 271	580	2

lineboats while most of the *L. lithognathus* (59%), *D. sargus* (94%), *U. canariensis* (85%) and *D. capensis* (99%) catches were made by shore-anglers. Overall, 86% of the beach-seine catch was *L. richardsonii*, 68% of the commercial line catch was other fish (e.g. *Thyrsites atun* and *Pachymetopon blochii*), whereas 88% of the shore-angling catch was the angling species shown in Table III.

DISCUSSION

Previous descriptions of beach-seine catches in South Africa have been derived largely from experimental seine-net hauls (e.g. Lasiak 1984, Bennett 1989, Romer 1990). Such studies gave a general idea of the structure of surf-zone fish assemblages along the South African coastline. There is, however, no real basis for comparison between those experimental catches and the catches monitored in commercial beach-seines during this study because the gear used differed considerably.

De Villiers (1987) dealt extensively with the commercial beach-seine fishery along the South African coastline, describing it as a well-managed fishery with stable catches. His work was, however, confined exclusively to *L. richardsonii* and did not take into account the "by-catch" of this fishery, the species that were the cause of some controversy at the time. Penney (1991) reviewed the beach-seine, purse-seine and line-fisheries in False Bay, but he stressed that the catch reports on which the study had been based had not been validated. The current study, in which individual beach-seine catches were observed directly, has provided the opportunity to verify reported catches.

Three species, *L. richardsonii*, *L. lithognathus* and *S. lalandi*, are targetted directly by the beach-seine fishery in False Bay, and are located visually or through a sound knowledge of the locations and environmental conditions under which they occur. All the other species in the catches are incidental, so forming a by-catch. The frequent small catches of non-targeted "angling" fish, when combined, may on occasion equal or exceed the total catch of targetted species.

The discrepancies between monitored catches, written catch returns and SFRI reports (Table II) may have a number of causes, for instance a lack of faith by the fishermen in the confidentiality of their reports, or a fear that catch restrictions would result from the reporting of large catches. Small catches, although frequent, are seldom reported because they are not

Table III: Contribution to the mean annual catch (numbers) of important angling species by the beach-seine, commercial line and recreational shore-angling fisheries in False Bay for the years 1985–1992. Values given as mean ± standard error

Species	Beach-seine (%)	Commercial line (%)	Shore-angling (%)	Total number caught
Seriola lalandi	77 ± 7,20	21 ± 6,92	2 ± 0,44	28 597
Lithognathus lithognathus	40 ± 8,25	1 ± 0,18	59 ± 8,23	13 957
Umbrina canariensis	15 ± 4,20	–	85 ± 4,20	2 462
Rhabdosargus globiceps	12 ± 3,56	85 ± 3,38	3 ± 1,62	163 158
Pomatomus saltatrix	10 ± 3,48	48 ± 4,15	42 ± 2,77	68 683
Argyrosomus hololepidotus	2 ± 0,75	80 ± 1,62	18 ± 1,67	77 894
Diplodus sargus	2 ± 0,55	4 ± 0,41	94 ± 0,68	30 080
Dichistius capensis	1 ± 0,22	1 ± 0,22	98 ± 0,41	17 076

regarded as being of any importance by seine fishermen. Some 5–10% of the "missing" catches may be attributed to mistakes by those collating the information or to arbitrary numbers assigned to reported catch masses. For example, the individual mass of all cartilaginous fish was assumed to be 1 kg. *Liza richardsonii* was the only species for which catches were reported correctly. This is a likely result of its targetting being actively encouraged by the management authorities.

All the angling species in Table III have at some time in their exploitation history been classified as vulnerable to overfishing or have experienced declines as a result of overfishing (Van der Elst and Adkin 1991, Bennett 1993a). Anglers share a substantial proportion of the species in their catch with those in the commercial net- and linefisheries in False Bay (Table III). The absence of any significant species unique to the catches of shore-anglers is a major cause of the conflict between the three fisheries (Lamberth and Bennett 1993). Shore-anglers do, however, account for over half the annual catches of *L. lithognathus*, *D. sargus*, *U. canariensis* and *D. capensis* by these combined fisheries in False Bay. In turn, the beach-seine fishery is responsible for large proportions of the *S. lalandi* (77%) and *L. lithognathus* (40%) catches (Table III). Further, it must be mentioned that the combined catches of other fish, e.g. *T. trachurus capensis*, *S. sagax* and *S. salpa*, both numerically and by mass, may, in some years, equal or exceed catches of *L. richardsonii*.

Beach-seine catches of *S. lalandi* (3,2%), *P. saltatrix* and *A. hololepidotus* (0,4%) represent a small portion of the national line catches of these species, but they are a significant part of the False Bay catch (Penney 1991). Beach-seine catches of *L. lithognathus* (25%) are a significant portion of the national catch (Bennett 1993a). Considered in isolation, the beach-seine fishery of False Bay may be very important, because the catch of some species by this fishery exceeds that of the other fisheries combined. The degree to which this localized effect is significant will depend primarily on the movement patterns of the species concerned, resident fish being the most vulnerable. *S. lalandi*, *P. saltatrix*, *A. hololepidotus*, adult *L. lithognathus* and possibly *U. canariensis* are all migratory (Van der Elst 1988, Penney *et al.* 1989, Bennett and Attwood 1991, Bennett 1993b) and move into and out of False Bay. *Diplodus sargus*, *Dichistius capensis* and sexually immature *L. lithognathus* are widespread, but individuals are predominantly resident (Bennett and Attwood 1991, Bennett 1993b). The concentrations of adult *L. lithognathus* in specific areas in False Bay during summer may, in fact, be a large proportion of the sexually mature population (Bennett 1993b). As a consequence, the stock decline that has occurred there may be a result of over-exploitation by the beach-seine fishery (Bennett 1993a).

Barring the effects of mesh selectivity, the catch compositions of commercial beach-seine hauls in False Bay are representative of the surf-zone fish assemblage. However, direct targetting of *L. richardsonii*, *S. lalandi* and *L. lithognathus* is likely to inflate their relative numerical importance in the surf-zone. With the exception of *L. richardsonii*, the eight most important species in observed beach-seine catches were all species which recreational fishermen regard as angling fish. Two of these, *S. lalandi* and *L. lithognathus*, are targetted directly by the beach-seine fishery while the rest form part of incidental catches. The multispecies nature of the beach-seine fishery has made it extremely difficult to manage and control. Observed catches have provided a valuable insight into the fishery and its impact relative to recreational shore-angling and the commercial linefishery. Unfortunately, the paucity of data on the recreational boat-based linefishery has meant that the total catch, nationally or locally, of most species has never been quantified. Consequently, the relative contribution by the beach-seine fishery to the total catch of these species could not be assessed accurately.

ACKNOWLEDGEMENTS

We are indebted to the numerous individuals who assisted in the field and laboratory, and to several members of the False Bay Trek-Fishermens' Association for their co-operation and assistance. Access to the National Marine Linefish System is appreciated. The research was undertaken under contract to the SFRI and was funded by the Sea Fishery Fund.

LITERATURE CITED

ARMSTRONG, M. J. and R. M. THOMAS 1989 — Clupeoids. In *Oceans of Life off Southern Africa*. Payne, A. I. L. and R. J. M. Crawford (Eds). Cape Town; Vlaeberg: 105–121.

BAIRD, D. 1977 — Age, growth and aspects of reproduction of the mackerel, *Scomber japonicus*, in South African waters (Pisces: Scombridae). *Zoologica Afr.* **12**(2): 347–362.

BENNETT, B. A. 1989 — The fish community of a moderately exposed beach on the Southwestern Cape coast of South Africa and an assessment of this habitat as a nursery for juvenile fish. *Estuar. coast. Shelf Sci.* **28**(3): 293–305.

BENNETT, B. A. 1991 — Long-term trends in the catches by shore anglers in False Bay. *Trans. R. Soc. Afr.* **47**(4 & 5): 683–690.

BENNETT, B. A. 1993a — The fishery for white steenbras *Lithognathus lithognathus* off the Cape coast, South Africa, with some considerations for its management. *S. Afr. J. mar. Sci.* **13**: 1–14.

BENNETT, B. A. 1993b — Aspects of the biology and life history of white steenbras *Lithognathus lithognathus* in southern Africa. *S. Afr. J. mar. Sci.* **13**: 83–96.

BENNETT, B. A. and C. G. ATTWOOD 1991 — Evidence for recovery of a surf-zone fish assemblage following the establishment of a marine reserve on the southern coast of South Africa. *Mar. Ecol. Prog. Ser.* **75**(2 & 3): 173–181.

BENNETT, B. A. and C. L. GRIFFITHS 1986 — Aspects of the biology of galjoen *Coracinus capensis* (Cuvier) off the South-Western Cape, South Africa. *S. Afr. J. mar. Sci.* **4**: 153–162.

BENNETT, B. A., ATTWOOD, C. G. and J. D. MANTEL 1994 — Teleost catches by three shore-angling clubs in the South-Western Cape, with an assessment of the effect of restrictions applied in 1985. *S. Afr. J. mar. Sci.* **14**: 11–18.

COMPAGNO, L. J. V. 1984 — F.A.O. species catalogue. **4**. Sharks of the world. An annotated and illustrated catalogue of shark species known to date: (1) Hexanchiformes to Lamniformes, (2) Carcharhiniformes. *F.A.O. Fish. Synop.* **125**: 1–249, 250–655.

DAVIES, D. H. 1956 — The South African pilchard (*Sardinops ocellata*). Sexual maturity and reproduction 1950–54. *Investl Rep. Div. Fish. S. Afr.* **22**: 155 pp.

DAY, J. H. 1970 — The biology of False Bay, South Africa. *Trans. R. Soc. S. Afr.* **39**(2): 211–221.

DAY, J. H., BLABER, S. J. M. and J. H. WALLACE 1981 — Estuarine fishes. In *Estuarine Ecology with Particular Reference to Southern Africa*. Day, J. H. (Ed.). Cape Town; Balkema: 197–221.

DE VILLIERS, G. 1987 — Harvesting harders *Liza richardsoni* in the Benguela upwelling region. In *The Benguela and Comparable Ecosystems*. Payne, A. I. L., Gulland, J. A. and K. H. Brink (Eds). *S. Afr. J. mar. Sci.* **5**: 851–862.

FREER, D. W. L. and C. L. GRIFFITHS 1993 — The fishery for, and general biology of, the St Joseph *Callorhinchus capensis* (Dumeril) off the south-western Cape, South Africa. *S. Afr. J. mar. Sci.* **13**: 63–74.

GELDENHUYS, N. D. 1973 — Growth of the South African maasbanker *Trachurus trachurus* Linnaeus and age composition of the catches, 1950–1971. *Investl Rep. Sea Fish. Brch S. Afr.* **101**: 24 pp.

GILCHRIST, J. D. F. 1899 — *Report of the Marine Biologist, Department of Agriculture, Cape of Good Hope, for the year 1898*. Cape Town; Government Printer: 362 pp. + 21 Charts.

GILCHRIST, J. D. F. and G. N. WILLIAMS 1910 — Report of the Fishery Advisory Board for the year 1909. In *Printed Annexures to the Votes and Proceedings of the House of Assembly* **1**. Cape Town; Government Printer: 205–207.

GRIFFITHS, M. H. and T. HECHT 1993 — Two South African *Argyrosomus hololepidotus* species: implications for management. In *Fish, Fishers and Fisheries. Proceedings of the Second South African Marine Linefish Symposium, Durban, October 1992*. Beckley, L. E. and R. P. Van der Elst (Eds). *Spec. Publ. oceanogr. Res. Inst. S. Afr.* **2**: 19–22.

HECHT, T. 1976 — The general biology of six major trawl fish species of the Eastern Cape coast of South Africa, with notes on the demersal fishery, 1967–1975. Ph.D. thesis, University of Port Elizabeth: [vii] + 353 pp.

HECHT, T. 1977 — Contributions to the biology of the Cape gurnard, *Trigla capensis* (Pisces: Triglidae): age, growth and reproduction. *Zoologica Afr.* **12**(2): 373–382.

JOUBERT, C. S. W. 1981a — A survey of shore anglers' catches at selected sites on the Natal coast, South Africa. *Investl Rep. oceanogr. Res. Inst. S. Afr.* **52**: 15 pp.

JOUBERT, C. S. W. 1981b — Aspects of the biology of five species of inshore reef fishes on the Natal coast, South Africa. *Investl Rep. oceanogr. Res. Inst. S. Afr.* **51**: 16 pp.

LAMBERTH, S. [J.] and B. A. BENNETT 1993 — When is an "angling" fish not an angling fish? Evidence from beach-seine catches in False Bay. In *Fish, Fishers and Fisheries. Proceedings of the Second South African Marine Linefish Symposium, Durban, October 1992*. Beckley, L. E. and R. P. Van der Elst (Eds). *Spec. Publ. oceanogr. Res. Inst. S. Afr.* **2**: 153–156.

LASIAK, T. A. 1982 — Structural and functional aspects of the surf-zone fish community in the Eastern Cape. Ph.D. thesis, University of Port Elizabeth: 459 pp.

LASIAK, T. A. 1984 — Structural aspects of the surf-zone fish assemblage at King's Beach, Algoa Bay, South Africa: long-term fluctuations. *Estuar. coast. Shelf Sci.* **18**(4): 459–483.

PENNEY, A. J. 1991 — The interaction and impact of net and line-fisheries in False Bay, South Africa. *Trans. R. Soc. S. Afr.* **47**(4 & 5): 663–681.

PENNEY, A. J., BUXTON, C. D., GARRATT, P. A. and M. J. SMALE 1989 — The commercial marine linefishery. In *Oceans of Life off Southern Africa*. Payne, A. I. L. and R. J. M. Crawford (Eds). Cape Town; Vlaeberg: 214–229.

ROMER, G. S. 1986 — Faunal assemblages and food chains associated with surf zone phytoplankton blooms. M.Sc. thesis, University of Port Elizabeth: 194 pp.

SPARGO, P. E. 1991 — False Bay, South Africa - an historic and scientific overview. *Trans. R. Soc. S. Afr.* **47**: 363–375.

TALBOT, F. H. 1955 — Notes on the biology of the white stumpnose, *Rhabdosargus globiceps* (Cuvier), and on the fish fauna of the Klein River estuary. *Trans. R. Soc. S. Afr.* **34**(3): 387–407.

TILNEY, R. L. 1990 — Aspects of the biology, ecology and population dynamics of *Galeichthys feliceps* (Valenciennes) and *G. ater* (Castelnau) (Pisces: Ariidae) off the south-east coast of South Africa. Ph.D. thesis, Rhodes University: 278 pp.

VAN DER ELST, R. P. 1976 — Game fish of the east coast of southern Africa. 1. The biology of the elf, *Pomatomus saltatrix* (Linnaeus), in the coastal waters of Natal. *Investl Rep. oceanogr. Res. Inst. S. Afr.* **44**: 59 pp.

VAN DER ELST, R. [P.] 1988 — *A Guide to the Common Sea Fishes of Southern Africa*, 2nd ed. Cape Town; Struik: 398 pp.

VAN DER ELST, R. P. 1989 — Marine recreational angling in South Africa. In *Oceans of Life off Southern Africa*. Payne, A. I. L. and R. J. M. Crawford (Eds). Cape Town; Vlaeberg: 164–176.

VAN DER ELST, R. P. and F. ADKIN (Eds) 1991 — Marine linefish. Priority species and research objectives in southern Africa. *Spec. Publ. oceanogr. Res. Inst. S. Afr.* **1**: 132 pp.

VAN HERWERDEN, L., GRIFFITHS, C. L., BALLY, R., BLAINE, M. and C. DU PLESSIS 1989 — Patterns of shore utilization in a metropolitan area: the Cape Peninsula, South Africa. *Ocean, Shoreline Mgmt* **12**: 331–346.

WALLACE, J. H. 1967a — The batoid fishes of the east coast of southern Africa. 1. Sawfishes and guitarfishes. *Investl Rep. oceanogr. Res. Inst. S. Afr.* **15**: 32 pp.

WALLACE, J. H. 1967b — The batoid fishes of the east coast of southern Africa. 2. Manta, eagle, duckbill, cownose, butterfly and sting rays. *Investl Rep. oceanogr. Res. Inst. S. Afr.* **16**: 56 pp.

WALLACE, J. H. 1967c — The batoid fishes of the east coast of southern Africa. 3. Skates and electric rays. *Investl Rep. oceanogr. Res. Inst. S. Afr.* **17**: 62 pp.

WALLACE, J. H. 1975 — The estuarine fishes of the east coast of South Africa. 3. Reproduction. *Investl Rep. oceanogr. Res. Inst. S. Afr.* **41**: 51 pp.

WHITFIELD, A. K. and S. J. M. BLABER 1978 — Distribution, movements and fecundity of Mugilidae at Lake St Lucia. *Lammergeyer* **26**: 53–63.

WILEY, J. W. E. 1985 — Wiley answers trek fishing critic. *Argus 11 February 1985*.

WINTER, P. E. D. 1979 — Studies on the distribution, seasonal abundance and diversity of the Swartkops Estuary ichthyofauna. M.Sc. thesis, University of Port Elizabeth: 150 pp.

ZAR, J. H. 1984 — *Biostatistical Analysis*, 2nd ed. Englewood Cliffs, New Jersey; Prentice-Hall: xiv + 718 pp.