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EVALUATION OF PARTICIPATION IN AND MANAGEMENT OF THE TRANSKEI SHORE LINEFISHERY

B. Q. MANN, A. M. McDONALD†, W. H. H. SAUER† and T. HECHT†*

Both roving creel and aerial surveys were used to quantify fishing effort along the former Transkei coast. A stratified random sampling procedure was used during shore patrols to assess catch and effort, and a questionnaire survey provided information on total fishing effort, fisher demographics and attitudes towards current regulations. A total of 13 field trips was undertaken, during which 341 fishers were interviewed and the catches of 760 fishers examined. In all, 175 patrols were undertaken, covering in all 1 117 km. Some 24 random aerial counts of shore-fishers were also carried out during the study. From the aerial surveys, average fisher density along the Transkei coast was estimated at 0.79 fishers km^{-1}, with an estimated total fishing effort of 170 457 fisher-days year^{-1}. Fisher densities were highest in spring (0.9 fishers km^{-1}) and lowest during summer (0.5 fishers km^{-1}). Fishers were most successful in winter (1.0 fish fisher^{-1} inspection^{-1}) and least successful in summer (0.4 fish fisher^{-1} inspection^{-1}). Catch rates amounted to 1.4 fish fisher^{-1} day^{-1}, or 0.86 kg fisher^{-1} day^{-1}, and the total catch was estimated at 147 tons year^{-1}. The main target species were bronze bream *Pachymetopon grande* (22%), blacktail *Diplodus sargus capensis* (19%) and dusky kob *Argyrosomus japonicus* (18%). Numerically, the most important species in the catches were elf *Pomatomus saltatrix* (18%) and blacktail (16%). By mass, the most important species were bronze bream (26%) and dusky kob (18%). Knowledge and compliance of regulations currently governing the linefishery in the Transkei was exceptionally poor, although most fishers supported the principle of regulations. Better-enforced and larger marine protected areas, establishment of a fisher awareness programme and improved enforcement of fishing regulations are suggestions for improving the current management of the Transkei shore-fishery.

Key words: linefish, management, roving creel and aerial surveys, shore-fishing, Transkei

The Transkei region of the Eastern Cape Province has one of the most rugged and inaccessible coastlines in South Africa, and it is considered by many shore-anglers to be a premier recreational angling destination. A study conducted by the Oceanographic Research Institute in 1993 showed that shore-angling was the second most important tourist attraction out of a list of 54 attractions to the Transkei coast (Fielding *et al.* 1994). In addition, many local inhabitants subsist by fishing from the shore.

Increasing numbers of shore-anglers (van der Elst 1993, McGrath *et al*. 1997) and an improvement in fishing techniques and equipment has resulted in a gradual decline in catch per unit effort (*cpue*) along the South African coast and a change in the species composition of catches (van der Elst and de Freitas 1988, van der Elst 1989, Bennett 1991, Attwood and Farquhar 1999). Recognition of fish stock decline and increased awareness of the importance of the linefishery were motivating factors that led to the initiation of a national programme on linefish management in South Africa. In April 1994, the Chief Directorate: Marine & Coastal Management (formerly Sea Fisheries) launched a national survey to evaluate the participation in and the management of the South African linefishery. Investigation of the shore-fishery along of the West Coast, South-Western Cape, South-Eastern Cape and KwaZulu-Natal was completed in 1996 (Brouwer *et al*. 1997, McGrath *et al*. 1997). However, the former Transkei region of the Eastern Cape was not included, because it fell outside South African jurisdiction at the start of the study. During 1994, the Transkei juristically was re-incorporated into the Eastern Cape Province of South Africa. The current study was therefore started in March 1997 in order to complete the national survey of the South African linefishery (note: the name Transkei is used hereafter).

The South African shore-based linefishery is an open-access one, managed by bag and size limits, closed seasons and marine protected areas. The regulations were first promulgated in 1984 under the Sea Fisheries Act No. 58 of 1973 (Government Gazette No. 9543 of 1984) and further revised in 1992 under the Sea Fisheries Act No. 12 of 1988 (Government Gazette No. 14353 of 1992). In the Transkei, the regulations were replaced in 1991 with regulations promulgated by the Transkei Government (Environmental Conservation Decree No. 9 of 1992), which were

* Oceanographic Research Institute, P.O. Box 10712, Marine Parade, Durban 4056. E-mail: seaworld@dbn.lia.net
† Department of Ichthyology and Fisheries Science, Rhodes University, P.O. Box 94, Grahamstown, 6140

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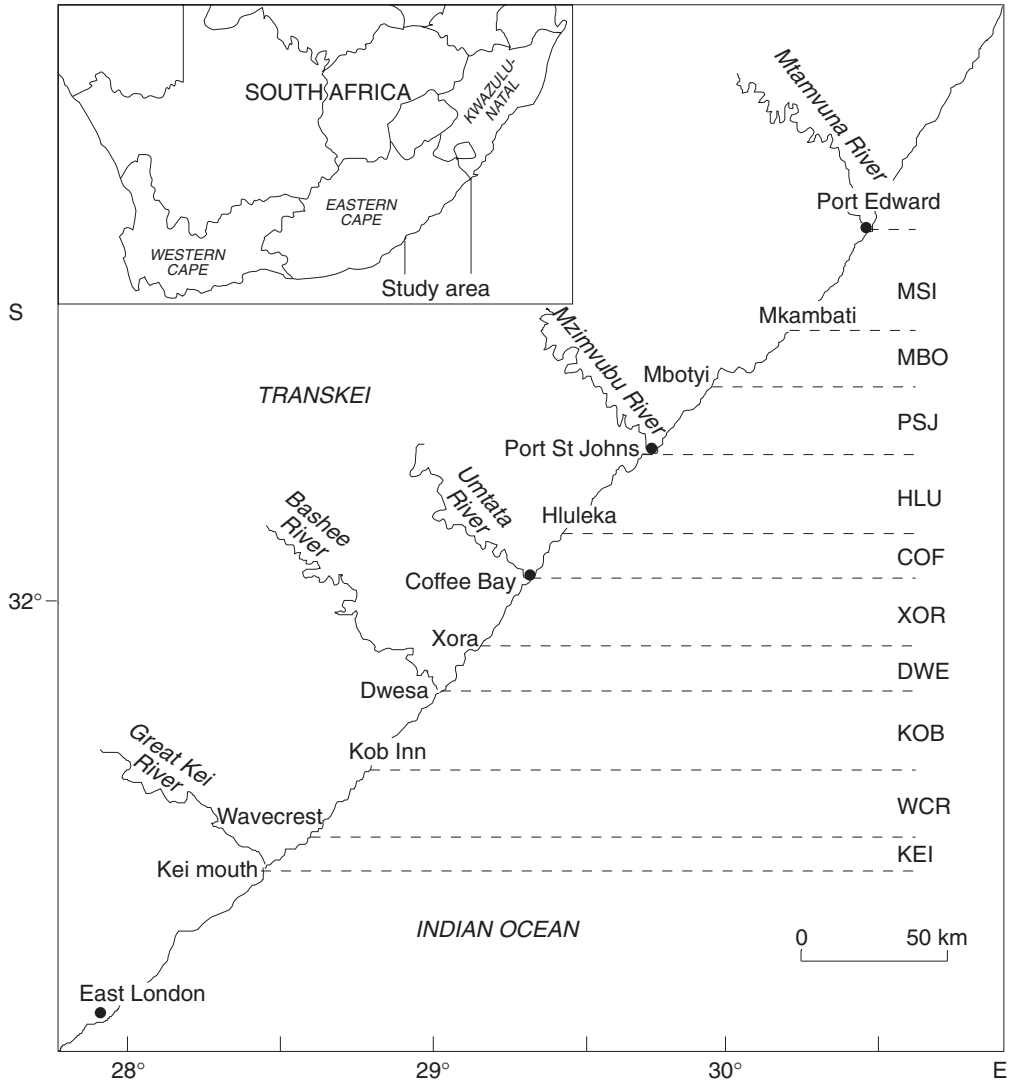

Fig. 1: Map of the study area showing the 10 zones the Transkei coast was divided into for the purposes of aerial surveys

similar to the South African regulations but included an angling permit for visitors. There was, however, very little enforcement of any of the regulations along the Transkei coast, primarily because of the limited accessibility of the area and the lack of a dedicated marine law enforcement agency. The Transkei regulations were subsequently re-amalgamated with the South African regulations in 1997 (Government Gazette No. 6029 of 1997).

Prior to the initiation of the national linefish survey in 1994 (Brouwer *et al*. 1997), a number of previous analyses of shore-angling catch-and-effort data in South Africa had been undertaken. Bennett (1991) and Bennett *et al*. (1994) analysed the situation in the

South-Western Cape, using angling club records. Coetzee and Baird (1981) used a similar approach with catches made off St Croix Island and Coetzee *et al*. (1989) examined shore-angling competition data from the Eastern Cape. Hughes (1985) analysed catch-and-effort data collected by the Natal Parks Board shore patrols off KwaZulu-Natal, and Joubert (1981) and Clark and Buxton (1989) conducted regional roving creel surveys using non-uniform probability sampling to assess angler catch and effort in KwaZulu-Natal and Port Elizabeth respectively. However, none of the above studies attempted to document fisher attitudes towards the regulations or the level of fisher compliance. Furthermore, other than anecdotal information (Fielding *et al.* 1994), few data are available on shore-fishing in Transkei. The primary aims of this study were to obtain estimates of angler participation, catch and effort, and to evaluate management of the Transkei shore-fishery as a component of the entire South African shore-fishery (Brouwer *et al*. 1997).

MATERIAL AND METHODS

Study area

The Transkei coastline stretches from the Kei River mouth (32°41´S, 28°23´E) in the south to the Mtamvuna River mouth at Port Edward (31°04´S, 30°11´E) in the north (Fig. 1). The coastline represents two recognized biogeographic zones, namely a transition zone between the subtropical East Coast Province and the warm temperate South Coast Province (Turpie *et al.* 2000). It is characterized by a large number of rivers and estuaries, many of which only open to the sea for short periods during the summer rainy season. From the Kei to the Xora River the shoreline consists predominantly of sandy beaches with a few rocky outcrops. From there northwards, the general topography changes from heavily wooded sand dunes to high, grass-covered hills that slope steeply down to the Indian Ocean. Along this stretch of coastline, sheer sandstone cliffs and rugged rocky shores are interspersed by short stretches of sandy beach and estuary mouths.

The major oceanographic feature along the Transkei coast is the Agulhas Current (Beckley and Ballegooyen 1992), which tends to flow just offshore of the shelf break. The coastline has a relatively narrow continental shelf (5–10 miles) and is exposed to exceptionally high wave energy, hence the region's common name of "Wild Coast". The mean sea temperature at Port Edward is approximately 20°C, with a range of about 5°C between the cooler winter and the warmer summer, although marked changes can occur on a much shorter time-scale as a result of localized upwelling events (Schumann 1988). Cooler shelf water, inside the Agulhas Current, tends to move northwards during winter (May–August), and this current reversal assists the northward migration of a number of migratory fish species during that period (Armstrong *et al*. 1991).

Because of the logistical difficulties associated with accessing the Transkei coast, and the limited budget and manpower available, the coast was divided into two study areas: a southern zone – Kei Mouth to Coffee Bay, and a northern zone – Coffee Bay to Port Edward. The first author (BQM) surveyed the northern section and the second author (AMM) surveyed the southern section (i.e. there were only two survey clerks). For the aerial surveys, the 275-km coastline was subdivided into 10 zones (Fig. 1). Definition of the zone boundaries was based on relatively even distribution along the coast and, more specifically, landmarks easily observed from the air.

Survey techniques

Roving creel surveys were conducted using a progressive count method, similar to that conducted in other regions of South Africa during the national linefish survey (Brouwer *et al*. 1997). This method appears to be the best approach to assess catch and effort in fisheries where effort is dispersed over a large area (Essig and Holliday 1991, Pollock *et al.* 1994). A stratified random sampling technique was used whereby shore-fishers were counted and interviewed on patrol. All patrols were done on foot during the day (06:00 –18:00) and, for safety reasons, no sampling was conducted at night; some areas were unsafe because of high crime levels. The duration of patrols depended on the distance patrolled and on the number of fishers encountered during the patrol. Because the creel survey was only conducted while travelling in one direction, it was seldom possible to conduct more than two patrols per day. When a group of fishers was encountered fishing together, only one of the group was questioned, but catch-and-effort information was collected for the whole group. Patrols were randomized in terms of starting time and direction of the patrol and stratified according to weekdays, weekend days and public holidays (Clarke and Buxton 1989). Because there are few access roads down to the coast, the starting point of patrols could not be randomized, but an attempt was made to patrol as much of the coast as possible during each field trip.

Only the marine shore-fishery was assessed during this survey, because time and manpower did not allow

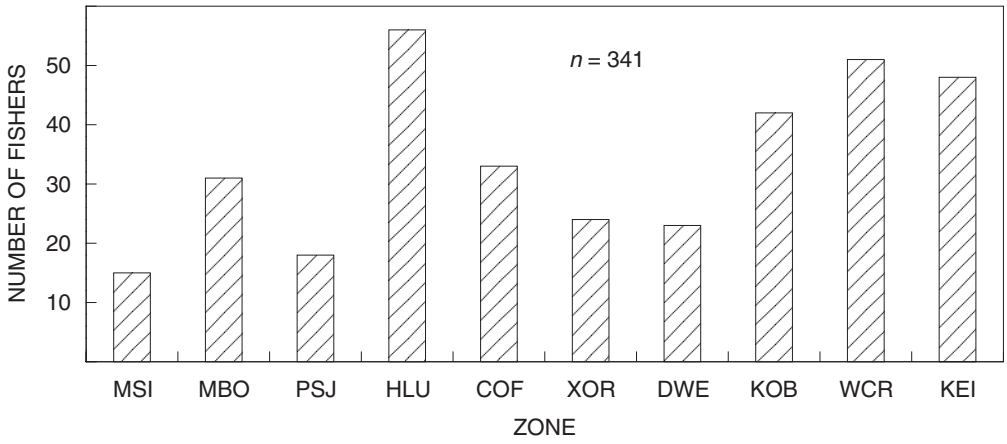

Fig. 2: Number of fishers interviewed in each of the 10 zones surveyed between Port Edward and Kei Mouth

the inclusion of the many estuaries along the Transkei coast. A total of nine field trips was completed in the southern zone, but only quarterly sampling was possible for the northern zone. Timing of sampling periods was stratified to coincide with holiday and non-holiday periods, and to ensure suitable coverage of the fishery in all four seasons. The duration of each field trip was 15–20 days. During each patrol, weather and sea conditions were recorded and subjectively classified into one of three broad categories. The first category was days with fine weather and good fishing conditions, the second was days with fair (mediocre) weather/fishing conditions and the last category was days of poor weather/fishing conditions. Although subjective, both survey clerks were experienced anglers and could make a reasonable assessment of the fishing conditions.

Monthly aerial surveys were conducted in order to obtain instantaneous counts of the total number of shore-fishers. Flights were conducted according to the same stratified random sampling schedule described above, but were subject to weather conditions and availability of aircraft. A fixed-wing aircraft, flying at low altitude (± 100 m) at approximately 160 km h^{-1} was used. A flight from Port Edward to Kei Mouth took approximately 2 h and, after a variable time interval at Kei Mouth, a return flight was undertaken. Counts were made in both directions on the same day (i.e. generally a morning and a midday/afternoon count if weather permitted) using a hand-held tally counter. Ground-truthing of aerial surveys was conducted during the KwaZulu-Natal and Eastern Cape components of the national linefish survey and revealed a minimal underestimate of 12% (Brouwer *et al*. 1997).

Fishing effort

Total annual shore-fishing effort was calculated from instantaneous aerial counts using a modified version of the method developed by Pollock *et al*. (1994):

$$E_{total} = E_{wk} + E_{we} \quad , \tag{1}$$

where E_{wk} and E_{we} are total effort estimates for week day and weekend days respectively (school holidays were considered as weekend days). These were calculated from:

$$E_{wj} = \left(\frac{\sum_{i=1}^{n} e_i}{(d/p)} \right) \times l \quad , \tag{2}$$

where j is weekdays or weekend days, e_i the number of anglers per kilometre on the ith day, d the number of days sampled, p the potential number of sample days and l is the total length of the sample area.

Estimation of catch per unit effort

Catch per unit effort (*cpue*) was calculated using the equation

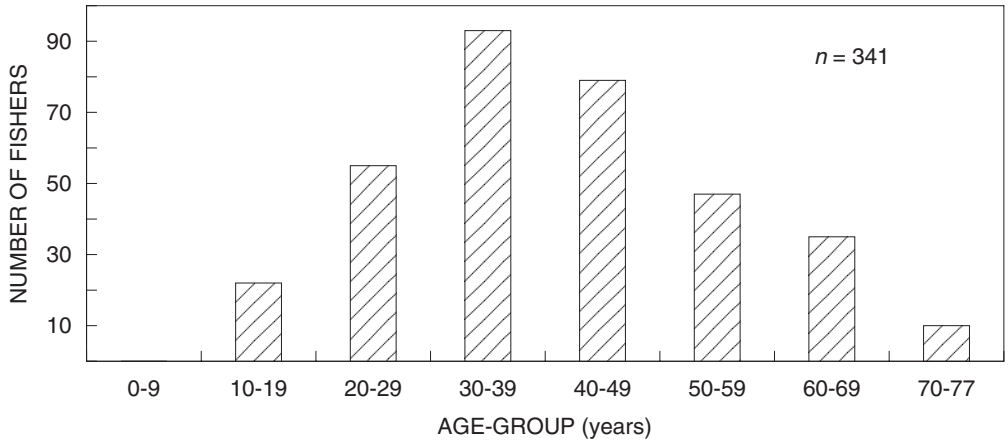

Fig. 3: Age distribution of shore-fishers interviewed along the Transkei coast

$$Cpue = \frac{\sum_{i=1}^{n} (C_i / E_i)}{n} \quad , \qquad (3)$$

where C_i is the number or mass (kg) of fish retained by the ith fisher, E_i the effort expended by the ith fisher and n is the number of fishers checked. Because catch rates were based on incomplete trips, the mean of ratios estimator was used.

Total catch was estimated by multiplying total effort by the *cpue*:

$$C_{total} = cpue \times E_{total} \quad . \qquad (4)$$

All fish caught by each fisher were identified, counted and measured to the nearest millimetre total length. Fish mass was subsequently estimated from published length/mass regression equations (van der Elst and Adkin 1991). Released fish were not included because of the unreliability of fisher reports (Claytor and O'Niel 1991). Recorded catch was therefore in effect "harvest" (Pollock *et al*. 1994).

Fisher attitudes and preferences

A detailed questionnaire survey was undertaken at the same time as the roving creel survey, and a random subsample of the shore-fishers encountered during patrols was interviewed (i.e. interviewees were representative of the fisher population). When fishers were encountered who had previously been interviewed using the detailed questionnaire, only catch-and-effort data were collected. The questionnaire used was similar to that employed by Brouwer *et al.* (1997), but slightly modified to incorporate certain unique aspects of the Transkei shore-fishery, such as the higher proportion of subsistence fishers (see Appendix). Questionnaires consisted of separate sections addressing catch-and-effort data, fisher demographics, economic information and fisher knowledge of, and attitudes towards, fishery regulations. Each questionnaire took approximately 12–15 minutes to complete and use of an interpreter was made when interviewing local Xhosa-speaking fishers. No fishers under the age of 15 were interviewed, because it was felt that they would not comprehend some of the questions.

RESULTS

A total of 13 field trips was undertaken during the study period (March 1997–February 1998), nine in the southern section and four in the northern section. A summary of the shore patrol results is shown in Table I.

Participation

The number of fishers interviewed in each of the 10 zones between Port Edward and Kei Mouth is shown

Table I: Summary of the shore patrol data collected along the Transkei coast between March 1997 and February 1998

Number of shore patrols	175
Distance patrolled	1 117
Duration of patrol (h)	369.2
Number of fishers checked	760
Number of fishers interviewed	341
Total hours fished	2 177.7
Total number of fish caught and kept	658
Total mass of fish caught and kept (kg)	404

in Figure 2. The age distribution of shore-fishers interviewed (Fig. 3) shows that most (27%) belonged to the 30–39 year age-group. Fishers interviewed were mostly males (98.8%), with similar numbers of white (46.6%) and black (48.4%). Coloured (3.8%) and Indian fishers (1.2%) were in the minority (Fig. 4). Most interviewees were Transkei residents (57.2%), with the second and third largest groups of fishers coming from the Eastern Cape (20.8%) and KwaZulu-Natal (14%) respectively (Fig. 5). Fishers interviewed had an average of 21 years of fishing experience.

Table II: Results of 24 aerial counts of shore-fishers and beach vehicles conducted along the Transkei coast between March 1997 and February 1998

Date	Time	Weather	Number of shore--fishers	Number of beach vehicles
03/03/97	09:25–11:05 WK	Fair	104	3
03/03/97	11:35–13:25 WK	Fair	95	3
29/03/97	08:23–10:00 WE	Good	400	47
29/03/97	10:45–12:36 WE	Good	458	158
26/04/97	08:07–09:50 WE	Good	231	39
26/04/97	10:32–11:50 WE	Fair	259	41
24/05/97	08:55–10:35 WE	Good	283	32
24/05/97	11:19–13:07 WE	Good	390	41
20/06/97	08:34–10:05 WK	Fair	146	10
20/06/97	11:42–13:24 WK	Fair	158	7
23/07/97	08:53–10:30 WK	Good	94	8
23/07/97	12:07–14:03 WK	Good	246	15
24/08/97	09:55–11:15 WE	Poor	124	22
22/09/97	09:30–11:05 SH	Good	187	37
22/09/97	13:20–15:05 SH	Good	203	19
30/10/97	08:30–10:25 WK	Fair	99	5
30/10/97	12:11–13:27 WK	Fair	73	5
20/12/97	09:15–10:25 SH	Poor	96	35
31/12/97	08:48–10:35 SH	Fair	302	77
31/12/97	11:05–12:24 SH	Poor	319	90
26/01/98	09:10–10:37 WK	Fair	72	2
26/01/98	12:20–13:47 WK	Fair	32	1
25/02/98	09:08–10:28 WK	Fair	166	10
25/02/98	12:10–14:11 WK	Poor	109	6

WE = Weekend
WK = Weekday
SH = School holiday

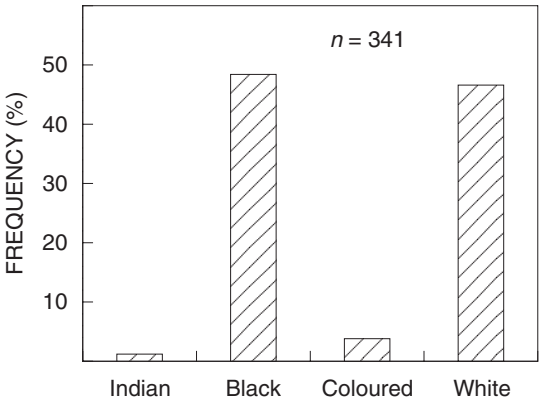

Fig. 4: Racial composition of shore-fishers interviewed along the Transkei coast

The majority of interviewees (67%) fished primarily for recreation, whereas 33% fished for subsistence. The latter were identified as those fishers who lived on the coast, had little other form of income (i.e. 85 of the 113 subsistence fishers were unemployed) and claimed to supplement their living by fishing (see Branch *et al*. 2002a). Most subsistence fishers interviewed along the Transkei coast were local Xhosa or Pondo people (95%). On average, they lived 4.5 km from the coast, fished a minimum of five times a month, and they and their families consumed most of the fish caught. However, if good catches were made, the fish were often sold. Although subsistence fishers from the Transkei would generally be considered to be living below the household poverty line (McGrath *et al*. 1997, Branch *et al*. 2002b), the majority (89%) of homesteads grew their own food (maize and various vegetables) and kept livestock (chickens, goats and/or cattle) for their own consumption.

Fishing effort

The results of the 24 aerial surveys conducted along the Transkei coast are shown in Table II. Average shore-fishing effort for the entire coast (Port Edward to Kei Mouth) was calculated from both shore patrols (0.73 ± 0.37 (*SD*) fishers km^{-1}) and aerial surveys (0.79 ± 0.25 fishers km^{-1}). The similarity in these two estimates suggests that both methods of quantifying effort were comparable. Instantaneous total annual shore-fishing effort along the Transkei coast was calculated at 70 118 $\pm$ 29 471 fisher-days year^{-1}). Accounting for angler turnover during the whole 24-h period (see Brouwer

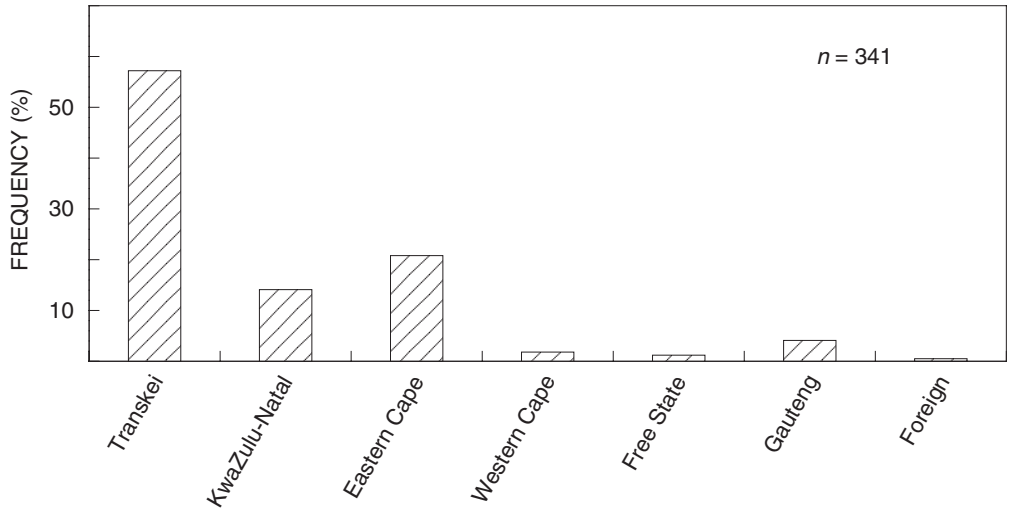

Fig. 5: Domicile of shore-fishers interviewed along the Transkei coast

et al. 1997), the best estimate of total annual shore-fishing effort along the Transkei coast would be 170 457 ± 71 644 fisher-days year^{-1}.

Total numbers of shore-fishers along the Transkei coast proved more difficult to estimate. Use of club: non-club ratios, as used by Mann *et al.* (1997a) in KwaZulu-Natal, was not feasible, because few resident Transkei fishers belong to fishing clubs and transient fishers (holiday-makers) tend to come from all over South Africa. For this reason, an attempt was made to use aerial counts to calculate total participation. From the questionnaire survey, shore-fishers fished for an average of 42 days year^{-1}. Correcting for avidity bias (Thompson 1991) using the negative exponential, me^{-mf}, where f is the frequency of days and m the parameter estimated, the average days fished is approximately 22 days year^{-1}. Dividing the total number of fisher-days year^{-1} by the average number of days fished gives an estimate of 7 748 shore-fishers. Although this is probably an underestimate of total participation, because many people fish infrequently (e.g. holiday fishers), it may be a reasonable estimate of more avid, and therefore more regular, fishers along the Transkei coast. This estimate of participation, however, remains highly uncertain and speculative.

Distribution of shore-fishing effort along the Transkei coast is shown in Figure 6. Aerial counts and shore patrols showed similar results. The highest effort was recorded in the Port St Johns to Hluleka (HLU) and the Hluleka to Coffee Bay (COF) zones and the lowest effort was recorded in the Mboyti to Port St Johns (PSJ) and the Xora Mouth to Dwesa (DWE) zones. The fewest fishers km^{-1} was recorded in summer (Fig. 7). This can partly be explained by the fact that the Transkei has summer rainfall and the weather and sea conditions then are frequently unfavourable for fishing. The highest fishing effort was recorded during spring (0.93 fishers km^{-1}), followed by winter (0.75 fishers km^{-1}), autumn (0.65 fishers km^{-1}) and summer (0.48 fishers km^{-1}).

Catch and estimation of *cpue*

The fishers checked had fished for a combined 2 177.7 h and caught 658 fish weighing 404 kg. The *cpue* for the Transkei shore-fishery amounted to 1.39 fish fisher^{-1} day^{-1} or 0.86 kg fisher^{-1} day^{-1}. Total annual catch for the Transkei shore-fishery was calculated at approximately 147 ± 25 tons year^{-1}).

The number of fishers encountered on patrol was

Table III: The relationship between fishing conditions (weather and sea conditions) and the number of fishers encountered and fish caught during shore patrols conducted along the Transkei coast

Conditions	Number of patrols	Fishers counted	Number of fish caught
Fine	58	370	422
Fair	65	323	183
Poor	52	88	35

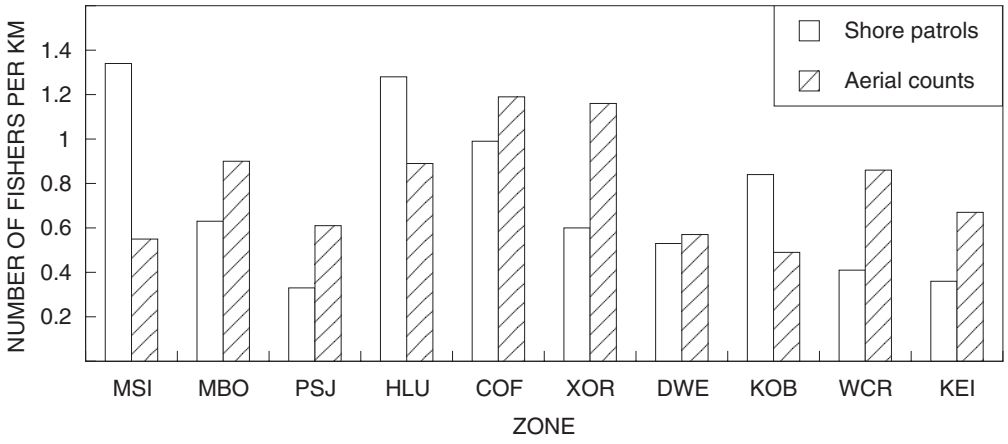

Fig. 6: Distribution of shore-fishing effort along the Transkei coast

strongly influenced by weather and sea conditions (Table III). Expectedly, in poor weather/fishing conditions, few fishers were encountered. Fishers encountered during such days also had a very low success rate (Table III). This means that, although patrols were stratified to ensure coverage during periods of high occupancy at hotels, resorts and cottages (i.e. during school holidays and weekends), this potential increase in effort was often not reflected in the data because of poor weather.

Fishing during winter had the highest success rate (0.96 fish fisher^{-1} inspection^{-1}), followed by autumn (0.95 fish fisher^{-1} inspection^{-1}) and spring (0.54 fish fisher^{-1} inspection^{-1}). Success rate in summer was lowest at 0.4 fish fisher^{-1} inspection^{-1}.

Catch composition

In all, 36 teleost species belonging to 20 families and three cartilaginous species representing three families were recorded in catches during the study period

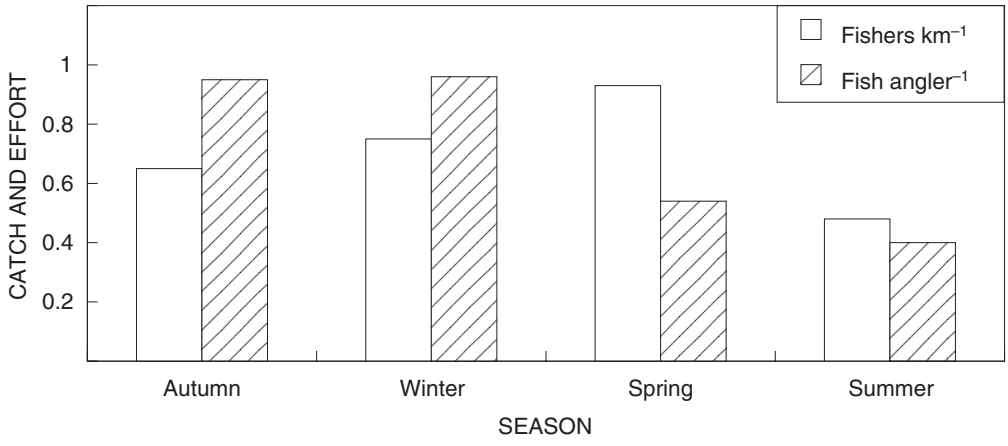

Fig. 7: Seasonal variations in catch and effort by shore-fishers checked along the Transkei coast

Table IV: Catch composition of 760 shore-fishers checked and the percentage targeting of 341 fishers interviewed between Kei Mouth and Port Edward during the period April 1997–January 1998

Species	Scientific name	Common name	Number caught	% of total catch (number)	% of total catch (mass)	% of targeting
OSTEICHTHYES						
Kuhliidae	*Kuhlia mugil*	Barred flagtail	13	1.98	<1	
Ariidae	*Galeichthys* spp.	Barbel	7	1.06	1.89	
Carangidae	*Lichia amia*	Garrick	2	<1	2.33	2
	Pseudocaranx dentex	White kingfish	1	<1	<1	
Cheilodactylidae	*Chirodactylus brachydactylus*	Twotone fingerfin	3	<1	<1	
Coracinidae	*Dichistius capensis*	Galjoen	9	1.37	2.06	5.26
	Dichistius multifasciatus	Banded galjoen	29	4.41	2.67	<1
Clinidae	*Clinus* spp.	Klipvis	3	<1	<1	
Dinopercidae	*Dinoperca petersi*	Cavebass	4	<1	<1	
Elopidae	*Elops machnata*	Tenpounder	1	<1	<1	<1
Gobiidae	*Caffrogobius caffer*	Banded goby	5	<1	<1	
Haemulidae	*Pomadasys commersonnii*	Spotted grunter	24	3.65	<1	2
	Pomadasys olivaceum	Piggy	14	2.13	<1	<1
Labridae	*Thalassoma hebraicum*	Goldbar wrasse	1	<1	<1	
Mugilidae	*Liza* spp.	Mullet	3	<1	<1	<1
	Liza tricuspidens	Striped mullet	1	<1	<1	
	Mugil cephalus	Flathead mullet	1	<1	<1	
Plotosidae	*Plotosus nkunga*	Barbel eel	4	<1	1.28	
Pomacentridae	*Abudefduf* spp.	Damsel	2	<1	<1	
Pomatomidae	*Pomatomus saltatrix*	Elf	120	18.23	14.37	6.63
Sciaenidae	*Argyrosomus japonicus*	Dusky kob	32	4.86	17.48	17.98
Serranidae	*Epinephelus andersoni*	Catface rockcod	1	<1	<1	
	Epinephelus marginatus	Yellowbelly rockcod	8	1.22	1.03	<1
Scorpididae	*Neoscorpis lithophilus*	Stonebream	75	11.40	5.80	5.38
Sparidae	*Acanthopagrus berda*	Riverbream	3	<1	<1	<1
	Diplodus sargus	Blacktail	106	16.11	6.90	19.15
	Diplodus cervinus	Zebra	3	<1	<1	<1
	Lithognathus lithognathus	White steenbras	4	<1	<1	3.75
	Sarpa salpa	Strepie	62	9.42	2.12	<1
	Sparodon durbanensis	White musselcracker	3	<1	3.10	4.38
	Cymatoceps nasutus	Black musselcracker	4	<1	4.08	2.63
	Pachymetopon grande	Bronze bream	81	12.31	26.41	21.78
	Polysteganus praeorbitalis	Scotsman	1	<1	<1	
	Rhabdosargus holubi	Cape stumpnose	22	3.34	1.24	<1
	Rhabdosargus sarba	Natal stumpnose	1	<1	<1	
Tetraodontidae	*Amblyrhynchotes honckenii*	Evileye blaasop	1	<1	<1	
CHONDRICHTHYES						
Dasyatidae	*Dasyatis chrysonata*	Blue stingray	1	<1	<1	
Myliobatidae	*Pteromylaeus bovinus*	Bullray	1	<1	<1	
Rhinobatidae	*Rhinobatos annulatus*	Lesser guitarfish	1	<1	<1	

(Table IV). By mass, bronze bream *Pachymetopon grande* (26.4%), dusky kob *Argyrosomus japonicus* (17.5%) and elf *Pomatomus saltatrix* (14.4%) were the most important species in the catches. Targeting effort was assessed for all fishers interviewed, regardless of whether they had caught anything, and they were allowed to nominate more than one species if this was the case. Although elf were not as frequently targeted as some of the other species (6.6%), it was numerically the most important fish caught and made up 18.2% of the total catch (Table IV). Other numerically important species caught were blacktail *Diplodus sargus capensis* (16.1%), bronze bream (12.3%), stonebream *Neoscorpis lithophilus* (11.4%) and strepie *Sarpa salpa* (9.4%). Bronze bream (21.8%) and blacktail (19.2%) were the most frequently targeted fish in the shore-fishery (Table IV). Although dusky kob only accounted for 4.9% by number of the total catch, it was a highly targeted fish (18.0%). Cartilaginous fish constituted only 1.6% by number of the total catch.

The most popular baits used by shore-fishers in the Transkei were sardine *Sardinops sagax* (28.2%), redbait *Pyura stolonifera* (16.9%) and pink prawn *Haliporoides* sp. (14.6%). Pink prawn is a commercially available crustacean and, although expensive, is favoured by recreational anglers targeting bronze bream. Other

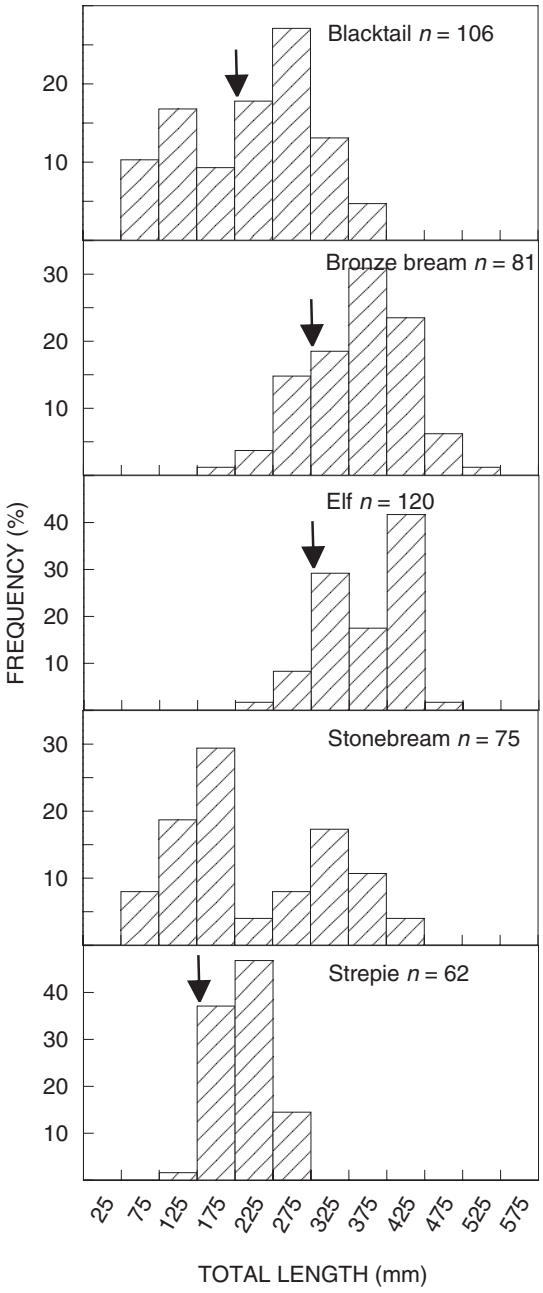

Fig. 8: Length frequency of the five most commonly caught species in the Transkei shore-fishery. Arrows depict the minimum size limit during 1997

popular baits used by shore-fishers were squid *Loligo* spp. (10.3%), sand prawn *Callianassa kraussi* (8.0%) and rock lobster *Panulirus homarus* (5.6%).

Some 49% of fishers interviewed said that they had caught five or more fish of one species (i.e. reached the bag limit for those species to which it applied) during an outing in their last 12 months of fishing. Bag limits for elf were the most commonly reached (46.9%), whereas bag limits for bronze bream (22.2%), blacktail (16.9%) and dusky kob (7.7%) were less frequently attained. In all, 35% of blacktail, 17% of bronze bream and 8% of elf measured were below the minimum size limit (Fig. 8).

Fisher attitudes and awareness

Response rates were good and only five fishers refused to answer the detailed questionnaire. When questioned on the necessity for, and the effectiveness of the fishing regulations, 82% of fishers interviewed agreed with minimum size limits, 78% with bag limits, 73% with closed seasons and 73% with marine reserves (Table V). Most of the fishers who disagreed with the regulations were local Xhosa folk, and it was clear that many of them had never heard of rules and regulations concerning the catching of fish. A high percentage of those interviewed admitted to disobeying minimum size limits (51%) and bag limits (42%), whereas relatively few admitted to disobeying closed seasons (29%) and marine reserves (6%). Fisher knowledge of the regulations for the species that they were targeting was extremely poor. Only 15.5% of the interviewees knew the minimum size, 21.3% knew the bag limit and 30.2% knew whether the species they were targeting had a closed season or not (Table V). Most interviewees that admitted to selling fish were local subsistence fishers, but nearly two-thirds (63%) of all those interviewed believed that they should be allowed to sell their catch (Table V).

Some 78% of the fishers interviewed were willing to pay for a fishing licence, provided that it applied to everyone and that the money generated was used for the benefit and conservation of the shore-fishery (i.e. improving angling facilities and ensuring better research and law enforcement). Most of those who objected to the implementation of a fishing licence were local Xhosa fishers, who claimed that they had insufficient money to afford a licence. The average price that interviewees were willing to pay for an angling licence was R60 per year.

Some 68% of the interviewees thought that shore-fishing catches had declined along the Transkei coast, the rest believed that it had remained relatively constant, but fluctuated from year to year. Several reasons were

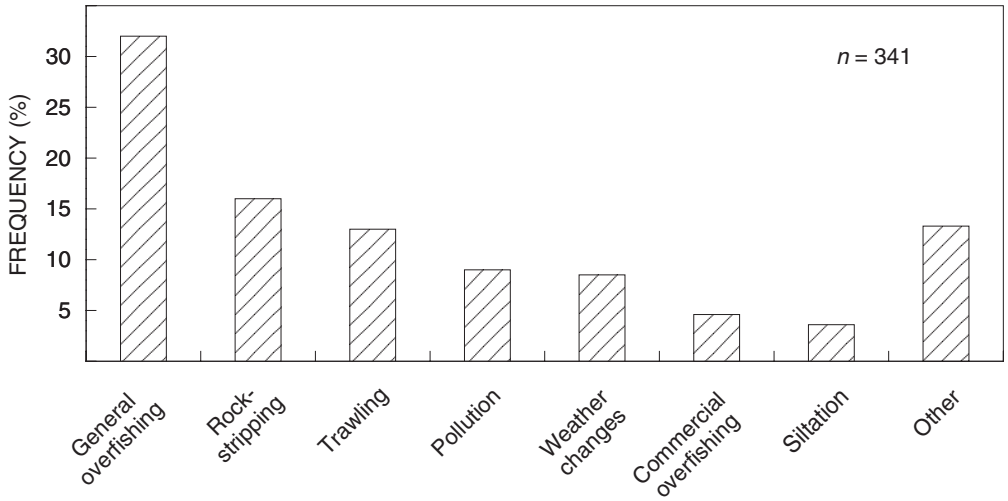

Fig. 9: Reasons given by fishers interviewed along the Transkei coast for the apparent decline in shore-fishing catches

given for the assumed decline, including general overfishing (32%), excessive bait collecting and rock-stripping (16%), trawling (13%), pollution (9%), changes in weather conditions (8.5%), commercial overfishing (4.6%) and siltation (3.6% – Fig. 9). Only 12% of interviewees had ever been inspected while fishing along the Transkei coast, most being holidaymakers who were checked in road blocks on the way home and not while fishing on the coast.

DISCUSSION

Participation

Although rather uncertain, the estimate of participation in the Transkei shore-fishery (7 748 fishers) was relatively low compared to that estimated for the adjacent KwaZulu-Natal coast in 1996 (72 000 fishers), where coastal ribbon development has resulted in much of the coastline becoming accessible to shore-fishers (Mann *et al.* 1997a). By contrast, much of the Transkei coast has experienced relatively little coastal development and access to large portions of the coastline still remains difficult. Essentially, participation in the Transkei shore-fishery involves two major user groups; the subsistence sector, represented by local Xhosa or Pondo fishers, and the recreational sector, consisting mostly of visiting holidaymakers. The latter can be further subdivided into cottage occupants, hotel guests and campers (Robertson and Fielding 1997). The economic importance of recreational fishing to the coastal economy of the Transkei was estimated to be about R9.6 million in 1995 (Robertson and Fielding 1997). With increasing political stability in the area following the re-incorporation of the Transkei into South Africa and the implementation of the Wild Coast Spatial Development Initiative, which is attempting to spearhead nodal micro-tourism developments along the coast (Beukes 1999), recreational fishing will become an increasingly important activity in the future.

Table V: Shore-fishers' attitudes and compliance with, and knowledge of, the linefish regulations along the Transkei coast

	Minimum size (%)	Bag limits (%)	Closed season (%)	Marine reserves (%)	Selling of catch (%)
Agree	82	78	73	73	63
Disobey	51	42	29	6	42
Knowledge	15.5	21.3	30.2		

The number of subsistence fishers encountered (33%) was higher along the Transkei coast than along either the KwaZulu-Natal coast (5.4% – Mann *et al.* 1997a) or the remainder of the Eastern Cape coast (4% – Brouwer 1997). The Transkei has a long history of subsistence use of marine resources, particularly rocky-shore intertidal invertebrates (Siegfried *et al.* 1985). The history of linefish use is less clear, some reports suggesting that traditionally Xhosa people did not catch fish because they were regarded as being a possession of their ancestors (Fikizolo 1996). However, the fact that most common shore-fish species have unique Xhosa names suggests that there has been a relatively long history of use of these species. Whatever the history, with western influence many of these beliefs are no longer adhered to and subsistence linefishing has now become an important source of food and income for Transkei coastal communities. The high level of unemployment (36.2% in 1999), coupled with a rapid population growth in the Eastern Cape (approximately 2.1% per year – Hirschowitz *et al.* 2001), has resulted in increased pressure being placed on the natural resources in the area, including linefish resources. Furthermore, according to McGrath *et al.* (1997), it is likely that participation in the shore-based linefishery will continue to increase in the future at a compound growth rate of at least 2% per year.

Fishing effort

The total annual shore-fishing effort estimated along the Transkei coast (170 457 fisher-days year^{-1}) was considerably lower than that estimated for either the KwaZulu-Natal coast (1 471 667 fisher-days year^{-1}) or for the rest of the Eastern Cape coast (903 186 fisher-days year^{-1} – Brouwer *et al.* 1997). However, the number of fishers determined from aerial surveys (0.79 fishers km^{-1}) was higher than that recorded for the rest of the Eastern Cape (0.36 fishers km^{-1}), but considerably lower than that recorded in KwaZulu-Natal (4.65 fishers km^{-1} – Brouwer *et al.* 1997). The higher fishing effort recorded along the Transkei coast compared to the rest of the Eastern Cape can largely be ascribed to the higher population density of coastal residents, many of whom fish, and the popularity of the Transkei coast as a fishing holiday destination.

Greatest fishing effort was recorded in the most developed and heavily populated areas of the Transkei coast, particularly the Port St Johns and Coffee Bay regions. In contrast, the lowest fishing effort was recorded in the least populated and least accessible areas along the coast, such as the Pondoland region north of Port St Johns and the Dwesa-Cwebe area south of the Xora River (Fig. 6). Seasonality of fishing effort was largely determined by weather and sea conditions, the highest fishing effort being associated with the best weather (winter and spring). In fact, the effect of weather and sea conditions largely overshadowed the differences between fishing effort recorded during holiday and weekday periods.

The low fishing effort recorded during this study could be masked by the availability (or abundance) of estuaries in the region. Estuaries represent sheltered environments, making it easier to fish, and hi-tech rods and reels are not required (i.e. very suitable for subsistence fishers).

Catch and *cpue*

There is little historical data available for the Transkei shore-fishery that can be used to determine trends in catches. Fielding *et al.* (1994) analysed tournament data captured on the National Marine Linefish System for the period 1985–1992 and found little trend in *cpue,* with catches averaging 1.16 kg fisher^{-1} h^{-1}. Catches were dominated by sharks and rays; competition anglers tending to target these fish because of their high individual weight. As a result of this bias, and the fact that competitive anglers are usually highly skilled, competition data is not directly comparable to the non-competitive fishing data collected during this study. The estimates made here therefore represent the first reliable estimates of catch and effort and provide an important reference against which future estimates can be compared.

Comparison of *cpue* with other regions along the South African coast suggest that, whereas shore-fishing in the Transkei has a higher *cpue* (1.39 fish fisher^{-1} day^{-1} or 0.86 kg fisher^{-1} day^{-1}) than KwaZulu-Natal (1.18 fish fisher^{-1} day^{-1} or 0.451 kg fisher^{-1} day^{-1}), it is lower than the *cpue* recorded in the rest of the Eastern Cape (2.06 fish fisher^{-1} day^{-1} or 1.15 kg fishe^{-1} day^{-1} – Brouwer *et al.* 1997). The total catch estimated for the Transkei shore-fishery during this study (147 tons year^{-1}) was similar to that estimated by Robertson and Fielding (1997; 187 tons year^{-1}). However, the latter estimate included catches made from recreational ski-boats and is therefore not directly comparable. These estimates nevertheless serve to highlight the fact that a substantial linefish catch is taken annually along the Transkei coast, and because many of the target species are considered to be overexploited (Mann 2000), careful management of this fishery is required to ensure sustainable catches.

Catch composition

Of the 39 species of fish recorded during the Transkei survey, only 10 contributed 2% or more (numerically)

to the total catch (Table IV). The catch composition was similar to that recorded by Brouwer *et al.* (1997) for KwaZulu-Natal and the remainder of the Eastern Cape. The Transkei region represents an important transition zone between the cooler Cape waters and warmer subtropical waters off KwaZulu-Natal (Turpie *et al.* 2000). An example is the white musselcracker *Sparodon durbanensis*, which is an important component of the Eastern Cape shore-fishery (Brouwer 1997), but was less important in the Transkei; no catches were recorded by Mann *et al*. (1997a) along the KwaZulu-Natal coast. However, elf, strepie and blacktail made appreciable contributions to shore-fisher's catches in all three regions. Blacktail is a non-migratory sedentary species, but elf and strepie undertake an annual winter migration from Cape waters to KwaZulu-Natal to spawn (van der Elst 1976, van der Walt and Mann 1998). Consequently, those two species revealed strong seasonality. This seasonal trend in catches probably accounted for the low targeting effort for these species (Table IV). Larger species such as dusky kob and bronze bream were clearly favoured target species (Table IV). Although species such as blacktail and stonebream do not grow as large as kob and bronze bream, they were heavily targeted because of their high relative abundance throughout the year. These species are generally found in very shallow water, which also makes them more accessible to fishers with low-tech gear and less experience.

Apart from species such as black musselcracker *Cymatoceps nasutus* and yellowbelly rockcod *Epinephelus marginatus*, shore-fishers generally do not catch species targeted by the Transkei skiboat fishery (Fennessy *et al*. 1999). However, there is an overlap of species taken by spearfishers (Mann *et al*. 1997b), but relative to shore-angling there are far fewer participants. Only three spearfishers were encountered during the creel surveys and 21 during the aerial surveys.

Although relatively few bronze bream were recorded in the KwaZulu-Natal survey (Brouwer *et al*. 1997), it was an important component of the Transkei and Eastern Cape shore-fishery. Shore-fishers primarily caught bronze bream during summer, although a few large specimens were also caught during winter. This does not necessarily mean that winter is a less productive season to fish for bronze bream, but rather a reflection of anglers targeting other species during that time, particularly elf.

Apart from sardine, squid and pink prawn, all other baits were collected from the local environment, prior to or during each fishing trip. Although there was some overlap, local and visiting fishers generally used different kinds of bait. Visiting anglers mostly used frozen baits such as sardine, squid and pink prawn that were purchased before their trip to the Transkei coast, whereas the local Xhosa and Pondo fishers used locally available baits such as redbait, sand prawns, crabs and mussel worms *Pseudonereis variegata*.

Although small, shallow-water species such as strepies, blacktail, stonebream and banded galjoen *Dichistius multifasciatus* were important in subsistence fishers' catches, many targeted larger fish such as bronze bream and kob. This is because larger fish fetch a better price from hotels and cottage owners. However, because of the scarcity of larger fish, 65% of the catch was used for own consumption by subsistence fishers.

Fisher attitudes and awareness

Fisher attitudes and knowledge of regulations in the Transkei shore-fishery followed a similar trend to the rest of the South African shore-fishery (Brouwer *et al.* 1997). Most fishers agreed with the principles of the various regulations, but their knowledge of these regulations was poor; a large proportion of fishers also admitted to transgressing them. In fact, fishers were often encountered in possession of undersized fish, even though they had agreed with the concept of minimum size limits. This situation requires the attention of a fisher awareness programme or the implementation of an effective management system involving regular shore patrols conducted by trained staff similar to that used along the KwaZulu-Natal coast (Coetzee 1993).

Few fishers reached the bag limit for any species, except for elf. This suggests that only elf receives any protection from the current bag limit of 5 fish fisher^{-1} day^{-1} and that most bag limits set for other species of fish have little effect in limiting the total catch taken by shore-fishers. A similar conclusion was reached in a study conducted on the recreational shore-fishery in the South-Western Cape (Attwood and Bennett 1995) and during the national linefish survey (Brouwer *et. al*. 1997). However, fishers frequently disregarded the set bag limits for elf. Restrictions on elf include a three-month closed season (1 September–30 November), but this regulation did not stop fishers from catching them. Approximately 35% of all elf catches were recorded during the closed season. This suggests that compliance is poor in the Transkei and that measures should be taken to rectify this. By increasing awareness of the regulations and the inspection rate in the Transkei, fishers will be deterred from transgressing the law. For example, Brouwer *et al*. (1997) showed that there was a close correlation between compliance with regulations and the frequency of inspection in KwaZulu-Natal.

Although the majority of fishers interviewed (71.6%) supported the establishment of marine protected

areas (MPAs) along the Transkei coast, the level of support was lower than elsewhere along the South African coast (Brouwer *et al.* 1997). Most fishers who disagreed with the concept were locals who had to walk extra distances to reach waters where fishing was allowed. However, MPAs provide one of the best management options for resident linefish species with complex life histories (Bennett and Attwood 1991) and they are also generally easier to enforce than species–specific regulations. Several of the commonly caught linefish species are endemic to South Africa and known to spawn along the Transkei coast (e.g. white steenbras *Lthognathus lithognathus*, white musselcracker, bronze bream). Local abundance of these species in Transkei waters, and the fact that some species occur in feeding and/or spawning aggregations (e.g. white steenbras), makes them particularly susceptible to high fishing mortality and consequently prime candidates for protection in MPAs. The present MPAs along the Transkei coast, Mkambati, Hluleka and Dwesa, are not adequately patrolled and provide little protection for shore-fish species (Attwood *et al*. 1997). They are therefore not fulfilling their conservation function in terms of linefish protection. Furthermore, the Hluleka MPA is considered too small (1.6 km of coastline) to provide adequate protection to a reasonable proportion of spawner biomass of any linefish species (Griffiths and Wilke 2002). For this reason, improved legislation and enforcement is needed in all three of Transkei's MPAs. An increase in the size the Hluleka and Mkambati MPAs, including "no take" areas from the shore, should be seen as a high priority.

CONCLUSIONS

Despite the opinion of a large proportion of shore-fishers interviewed that fishing has deteriorated (68%), the Transkei shore-fishery still appears to be in reasonable condition given the overall catch composition (i.e. high proportion of endemic, vulnerable species) and the mean size of fish caught. This is probably attributable to the inaccessibility of many areas along the coast (which may act as *de facto* MPAs) and that extremes in weather and sea conditions have afforded fish stocks some measure of protection. However, caution is required in balancing the possible effects of natural refugia along the coast with the increased susceptibility to capture certain species, as a result of localized aggregations. A good example of this is the vulnerability of white steenbras to capture in spawning aggregations in the vicinity of the Bashee River mouth (Bennett 1993).

With the current lack of awareness and compliance enforcement, it is unlikely that the regulations have had any effect in controlling fishing effort or fishing mortality. However, with increasing political stability in the area and plans for development and upgrading of infrastructure along the Transkei coast, fishing effort is likely to increase in the future, resulting in an increase in fishing mortality on target species. Bearing in mind that the stocks of a large number of important species caught in the Transkei shore-fishery are already considered overexploited (e.g. dusky kob, white steenbras, black musselcracker – Mann 2000), it is only through sound management objectives and implementation of clearly defined operational management procedures (Griffiths *et al*. 1999) that future catches will be sustained.

Currently, nearly half the participants in the Transkei shore-fishery are historically disadvantaged, many of whom rely on linefishing to supplement their livelihoods. Subsistence fishers have, for the first time, been recognized as a formal sector in terms of the Marine Living Resources Act (Anon. 1998). In the past, shore-based subsistence linefishers have had to conform to the recreational linefishing regulations, and sale of fish by them was therefore illegal. An important challenge is going to be how to accommodate these fishers in the new legislation in an equitable manner and still ensure that linefish resources are used sustainably (Harris *et al.* 2000).

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APPENDIX

Transkei shore-angling questionaire

Questionnaire no._____

Section A: (to be completed by interviewer)

Brief description of site: _____ Angler code:_____

Locality: _____ Date: _____ Time: _____ Rods used: _____ Beach vehicle: _____

Section B: (Catch and effort)

What time did you start fishing? _____ What time do you anticipate leaving? _____

What types of fish are you targeting (list 3)? _____

What baits are you using? Sardine _____ Squid _____ Pink prawn _____ Red bait _____
Other (specify) _____

How many days have you spent fishing in the last week _____ month _____ and in the last 12 months? _____

Do you ever fish at night? _____ If YES, how often in the last 12 months? _____

Which stretch of coast do you normally fish? _____

Which fishing club do you belong to? _____

How many years have you been fishing? _____ How old are you? _____

Section C: (Attitude to management)

Which of the following regulations, in your opinion, are effective in managing our fish stocks? YES/NO

Minimum size limits? _____ Bag limits? _____ Closed seasons? _____
Marine reserves? _____

Ever kept undersized fish? _____ More than you bag limit? _____ Kept fish in a closed season? _____ Fished in a marine reserve? _____

Have you ever sold your catch? _____ Do you think that you should be allowed to sell your catch? _____

	Target 1	Target 2
Species:		
Minimum size:		
Bag limit:		
Closed season:		

Have you ever been inspected? YES/NO. If YES, how often in the last 12 months? _____
Where were you checked? _____

While fishing have you ever reached your bag limit? YES/NO. If YES, specify for which species? _____ and how often? _____

Section D: (Economics)

What is your occupation? (write in detail, include casual work) _____

If unemployed/retired what was your last occupation? _____

Where do you live? _____

Are you on an overnight, weekend or longer trip/holiday? (i.e. staying away from home) YES/NO

If YES (i.e. trippers/ holiday makers), where are you staying? _____

What method of transport did you use to come on this trip? (describe vehicle type and c) _____
_____

How many people came with you on this trip? _____ How many of this group will be fishing? _____

How many days will you spend away from home on this trip/holiday? _____

How many days of this trip/holiday will you spend fishing? _____

What is the estimated cost of your trip/holiday? (all members excluding transport and food) _____

How far did you travel to come fishing today (kilometres one way) _____

What method of transport did you use (describe vehicle type, cc) _____

If own vehicle, specify number of passengers _____ How many of this group are fishing? _____

If not own vehicle, what were your transport costs? (e.g. bus, taxi etc.) _____

How much did you spend this outing on: Bait? _____ Other? _____

How much have you spent on terminal tackle in the last month? (line, hooks, sinkers etc.) _____

Expenditure on rods or reels in the last 12 months? _____

What is the estimated value of all your R & S fishing equipment? (i.e. what would they sell it for?)

Beach vehicle?_____ Rods?_____ Reels?_____ Tackle?_____

Is your beach vehicle used exclusively for fishing? _____

Why do you fish? (record answer only) Food _____ Recreation _____ Competition _____ Livelihood _____ Other (specify) _____

What will you do with your catch? Eat _____ Give away _____ Release _____ Sell _____ Other (specify) _____

SUBSISTENCE FISHERS

How often in the last month did you eat fish? _____ or sell fish? _____ Estimate proportion of catch that is eaten _____

What is your highest educational qualification? _____ Who is the head of your household? (relationship) _____

Does your household grow food and/or keep livestock for consumption? _____ How many people live in your household? _____

How many of these are at school? _____ How many earn a pension or collect UIF? _____

How many absent members of your household contribute to its income? _____

Section E: (general)

Have you ever caught a tagged fish? YES/NO. If YES, what happened to the tag? (specify) _____

Has fishing deteriorated over the years? YES/NO. If YES, what is the cause of this decline?

Pollution _____ Siltation _____ Seine netting _____ Gill netting _____ Trawling _____ General overfishing _____

Commercial overfishing _____ Other (specify) _____

Would you be prepared to pay for a marine angling licence to provide funds for fisheries conservation?

YES/NO (Give reason for answer) _____

If YES, how much would you be prepared to pay for a licence of this nature? _____

Do you participate in any other form of fishing? _____

Species	Number	Total length