

## THE STATUS OF THE SOUTH AFRICAN BEACH-SEINE AND GILL-NET FISHERIES

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Initial estimates indicate that there are at least 7 000 fishermen active in fisheries using beach-seine and gill nets in South Africa, mostly (86%) along the West and South coasts. Those fishermen utilize 1 373 registered and 458 illegal nets and report an average catch of 1 600 tons annually, constituting 60% harders *Liza richardsonii*, 10% St Joseph shark *Callorhynchus capensis* and 30% "bycatch" species such as galjoen *Dichistius capensis*, yellowtail *Seriola lalandi* and white steenbras *Lithognathus lithognathus*. Catch composition by mass varies between 70, 74 and 90% *L. richardsonii* off the Western, Southern and Eastern Cape coasts respectively to 88% sardine *Sardinops sagax* in KwaZulu-Natal. Catch-per-unit-effort declines eastwards from 294 and 115 kg·net·day<sup>-1</sup> for the beach-seine and gill-net fisheries respectively off the West Coast to 48 and 5 kg·net·day<sup>-1</sup> off KwaZulu-Natal. Consequently, the fishery changes in nature from a largely commercial venture on the West Coast to an artisanal/subsistence fishery on the East Coast. Attempts to validate compulsory catch returns indicate that at least half the annual catch, notably bycatch, is not reported. Reasons for this indicate an unwillingness to declare prohibited species, perceived avoidance of the taxman, ignorance as to the importance of catch statistics, multiple licensing authorities and management inadequacy to police illegal catches and nets.

The beach-seine and gill-net fisheries are South Africa's oldest commercial fisheries. Seining dates back to the arrival of the first European settlers in 1652, whereas the introduction of gill nets is attributed to Portuguese fishermen during the 1860s (Thompson 1913, Thom 1952). There were few management measures for the seine and gill-net fisheries until the latter half of this century. Then, as now, they were mostly implemented in an attempt to minimize conflict between net fishermen and other fishing sectors (De Villiers 1987, Lamberth 1994, Kyle 1995). During 1883, conflict between anglers and seine fishermen resulted in the Zwartkops Fish Protection Act, which provided for a closed season with regards to netting and the dynamiting of fish in the Zwartkops River, Port Elizabeth (Gilchrist and Williams 1910). In 1908, disputes between seine and gill-net fishermen on the West Coast saw the prohibition of the use of set gill nets within a two mile radius of any seine-netting ground (Du Toit 1909). Over the following 50 years, the only new regulation in the net fisheries was the implementation of a minimum mesh size of 44 mm. The Yeats Commission (Yeats *et al.* 1966) recommended that the catching of linefish species by nets be prohibited between Cape Point and Danger Point. Although this recommendation was not followed up

with regards to the gill-net and seine fisheries, it was the first official expression of disquiet at the catching of linefish by net fishermen (Penney 1991).

Over the next 16 years, following the Yeats Commission, complaints from anglers and conservation bodies over net catches of linefish, as well as complaints from professional fishermen that there were too many amateur net fishermen, were addressed by several investigations (Treurnicht *et al.* 1980, Theart *et al.* 1983, Stander 1991). As a result, by the early 1980s a whole suite of new management measures were in force. Reduction of net fishing had become official policy, numerous gear restrictions were implemented and a permit system was introduced whereby daily catch returns were to be submitted on a monthly basis to the Sea Fisheries (De Villiers 1987, Stander 1991). However, those regulations were only applicable to permits issued by Sea Fisheries in the then Cape Province and did not apply to those issued in KwaZulu-Natal, or by other licensing bodies such as Cape Nature Conservation and the National Parks Board.

Previous works on the South African gill-net and beach-seine fisheries are few, and are mostly confined to studies covering narrow geographical regions such as False Bay (Penney 1991, Clark *et al.* 1994a, b,

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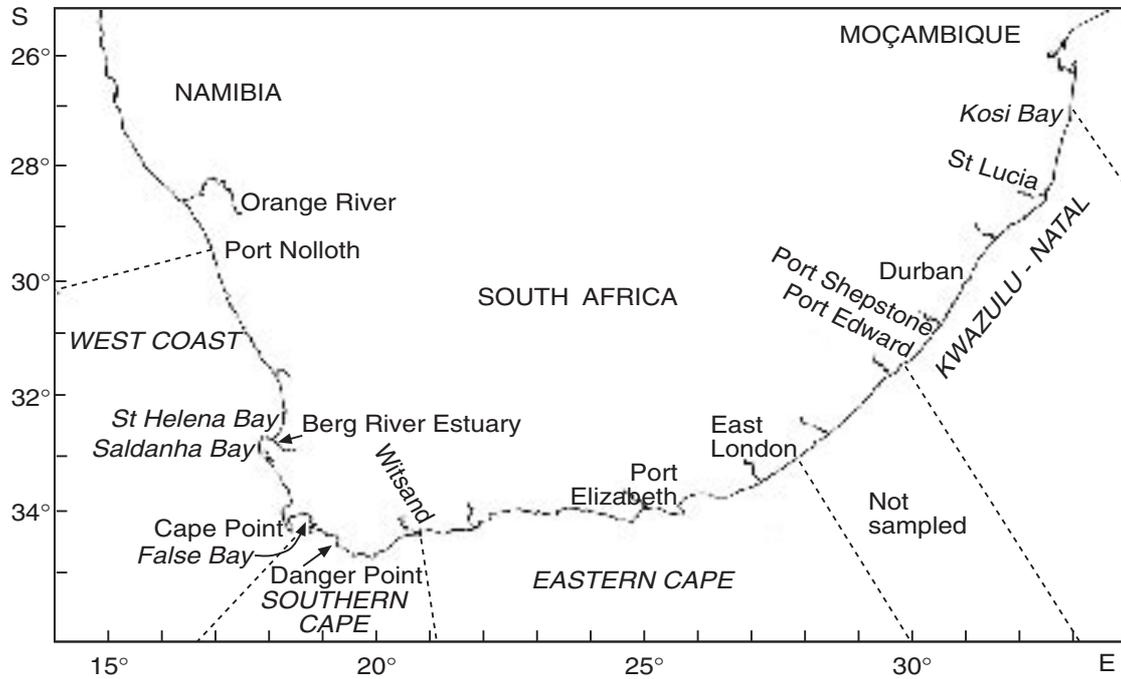


Fig. 1: Map of South Africa showing the four coastal regions and other places mentioned in the text

Lamberth *et al.* 1994, 1995a, b, c), St Lucia Estuary (Mann 1995), Kosi Bay (Kyle 1996) and Durban (Beckley and Fennessy 1996). De Villiers (1987) provided a broad overview of the net fishery for harders (mullet) *Liza richardsoni* in the Cape Province and concluded, on the assumption that catches were correctly reported, that it was a well-managed fishery. However, with the exception of Lamberth *et al.* (1994), no attempt has been made to validate the accuracy of any of the catches reported by the gill-net and beach-seine fisheries.

This study provides an overview of the gill-net and beach-seine fisheries by comparing participation, catch and effort between four different regions along the South African coastline. In doing so, published data and catch reports validated on the West Coast during this study are used with a view to providing an estimate of the true or possible total catch of the South African gill-net and beach-seine fisheries. The current study forms part of a broader programme to evaluate participation in and management of the South African marine linefishery (Lamberth and Bennett 1994). Consequently, this paper is intended to be a companion study to those on the economics of the South African linefishery (McGrath *et al.* 1997),

recreational shore-angling (Brouwer *et al.* 1997), recreational spearfishing (Mann *et al.* 1997) and the commercial and recreational boat fishery (Sauer *et al.* 1997).

## METHODS

For the purpose of this study, the South African coastline was sub-divided into four regions (Fig. 1): the West Coast (Port Nolloth to Cape Point), the Southern Cape coast (Cape Point to Witsand on the Breede river mouth), the Eastern Cape coast (Witsand to East London) and the KwaZulu-Natal coast (Port Edward to Kosi Bay).

Beach-seining, or treknetting, is an active form of fishing in which woven nylon nets are rowed out into the surf zone to encircle a shoal of fish. They are then hauled shorewards by a crew of 6–30 persons, depending on the size of the net and the length of the haul. Beach-seine nets to the west of Walker Bay are restricted to 275 m in length, whereas on the rest of the Southern and the entire Eastern Cape coasts they may not exceed 137 m. Beach-seine nets on the

KwaZulu-Natal coast are restricted to a length of 100 m. Minimum mesh sizes permitted are 44-mm stretched mesh on the West Coast and the Southern and Eastern Cape coasts and 14 mm on the KwaZulu-Natal coast.

Gill netting is a passive form of fishing in which monofilament or braided nylon gill nets are deployed either from a boat or by walking them out from the shore, in the hope that a shoal of fish will swim into them and become entangled. These nets may either drift, be staked or be anchored, but they may not be left unattended, except in KwaZulu-Natal where they are set overnight and retrieved in the morning. Gill nets in all four regions are restricted to 30 m long, but fishermen on the West Coast and the Southern and Eastern Cape coasts are not prevented from cooperating and coupling their nets together, on condition that all the permit-holders are present. Minimum mesh sizes allowed are 44-mm stretched mesh on the West Coast and the Southern and Eastern Cape coasts and 90 mm on the KwaZulu-Natal coast (Stander 1991, Mann 1996).

The number of net permits issued for each region was obtained from the Sea Fisheries Research Institute database (West Coast and Southern and Eastern Cape) and from the Natal Fisheries Licencing Board, Natal

Parks Board and KwaZulu Department of Nature Conservation (KwaZulu-Natal). The number of illegal nets in operation was calculated from observer estimates for each region and from the total length of nets confiscated annually. The number of crew members used in net-fishing operations was estimated from direct observation.

During 1995 and 1996, beach-seine and gill-net catches and effort were monitored on the West Coast. In each observed haul, all fish were identified and either counted or weighed. Observed hauls were compared with those reported by permit holders on monthly catch return forms submitted to Sea Fisheries. For each species, data were divided into three groups:

- (i) observations where both reported and monitored catches were zero;
- (ii) where non-zero catches were observed, but catch reports were zero or missing; and
- (iii) where catches were observed and reported.

This procedure aimed to obtain a correct ratio of actual to reported catch, after accounting for differences between reported and non-reported catches and biases such as observer accuracy. The statistical procedure

Table 1: The number of gill nets and beach-seines issued by various authorities in the four sampling regions along the South African coast. Included are estimates of the number of illegal nets and "ration" permits, which are issued to farmers to feed their workers

Region	Gill nets	Beach-seine nets	Issuing authority
West Coast	842 174 21 5 268	84    unknown	Sea Fisheries Cape Nature Conservation National Parks Board Ration permits Illegal nets
Total	1 310	84	
Southern Cape coast	14 25 3 60	76   10	Sea Fisheries Cape Nature Conservation Ration permits Illegal nets
Total	102	86	
Eastern Cape coast	2 unknown	8 unknown	Sea Fisheries Illegal nets
Total	2	8	
KwaZulu-Natal coast	57 35 120	  27 unknown	Natal Parks Board KwaZulu Department of Nature Conservation Fisheries Licencing Board Illegal nets
Total	212	27	
Overall total	1 626	205	

followed is detailed in Sauer *et al.* (1997). However, it is not outlined here, because it was not successful for reasons which are discussed later. Instead, a direct comparison of total observed to total reported catch was made for all the monitored hauls.

The degree of under-reporting calculated from the observed catches was assumed to be constant for the entire fishery on the West Coast and was used to scale up the data on the Sea Fisheries database in order to provide a crude estimate of total catch for the gill-net and beach-seine fisheries.

## RESULTS AND DISCUSSION

There are some 1 831 nets in use along the coastline under study, consisting of 1 178 gill nets, 195 beach-seines and 458 illegal nets (mostly gill nets, Table I). Of that total, 77% are utilized along the West Coast, 9% on the Southern Cape coast, 1% on the Eastern Cape coast and 13% on the KwaZulu-Natal coast. Working on the assumption of net-to-crew ratios of three and 10 persons for gill nets and beach-seines respectively, at least 7 000 fishermen are involved in the two fisheries. However, this is a minimum value, because crew turnovers, especially of part-time fishermen involved in other fisheries, are high. It is likely that many part-time, rather than a few fulltime, fishermen participate in those fisheries. Netting on the West Coast is intensive. In St Helena Bay and the Berg River Estuary, some 600 nets are used, equivalent to approximately 20 nets per km of coastline. In comparison, netting in the other three regions is relatively sparse, which is largely a result of management attempts to reduce participation, especially of part-time fishermen, in the late 1970s (De Villiers 1987).

Six licensing authorities are responsible for the issue of net permits; Sea Fisheries, Cape Nature Conservation and National Parks Board to the west of East London, and the Fisheries Licensing Board, Natal Parks Board and KwaZulu Department of Nature Conservation on the KwaZulu-Natal coast. Of those authorities, only Sea Fisheries, the National Parks Board and the Fisheries Licensing Board require permit-holders to report catches. However, the Natal Parks Board and the KwaZulu Department of Nature Conservation have ongoing monitoring programmes in St Lucia and Kosi Bay (Kyle 1996, Mann 1996). The two most serious pitfalls of this system of multiple licensing authorities are that there is no central database for catch statistics and that permit-holders in any one region may hold permits issued by up to three different bodies. For example, net fishermen require a

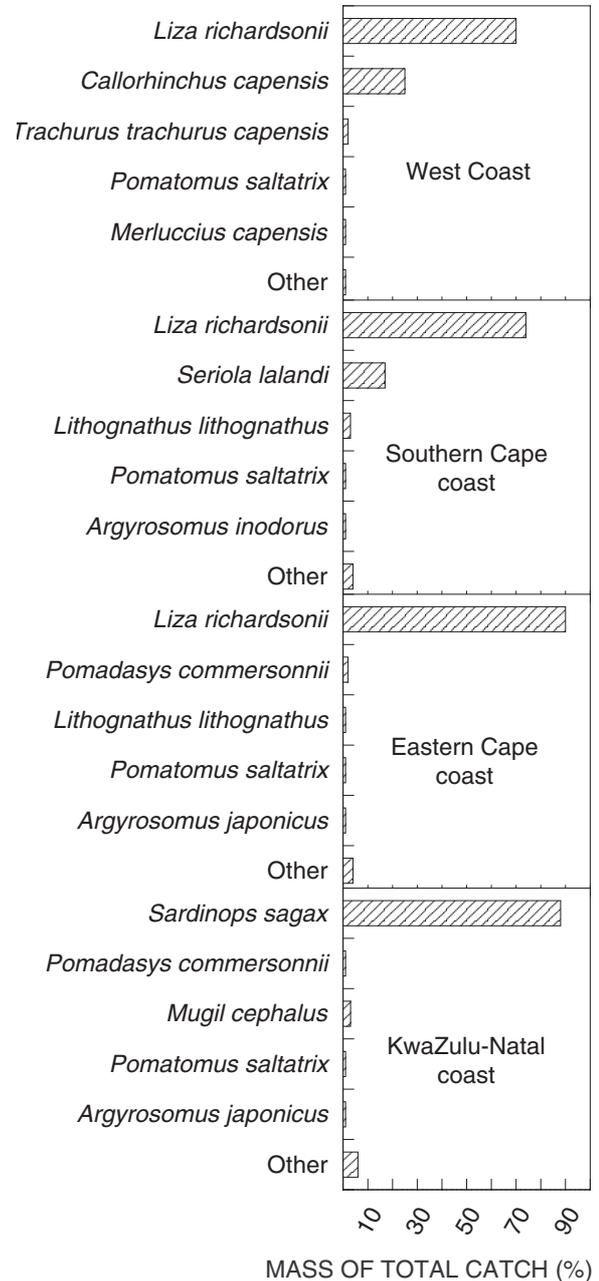


Fig. 2: Catch composition and frequency by mass of fisheries using gill nets and beach-seines along the West Coast, the Southern and Eastern Cape coasts and the KwaZulu-Natal coast

Table II: Catch per unit effort (*cpue*) based on monitored catches of the gill-net and beach-seine fisheries in the four sampling regions along the South African coast. The West Coast data are from catches monitored during this study. The Eastern Cape data are based on catch reports which have not been validated, and the KwaZulu-Natal data do not include catches of *Sardinops sagax*

Gear	<i>Cpue</i> (kg·net·day <sup>-1</sup> )			
	West Coast	Southern Cape coast	Eastern Cape coast	KwaZulu/Natal coast
Gill nets	115	71 <sup>a</sup>	59 <sup>b</sup>	5 <sup>c, d</sup>
Beach-seine nets	294	393 <sup>a</sup>	199 <sup>b</sup>	48 <sup>e</sup>

<sup>a</sup> Lamberth *et al.* (1994)

<sup>b</sup> Sea Fisheries Research Institute, unpublished data

<sup>c</sup> Mann (1996)

<sup>d</sup> Kyle (1996)

<sup>e</sup> Beckley and Fennessy (in press)

permit issued by Sea Fisheries to operate in Saldhana Bay and one acquired from the National Parks Board to fish in the adjacent Langebaan Lagoon. Fishermen do not distinguish between catches made in the two areas, but lump them together in one catch report. As a result, one authority receives inflated catch figures and the other a report of zero catch or no fishing.

Figure 2 depicts the combined species composition of monitored catches of gill nets and beach-seine nets for the four different fishing regions. Catches on the West Coast, and the Southern and Eastern Cape coasts are dominated by harders, which provide 70% or more of the total catch by mass. Off KwaZulu-Natal, the catches are dominated by sardine *Sardinops sagax* (88%). However, sardines are available only for a short season and for most of the year catches off that coast are dominated by various species of mullet, mostly *Mugil cephalus*. St Joseph sharks *Callorhynchus capensis* contribute 25% of the catch on the West Coast, whereas yellowtail *Seriola lalandi* (17%) and white steenbras *Lithognathus lithognathus* (3%) are important off the Southern Cape. Elf *Pomatomus saltatrix* provide 1% of catches in all four regions (Fig. 2). Two species of kob are caught, *Argyrosomus inodorus* off the West Coast and the Southern Cape and *A. japonicus* off the Eastern Cape and KwaZulu-Natal coasts (Griffiths and Heemstra 1995). The proportion of other or "bycatch" species increases from west to east. The implication of this is that the risk of overexploitation of non-targeted species increases from west to east.

The catch compositions in the different regions reflect targeting and conditions under which permits are issued. Net permits on the West Coast are solely for the capture of *L. richardsonii* and *C. capensis*, whereas

on much of the Southern Cape coast targeting of line-fish species such as *S. lalandi* and *L. lithognathus* is permitted. Off the Eastern Cape, only the catching of *L. richardsonii* is allowed. On the West Coast and the Eastern Cape coast, net fishermen are permitted to retain a bycatch of 30 "dead linefish" per day. In KwaZulu-Natal, about 20 permits are issued each year to catch only *S. sagax* with seine nets. There are only three permanent, fulltime beach-seine teams that are permitted to catch "shoaling species" from the surf zone in that region (Beckley and Fennessy 1996). The gill-net fishery is confined to the St Lucia, Kosi Bay and Umfolozi estuaries and Richard's Bay Nature Reserve in the form of closely monitored, community-based subsistence fisheries under the auspices of the Natal Parks Board and the KwaZulu Department of Nature Conservation (Mann 1995, Kyle 1996). Those fisheries are responsible for the catch of species other than *S. sagax* on the KwaZulu-Natal coastline.

Catch per unit effort (*cpue*), calculated from monitored catches of the beach-seine fishery, ranges from 393 kg·net·day<sup>-1</sup> on the Southern Cape coast to 48 kg·net·day<sup>-1</sup> on the KwaZulu-Natal coast (Table II). *Cpue* of the gill-net fishery is highest on the West Coast (115 kg·net·day<sup>-1</sup>) and lowest off KwaZulu-Natal (5 kg·net·day<sup>-1</sup>). The *cpue* of the Eastern Cape gill-net fishery is high relative to KwaZulu-Natal, but is calculated from unvalidated catch return forms and not from monitored catches. KwaZulu-Natal seine catches of *S. sagax* are excluded from estimates of beach-seine *cpue* because only total catch is known and not effort. Generally, *cpue* of the net fisheries declines eastwards. Consequently, the net fishery changes in nature from a largely commercial venture on the West Coast to an artisanal or subsistence fishery on the East Coast. The low *cpue* for the gill-net fishery on the Southern and Eastern Cape and KwaZulu-Natal coasts suggests that any new operations in these regions are unlikely to develop into commercially viable ventures.

Most net permit-holders on the West Coast and the Southern and Eastern Cape coasts are required to report the type and number of nets used, as well as their daily catches by number and mass of each species on catch return forms, which they submit to Sea Fisheries at the end of each month. Attempts to validate these reports were unsuccessful, as reporting by net fishermen was extremely erratic and there were too many zero values for statistical analyses because of >80% of observed catches not being reported at all (T. J. Stewart, Department of Statistical Sciences, University of Cape Town, pers. comm.). Therefore, the total observed catch could only be compared to the total reported catch to obtain a crude estimate of

Table III: Catches observed and reported by fishermen for 383 hauls by gill nets and beach-seines on the West Coast during 1995 and 1996

Species	Mass caught (kg)	Mass reported (kg)	Reported (%)
<i>Liza richardsonii</i>	79 888	3 146	3.9
<i>Callorhynchus capensis</i>	30 277	943	3.1
<i>Trachurus trachurus capensis</i>	2 227	11	0.5
<i>Pomatomus saltatrix</i>	872	40	4.6
<i>Merluccius capensis</i>	636	16	2.5
<i>Galeichthys feliceps</i>	236	2	0.9
<i>Chelidonichthys capensis</i>	224	6	2.7
<i>Dichistius capensis</i>	126	0	0
<i>Thyrstites atun</i>	106	0	0
<i>Argyrosomus inodoros</i>	62	0	0
Other	840	32	3.8
Total	115 567	4 196	3.6

the degree of under-reporting within the two fisheries. Table III compares catches reported on catch return forms with observed catches for 383 hauls on the West Coast during 1995 and 1996. Of a total of 116 tons caught, only 4 tons (3.6%) of the total catch were reported. Reporting of the two target species, *L. richardsonii* and *C. capensis*, was also very low (<4%). By contrast, on the Southern Cape coast 89% of the *L. richardsonii* catch was reported (Lamberth *et al.* 1994). The more accurate reporting of catches from the Southern Cape is probably attributable to net fishermen in this region being more in the public eye and more frequently under management scrutiny (Lamberth 1994). The average annual reported catch for each region varies from 988 tons on the West Coast to 37 tons on the Eastern Cape coast (Table IV). The total annual reported catch countrywide is in the region of 1 600 tons. However, if the 988 tons reported on the West Coast represents only 3.6% of the true catch there, then the total South African catch by the gill-net and beach-seine fisheries could be of the order of 28 000 tons. This value is equivalent to the combined catch of the commercial and recreational fisheries (Chief Director of Sea Fisheries 1995).

In terms of effort, of the 383 net-days monitored, 85% were not reported on return forms, whereas 4% were not fished but reported as so, and 11% were reported. Of the 11% who reported going to sea, only one-quarter reported catches within 50% accuracy of those observed. Scaling up by the ratios of reported to observed catches is not a strictly valid way of estimating total catch or effort, but it gives a reasonable reflection of the orders of magnitude of error. Approaching the argument from another perspective, if the number of net-days reported annually (Table V) are compared with the number of nets in each region

Table IV: Mean annual reported catch for gill nets and beach-seines used in the four sampling regions along the South African coast

Gear	Mean annual reported catch (tons)				Total
	West Coast	Southern Cape coast	Eastern Cape coast	KwaZulu/Natal coast	
Gill nets	730 <sup>a</sup>	5 <sup>a</sup>	13 <sup>a</sup>	30 <sup>b,c</sup>	778
Beach-seine nets	258 <sup>a</sup>	376 <sup>a</sup>	24 <sup>a</sup>	185 <sup>d,e</sup>	843
Total	988	381	37	215	1 621

<sup>a</sup> Sea Fisheries Research Institute, unpublished data

<sup>b</sup> Mann (1995)

<sup>c</sup> Kyle (1996)

<sup>d</sup> Beckley and Fennessy (in press)

<sup>e</sup> Natal Fisheries Licensing Board, unpublished data

(Table I), it appears that each net is seldom used. This is especially true for the West Coast where, reportedly, each net is used on an average of only seven days per year.

There are numerous reasons given by net fishermen for not reporting catches (Lamberth 1994). These include a perceived lack of confidentiality and the fear that catch returns are readily available to the Receiver of Revenue and other authorities. Ignorance plays a part, because many fishermen do not know why they have to report catches. Many believe that, if reported catches are too high or contain too many prohibited species, such as *P. saltatrix* and galjoen *Dichistius capensis*, then their permits will be withdrawn. Apathy is common, because many do not bother to report catches, often on the pretext that management provides no feedback. Also, some fishermen are involved in targeting prohibited species, particularly *D. capensis*, for which a large but illicit fishery exists (Bennett 1988).

There is also the perception among fishermen that the chance of being caught for illegal activities is small, management being unable to apprehend offenders (Brouwer *et al.* 1997). In turn, the large price difference between *L. richardsonii* (R1–2 kg<sup>-1</sup>) and linefish (R6–10 kg<sup>-1</sup>) creates a major incentive for fishermen to target prohibited species. This situation is not unique to South Africa, but merely reflects what amounts to an almost traditional distrust that exists between management and fishermen in many small-scale fisheries throughout the world (e.g. Matthiessen 1988, McGoodwin 1990, Finlayson 1994).

Whereas the current authors acknowledge the wide array of socio-political issues surrounding the inshore net fisheries, detailed analysis of these have been deliberately avoided in this paper. These diverse and complex issues form the basis of a separate study currently under way (Lamberth in prep.). In conclusion, knowledge of the South African fisheries using gill

Table V: Mean annual reported effort (net-days-year<sup>-1</sup>) of the gill-net and beach-seine fisheries in three sampling regions along the South African coast. Total reported *cpue* for KwaZulu-Natal was unavailable

Net type	Mean annual effort (net-days-year <sup>-1</sup> )		
	West Coast	Southern Cape coast	Eastern Cape coast
Gill nets	6 723	179	108
Beach-seine nets	935	1 406	140
Total	7 658	1 585	248

nets and beach-seines is poor, with up to 85% of catch and effort unaccounted for. The future and present status of those net fisheries need to be determined. Numerous recent requests for more net permits to be issued, especially on the Southern and Eastern Cape coasts, have been received. Moreover, before any expansion of effort, a management plan and a means of validating the catch are required. Indications are that the net fisheries are responsible for a substantial proportion of the total South African linefish catch and therefore that this fishery should not be managed in isolation from the recreational and commercial linefisheries.

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