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SOCIO-ECONOMIC CHARACTERISTICS OF GILLNET AND BEACH-SEINE FISHERS IN THE WESTERN CAPE, SOUTH AFRICA

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Data collected by questionnaire and telephone surveys conducted during 1998 and 1999 are used to describe the socio-economic characteristics of inshore netfishers in the Western Cape. Approximately two-thirds of netfishers work or have worked in other fishing sectors and a further 6–50%, depending on the area surveyed, are retired. Very few (0–11%) permit-holders in most areas classified their occupations as netfishers and the majority claimed to make <5% of their income from netfishing. Estimated costs and returns to net permit-holders suggest that, in most areas, commercial netfishing at current levels of catch and effort is not economically sustainable in the long-term. Only Saldanha-Langebaan gillnetters and beach-seine permit-holders, on average, manage to cover their opportunity costs and make an economic profit. The lack of profits in other areas is compelling evidence that the net fisheries are at or beyond the open access equilibrium point, suggesting that effort reduction in the order of 60% is necessary if maximum economic yield is to be obtained from the fishery. The netfisheries provide part-time employment for approximately 2 000 crew in the Western Cape. Additional economic benefits and employment directly related to the fishery in the form of equipment and fuel purchases made by fishers, maintenance of fishing gear and the sale of fish are estimated to contribute at least R15 million to the regional economy annually. Between 42 and 76% of respondents felt that their catches had declined since they had started netfishing and most felt that no new permits should be issued. Knowledge of catch restrictions among respondents was low (53–73%), indicative of a lack of communication between management and fishers, poorly defined permit conditions and a lack of enforcement. Many fishers interviewed feel it is unfair that they are restricted to catching only low-value target species and do not adhere to the catch restrictions, even if they do know them. The importance of the netfishery for participants varies greatly between and within areas. In order to reduce effort equitably, current and potential new permit-holders should be assessed on an individual merit basis.

Key words: beach-seines, costs and returns, economic viability, fisher demographics, gillnets, socio-economics

Since the licensing of gill and beach-seine nets became compulsory in 1974, inshore net permits in the Western Cape have always been classified as commercial fishing rights (De Villiers 1987). This implies that permit-holders fish with the primary aim of making profit whether financial or economic. Management was, however, aware that most permit-holders did not rely solely on netfishing as an occupation, but rather relied on the fishery to supplement income, particularly when other fisheries were not productive. The part-time commercial nature of the fishery was actively encouraged by management, with permits awarded preferentially to applicants who were considered *bona fide* fishers with employment in other fishing sectors, or to retired fishers (De Villiers 1987, Stander 1991). Unfortunately, this policy amounted to effort subsidization in the netfisheries, to the detriment of those who were attempting to operate as full-time commercial netfishers.

In theory, access to the Western Cape netfisheries is controlled by the permit system. Management, however, faced huge political pressure when not all applicants for permits in 1974 were successful (Treurnicht *et al*. 1980). Management capitulated and permits were issued to all applicants, with the result that the initial situation was essentially that of open access. Later investigations into the netfisheries recommended a substantial reduction in the number of permit-holders (Theart *et al*. 1983, Stander 1991), but with the exception of areas that were regarded as sensitive (e.g. False Bay and Walker Bay), only moderate reductions in total effort were implemented in most areas. The only other regulation aimed at limiting total effort, a restriction on the maximum length and number of nets that may be used by permit-holders, is seldom enforced effectively.

With access to the fishery being almost totally open (just excluding fishers without the right political connections), fishers do, or have, operated at effort levels greater than that which would result in maximum or optimal sustainable yield. As a result, the resource has been overexploited (Anderson 1986, McManus 1996). This is the usual outcome of open access fisheries, individual, competitive use of common property

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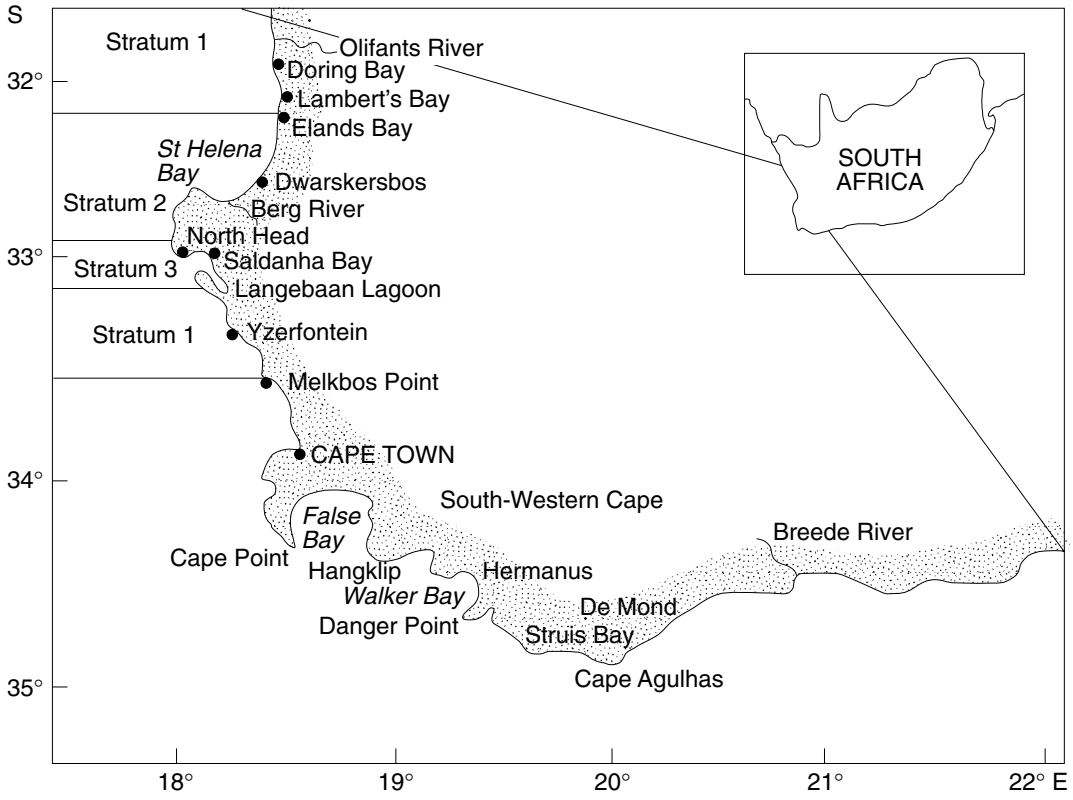

Fig. 1: Map of the Western Cape showing the areas for which the socio-economic characteristics of netfishers are described. Note that Stratum 1 includes the areas north of St Helena Bay and south of Langebaan Lagoon. Also, no gillnetting and only beach-seining takes place south and east of Melkbos Point

resulting in a "tragedy of the commons" scenario (Hardin 1968). Indeed, in areas with high levels of effort, the fishery may be operating at or beyond the open access equilibrium point, i.e. at a level of at which no excess (or economic) profit is possible (Anderson 1986, McManus 1996).

One of the primary aims of South Africa's Living Marine Resources Act of 1998 is to provide more equitable access to marine resources, particularly for those who have been historically disadvantaged or excluded by past political policies. Low technology fisheries, such as gillnetting and beach-seine netting appear to be ideal solutions for allowing poor coastal communities access to marine resources (Grant 1981). However, before any new net permits are allocated, information on the demographics and economic status of the current permit-holders, their attitudes towards management regulations and perception of the resource is needed. In terms of the optimum yield concept, fisheries managers are required to consider biological, ecological and socio-economic aspects of a fishery (Riechers *et al.* 1991). This paper does not attempt a comprehensive economic evaluation of the inshore netfisheries, but it does supply largely descriptive information comparable to that provided by McGrath *et al.* (1997) for the South African linefishery and should assist fisheries management in decision-making.

MATERIAL AND METHODS

The study examines the netfishery of the Western Cape from the Olifants to the Breede rivers (Fig 1). There is marked variation in nature of the gillnet fishery within the study region. Permit-holders to the north of Dwarskersbos operate infrequently, and mostly on a subsistence level, whereas those farther

south operate either recreationally or in a part-time commercial manner. Gillnet fishers were therefore considered separately in three different regions of the West Coast and at the Berg River (Fig. 1). The beach-seine fishery, which operates along the entire Western Cape coast, was not stratified, but certain data relevant to permit-holders and crew are presented separately.

After several trial interviews, a detailed questionnaire was developed (Appendix 1). Fishers involved in netting activities were questioned face-to-face, either on site where vessels landed, or off site at their places of residence. Addresses were obtained from Marine & Coastal Management (MCM) and South African National Parks lists of permit-holders. Estuarine net-fishers were requested to complete questionnaires at the 1998 AGM of the Berg River Net-fish Association. Gillnet fishers who operate in the Olifants River estuary and beach-seine fishers from False Bay were not contacted during this survey, because both have been the focus of recent studies, viz. Lamberth (1994) and Sowman *et al*. (1997).

In order to assess the costs and returns to netfishers, respondents were asked to supply information on the type and estimated replacement value of equipment used, the anticipated lifespan of the equipment, annual maintenance costs, daily running costs, their activity levels, average catches, payment of crew and sale or consumption of the fish caught. The replacement costs of the outboard motors and nets used by fishers were obtained from local suppliers. Daily petrol expenditure was calculated from the claimed litres used per trip multiplied by the 1999 petrol price of R3 per litre (US$ = R6 in 1999). The average annual depreciation of fishing equipment was calculated as the 1999 replacement cost divided by the average expected life of the item.

Based on claimed daily catches, annual effort levels and calculated fixed and variable costs, permit-holders' returns to capital and average annual profits were estimated. It is important to note that the costs and profits estimated are applicable to individual permit-holders or crew and do not reflect the economic value of the fishery to society as a whole. The proportion of the catch retained for own or crew consumption, although not sold, was valued as if it had been. The average daily catch was multiplied by the average sale price, and the daily expenses of fuel and crew pay were subtracted, giving a net trip income for each area. Annual net income was calculated by multiplying the net trip income by the claimed average number of days fished per year. The annual accounting profit or loss for the average permit-holder was calculated by subtracting the relevant fixed costs. Permit-holders' annual excess profits or losses were calculated by subtracting the opportunity costs of investment capital and own labour (when applicable) from annual accounting profit. For this analysis, the most realistic telephone survey effort values and catch rates based on monitored or factory sales records were used (Hutchings and Lamberth 2002a). Only eight landings were monitored from Stratum 1 (average = 9.78 kg) and no factory records were available, so the average daily catch rate claimed by telephone survey respondents (26 kg) was used. When the calculations were made simply using the effort levels and catch rates claimed by questionnaire survey respondents, annual accounting profits (excluding opportunity costs) were unrealistically negative (as much as -R5 000) for St Helena Bay and Berg River fishers.

The annual opportunity cost of permit-holders' capital invested in fishing equipment was calculated as 7.5% of the estimated replacement value (equivalent to investment in a savings account at the current prime interest rate of 14.5% less an inflation rate of 7%). The opportunity cost of permit-holders' own labour was calculated on the basis of what they would have earned if they had spent their time fishing as crew on a commercial linefishing boat rather than netfishing. In reality, permit-holders are skilled and qualified seamen and could earn more as skippers on commercial skiboats. If this opportunity existed, the opportunity cost of the permit-holders' labour would be greater, because skiboat skippers earn substantially more (at least double) than crew. Commercial linefishing is a likely alternative source of employment for netfishers. Retired fishers are no longer economically active and the opportunity cost of the average net fisher was adjusted accordingly.

The rate of return on investment, for areas where the average fisher achieved a positive residual return that was greater than the opportunity cost of his labour, was calculated using the method recommended by Yater (1982) as

$$\text{Rate of return} = \frac{\text{Accounting profit} - \text{labour opportunity cost}}{\text{Acquisition cost}}$$

North of Dwarskersbos (Stratum 1), harders *Liza richardsonii* seldom occur in sufficient densities, and the sea conditions are often too rough, to allow for commercial scale exploitation with gillnets. It is clearly not economically viable for fishers there to invest in gear, or to go to sea solely for the purpose of gillnetting for *L. richardsonii*. Many Stratum 1 permit-holders have only invested in the net and go to sea with other fishers who own the boat and outboard, or if they own the equipment themselves, it is also used to harvest other resources. In these areas, long trips (where the fuel cost will be high) are often undertaken

Table I: Number of permit-holders, interviews conducted, occupations of net permit-holders and time spent in the fishery

Parameter	Respondents (%)				
	Gillnets				Beach-seines
	Stratum 1 (Doring–Elands + Yzerfontein)	Stratum 2 (Dwarskersbos–North Head)	Stratum 3 (Saldanha–Langebaan)	Berg River	
Number of permit-holders	58	235	28	120	93
Number of interviews conducted	41	61	16	42	40
Occupation					
Fishers (several sectors)	29	18	19	8	15
Retired	20	18	6	51	23
Pelagic fishers	12	30		10	15
Linefishers	15	7			12
Rock lobster fishers	7				
Various jobs	17	15	25	31	35
Netfishers	0	11	50	0	0
>10 years in fishing industry	77	75	87	82	85
<10 years in netfishery	49	30	33	24	38

for the purpose of catching rock lobster *Jasus lalandi* using hoopnets or hottentot *Pachymetopon blochii* and snoek *Thyrsites atun* using handlines, and a gillnet is taken along to supplement the day's catch. For these reasons, all costs to Stratum 1 permit-holders are calculated as 30% of the total costs, the average proportion of fishing time these respondents claim to spend netfishing.

A follow up telephone survey was also conducted (Appendix 2), primarily to obtain more accurate effort estimates (see Hutchings and Lamberth 2002a for survey design). During the telephone interview, respondents were asked whether they netfished primarily for food, income or relaxation, if they had applied for commercial permits for the coming year and the amount they were prepared to pay for a net permit.

RESULTS AND DISCUSSION

Demographics of the net permit-holders

A total of 158 face-to-face interviews was conducted and a further 42 estuarine permit-holders completed questionnaires at the Berg River Net-fish Association AGM (Table I).

Nearly all respondents were male (99%) and Afrikaans speaking, with approximately equal numbers of white and coloured permit-holders in Strata 1 and 3. Because of the policies of the former government, South Africa has historically been divided along racial lines. It is widely accepted that non-whites were discriminated against under the apartheid system and the term "previously disadvantaged" is now often used to describe people from non-white race groups. In an attempt to rectify the wrongs of the past and to ensure more equitable distribution of marine resources, race has recently become a criterion in the allocation of fishing rights. The majority (76–91%) of St Helena Bay (Stratum 2), Berg River and beach-seine permit-holders, however, were white or coloured, with only one black beach-seine permit-holder (who was inactive) interviewed. The racial composition of gillnet respondents from these areas is similar to that of commercial skiboat operators (80% white; McGrath *et al*. 1997). The anomalous domination of the inshore netfishery by white males is further highlighted by the fact that the white population group only constitutes some 21% of the population in the Western Cape (Statistics South Africa 1998). About half the gillnet permit-holders in Strata 1 and 3 and beach-seine permit-holders claimed to be affiliated to some fisher association (often not strictly netfish) but stated that many of the associations had not had meetings for several years. Association affiliation was much higher (>70%) among St Helena Bay and Berg River permit-holders, areas where well-supported netfish associations hold annual meetings.

The youngest netfisher interviewed was 16 (using his father's nets) and the oldest was 78, most respondents being in the mid to late forties. In some areas netfishing is a traditional cultural activity, with skills and equipment passed from father to son. Considering that only 4.5% of the population in the Western Cape is over the age of 65 (Sideropoulos *et al*. 1998), a disproportionate number of gillnet permits are held by people over the age of 60. Nearly one-third of Berg

River respondents were over 60 years of age. This is largely due to the Berg River Netfish Association's policy to award permits to older fishers who can no longer fish in the sea (J. V. F. Heydenreich, Berg River Netfish Association, pers. comm.).

Most respondents lived <5 km from where they launch their boats. Commercial netfishers, unlike commercial linefishers, are restricted in terms of their permit conditions to specific areas where they may fish. As a result, the average distance traveled to launch sites, 4.8 and 7.8 km for gillnet and beach-seine fishers respectively (this study), is substantially less than that covered by commercial skiboat linefishers, 44 km (McGrath *et al.* 1997). A large proportion of netfishers do not transport their boats, but keep them moored in harbours or simply stored on the beaches from where they launch. Commercial netfishers therefore have lower travel costs than commercial skiboat fishers, but skiboat fishers benefit from being able to follow aggregations of migrating species such as *T. atun* and yellowtail *Seriola lalandi* around the coast (Penney *et al*. 1989, Sauer *et al*. 1997).

Occupations of netfishers

The large number of net permit-holders who are involved in other fishing sectors, or are retired (Table I), is largely the result of a management policy implemented in 1975 to award permits preferentially to *bona fide* fishers and pensioners (De Villiers 1987). Many permit-holders were employed in the pelagic fishery, which usually has a closed season over the summer, a period when netfishing activity peaks. Other occupations listed by respondents included fish factory owners, farmers, navy personnel, shop owners, teachers, electricians, builders and state employees. Often, these permit-holders had worked in fisheries in the past or had been involved in netfishing since childhood and felt that they had traditional rights to be involved. Given that the majority of net permit-holders do not work solely in the netfishery, there is no logical reason why those who do not work in the fishing industry should be excluded from obtaining net permits.

While 50% of the Saldanha-Langebaan respondents classified their work as netfishing, very few respondents from other areas did so (Table I). The fact that approximately 70% of permit-holders remained in the netfisheries for >10 years (Table I) indicates fairly low turnover. Net licence fees in the past have been particularly cheap (R25 per net per year in 1998) and permit-holders had little to lose by remaining in the fishery, even if mostly inactive and simply fishing during times of high fish abundance, or when other fisheries were not productive. On average, respondents had been netfishing for 20 years, a longer period than commercial skiboat skippers, who on average had fished for 15 years (McGrath *et al*. 1997).

Most gillnet permit-holders interviewed (82–100%, depending on the area surveyed), took 1–2 crew when fishing, whereas all beach-seine permit-holders used 5–22 crew (average of 12). More than two-thirds of netfishers had regular crew who had fished with them for 5–13 years. In addition to crew who help with the fishing operation at sea, commercial gillnet fishers from St Helena Bay usually employ 2–10 (average of 4) casual helpers to remove fish from the nets on shore. These casual helpers get paid R5 per crate of fish (approximately 5% of the value) and take most of the small bycatch as "fries", but only work for a few hours a day. Only 30% of Berg River crew and one crewman from Saldanha had other work and as many as 70% of beach-seine crew were unemployed; however, 60–90% of crew in other areas had other work. Like permit-holders, most crew members were employed in other fisheries, but a greater proportion had jobs outside the fishing industry, mostly in the form of casual labour. Only 6% of crew in St Helena Bay worked solely in the netfishery, but 86% of Saldanha-Langebaan respondents claimed their crew worked only in the netfishery.

Based on the number of permit-holders and their labour requirements, approximately 2 700 (640 permit-holders and 2 060 crew) people could potentially derive some income from netfishing. About half the crew are employed in the beach-seine fishery, but they work less frequently and earn less than those working in the gillnet fishery. This figure is probably an overestimate because a large proportion (14% of gillnet and 23% of beach-seine telephone survey respondents) admitted to being inactive for the 12 months preceding the interview. In contrast, an estimated 24 000 people are employed in the commercial skiboat fishery, a ratio of six employees per operator (McGrath *et al*. 1997). Although a large number of crew are temporally employed in beach-seine operations, gillnetting is not a labour-intensive fishing method.

Income distribution of netfishers

Income derived from fisheries is highly variable, fluctuating with annual quotas and the availability of fish. In an attempt to better qualify the economic status of net permit-holders, fishers were asked to estimate their approximate annual take-home pay (after income tax) from all work. Many respondents declined to answer, and it was apparent that the more affluent respondents were the least inclined to answer, or obviously underestimated their income. The estimates of

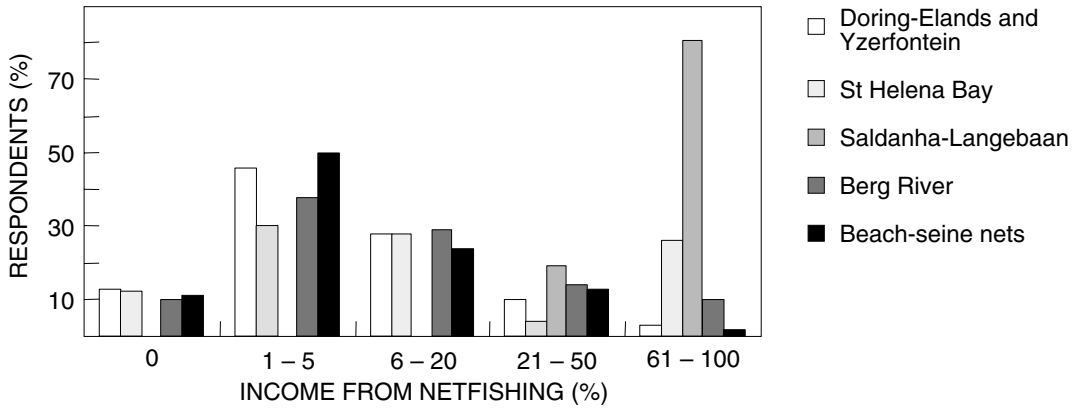

Fig. 2: Percentage of respondents' total income from netfishing

income presented below are therefore likely underestimated. With the exception of Saldanha Bay permit-holders, more than half the gillnet respondents and all beach-seine crew claimed to take home <R20 000 per year, with more than one-third claiming to earn <R10 000 per year, which is less than the household subsistence level estimated for Cape Town households in 1997 (R12 362; Potgieter 1997). Most respondents claimed to be the sole income earners in their households and supported an average of 2.8 dependents on their income. In contrast, the six gillnet permit-holders from Saldanha-Langebaan who provided information on their income, and more than two-thirds of the beach-seine permit-holders interviewed, claimed to take home >R20 000 per year. More than half these fishers claimed net incomes >R60 000 per year. This is similar to the 1995 estimate of the average annual income in the Western Cape (R53 000) and, although considerably less than the annual average of R98 000 earned by white people in the Western Cape in 1995 (Sideropoulos *et al*. 1998), is probably not declared for income tax purposes.

For the majority of respondents, netfishing only contributed a small percentage of their income relative to other occupations. With the exception of Saldanha-Langebaan permit-holders, 42–61% of questionnaire respondents claimed to make <5% of their income from netfishing (Fig. 2). It is clear that only in St Helena Bay (Stratum 2) and Saldanha-Langebaan, where 26 and 81% of respondents respectively claim to make more than half their income from netfishing, are a substantial number of participants truly reliant on commercial netfishing.

Given the average contribution of netfishing to household income, it is counter-intuitive that so many fishers spend a disproportionately long time in the fishery: more than one-quarter of respondents claim to spend >80% of their fishing time in the netfishery (Fig. 3). Berg River respondents are not included in this proportion, because many are retired from other fisheries and therefore allocate 100% of their time to the netfishery, but live off their pensions. Only in Saldanha-Langebaan is the effort allocated to the netfishery comparable to the financial benefit the participants claim to derive from the fishery. It is highly likely, given the current review of access rights and the fishers' uncertainty over their future status as permit-holders, that many respondents overestimated their participation in the netfishery out of fear of being seen as inactive. Many may also have underestimated the contribution of the netfishery to their total income, possibly in an attempt to influence management's perception of the value of the fishery and so to discourage allocation of permits to new entrants.

Costs and returns to netfishers

INVESTMENT COSTS

Despite the small income contribution of the fishery, most respondents claimed to have invested heavily in fishing gear, suggesting that catches and hence financial returns were greater in the past (Table II). Purchase of boats (mostly dinghies) and the associated safety and navigational equipment accounts for 30–40% of gillnet fishers' investment costs (Table II). Outboard motors (5–85 hp) accounted for the largest proportion (40–56%) of gillnet respondents' investment costs (Table II). Nearly all the respondents from Strata 2

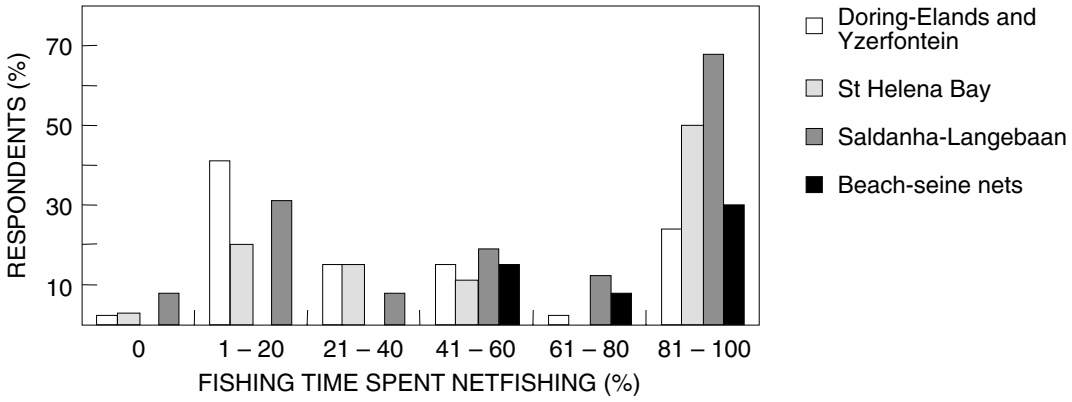

Fig. 3: Claimed proportion of fishing time spent netfishing

and 3 and the Berg River owned at least one outboard motor. The larger dinghies and greater proportion of skiboats used by Stratum 2 netfishers necessitates the use of larger outboards (average = 25 hp), whereas fishers who operate in the more sheltered waters of Langebaan Lagoon and the Berg River use smaller (10–15 hp) motors. Less than half the permit-holders interviewed from Stratum 1 used outboard motors (average 10 hp) when netfishing, but this item still accounted for 42% of the average netfisher's investment costs.

Nets accounted for 9–34% of gillnet respondents' overall investment costs. Although 74% of Stratum 2 permit-holders had invested in "St Joseph" (178 mm) nets, very little effort (only eight landings) was directed at St Joseph *Callorhynchus capensis* during this study. Most respondents stated that they no longer targeted *C. capensis*, because of the low sale price (90 c kg^{-1}) and the collapse of the central African market for the fish (B. T. Pedro, B. P. Fish Products, pers. comm.). Lack of accurate data on *C. capensis* catch rates and effort levels precluded the incorporation of St Joseph gillnetting in the cost-benefit analysis. If the market for that species were to recover, targeting it could provide additional income to Stratum 2 permit-holders with a relatively small increase in costs. Some 15 respondents out of the total of 118 (13%) who used gillnets in the sea admitted to owning illegal nets, either unlicensed 44–64 mm gillnets, beach-seine nets or gillnets with illegal mesh sizes (65–145 mm stretch mesh). Investment in these illegal nets was not included in analysis of costs and returns, because it was not possible to obtain accurate estimates of returns from illegal netfishing activities.

Although 30–58% of gillnet respondents from the different areas used vehicles to facilitate their fishing activities, none used their vehicles solely for netfishing. Purchase of a vehicle was therefore not considered as an investment in fishing gear and the investment costs of vehicles were not assessed for gillnet fishers. Vehicle fuel and maintenance costs were, however, taken into account in estimating operating costs. Total investment in fishing gear by the average gillnet respondent varied considerably between areas (Table II). On average, commercial netfishers from Stratum 2 invest the most in fishing gear (R30 461), whereas respondents from Saldanha-Langebaan and the Berg River had also made a substantial investment (R18 400 –21 100). Stratum 1 fishers on average invested much less in equipment than respondents from other areas (R3 423). This is indicative of the more subsistence nature of the fishery, not by choice, but by low availability of fish in these areas and the shorter distances traveled.

Entry into the beach-seine fishery requires the greatest investment, approximately R77 000 (Table II), mostly for purchasing the net. Although beach-seine nets were much cheaper in the past, decreases in demand mean that the mesh size is no longer manufactured regularly and has become prohibitively expensive (Allnet, pers. comm.). A four-wheel drive vehicle is a necessary part of beach-seine fishers' equipment and contributes on average 45% of respondents' investment.

FIXED COSTS

Capital invested in and the subsequent depreciation of fishing equipment accounts for the greatest proportion of netfishers fixed costs (Table II).

Average net life is inversely related to the frequency with which it is used. The most active Saldanha-

Table II: Average investment costs and depreciation of fishing gear used by respondents

Item	Average number owned per respondent	Average 1999 cost per respondent (Rand)[1]	Average expected life (years)	Average annual depreciation per respondent (Rand)[2]
		*Stratum 1**		
Boat[3]	0.73	818	20[5]	41
Outboard[4]	0.48	1 440	15[6]	96
44–64 mm nets	1.3	1 165	3.8[7]	122[8]
Total		3 423		259
		Stratum 2		
Boat	0.91	14 056	20	703
Outboard	1.06	13 144	9.6	1 367
44–64 mm nets	3.64	3 261	1.9	684
Total		30 461		2 754
		Stratum 3		
Boat	1.13	7 425	20	371
Outboard	1.07	11 770	3.5	3 343
44–64 mm nets	2.13	1 904	0.7	531
Total		21 099		4 245
		Berg River		
Boat	1	7 510	20	375
Outboard	0.92	9 200	9	1 012
44–64 mm nets	1	896	3.4	105
Total		18 406		1 492
		Beach-seines		
Boat	0.81	2 855	20	218
Net	1.2	39 600	30	1 320
Vehicle	0.85	34 446[9]	20	1 722
Total		77 050		3 260

[1] Average cost per item × average number owned per respondent
[2] Average cost per respondent ÷ average expected life
[3] As estimated by respondents, including accessory equipment (navigational, safety and fish finding equipment, etc.)
[4] Based on 1999 supplier value of average size (horsepower) motor used by respondents in that Stratum
[5] Based on maximum age of boats used
[6] Based on an outboard lifespan of 1 250 h ÷ (average claimed effort × 2.5 h running per trip)
[7] As claimed by respondents
[8] Calculated using replacement cost of mesh alone
[9] As estimated by respondents
* Stratum 1 investment in boat and outboard calculated at 30% of total, because equipment is not used solely for netfishing

Langebaan fishers, who on average claim to make 142 trips a year, replace complete meshes on average almost twice a year, whereas in Stratum 1 (where fishers claim an average of 33 trips per year) nets last nearly 4 years (Table II). Fishers usually only need to replace the monofilament mesh of the nets, because the cork and lead-lines last considerably longer. Initial investment cost was therefore calculated using the price of the complete net, but depreciation of nets was calculated on the cost of replacement mesh alone. The expected life of outboard motors is also directly related to the level of use, and depreciation of this item accounts for the majority (80% for Saldanha-Langebaan fishers) of the total annual depreciation costs for gillnet fishers.

Although beach-seine respondents had made the greatest initial investment, the average annual depreciation of their gear was slightly less than for commercially active gillnetters (Table II). This is a result of the relatively low acquisition cost and long lifespan of rowing boats used. Depreciation of the four-wheel drive vehicle contributed >50% of the total annual depreciation costs, even using an optimistic expected lifespan of 20 years. Although no respondents had replaced their complete beach-seine net, it would eventually wear out and this item amounts to 40% of the total annual depreciation costs.

Annual maintenance costs (for repairs and services to all fishing gear, including vehicles and trailers) increased from Stratum 1 to Stratum 3 (Table III). This

Table III: Average income and returns to net permit-holders, based on *Liza richardsonii* directed catch and effort only

Parameter	Stratum 1 (Doring–Elands + Yzerfontein)	Stratum 2 (Dwarskersbos –North Head)	Stratum 3 (Saldanha–Langebaan)	Berg River	Beach-seines
			Daily catch		
Average catch (kg)	26	183	136	37	795
Value of fish sold (Rand)	84	439	408	74	1 590
			Daily operating costs		
Fuel	6	93	51	30	50
Crew pay	39	146	136	25	954
Total	45	239	187	55	1 004
			Income		
Net trip income	39	200	221	19	586
Number of trips per year	33	52	142	40	24
Annual net income	1 287	10 400	31 382	760	14 064
			Annual fixed costs		
Net license fee	39	186	64	30	36
Boat survey fee	38	150	150	150	90
Depreciation	259	2 754	4 245	1 492	3 260
Maintenance	351	2 876	3 650	1 413	n/a
Total annual fixed costs	687	5 966	8 109	3 085	3 386
Annual accounting profit or loss	600	4 434	23 273	-2 325	10 678
			Annual opportunity costs		
Of investment capital[1]	257	2 285	1 582	1 380	5 779
Of own labour[2]	2 508	4 051	12 681	1 862	1 663
Total	2 765	6 336	14 263	3 242	7 442
Annual excess profit or loss	-2 165	-1 901	9 010	-5 567	3 236
Rate of return (%)	-56	1.25	50	-23	12

[1] Based on 7.5% of acquisition cost
[2] Calculated by multiplying trips per year by opportunity cost and proportion of respondents who were not retired. Valued at R95 day^{-1}; the average daily crew wage earned on commercial skiboats in 1995 was R65 day^{-1} (McGrath *et al.* 1997)

is a result of the equipment used (a dinghy has very low maintenance compared to a skiboat), the number of nets owned and the average annual effort expended by fishers. Beach-seine permit-holders could not put a figure on annual maintenance related directly to fishing, because no outboards are used and boats and nets are usually repaired by hand at little expense. Wear and tear on four-wheel drive vehicles used by beach-seine operators during fishing is obviously substantial, but no respondents used their vehicles solely for beach-seining and could not value this expense.

Additional fixed costs to netfishers include an annual boat safety survey fee and annual net permit fees. The cost of a safety survey for motorized commercial fishing vessels that operate <10 miles from shore is R150 for a 4.2 m (the average size boat used by gillnet respondents) boat. This fee is applicable to most gillnetters operating in Stratum 2, the Berg River, Saldanha Bay and Langebaan Lagoon. The survey fee for non-motorized rowing boats is slightly cheaper (R90) and, because only half the Stratum 1 fishers used outboard motors and the boats are also used to catch linefish and rock lobster, an average safety survey cost of R38 is applicable to these fishers. Although beach-seine fishers normally operate within one nautical mile of the shore, they also require safety certificates for their rowing boats (R90). Each individual net owned by permit-holders requires a separate annual permit issued by the licensing authority (MCM). Permit costs during 1999 were R30 per net.

VARIABLE/OPERATING COSTS AND SHARING SYSTEMS

Daily petrol expenditure (boat and vehicle fuel) was greatest for gillnet fishers operating in St Helena Bay, because of the greater number of skiboats used

Table IV: Sale of fish caught by netfishers

Parameter	Gillnets				Beach-seines
	Stratum 1 (Doring–Elands + Yzerfontein)	Stratum 2 (Dwarskersbos –North Head)	Stratum 3 (Saldanha–Langebaan)	Berg River	
Amount sold (%)	70	91	99	79	75
Average price (R kg^{-1})	3.24	2.40	3.00	2.00	2.00
Dealers/factories (%)	25	80	75	90	54
Out of hand (%)	75	20	25	10	46
Process own fish (%)	12	11	19	55	38

and the distances covered when fishing (Table III).

Beach-seine respondents on average claimed to pay their crew 60% of the gross value of the catch. However, this could be an attempt by permit-holders to convince management that they are distributing the catch fairly. In contrast to claims by permit-holders, a few of the crew interviewed claimed to receive just R25 per fisher and 20 fish from a catch valued at R2 500 (approximately 1 ton). This amounts to only 15% of the value of the catch, with the permit-holder receiving 85%. It was not possible to verify these claims, and the crews' share was calculated as 60% of the gross – the average claimed by permit-holders. Fishers from Stratum 1 claimed to split the catch equally among the crew, but usually also to share the daily fuel costs. Crew working on the commercial boats received on average one-third of the value of the catch, with one-third traditionally going towards equipment maintenance and daily expenses and the remaining third to the permit-holder. The sharing systems used by net permit-holders mean that they incur no fixed labour costs, crew only receiving pay in proportion to the amount of fish caught. This obviously results in little financial security for labour, but given the sporadic availability of fish and the high-risk nature of the fishery it is the only viable way in which permit-holders can employ crew.

SALE OF FISH

On average, respondents from St Helena Bay (Stratum 2) and Saldanha-Langebaan sold more than 90% of their catch, whereas Stratum 1, Berg River and beach-seine fishers kept 21–30% of the catch for their own consumption (Table IV). Generally, the price obtained was inversely proportional to the amount sold to dealers and to the size of the catch. The exceptions are beach-seine permit-holders, who often operate in areas where there is no formal market for *L. richardsonii* and therefore retain a large proportion of the catch to sell to farm labourers or other employees at a low price.

Berg River permit-holders sell their fish for slightly less than fishers from St Helena Bay, who usually sell to the same buyers. This is probably related to the average size of the fish caught in the Berg River, where a large proportion of the catch is small fish, or "bokkoms", which are only suitable for salting and drying and not for the more lucrative fresh fish or bait markets. The relatively good price obtained by Saldanha-Langebaan permit-holders is also related to the size and quality of their fish. The particularly large fish caught in Langebaan Lagoon are highly sought after as fresh fish and as bait for tuna longline operations. One local factory packs in the region of 20 tons per month for this bait market. Between 10–20% of the marine gillnet fishers interviewed processed a small proportion of their catch, usually into "bokkoms", but this was for their own consumption and not for sale. A fairly high proportion of beach-seine and Berg River fishers interviewed however, claimed to make "bokkoms", either for sale to the public or to their own employees.

RETURNS TO NET PERMIT-HOLDERS

The results in Table III suggest that, on average, only gillnetters from Saldanha-Langebaan and possibly beach-seine fishers are potentially making a living from netfishing. Saldanha-Langebaan permit-holders, even using 1999 acquisition costs, achieved a favourable rate of return, substantially more than the opportunity cost of their capital investment, and made a reasonable pure profit. The average beach-seine permit-holder also achieves a positive rate of return on his investment, and makes a small pure profit. Stratum 2 permit-holders just cover the opportunity cost of their labour, but their rate of return is much less than the opportunity cost of their capital, and they make a pure loss. The average Stratum 1 and Berg River permit-holder does not cover the opportunity cost of own labour and has a negative rate of return on his investment (i.e. loses money).

The average gillnet permit-holder in most areas is currently barely covering total costs, or if the claimed daily expenses of Berg River fishers are to be believed, is running at an annual loss. At current levels of effort, gillnetting in the Berg River must be seen a recreational pastime for pensioners rather than a commercial operation. Berg River fishers, however, feel strongly that they have a historical right to participate in the fishery and appear willing to accommodate annual losses to remain in the fishery. Berg River fishers do retain a sizable proportion of their catch for their own consumption and many process their catch into "bokkoms". This will increase their returns relevant to those shown in Table III. Even for the average St Helena Bay permit-holder, their accounting profit was less than the opportunity costs of their labour and capital.

From estimates of current costs and returns to netfishers, it is not clear why these fisheries continue to exist. Investment costs and depreciation in value of equipment were, however, calculated using 1999 replacement costs and fishing equipment was relatively cheap in the past. The fall in the South African currency over the past decade has resulted in drastic increases in the costs of imported equipment, particularly monofilament gillnet mesh and outboard motors. The value of bycatch was also not included in the analysis. Bycatch in the legal gillnet fishery, however, is usually low-value species that contribute <5% of the total catch (Hutchings and Lamberth 2002b) and represent little in the way of a financial return to gillnet permit-holders. On the other hand, bycatch of "angling" fish provides more than 60% of the total value of the False Bay beach-seine catch (Lamberth 1994). Although not quantified in this study, the illegal sale of bycatch could represent a considerable return to beach-seine permit-holders, particularly along the South-West Coast. The *L. richardsonii* stock seems to be overexploited in areas with high levels of effort (Hutchings and Lamberth 2002a, b), so it is likely that catches and hence returns were substantially greater when fishers originally entered the fishery. As there are limited alternative opportunities or resources that netfishers can exploit using their gear, they cannot simply leave the fishery without losing the capital they have invested in fishing equipment. Most permit-holders probably recovered their investment costs during more profitable years in the past and subsidize their continued participation in the fishery with income from other employment in the hope that things will improve in future. However, equipment will eventually wear out, and in most areas at current levels of effort, the netfishery as a commercial operation is not economically sustainable in the long-term.

The listed costs and returns are based on a hypothetical "average" commercial netfisher. In reality there are a limited number of permit-holders who do make substantially more by operating more often and efficiently than the "average" netfisher. It is almost certainly these more successful netfishers that "drive" effort in the netfisheries. In reality, most fishers do not consider opportunity costs or even fixed costs such as depreciation on a day-to-day basis. Fishers would rather focus on short-term gross profit, i.e. revenue from fish sold minus the days' operating costs (fuel and crew pay). These are probably the reasons why the fishery still continues to operate, despite the apparently poor financial returns. There are also many permit-holders who do not operate commercially at all, but are inactive or fish recreationally only a few times per year. The general feeling of most netfishers interviewed was that netfishing as a source of income was no longer economically viable owing to decreased catch rates, low and sporadic availability of fish and increases in costs, particularly the fuel price in recent years. Indeed, 10% of Stratum 2 and 42% of Stratum 1 respondents admitted to being inactive for the 12 months preceding the interview, citing the high risk of running at a loss as the main reason for not fishing.

The marked exception in the West Coast gillnet fishery is the Saldanha-Langebaan fishery, where respondents spent more time, made a larger proportion of their income, invested more and could make a living from the fishery. The reasons for netfishers there doing better than in other regions is partly attributable to the year-round availability of fish, but it can also be largely a result of mismanagement of the fishery elsewhere. The large proportion of *L. richardsonii* retained by Stratum 1 permit-holders for their own consumption (30%) underlies the importance of gillnetting to meeting food requirements, rather than as a commercial enterprise. Furthermore, the market for fish in those areas is limited, and the low value of the fish makes it uneconomical to transport catches by road to the "bokkom" factories at Veldrift. In remote areas, demand is often so low that it is uneconomical to harvest fish other than for household consumption or small local markets (Ruddle 1996).

The St Helena Bay (Stratum 2) annual catch is estimated to be around 2 000 tons, substantially more than the 500–600 tons estimated for Saldanha-Langebaan (Hutchings and Lamberth 2002a). Absolute fish abundance is therefore not the reason for St Helena Bay permit-holders not deriving the same economic benefit from the netfishery as Saldanha-Langebaan fishers. The St Helena Bay catch is, however, shared between 235 permit-holders, who mostly use the maximum of four nets allowed. By contrast, only 28 permit-holders are permitted to fish in Saldanha-Langebaan, using a maximum of two nets in the Bay

Table V: Daily and annual income and returns to netfish crew

Parameter	Gillnets				Beach-seines
	Stratum 1 (Doring–Elands + Yzerfontein)	Stratum 2 (Dwarskersbos –North Head)	Stratum 3 (Saldanha–Langebaan)	Berg River	
Number of trips per year	33	52	142	40	24
Daily income (Rand)	39	146	136	25	79
Annual net income (Rand)	1 287	7 592	19 312	1 000	1 896
Less opportunity cost[1]	3 135	4 940	13 490	3 800	2 160
Pure profit or loss (Rand)	-1 848	2 652	5 822	-2 800	-264

[1] Of own labour, calculated @ R95 day^{-1} (only applicable if alternative fishing work was available)

area and only one in the Lagoon. Saldanha-Langebaan permit- holders also use nets of larger mesh than St Helena Bay permit-holders (51–64 mm cf. 44–51 mm stretch mesh) and therefore catch larger fish that fetch higher prices. The availability of fish to individual St Helena Bay fishers is much lower than to individual Saldanha-Langebaan fishers, who make many more trips per year. Furthermore, the majority of Saldanha-Langebaan fishers are not involved in other fishing sectors that could prevent them from netfishing for much of the year.

The gillnet fishery of the Berg River and St Helena Bay (Stratum 2) is massively oversubscribed, with a large amount of latent and recreational effort making the fishery economically inefficient. The lack of pure profit, or even positive accounting profit, to permit-holders in those areas is compelling evidence that the fishery is indeed at or beyond the open access equilibrium point. It is likely that an effort reduction in the region of 60% is required to obtain Maximum Economic Yield from the fishery (McManus 1996). Catch per unit effort almost always declines with increasing effort (McManus 1996). A reduction in the number of St Helena Bay and Berg River fishers should improve catch rates for those remaining, even at the current overexploited stock size, simply through reducing competition for the available fish. However, it is unlikely that a reduction in the number of Stratum 1 fishers would result in increased catches for the remaining permit-holders there. Many of those permit-holders are inactive (40%) anyway, and catch rates are still low. Natural low densities of *L. richardsonii*, an exposed coastline and lack of local markets make this area unsuitable for commercial gillnetting.

A 60% effort reduction could also enhance catch rates if recruitment increased via a positive stock-recruitment relationship, i.e. greater economic yields as a result of the recovery of an overexploited stock. The assumption that a positive stock-recruitment relationship exists and will continue to exist at greater stock sizes needs to be true if the benefits of reducing fishing effort are to be realized (Milliman *et al*. 1987). Because of the increased intraspecific competition for resources at higher population levels, growth rates may also decrease, resulting in decreased yield-per-recruit (Milliman *et al*. 1987). Furthermore, unfavourable environmental conditions or other extraneous factors may suppress stock recovery even when fishing effort is reduced. These biological uncertainties mean that the extent of or time period for recovery of the *L. richardsonii* stock at lower levels of gillnetting effort cannot be known accurately. For stock recovery to occur, effort would initially have to be reduced to a level that results in a catch smaller than the productivity of the stock. During that period, the cost of the forgone catch may equal any future returns (which would have a relatively lower present value because of discounting), resulting in zero long-term economic gains (Anderson 1986, Milliman *et al*. 1987). Even under an optimistic scenario, if stock recovery was rapid, effort, in terms of the number of permit-holders, should never be increased to the obviously unsustainable current level.

Annual gross income (value of catch minus crew share) from netfishing for permit-holders from most areas in 1998/99 (R1 386–R17 992) was much lower than the R54 600 estimated for commercial skiboat linefishers in 1995 (McGrath *et al*. 1997). Most netfishers are, however, part-time participants and claim to make <5% of their total annual income from the fishery. A large proportion of Saldanha-Langebaan permit-holders do qualify themselves as full-time commercial netfishers and deploy similar annual levels of effort to those of commercial skiboat linefishers (119 and 142 trips per year respectively). Those fishers had an average gross annual income in 1998/99 of R50 694, less than the gross that the average commercial skiboat operator made in 1995. Details on the total fixed and variable costs for commercial skiboat operators are not given in the study by McGrath *et al.* (1997), so it is not possible to compare pure profits or rates of return to owners in the two fisheries.

Table VI: Questionnaire respondents' perception of the status of the resource and opinions on increased participation in the netfishery

Parameter	Respondents (%)				
	Gillnets				Beach-seines
	Stratum 1 (Doring–Elands + Yzerfontein)	Stratum 2 (Dwarskersbos –North Head)	Stratum 3 (Saldanha–Langebaan)	Berg River	
Catches declining	76	70	56	74	42
No more permits	42	66	66	62	72

RETURNS TO CREW

Netfishing crews are not (usually) assured of a standard daily wage. The sharing systems in place essentially force them to become partners with the permit-holder, sharing the risk of making a catch on any day and hence the resultant income. Crew do not, however, have to cover any of the fixed or running costs of the outfit and only have to cover the opportunity cost of their own labour. Once again, this should only be considered if alternative employment is available during the periods they spend netfishing. This is seldom true along the West Coast, where unemployment levels are high and much of the crew is not equipped with the skills necessary to undertake alternative non-fishing/formal sector work. Daily and annual income for the average crew member are shown in Table V. The opportunity cost of labour is calculated as if the crew member had fished on a commercial skiboat and made R90 per day, rather than netfishing. Beach-seine crew earn a comparable amount to commercial skiboat crew, and fishers who worked on St Helena Bay and Saldanha-Langebaan gillnet boats made slightly more. These fishers make a small annual pure profit or loss and would do equally well working in either sector. Stratum 1 and Berg River crews on average make less than they would by commercial linefishing. In those areas, there is therefore strong economic motivation for crew to target linefish when the opportunity arises, rather than to netfish. This is borne out in practice, netfishing activity only taking place when alternative fishing activities are less productive.

Contribution of netfishing to the regional economy

The landed wholesale value of the *L. richardsonii* catch in the study area (estimated at around 5 000 tons; Hutchings and Lamberth 2002a) is approximately R12.5 million. There are additional economic benefits and employment directly related to fishery in the form of equipment purchases made by fishers and the sale of value-added products produced by the buyers of netfish. The 481 permit-holders who claim to be active within the study area have invested a total of approximately R16.6 million (1999 replacement values) in fishing gear. They spend approximately R1.07 million on maintenance of fishing equipment and R1.48 million on fuel annually. Approximately 580 monofilament gillnets with a value of around R200 000 are sold annually (J. Eigelaar, pers. comm.). In the vicinity of the Berg River mouth, nine "vis winkels" that buy fish from Stratum 2 and Berg River fishers and produce "bokkoms" for sale rely exclusively on the netfisheries for their business. Although farmers are still the main buyers, "bokkoms" are now regarded as a West Coast delicacy and are finding an increasing market among tourists. These businesses are usually owner-run, but do employ 1–5 full-time workers and take on additional temporary help during times of high fish abundance. Other larger fish processors in St Helena Bay, Saldanha and Langebaan also deal in net-caught fish, packing blast-frozen *L. richardsonii* for longline bait and producing dried or frozen *C. capensis* and houndshark *Mustelus mustelus* fillets for export. Those factories employ considerable numbers of workers, but they do not deal exclusively in net-caught fish, also buying and processing line- and trawl-caught fish.

With the exception of a few beach-seine operations (at Elands Bay, St Helena Bay, Paternoster, Struis Bay and Arniston), very few "previously disadvantaged" permit-holders appear to rely on the netfishery as an alternative source of food or income when other fisheries are not productive. For example, although there are >40 gillnet permit-holders in Lambert's Bay and Doring Bay, only one (a local restaurant owner) used his nets regularly. Part of the explanation for the apparent lack of activity by poor permit-holders may be their inability to purchase or maintain the equipment, or their choice not to take the risk of having their nets damaged by seals for a small catch. It is clear that the simple allocation of net permits will not relieve hardship among poor communities. Financial

Table VII: Questionnaire respondents' perceived reasons for catch declines

Reasons for catch declines	Respondents (%)				
	Gillnets				Beach-seines
	Stratum 1 (Doring–Elands + Yzerfontein)	Stratum 2 (Dwarskersbos –North Head)	Stratum 3 (Saldanha–Langebaan)	Berg River	
Pelagic bycatch	20	10	*		
Environmental changes	19	3	*	9	*
Reduced estuary flow	13	5		27	
Red/black tides	10	38	*	9	*
Seals, seabirds	10	7	*		
Too many nets	6	19		54	
No idea		19	*		

*Reasons were given by fishers as possible causes of catch declines. Columns do not necessarily sum to 100%, because often fishers felt that there were several causes for catch declines

assistance to the permit recipient and the innovative development of new, more lucrative (than "bokkoms") markets – for example, fresh iced, smoked or pickled fish – may need to occur at the same time.

Attitudes and responses to management

RESPONDENTS' PERCEPTIONS OF THE RESOURCE STATUS

More than 70% of gillnet fishers operating outside of Saldanha-Langebaan felt that their catches had declined since they had entered the fishery (Table VI). Although only 56% of Saldanha-Langebaan respondents and less than half the beach-seine fishers interviewed felt that their catches had declined, almost all stated that no more permits should be issued for the area where they operated and many complained that there were already too many operators. It is surprising that most fishers interviewed from the Doring-Elands Bay area felt that more permits could be issued, despite the fact that they felt their catches were declining and at least 42% admitted to being inactive. When questioned about their reasons, many felt that they did not want to deprive others from attempting to make a living catching *L. richardsonii*, even if they were not successful themselves.

When asked for the reasons they felt their catches had declined, with the exception of Berg River fishers, very few respondents blamed the number of participants in the fishery. A host of other factors were given, including animal competitors (birds and seals), human interference (other fishers, recreational watercraft) and environmental changes and degradation (Table VII). A large proportion of respondents felt that the numerous and severe anoxic events (low oxygen conditions associated with the decay of plankton blooms) along the West Coast in the past decade (which resulted in large fish kills) were the cause of the catch declines experienced. Several of the reasons provided by respondents have almost certainly played a role in making the harder stock vulnerable to overexploitation, whereas others are obviously attempts to apportion blame elsewhere. Whatever the reasons for the catch declines experienced by netfishers, it is clear that there is no justification for increasing the number of participants in the areas where these fisheries currently operate.

FACTORS DRIVING EFFORT IN THE NETFISHERIES

In light of the apparently low or negative financial returns to net permit-holders, other social rather than economic factors may be driving some of the effort in the fishery. In an attempt to better understand these factors, telephone survey respondents (marine net permit-holders) were asked whether they fished primarily for food (i.e. subsistence), income (i.e. commercial) or relaxation (i.e. recreational). Respondents' answers to these questions are summarized in Table VIII.

It is not surprising, given the apparently low financial attraction of commercial gillnetting, that 75% of Stratum 1 respondents claimed that obtaining food, or a combination of food and income, were their main reasons for netfishing. In all, 42% of respondents in this area admitted to having been inactive in the 12 months preceding the interview and one-third stated that they had not reapplied for commercial permits in the coming year. Most also expressed an interest in obtaining a cheaper subsistence net permit, if they became available, even if this restricted the length of net they would be permitted to use and the sale of fish they caught. Recreation does not feature as a motivation for netfishers there.

Table VIII: Factors driving effort in the marine gillnet and beach-seine net fishery

Reasons for fishing	Respondents (%)			
	Gillnets			Beach-seines
	Stratum 1 (Doring–Elands + Yzerfontein)	Stratum 2 (Dwarskersbos –North Head)	Stratum 3 (Saldanha–Langebaan)	
Income	25	52	80	21
Food	42	15	0	16
Relaxation	0	4	0	10
Income and food	33	17	20	47
Income and relaxation	0	4	0	5
Food and relaxation	0	8	0	0
Inactive	42	10	0	23
Reapplied for permits	66	88	100	82
Interested subsistence	66	15	0	0
Prepared to pay ±*SD*	R222 ± 57	R119 ± 21	R59 ± 11	R185 ± 61

The majority of St Helena Bay (Stratum 2) respondents claimed that income was the primary reason they fished, whereas some felt that obtaining food and relaxation played a role. A few St Helena Bay permit-holders admitted to being inactive and 15% wanted to be classified as subsistence rather than commercial. All Saldanha-Langebaan respondents netfished for commercial reasons, although few claimed that meeting food requirements was also important. Understandably, no Saldanha-Langebaan respondents were interested in being classified as subsistence if this would restrict the sale of fish. Beach-seine respondents fished both for financial gain and to obtain food for own consumption or for their employees (usually farm workers). Nearly one-quarter of the beach-seine permit-holders contacted admitted to having been inactive and said that they were not reapplying for permits.

A large proportion of Stratum 1 and beach-seine respondents claimed that obtaining food from netfishing was important, and were willing to pay more on average for a permit than the more commercially orientated St Helena Bay and Saldanha-Langebaan fishers. For all respondents combined, 46% claimed that obtaining food was one of the reasons they participated in the netfishery. This is probably one of the main reasons why many netfishers remain in the fishery, despite the limited economic benefit.

RESPONDENTS' KNOWLEDGE AND SUPPORT FOR MANAGEMENT REGULATIONS

Knowledge of the catch restrictions relevant to fish caught in nets among fishers interviewed was disturbingly low (Table IX), considering that the people interviewed are permit-holders with commercial fishing rights and have presumably been informed of the conditions under which they may operate. This clearly indicates a lack of ongoing communication between management and the fishers and the lack of enforcement of these regulations. As many as 70% of respondents in some areas had never had their catch inspected, and the likelihood of being apprehended for contravening a regulation is so low that many fishers simply do not bother to learn the regulations. Commercial skiboat fishers generally have a slightly better knowledge (63–83% of respondents) of management regulations than commercial netfishers (Sauer *et al.* 1997). Commercial linefishers on the West Coast on average have their catches inspected 12 times per year, indicating a direct link between the level of enforcement and the fishers' knowledge of regulations. It is ironic that the majority of recreational skiboat fishers (41–74%) and shore-anglers (75–67%) on the West Coast, who are the most vociferous opponents of commercial netfishing, do not know the current management regulations (Brouwer *et al.* 1997, Sauer *et al.* 1997). Inspection rates in the recreational linefishery, particularly for shore-anglers on the West Coast, is very low, <2% of anglers ever having had their catch inspected (Brouwer *et al.* 1997).

Support for gear restrictions among permit-holders

Table IX: Knowledge of regulations among netfishers interviewed

Parameter	Respondents (%)			
	Size limits	Bag limits	Closed seasons	Sales ban
Know	60	59	72	53
Do not know	17	19	10	30
Would not answer	23	22	18	17

Table X: Netfish respondents support for restrictions

Parameter	Gear (net) restrictions			Catch restrictions		
	Length	Depth	Mesh size	Target species	Size limits	Bag limits
Support	71	89	89	52	76	48
Do not support	27	9	8	40	13	42
Would not answer	2	2	3	8	11	10

was fairly high (these are not really restrictive), but approximately half the fishers interviewed did not support restrictions on type and quantity of bycatch species they may retain (Table X). Many netfishers have traditionally caught valuable linefish and feel it is unfair that they are now restricted to catching relatively low value *L. richardsonii* and *C. capensis*. Current catches of large linefish are sporadic and fishers feel that when they do manage to catch these fish they should be allowed to retain and sell them because many are struggling to remain economically viable on catches of the legal target species alone. Support for catch restrictions among West Coast commercial (60–91%) and recreational linefishers is greater than among netfishers. However, linefishers are not restricted to targeting only two species and a substantial proportion (as many as 50%) admitted to having contravened the regulations despite claiming to support them (Sauer *et al.* 1997, Brouwer *et al.* 1997).

CONCLUSION

The study highlights the socio-economic complexities of the inshore net fisheries. It is clear that the importance of the fishery, as a source of income, recreation or food, for permit-holders and crew varies greatly between and within different areas. On average, net permit-holders are not an affluent group and netfishing cannot be considered a particularly lucrative activity. The limited economic analysis that was conducted suggests that, at current effort levels, commercial netfishing has poor financial viability in most areas. In the past, and for a small proportion of the current participants, netfishing undoubtedly plays an important role in supplementing income from other sources. For the majority of permit-holders, however, it only constitutes a small proportion of earnings, or in some cases could represent a cost. The social and cultural importance of the fishery for participants should not be underestimated and they will vigorously defend their perceived traditional right to continue fishing. The fishery as a whole plays an important role in supplying cheap protein to rural communities and as a source of work in areas where employment of any type is rare. Equipment and fuel purchased by netfishers and the sale of fish caught also make a substantial contribution (approximately R15 million annually) to the regional economy. Management faces a difficult task in reducing effort to a more sustainable level, while at the same time maintaining the positive socio-economic aspects of the fishery and improving cooperation with fishers and their compliance with regulations.

In order to reduce effort in a fair and equitable fashion, it is suggested that current and potential new permit-holders be assessed on an individual merit basis. In terms of criteria, net permit- holders should:

- be able to prove some past involvement in the netfishery, either having worked as crew for current permit-holders or having operated their own equipment. This would ensure that they have the skills and experience necessary to be successful netfishers;
- have the financial means to afford the initial capital outlay for their equipment (if they do not already have access to it) and be able to afford the daily running and maintenance expenses;
- motivate that they have the time available, in that they do not have other work or fishing obligations, and the economic need to netfish regularly;
- demonstrate that they have the business skills required to fish in an economically viable manner;
- show that a market is available for the fish they catch or provide information on how they process and market their own catches;
- demonstrate a knowledge of and respect for the regulations relevant to netfishing and a concern for the sustainability of the resource.

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LITERATURE CITED

ANDERSON, L. G. 1986 — *The Economics of Fisheries Management,* Revised and Enlarged Ed. Baltimore; Johns Hopkins University Press: 296 pp.

BROUWER, S. L., MANN, B. Q., LAMBERTH, S. J., SAUER, W. H. H. and C. ERASMUS 1997 — A survey of the South African shore-angling fishery. *S. Afr. J. mar. Sci.* **18**: 165–177.

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.

GRANT, C. J. 1981 — Gill net selectivity and catch rates of coastal pelagic fish in Jamaica. *Estuar. coast. Shelf Sci*. **12**: 167–175.

HARDIN, G. 1968 — The tragedy of the commons. *Science, N.Y*. **162**: 1243–1247.

HUTCHINGS, K. and S. J. LAMBERTH 2002a — Catch and effort estimates for the gillnet and beach-seine fisheries in the Western Cape, South Africa. *S. Afr. J. mar. Sci*. **24**: 205–225.

HUTCHINGS, K. and S. J. LAMBERTH 2002b — Bycatch in the gillnet and beach-seine fisheries in the Western Cape, South Africa, with implications for management. *S. Afr. J. mar. Sci.***24**: 227–241.

LAMBERTH, S. J. 1994 — The commercial beach-seine fishery in False Bay, South Africa. M.Sc. thesis, University of Cape Town: 122 pp.

McGRATH, M. D., HORNER, C. C. M., BROUWER, S. L., LAMBERTH, S. J., MANN, B. Q., SAUER, W. H. H. and C. ERASMUS 1997 — An economic valuation of the South African linefishery. *S. Afr. J. mar. Sci.* **18**: 203–211.

McMANUS, J. W. 1996 — Social and economic aspects of reef fisheries and their management. In *Reef Fisheries*. Polunin, V. C. and C. M. Roberts (Eds). London; Chapman & Hall: 249–281.

MILLIMAN, S. R., BISHOP, R. C. and B. L. JOHNSON 1987 — Economic analysis of fishery rehabilitation under biological uncertainty: a conceptual framework and application. *Can. J. Fish. aquat. Sci.* **44**: 289–297.

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.

POTGIETER, J. F. 1997 — *The Household Subsistence Level in Major Urban Centres of the Republic of South Africa, September 1997.* University of Port Elizabeth, Institute for Development Planning and Research. Fact paper **105**: 19 pp..

RIECHERS, R. K., MATLOCK, G. C. and R. B. DITTON 1991 — A dual survey approach for estimating the economic aspects of fishing. *Am. Fish. Soc. Symp.* **12**: 344–355.

RUDDLE, K. 1996 — Geography and human ecology of reef fisheries. In *Reef Fisheries*. Polunin, V. C. and C. M. Roberts (Eds). London; Chapman & Hall: 137–160.

SAUER, W. H. H., PENNEY, A. J., ERASMUS, C., MANN, B. Q., BROUWER, S. L., LAMBERTH, S. J. and T. J. STEWART 1997 — An evaluation of attitudes and responses to monitoring and management measures for the South African boat-based linefishery. *S. Afr. J. mar. Sci.* **18**: 147–163.

SIDIROPOULOS, E., JEFFERY, A., FORGEY, H., CHIPPS, C., CORRIGAN, T., MOPHUTHING, T., HELMAN, A. and T. DIMANT 1998 — *South Africa Survey 1997/98*. Johannesburg; South African Institute of Race Relations: xiv + 612 pp.

SOWMAN, M., BEAUMONT, J., BERGH, M. [O.], MAHARAJ, G. and K. SALO 1997 — An analysis of emerging co-management arrangements for the Olifants River harder fishery, South Africa. In *Fisheries Co-management in Africa. Proceedings of a Regional Workshop on Fisheries Co-management Research*, *Malawi*, *March 1997.* Normann, A. K., Nielsen, J. R. and S. Sverdrup-Jensen (Eds). Fisheries Co-management Research Project Research Report **12**: 177–203.

STANDER, G. H. 1991 — Suid-Afrika se strandtrekseën-, dryf-, en St Joseph-haai-netbedryf. Cape Town; Chief Directorate Sea Fisheries: 57 pp. + Annexures.

STATISTICS SOUTH AFRICA 1998 — *The People of South Africa. Population Census, 1996. Community Profile Database.* Pretoria; Statistics South Africa. (CD-Rom – no pagination).

THEART, J. D, THEART, F. G. A. and H. B. CROUS 1983 — Verslag van die takkomitee na die uitreiking en benutting van net permitte. Unpublished Report, Chief Directorate, Marine Development, Cape Town: 135 pp.

TREURNICHT, N. F., ALBERTYN, J. T., BARTLETT, G. S., DELPORT, W. H., LORIMER, R. J., MARAIS, P. S., MYBURGH, P. A., PRETORIUS, N. J., VAN RENSBURG, H. M. J., WESSELS, L. and J. W. E. WILEY 1980 — *Report of the Commission of Enquiry into Certain Aspects of the Conservation and Utilization of the Living Marine Resources of South Africa*. Commission of Enquiry Report **R.P. 93/1980**. Pretoria; Government Printer: 59 pp.

YATER, F. 1982 — Gill-netters: Costs, returns and sharing systems. In *Small-scale Fisheries of San Miguel Bay, Philippines: Economics of Production and Marketing.* Smith, I. R. and A. N. Mines (Eds). *ICLARM tech. Rep.* **8**: 143 pp.

APPENDIX I

Netfishing questionnaire

The purposes of this survey are to improve our understanding of the people involved in the inshore netfishery and to estimate the economic value of the fishery. Your answers are completely confidential and will not influence your current or future status as a permit-holder.

Place _____ Date _____ Time _____

Types of nets in your possession (length ¥ depth ¥ mesh size) (e.g. 70 m ¥ 3 m ¥ 2 inch)
Drift/set gillnets: _____
Beach-seines: _____
Do you use any unlicensed nets? YES NO (circle your choice) What type of nets? _____

Name _____ Age _____ Sex _____ 1 2 3 4 (Population group)

Position on team (owner/skipper/crew)? _____ Occupation? _____ or retired? _____

If you are a full-time fisher, what percentage of your time do you spend in the different fisheries?

Purse-seine _____ Line _____ Rock lobster _____ Inshore net _____ Trawl _____

Do you belong to any fisher's union, association or club? YES NO Name of organization? _____

List the three places you most often set your nets? _____ _____ _____

How many years have you been involved in the fishing industry? _____ Inshore netfishing? _____

How many people are dependent on your fishing income? (Wife, children, etc.) _____

Set method _____ if boat, do you own it? YES NO

Boat type _____ Length _____ Age _____ Estimated replacement value? _____

Do you use an outboard motor? YES NO Horsepower: _____

How far is your house from the place where you netfish? (km, one way) _____

Do you use a vehicle for your fishing work? YES NO If yes: make, model and engine size _____

Estimated replacement value of your vehicle: _____

Approximately how many litres of petrol do you use for a fishing trip (vehicle and boat)?
How often do you replace your: nets _____ cork and lead ropes _____ buoys _____ oilskins _____

How much have you spent in the last 12 months on maintenance of your fishing equipment (vehicle, boat, outboard etc.)? _____

How many netfishing trips did you make in the last week? _____ Month? _____ 12months? _____

Do you set nets at night? YES NO How often? (Percentage of the time) _____

When you set your nets, how long do you leave them in the water (average estimate) _____ hours?

Test questions, to establish the effectiveness of communication between MCM and/or nature conservation and net permit-holders. Do you know if the following regulations are applicable to the fish that you catch in your nets?

5 species of fish that you most often catch	Average catch per set or haul	Average market price	Is there a size limit?	How many may you keep?	Is there a closed season?	May you sell the fish?
e.g. Kob	3	–	40 cm	5	No	No
1.						
2.						
3.						
4.						
5.						

Do you catch any other species of fish? _____ _____ _____

_____ _____ _____

Do you think that the regulations governing net length, depth or mesh size must be changed? YES NO
If yes, how? _____
_____

Do you think that the regulations governing the type and size of fish must be changed? YES NO
If yes, how? _____
_____

Do you sell all the fish that you catch? YES NO If no, how many (percentage) do you eat or give away? _____

Who buys your fish? _____ Do you process your own fish in any way (bokkoms, rollmops, etc.)? _____

How many crew do you take when fishing? _____ Do you take the same, or different crew? _____

How long has your crew fished together? _____ Crew pay/share of the fish? _____

Do your crew have other employment? YES NO What? _____

What is your approximate annual take-home pay? (After tax) Please circle one.
1. Under R1000 2. R1000 – R9999 3. R 10 000 – R19 999 4. R20 000 – R39 999
5. 40 000 – R59 999 6. R60 000 – R79 999 7. R80 000 – R99 999 8. R100 00 – R119 999
9. R120 000 – R139 000 10. More than R140 000

What percentage of this income is from netfishing? _____

And from the other fisheries? Rock lobster _____ abalone _____ line _____ purse-seine _____ trawl ____

Have your netfish catches decreased? YES NO Why? _____

How many times were your catches inspected in the last month? _____ 12 months? _____ ever? _____

Have you ever caught a tagged fish? YES NO What did you do with it? _____

Do you think that more net permits can or should be allocated for this area? YES NO Why? _____

APPENDIX II

Telephone survey

1. How many days did you fish with your nets in the previous month and in the previous 12 months?

2. How many or what mass of harders did you catch in the previous 12 months?
   Other species – St Joseph, kob, steenbras, galjoen, barbel, sharks, elf, etc.?

3. Do you fish mainly for (a) money, i.e. income?
   (b) Food, i.e. subsistence?
   (c) Relaxation and/or recreation?

4. If the cost of a net permit were to increase, would you still apply for one?

5. How much are you prepared to pay for a net permit?

6. Would you be interested in a cheaper "subsistence" net permit, which would limit the length of net you may use and the sale of your fish?