BEACH-SEINE NET FISHING: AN ANALYSIS OF THE ECONOMIC CONDITIONS AND ENVIRONMENT OF THE FISHERY IN FALSE BAY.

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Abstract

This paper examines the economic effects of management policies on four of the seven beach-seine net fishing operations in False Bay. The effects of past regulations are examined by assessing whether or not this industry is at present profitable. It was found that under the present management policies all fishing crews are profitable. A new policy preventing fishermen from catching white steenbras has been introduced. This was examined and it was shown that only one of the crews examined would be effected. Two proposed policies were examined to determine their impact on the sector. The first proposal aims to remove kob as a target species, however none of the crews would be significantly effected by this proposal. The second proposal aims to restrict fishing to working days, this proposal would result in collapse of two crews. Long term feasibility was examined using three models that predict the NPV of income for each crew under different assumptions. It was shown that if stocks continue to decline and white steenbras remains restricted all crews except one would collapse. If stocks improve but the catching of white steenbras remains prohibited for10 years, one of the crews will collapse. The final section assessed the validity of a proposal that the Marine Resource Fund be used to buy trek fishermen's permits, it was concluded that this is not a feasible proposal.

1. Introduction

The earliest reports of beach-seine net fishing date back to 1652 when Jan van Riebeeck sent crew members to seine fish in Table Bay (Thompson 1913). As European ships began docking in South Africa the demand for fish grew and beach-seine net fishing became the first commercial fishery in South Africa (Penny 1991). Before 1900 beach seining and gill netting were responsible for the bulk of the catch along the South African coastline. The 20th century saw the development of modern offshore fishing techniques; this marked the decline in prominence of beach-seine net fishery (Lamberth 1994). By 1950 beach-seine net fishing contributed negligibly to total annual catch and at present is the smallest fishing sector in False Bay.

Even though the proportional contribution beach seine-net fishing made to total national catch declined the industry itself didn't shrink and was allowed to continue operating as an unregulated open access fishery. This however changed in the 1960's when management began to regulate this sector. Over the last 30 years the evolution of the False Bay trek fishing industry has been driven by management[1] policies many of which, were created due to pressure from recreational anglers who claimed that trek fishermen were degrading the marine environment[2]. The conflict between recreational and trek fishermen occurs due to the fact that both sectors fish from the beach and catch species which inhabit the sandy beach surf zone. Furthermore this conflict is characterised by an imbalance of power between these two groups. The recreational fishing sector's participants are mostly "white"[3] males earning incomes that fall in the top two quintiles of income distributions. In contrast, Hutchings (2000) showed that beach seine-net fishermen are largely "coloured"[3] males with incomes falling below the upper two quintiles of income distribution for South Africa. Due to recreational fishermen's relative wealth, access to power and in the past their race they have been able to enforce their will through management decisions[4]. Hutchings (2000) stated that many management decisions have been taken without either scientific evidence or knowledge of their implications. He argues that the net fishery's recent history in the Western Cape is typified by management decisions that have aimed to reduce conflict between net fisheries and other fishing sectors.

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[1] The term management refers to the Department of Sea Fisheries.

[2] Lamberth (1994) investigated a list of complaints recreational fishermen have made over the years (see appendix A). He found that the trek fishermen were having no significant impact on the marine environment.

[3] It is important to note that the words white and coloured are social constructs, they imply different social context, power to affect change, historical positions and socio-economic standings. It should be noted that the coloured population was marginalised during the apartheid era and this legacy is still evident within the trek-fishing sector.

[4] The False Bay trek fishing industry is one of the most regulated fisheries in the country. Appendix B gives a list of the current regulations imposed on the fishery

It is against this backdrop that this paper was written. There are three broad objectives of this paper. Firstly, to assess the current profitability of the sector under the prevailing management measures. Second, to examine how new and proposed regulations will impact on the profitability of the sector. Third, to addresses the validity of a proposal by recreational fishermen that the Marine Resource Use Fund be used to buy the False Bay trek fishermen's permits.

The paper addresses these issues by first describing what trek fishing is, where it occurs within False Bay and who partakes in the industry. This is followed by an explanation of how trek fishermen earn their revenue. Hereafter the costs are discussed and the income fishermen earn is presented, the present profitability of the sector is thus addressed. The next section examines the effect of a new regulation that prevents fishermen from catching white steenbras[5]. Two proposed regulations (one that aims to prevent fishing on public holidays and weekends and one that aims to prevents the capture of kob) are also examined to determine their effect on profitability. Once this has been done the paper puts forward three models predicting income over the next 30 years. These models are used to assess the long-term feasibility of the sector under the new and proposed management policies discussed above. The final section addresses the proposal that trek-fishing permits should be bought.

2. Methods:

The data collected for this report was obtained from two sources. First, catch records from the department of Sea Fisheries: From these the total monthly catch of each species for each operator was obtained. However Lamberth (1994) noted that these records were consistently under reported. On the basis of observation he developed a scale by which each species was under reported. The catch records used were adjusted using Lamberth's (1994) scaling. A further weakness in this data was that, of the seven permit holders only five had handed in catch return cards. Thus the Simons Town and one of the Fishoek crews were omitted from the report.

[5] White steenbras has been removed as a target species from the 2001/2002 onwards due to its low stock levels.

Second, interviews and telephonic surveys were conducted from May to July during the year 2000. Permit holders and crewmembers were interviewed at their homes. Of the total number of permit holders only four were willing to be interviewed, Muizenberg/Strandfontein and Macassar, Muizenberg/Strandfontein, Fishoek and Smitswinkel Bay operators. From each of these operations five crewmembers were interviewed. Due to the fact that the interviews were conducted in winter when many operations close down it was not possible to obtain an adequate sample of crewmembers. Interviews were conducted on a basis of availability of interviewees. Hence only the more established crewmembers were interviewed. Permit holders and crewmembers were questioned with regard to life history in relation to fishing and particularly trek fishing, income, costs, management practises, crew practices, and fish sales, prices and socio-economic status. The False Bay beach-seine net fishermen have been under close scrutiny for many years and feel suspicious and distrustful toward any interview. Thus it was not possible to use a questionnaire and all information received during interviews had to be validated by other sources. Information pertaining to prices and selling and buying practices was obtained from an interview with I&J's[6] fish buyer, who buys the bulk of the trek fishermen's catch. Telephonic interviews were conducted with restaurants to ascertain whether fish are bought and if so what price is paid. Finally the suppliers of fishing equipment were interviewed to determine the replacement cost of equipment. Due to the nature of this industry and the methods employed by this paper, there are often contradictions between sources of information. These contradictions are noted in the relevant sections.

3. The False Bay Beach- Seine Net Fishery

3.1 Beach-Seine Net Fishing Techniques.

Before discussing the beach seine net industry in False Bay it is imperative to explain what beach seine net fishing is. A seine net is a fishing net containing floats on the top and weights on the bottom thereby enabling the net to hang vertically downwards from the surface of the water. The net is set around a shoal of fish and the ends are brought together catching the fish in what is colloquially called the "kuil" or bag of the net. Seine nets are used in two fishing industries in South Africa, namely, the purse seine net industry (where nets are set from boats at sea) and the beach seine net industry (where nets are set from the beach).

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[6] I&J is an old well-established commercial fishing company, which is listed on the JSE.

A beach seining operation is run as follows (see figure 1): One crewmember ("the spotter") visually locates a shoal of fish from an elevated position (cliffs or sand dunes depending on the site). Once a shoal is located he signals to the crew on the beach. Signalling is done using flags and whistles or two-way radios depending on the spotter's distance from the beach. The crew holds one end of the headrope on the shore while the net is rowed around the shoal. A skipper "shoots"[7] the net whilst steering the rowing boat around the shoal under the spotters directions. Once the net has encircled the shoal the boat is rowed to shore. By this stage the entire net is released from the boat and the remaining end of the headrope is held by crewmembers on the beach (DE Villiers 1995). The ends of the head rope are then pulled together catching the shoal in the "kuil" of the net. The net is then pulled ashore (Hutchings 2000). Beach-seine net fishermen also practice what is known as "blinde" (blind) "treks" The techniques and equipment are identical to those described above but the fish are not located visually. Shoals are caught through a comprehensive knowledge of locations and environmental conditions most likely to yield catches (Lamberth *et. al.* 1994). A final method employed is the use of the "Russman" net[8]. The technique is as described above but the net used is heavily weighted and thus drags along the ocean floor. It is used to catch bottom dwelling species such as white steenbras (Lamberth *et. al* 1997). Since its inception to South Africa in 1652 there have been no significant changes to the technique trek fishermen employ. There have however been changes with regard to equipment: nylon nets have replaced cotton nets, dinghies are generally fibreglass and four wheel drive vehicles are used to transport equipment to fishing sites (Hutchings 2000).

The average trek fishing crew contains 12 members, for all operations except the Smitswinkel Bay operation crewmembers are "coloured" males. The Smitswinkel Bay operation is made up of "white" males who exhibit a unique set of socio-economic characteristics. Furthermore each operation consists of four distinct labour groups: the permit holder, high-skilled permanent crewmembers, low-skilled permanent crewmembers and part-time crewmembers. The permit holder owns and maintains the equipment and in some cases is directly involved in fishing. High-skilled permanent crewmembers include one spotter, two-three rowers and one skipper[9]. Low-skilled permanent crewmembers haul the net onto the beach. Similarly part-time crewmembers also haul the net but they only fish occasionally. Income is earned in accordance to the function and participation frequency crewmembers display.

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[7] The term shooting refers to the releasing of the net behind the boat.
[8] The "Russman" net obtains it's name from it's Russian origin where it was used for catching sturgeon
[9] For each crew the number of rowers, spotters and skippers may vary due to equipment used and due to the fact that some functions are shared between crewmembers.

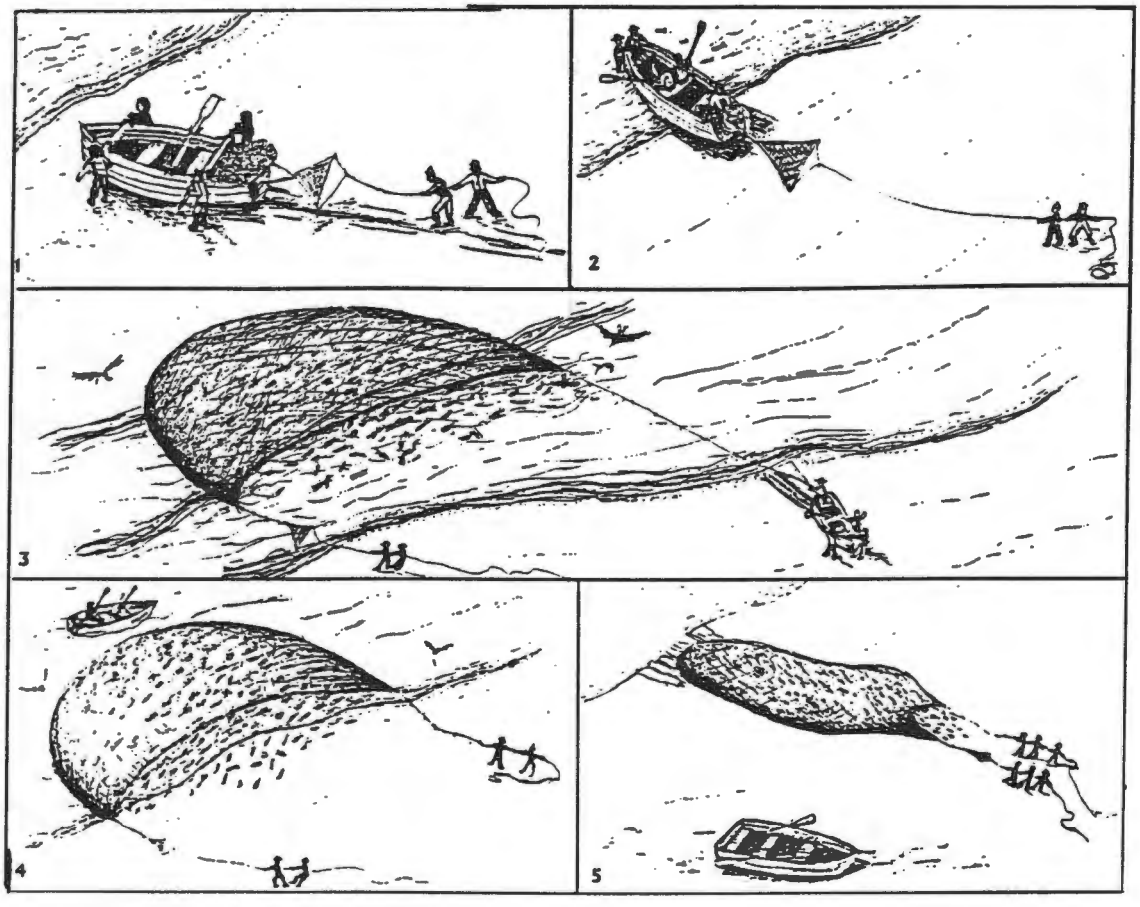

Figure 1.Beach seine-net fishing technique (Hutchings 2000).

3.2 False Bay Beach-Seine Net Fishing Distribution.

Beach seining can only be successfully undertaken on sandy low gradient beaches where launching of boats is possible and where a sandy substrate contains few obstacles that snag nets. Within False Bay the west and east coasts are rocky and inadequate for beach seining. Only the sandy northern shore and a few isolated beaches in the south are feasible options for the fishery (Penny 1991). In 1960 there were over 100 crews operating in False Bay. Management policies and the introduction of a permit system[10] have reduced this number to a present total of seven.

[10] Permits are non-transferable and each permit is allotted for a specific area.

Along the northern shore there are three permits but only two permit holders (two permits are held by a single operator). This operator holds permits at Muizenberg/Strandfontein and at Macassar.
The remainder of the paper refers to this operator as the Muizenberg/Strandfontein and Macassar operator. The section of beach that extends from Muizenberg to Strandfontein is shared with another operator who is referred to as the Muizenberg/Strandfontein operator. In the south two permits and two permit holders operate independently at Fishoek. With the remaining permits held at Simons Town, Glencarine and Smitswinkel Bay (see figure2).

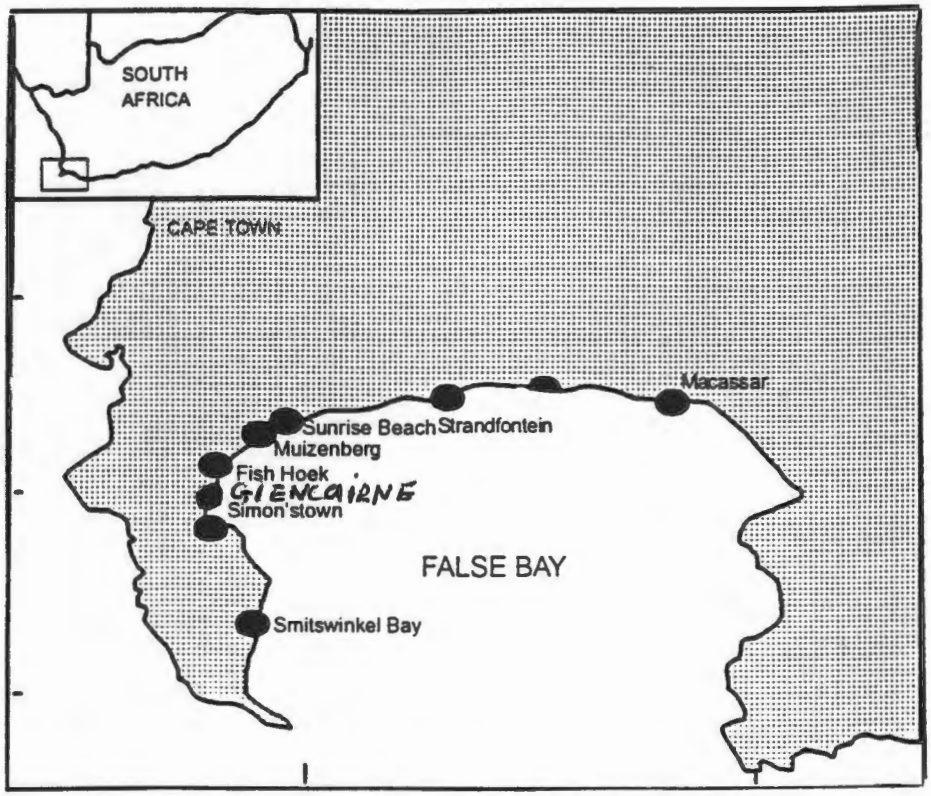

Figure 2. Map of False Bay indicating where beach-seine net fishermen mentioned in this study operate (Lamberth 1994).

3.3 Socio-economic Characteristics of the False Bay Beach-seine Net Fishermen.

This section aims introduce the fishermen to the reader. As was noted earlier only a limited number of participants in the industry were interviewed. It was therefore not possible to proceed with any quantitative analysis. Hence a qualitative analysis was employed; whereby a summary of the socio-economic characteristics of one crewmember from each of the four labour groups presented earlier is given[11]. This is followed by a brief comparison of the similarities and differences this crewmember has with other crewmembers in the same labour group.

[11] It was not possible to locate part-time crewmembers for interviews. It is therefore important to note that a significant proportion of each crew has been omitted from this study.

Permit Holder.

Mr H is a 48-year-old "coloured" male who has held a permit for 2 years. He was educated to standard 8 and has been working as a trek fishermen for the last 20 years. The original permit was held by his father who worked as a trek fishermen for over 40 years and who taught Mr H how to fish. Mr H's mother used to make all the nets for operation. However at 80 she finds this task impossible and now only mends nets. Mr H crewed for his father for 18 years, however this was in a part time capacity as he held a job with the Cape Town Municipal Council in the mornings. Two years ago his father died and there was dispute over whom would inherit the permit and equipment. Mr H was able to retain the permit but lost all the equipment. He has subsequently had to invest in new equipment. Mr H estimates that it will take 10 years before he has a complete set of equipment. Mr H runs the practical side of the operation while his wife manages the business side of the operation. The income earned from fishing is their sole source of income and supports 7 people. This paper estimates the household's annual income before tax to be R107 926 or R8993.8 per month. Furthermore he is burdened with monthly repayments on a house, car and all his equipment. Hence the household disposable income is low. Mr H when asked how he felt about the future of trek fishing argues:

"I always look on the positive, but every year we face more regulations and restrictions which only make our life more difficult and keep us poor".

Mr H argues that regulations imposed are based on political pressure from wealthy recreational fishermen and due to public outcry. During 2000 Mr H landed the biggest shoal of kob in recent memory. This sparked a public outcry and articles appeared in the local press accusing Mr H and trek fishermen of catching undersized fish. Mr H argues that the public and recreational fishermen have no understanding of trek fishing operations. He states:

" People think we catch every day, but most days especially in winter we do not fish and in summer we can't fish every day, even when we do fish we often wait days for a catch. People only notice when you make a rare big catch".

Furthermore when catches are made particularly in summer there are many people on the beach. Mr H argued that the situation gets volatile as people attempt to steal fish. However even though he is faced with a large amount of opposition and the uncertainty inherent in this trade Mr H states:

" I wouldn't do another job for twice the salary, I belong at the sea".

Mr H's story was chosen as it illustrates the difficulty faced by permit holders in acquiring the initial capital to start their operations. Of the three remaining permit holders interviewed all are more established, have fewer dependants and more disposable income than Mr H.

Furthermore only one of these permit holders doesn't rely solely on trek fishing for his income. Mr H and the other permit holders are all sceptical about the future of trek fishing and fear more regulations.

Highly Skilled Permanent Crewmember

Mr W is a 60 tear old coloured male with a standard 2 level of education. He started going fishing with his father when he was 10. Once he left school at the age of 12 he became part of a crew.
Mr W's father was a crewmember for Mr W's permit holder's father. It was his father who taught him the trade. He slowly progressed up the crewmember hierarchy, first as a rower, then skipper and finally as he got older as the spotter. He has been trekking in False Bay for 50 years. At present he works during the summer months as a trekker and in winter he buys fish from other fishing sectors. These fish are either dried or smoked and sold inland. Mr W estimates that 75% of his annual income comes from trekking. He lives in a house, which he owns together with his sister (who is a secretary and earns approximately R1600 a month). Mr W according to this study earns an income of R20 358.9 from trek fishing. Thus his annual income is R27 145.7 or R2262.1 per month. Mr W and his sister support 6 people. They are the only income earners but their house is paid off and all income earned is pooled and used to maintain the household. Mr W owns the only car in the household. When asked if he would have enjoyed another profession he answered

"Never, I belong to the sea and you would have to pay me a lot more to change that".

Mr W is concerned about the future of trek fishing. His sister has two sons, neither of which has ever been involved in trek fishing. When asked why this was Mr W answered

" There is no future I used to earn more than double what I earn now".

As with the permit holders Mr W blames this decline in income on regulations and restrictions which have been imposed on the sector over the last 20 years. He feels that the regulations are unfair and arose due to public pressure exerted by influential recreational fishermen.

Mr W shares many characteristics with other crewmembers in this group. That is most of these fishermen were over 45 and had slowly progressed to their current position within the crew. Most have similar incomes to Mr W and either buy and sell fish or work on the pelagic line fishing boats during winter. All fishermen complained about a decline in income over the last 10 years and all blamed this decline on what they call unfair regulations. The fishermen in this category have not been able to provide for their old age and will thus continue to work until they are no longer physically able. Thereafter they will rely on government pensions.

Low Skill Permanent Crewmember

Mr Z is a crewmember who hauls the net for an operation that operates in summer. He is a 28-year-old coloured male and has been working as a trekker since he left school after completing matric. A friend introduced MR Z into the profession; he has been working for ten years and occasionally rows for the team. Over the ten-year period Mr Z has worked for two permit holders. He has a wife and a child and lives with his parents, brother, sister in law and their two children. His income along with his brother who works as a store clerk and his parents whom receive government pensions are pooled and go toward maintaining the household. According to this paper Mr Z earns R10 200 per season. This was concurred by Mr Z.
During the winter months he seeks employment on pelagic line fishing boats. However he has also worked as a gardener and on construction sites. He estimates that 80% of his income is due to trek fishing. Thus resulting in an annual income of R12 750 or R1275 per month. As with all other interviewees Mr Z expressed concern about the future of trek fishing. He was particularly concerned about the loss of white steenbras as a target species.

" In the mornings we make a "blinde" trek and usually get a couple of steenbras for the crew, I always bring home this fish for dinner".

He argued that the long periods of waiting for catches were sustainable due to these catches which keep money in crewmembers pockets or provide food for the families. As with the other groups of fishermen Mr Z argued that a poor public perception has resulted in restrictive regulations, which have lead to a decline in his income over the last 10 years. Mr Z stated that his entry into the industry was largely due to a lack of alternatives. He is worried about the future of the industry and argues that it is not easy to find work in other fishing sectors. Mr Z identifies himself strongly as a trek fisherman and argues that he loves his job. However if a more stable and consistent income source were to present itself he would take it.

Mr Z shares many characteristics with other the other fisherman in this labour group. That is, most of the fishermen in this group are under 40 years of age and are working their way up the crew hierarchy. For all crewmembers in this labour group the level of incomes earned, number of dependants and socio-economic situation were similar to Mr Z. Furthermore most of these fishermen do find employment when fishing does not take place. However this employment generally contributes less than 25% to annual income. Finally all fishermen in this group expressed concern about the future of trek fishing.

It has been noted that the Smitswinkel Bay crewmembers are racially, socially and economically distinct from all other crews. That is they are all "white", have work during the off-season which contributes on average 70% to annual income, have fewer dependants and partake in the industry by choice rather than through a lack of alternatives[12].

[12] These distinctions hold for all labour groups within this crew. Due to the scope of the paper it was not possible to include interviews with this crew or to discuss why they are an all "white" crew. It is however important to note that they are considerably wealthier than any of the other crews and thus more resilient to any loss of income.

4. The Generation of Revenue by the False Bay Beach-Seine Net Fishery.

This section illustrates how the False Bay trek fishermen generate revenue. It does this by discussing what species of fish are caught, when these species are caught and how much is paid for each species. Total revenue is then calculated and the effects of new and proposed management decisions on revenue are examined.

4.1 Catch Composition for the Industry

At present beach-seine net fisheries in the Western Cape may legally target two species of fish namely *Liza richardsonii* (harder) and *Callorhinchus capensis* (St Joseph). An exception has been made for False Bay trek fisherman who argued that they had traditionally targeted other species. Thus the catching of *Seriola lalandi* (yellow tail) and *Lithognathus lithognathus* (white steenbras) has been allowed. However from the year 2001 white steenbras may no longer be targeted. Any other species caught are considered by catch and may be sold if they are not a prohibited species. Within False Bay the species that contributed significantly to total catch (in kilograms) are presented in Figure 3 below. The totals presented below have been scaled up using Lamberth's adjustments (1994). As was noted earlier only five of the seven operators returned catch cards, therefore two crews have been omitted from this discussion.

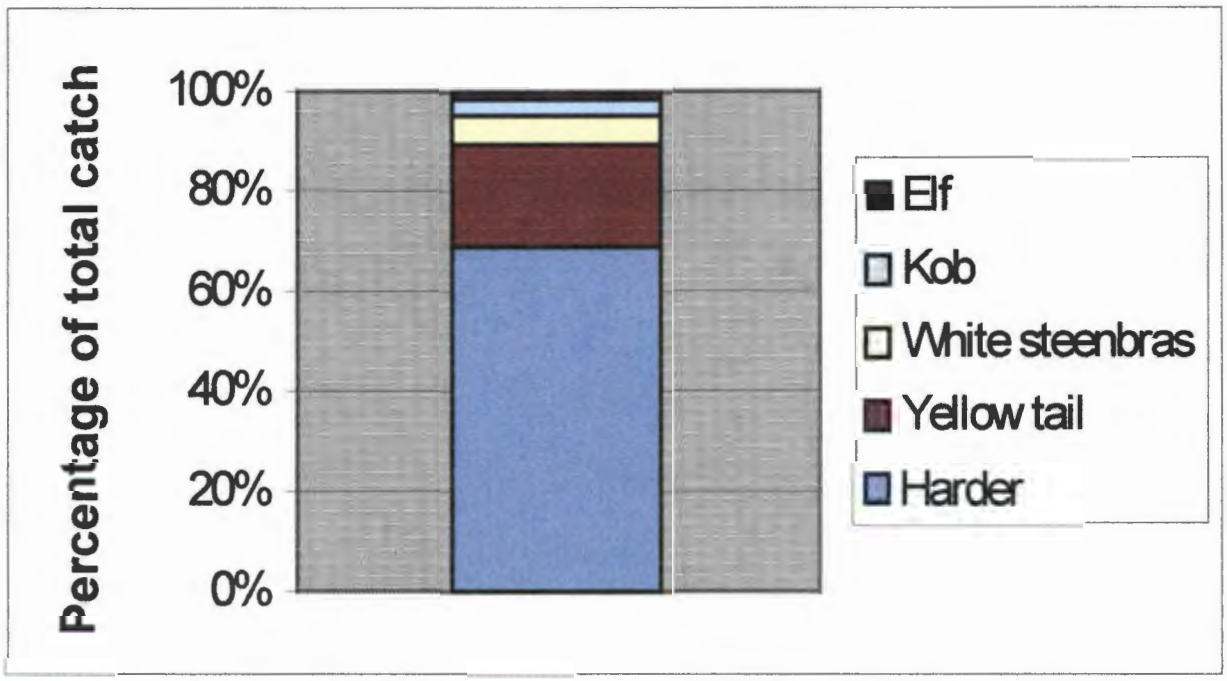

Figure 3. The six species that contribute significantly in terms of mass (kilograms) to the False Bay beach-seine net fishing industry.

From the figure it is clear that harders contribute over 60% to total catch, the next largest contributors are yellow tail, white steenbras, kob (*Agrosomus inodorus)* and elf *(Pomatomus saltrix).* It is important to note that other species of fish such as belman, St Joseph, white stumpnose, strepies, pilchards and snoek were caught by trek fishermen. These species contributed less than 5% to total catch and total revenue and were thus excluded from the analysis.

4.2 Catch Composition and Seasonality for Each Operator

The figure above depicts the relative importance of each species for the entire industry. However each species relative importance varies from one operation to the next and in most cases is inconsistent with the relative importance each species holds for the industry's total catch. The reason for this is that permit holders are restricted to certain areas. These areas differ in the habitats they provide, and consequently in the species they commonly yield. Furthermore a closed season requires that all species except harders be returned between 1st May and 30th October[13]. Hence operations which don't catch significant quantities of harders can only operate between 31st October and 30th April. The figures below depict the monthly catch for each significant species for each operator.

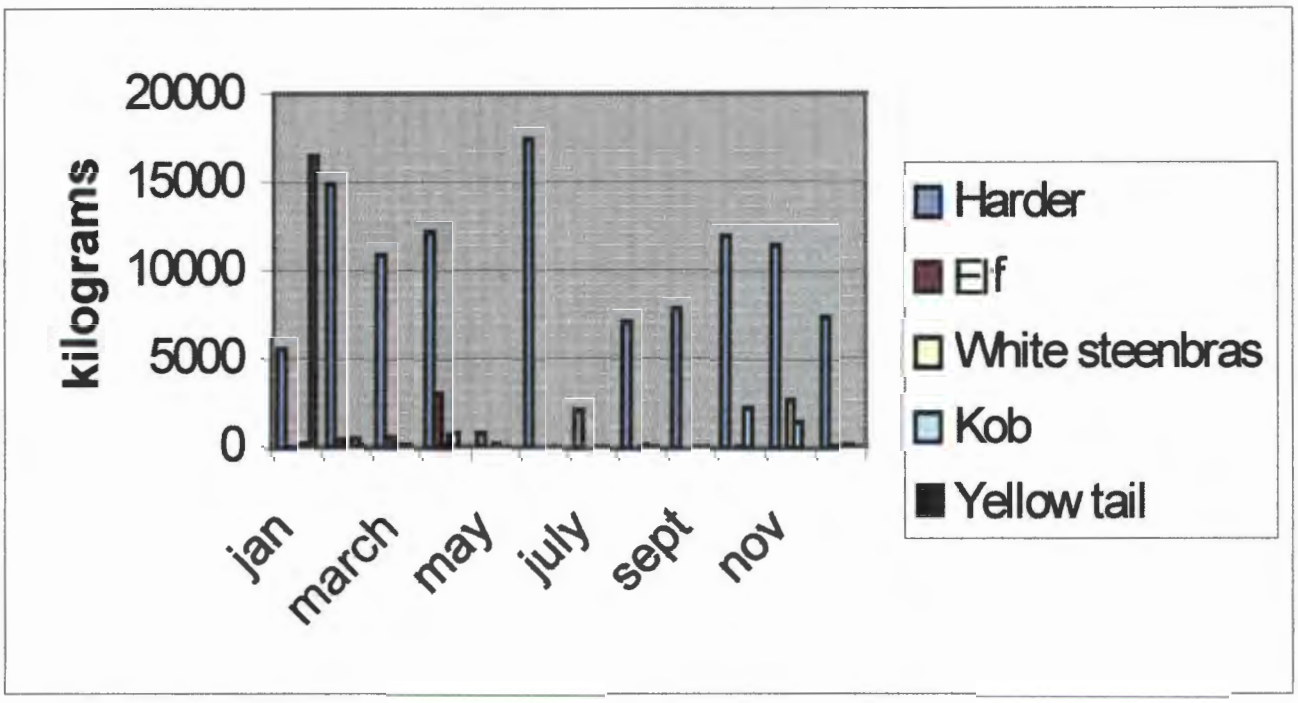

Figure 4. Total monthly catches for each species for the Muizenberg/Strandfontein and Macassar operator.

[13] This regulation is somewhat unnecessary as most species caught by trek fishermen migrate out of False Bay during winter and return during spring.

This is only one of two crews, which operate through out the year. Harders are the most significant species and are caught throughout the year. There were some large catches during the winter but there is a decline in catch over winter.

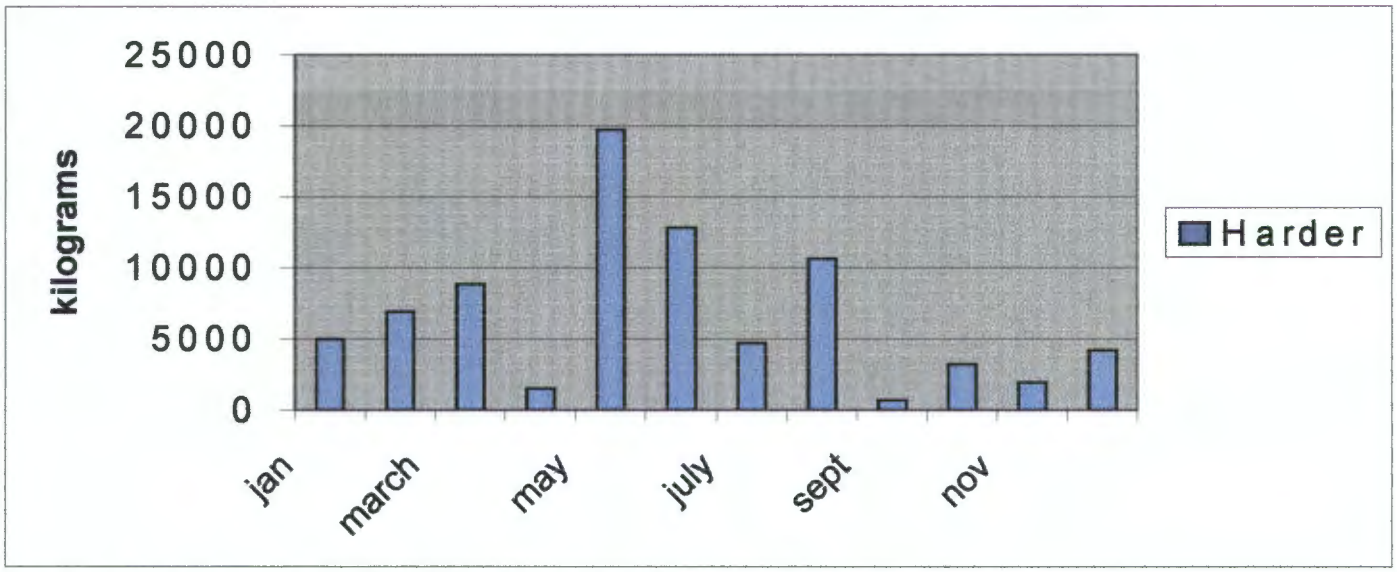

Figure 5. Total monthly catch of harder for the Muizenberg/Strandfontein operator.

This is the second operator who fishes through out the year. The high levels of harders caught during May and June were somewhat anomalous as this crew's catch normally falls during winter. White stumpnose, elf, white steenbras and kob are caught in significant quantities during summer but their individual mass is small relative to harders that dominate the graph.

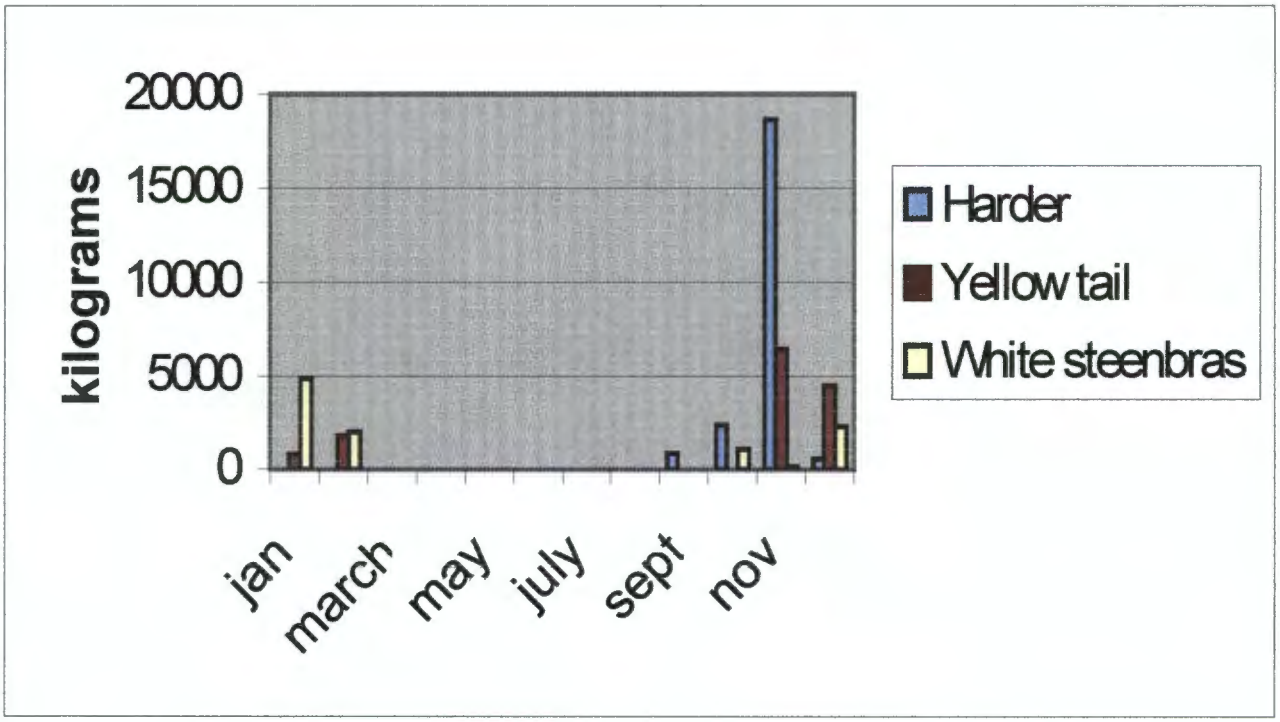

Figure 6. Monthly catches for the Glencairne operator.

This operator does not fish during winter. Relative to the above crews they catch few harders. However this crew catches significant quantities of yellow tail and white steenbras.

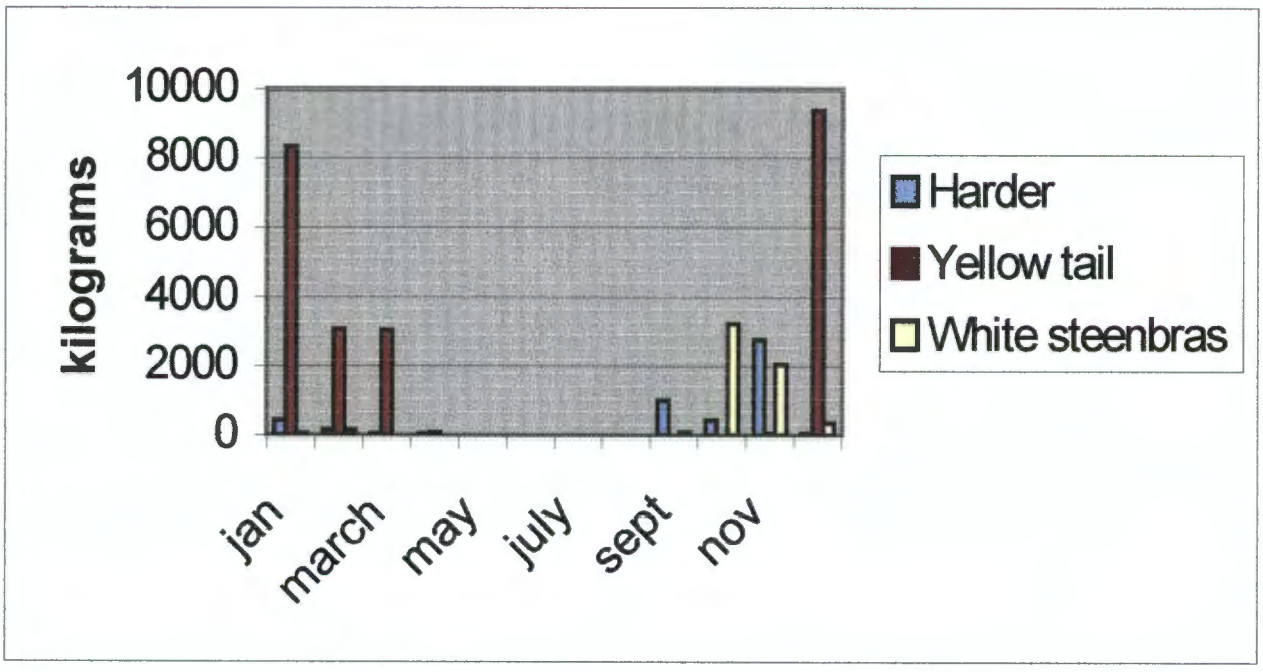

Figure 7. Total monthly catch for the Fishoek permit holder.

This operation is similar to the Glencairne operation in that they don't operate in winter and rely on the same three species of fish. Over recent years the white steenbras catch at Fishoek has fallen considerably, consequently this operation depends on yellow tail. Harders constitute a very small proportion of total catch.

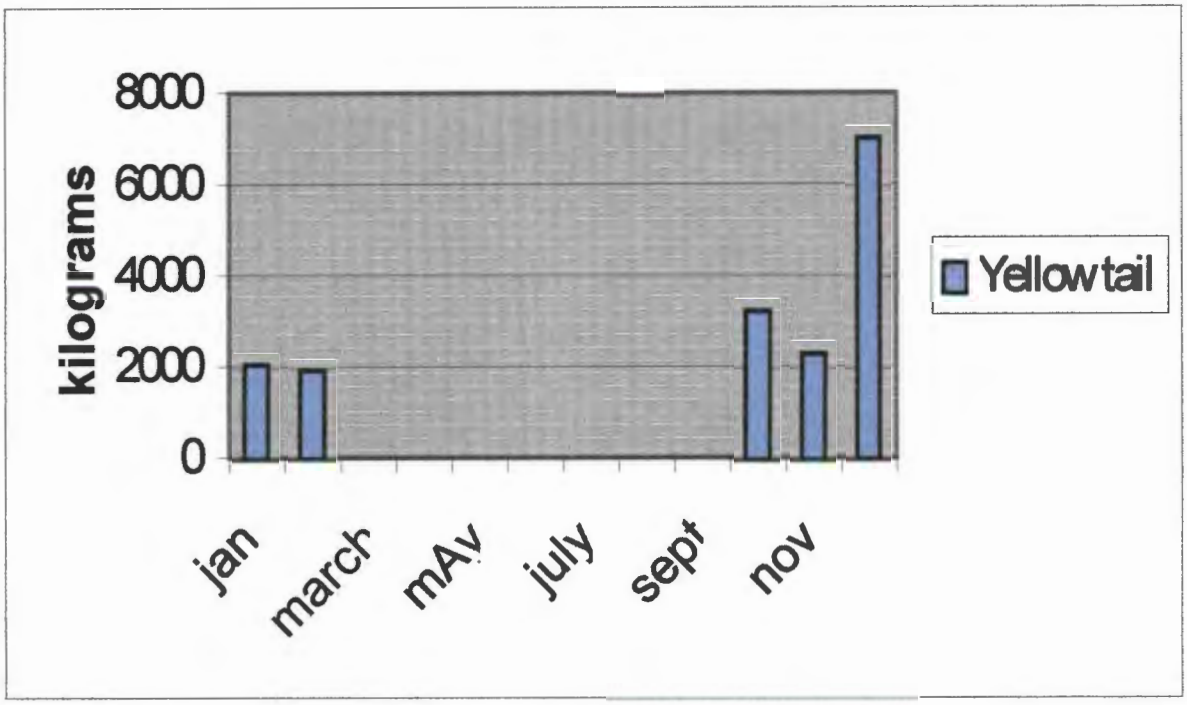

Figure 8. Total monthly catch for the Smitswinkel Bay permit holder.

The Smitswinkel Bay operation closes for the winter months. It relies on yellow tail for revenue. Small quantities of harder are also caught but contribute negligibly to revenue and total catch.

The above figures depict when fish are caught and provide an adequate explanation for the variability in monthly income trek fishermen earn. These figures don't however show the relative importance each species has to total revenue. The reason being that different species command different prices per kilogram. It therefore follows that each species proportional contribution to total income differs from its proportional contribution to total mass. Before revenues can be calculated the fish selling and price system needs to be discussed.

4.3 Fish Sales and Prices.

Fish price data were provided by an agent who buys and sell for I&J. This monger has been the sole large scale buyer of fish caught by the beach-seine net fishermen in False Bay for over twenty years. The operators at Fishoek, Smitswinkel Bay and Glencairne estimate that this buyer buys 90% of their catch. The remaining two operators are the north shore operators who estimate that only 50% of their catch is bought by this buyer. The reason for this is that these crews catch is dominated by harders, most of which are sold to small-scale buyers. Furthermore he offers a set seasonal price for each species[14].

Despite the set price offered payments to fishermen can vary for species-specific reasons. The False Bay trek fishermen are the only commercial fishery that catches white steenbras. Thus trek fishermen can supply as much white steenbras as they wish without prices falling. Fishermen received R13.5 per/Kg for the year 2000 for fish of reasonable size and quality. However if quality and size were poor prices fell to R12.5 per/Kg.

Yellow tail prices vary inversely with the supply of yellow tail by other fishing sectors and directly with quality. The price paid for yellow tail during the year 2000 was R12per/Kg. However if supply was high and quality was average the buyer offered R11 per/Kg. Yellow tail doesn't keep well unfrozen and may become slightly toxic. Thus poor quality fish were seldom bought.

Kob and elf are the smallest contributors to total catch for trek fishermen. They are generally caught in small shoals and receive a fixed price, which for the year 2000 was R12 and R9 per/Kg respectively. If the supply of these species was high, size was small or quality was poor the fish buyer offered R1 per/Kg less for each of these species. The trek fishermen interviewed concurred with the above information except in one instance. During December of 2000 one crew made a massive kob haul. The fish buyer only paid R6 per/Kg for these fish. When questioned about this he argued that many of these fish were undersize and that the haul was so large it flooded the market for kob.

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[14] Set prices are offered due to the fact that the trek fishing industry often provides fish when other sectors have not caught. Furthermore due to their proximity and delivery speed the fish received are often of a better quality than those caught on boats.

The harder price and selling system differs from that of the other species. The I&J fish buyer buys approximately 45% of all harders caught. For the year 2000 he paid R2.20 per/Kg for harders. However if the supply was high, quality poor and size small he offered R1.90 per/Kg. Another 45% are sold to small-scale buyers. Of the two crews that caught significant amounts of harder one argued that the prices received for these fish were similar to those paid by I&J while the other crew argued that prices were lower. However the fishermen keep no records and it was impossible to gain an accurate measure of fish price and price elasticity.

The set price paid for each species over the last three years were available and were used to calculate the average annual change in set price fishermen received. This is presented in the table below.

Species	**Harder**	**Yellow tail**	**White steenbras**	**Elf**	**Kob**
Percentage change in price	12.2 %	4.2 %	6.2 %	5.9 %	4.2 %

Table 1. Average annual change in price by species. 1998-2000 (I&J prices).

Regardless of who buys the fish, 10% of total catch accrues to crewmembers in two forms. First as "fry", these are fish that each crewmember receives over and above their share of the catch. These fish can be eaten or sold. They are generally sold to restaurants, next to the road or to fish shops. Secondly some crews have a system called "fuzzies". "Fuzzies are fish which are sold to the public on the beach in the first half an hour after the catch is landed. Prices received for "fuzzies" and "fry" are typically 20%-25% higher than those paid by large-scale fish buyers[15]. Permit holders receive no income from "fry" and "fuzzies", crew members take 10% of the catch once this has been done the remainder is sold and divided amongst the permit holder and crew.

[15] For all crews interviewed regardless of whether they used the "fry", "fuzzies" or both systems the percentage of total catch provided was estimated at 10%.

4.4 Species Contribution to Revenue.

To obtain gross revenue estimates, scaled catches were adjusted down by 10% to correct for "fry" and "fuzzies"[16], this adjusted catch was then multiplied by the set price I&J (see table 1.) paid for each species. Each species revenue contribution to the industry is presented below.

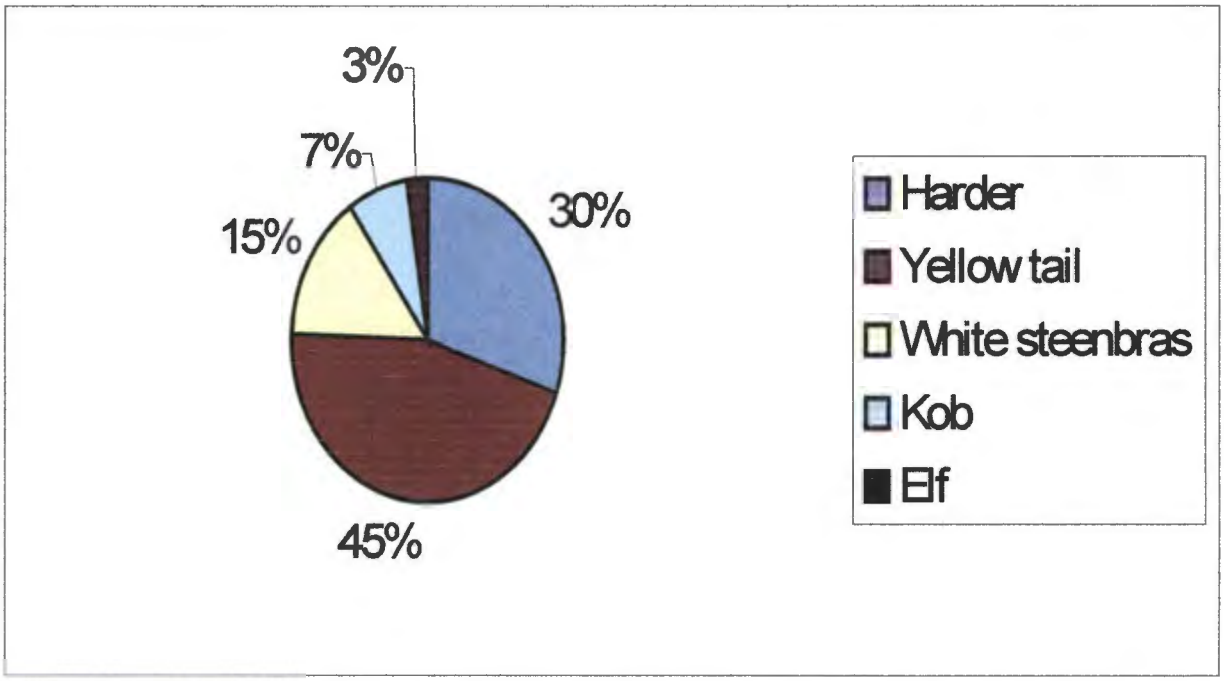

Figure 9. The proportion each species contributes toward total revenue for the False Bay beach-seine net fishery.

It is interesting to note that though harder contribute most to total catch in kilograms they contribute only 30% to total revenue. Yellow tail contribute most significantly (45%) with kob (7%) and white steenbras (15%) also contributing significantly to revenues. Other species contribute insignificantly to total catch and total revenue, and are generally kept by the crew as "fry". These species were excluded from this discussion. The loss of white steenbras would lower revenue for the entire industry by 15%, however this loss would be felt asymmetrically with some crews being unaffected. The two crews excluded from this analysis catch significant amounts of white steenbras and yellow tail. These figures therefore underestimate these species' contribution[17].

[16] "Fry" and "fuzzies" can be viewed as a 10% loss of income for permit holder as they do not receive any of the income generated through these systems.

[17] Although no catch records were available for the two missing operators it is valid to make this statement for three reasons. Firstly both operations are located in the south where habitats are suitable for these species. Second, one operation is at Fishoek and catches similar species to the other Fishoek operation. The second operation is at Simons Town and catches similar species to the Glencairne operation. Thirdly, the fish buyer confirmed this observation.

The figure below indicates which species contribute significantly toward total revenue for each crew.

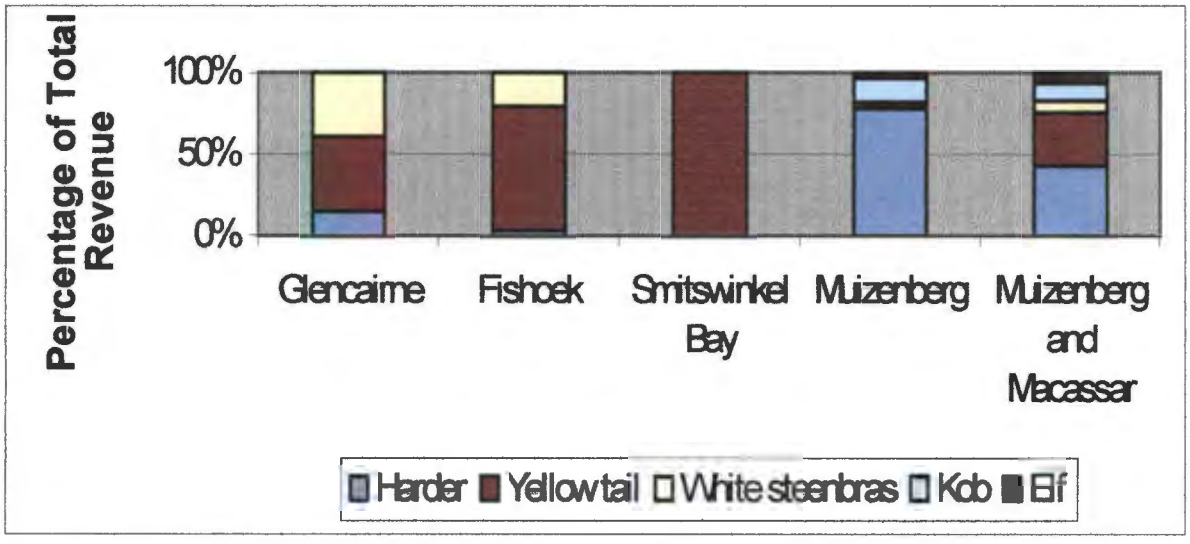

Figure 10. The proportion each species contributes toward total revenue for each permit holder.

The Smitswinkel Bay, Fishoek and Glencairne crews rely heavily on yellow tail. White steenbras contributes 30% and 11% toward total revenue for the Glencairne and Fishoek operations respectively. The crews operating on the northern shore rely heavily on harder (>40%) for revenue. Yellow tail contributes more than 20% to total revenue for the Muizenberg/Strandfontein and Macassar operator. The Muizenberg/Strandfontein crew caught large quantities of kob in two hauls. However they received only R6 per kg for these fish due to the small size and large quantity of the fish. Thus kob contributed negligibly toward total revenue. Elf contributes small amounts to total revenue for the north shore operators and, as with all other species except harder, are only caught in summer.

4.5 Revenue Estimations and the Change in Revenue Associated with Management Decisions

The total revenue calculated as described above is presented for each operator in the table 2. Two measures of total revenue are presented. Namely revenue from all fish caught and revenue from all fish except those caught on weekends and public holidays during the year 2000.

Operator	*Muizenberg and Macassar*	*Muizenberg/ Strandfontein*	*Glencairne*	*Fishoek*	*Smitswinkel Bay*
Revenue from all catches	R600 865.03	R 295 768.9	R 355 554.7	R 377 118.9	R200 040.6
Revenue excluding weekends and public holiday catches.	R 513710.81	R 184 962.3	R 272 062.4	R 287 542.2	R118 192.
Revenue Contribution of Weekend and Public Holiday Catches	14.5%	38%	23 %	24 %	41%

Table 2. Total revenue for each crew, with revenue calculated for total catch and for total catch less weekend and public holiday catch.

From the above it is clear that removing fishing rights for weekends and public holidays will have a profound impact on all operators, revenue falls range from 14.5% to 41%. There are several reasons for this decline. Firstly the number of days which can be fished is already restricted by the availability of fish and adequate weather conditions. Second, yellow tail are the most important species for operators in the south and are caught by visually locating shoals. Furthermore over 95% of all yellow tail catches are larger than 500kg, each catch is therefore worth approximately R6000. The correct weather conditions are essential for catching yellow tail hence removing fishing days when catches could be made could prove disastrous. Third, during the summer months 28% of all days are weekends and public holidays the average is slightly lower at 25.7% for the entire year.

This accounts for more than one quarter of all days that could be spent fishing if every day was suitable for fishing. This is however not the case and on average fishermen argue that they fish 3-4 times per week. The north shore operators who operate throughout the year catch relatively few yellow tail and rely on "blinde" treks for the bulk of their catch. It therefore follows that they would be effected less by this proposal. However the Muizenberg/Strandfontein crew caught large shoals on what could be restricted days. Under the proposed regulation they would have experienced a 38% decline in income. Similarly the Smitswinkel Bay crew caught large shoals of yellow tail during the Christmas season of 2000; their income would have fallen by 41%. This indicates the random nature of the industry where large periods of time are spent waiting for shoals of fish. Furthermore the level of effort exerted by crews is already at a maximum and operators could not fish more on other days to make up this loss of income. This proposal is therefore aimed to minimise conflict between the fishing sectors and is not based on scientific or economic evidence.

The table below shows the loss incurred by operators due to the loss of white steenbras as a legitimate target species.

Operator	***Muizenberg and Macassar***	***Muizenberg/ Strandfontein***	***Glencairne***	***Fishoek***	***Smitswinkel Bay***
Revenue from all catches	R600 865.03	R 295 768.9	R 355 554.7	R 377 118.9	R200 040.6
Total revenue less revenue from white steenbras	R 553 276.15	R 289 170.2	R 214 526.5	R297 961.2	N/A
Percentage loss in Revenue	8%	2%	40 %	21 %	0%

Table 3. Total revenue for all crews, with revenue totals for total catch and total catch less white steenbras.

The removal of white steenbras as a legitimate target species impacts on four of the operators with losses of revenue ranging from 2% to 40%. Whether this loss is significant will be discussed in section six.

The effect on income of the possible removal of kob as a commercial species is depicted in the table below.

Operator	***Muizenberg and Macassar***	***Muizenberg/ Strandfontein***	***Glencairne***	***Fishoek***	***Smitswinkel Bay***
Revenue from all catches	R600 865.03	R 295 768.9	R 355 554.7	R 377 118.9	R200 040.6
Total revenue less revenue from kob	R538 495.0	R 260 600.4	N/A	N/A	N/A
Percentage loss in Revenue	10.4 %	12%	0%	0%	0%

Table 4. Total revenue for all crews, with revenue generated from total catch and total catch less kob catches.

From the table above it is clear that removing kob as a commercial species will only affect two operators .The Muizenberg/Strandfontein operator will be severely affected with a loss of 12% in income. However this crew caught a few very large hauls of kob and were paid half the set price for these fish. Had they received the set price this loss of revenue would have been larger. The only other crew affected lost 10.4 % of its revenue. Whether these losses of income are significant will be discussed in section 6.

5. Costs Associated with Beach-Seine Net Fishing in False Bay.

The costs of running a beach-seine net fishing operation were calculated for each permit holder interviewed. It should be noted that of the seven permit holders only four could be interviewed. As the information on costs was obtained through interviews only four operators are discussed. For a complete break down of how each permit holders costs were calculated see appendix C. This paper addresses three types of costs facing permit holders: investment costs, annual costs and opportunity costs. Each of these are discussed separately, thereafter a comment on annual and opportunity costs facing crewmembers is made.

5.1 Investment Costs.

The investment costs was calculated for each permit holder. It constituted the replacement cost of all the equipment presently used by the operator. Generally crews use nets, boats, oars, cars, trailers, oilskins, wet suites, life jackets, binoculars and sunglasses. In some cases when equipment is not stored on the beach storage facilities have been built.

5.2 Annual Costs.

Annual or running costs were calculated for each crew. This included the maintenance cost for all equipment, trek fishing license fees, boat survey licence fees and municipal fees for boat storage and the use of cars on beaches. Depreciation costs for fishing equipment were obtained by dividing the replacement cost of the equipment by its life span. This was feasible as the equipment lasts a long time and its rate of depreciation is roughly constant, allowing linear depreciation. Maintenance and depreciation costs were summed to obtain annual or running costs.

5.3 Total Cost.

	Smitswinkel Bay	***Muizenberg/ Strandfontein and Macassar***	***Muizenberg/ Strandfontein***	***Fishoek***
Investment Cost	**R127 038**	**R202 080**	**R80 295**	**R130 284**
Annual or Running Cost	**R15 658.2**	**R38 579.5**	**R22 169.9**	**R25 103.8**

Table 5. Total investment and annual costs accruing to the Beach-seine net fishermen interviewed.

Table 6 below indicates the annual running or operating costs as well as the fixed costs for all permit holders interviewed. The low investment cost of the Muizenberg/Strandfontein permit holder is due to the fact that this operator has just begun his own operation and has less equipment than the other operations. Hence the other operations investment costs are far larger. The Muizenberg/Strandfontein and Macassar permits holder owns the most equipment, hence his high investment costs. Furthermore he transports crewmembers and equipment to the beach. He uses two cars and operates throughout the year and incurs high running costs. The Muizenberg/Strandfontein permit holders operates throughout the year but relies on one car hence petrol and vehicle depreciation major contributors to total cost, are less. The Fishoek and Smitswinkel Bay crews operate only in summer. Both crews have similar amounts of equipment. The reason for Fishoek's high running cost is that they have two cars that are used daily. The Smitswinkel Bay permit holder is not actively involved in trek fishing, crew members provide their own transport and fish are transported by boat. Thus no vehicle cost is included resulting in low running costs for this permit holder. The transporting of fish by boat to Kalk Bay costs this operation R600 per ton of fish. This cost is born by both the permit holder and crew as transport costs are subtracted from total revenue before it is shared.

5.4 Cost Accruing to Crewmembers.

Crewmembers are also faced with costs even though they have no responsibility toward supplying equipment. For all crews except the Smitswinkel Bay crew the operator supplied transport. For the Smitswinkel Bay crew the annual transport costs were calculated using the AA's per rate kilometre and came to R3 744 per person per season. Furthermore all crews have to supply their own food however as crews would have had to eat regardless of whether they fished or not this cost is not included. In some cases spotters had to purchase their own binoculars and sunglasses. These are replaced every 2 years and cost on average R720 and R600 respectively. Thus for all crews except the Smitswinkel Bay crew there were no costs arising due to their occupation.

5.5 Opportunity Costs.

Three types of opportunity cost will be discussed. The first is the opportunity cost of the capital invested by the permit holders and is the amount of interest they would have gained had they invested their money in a financial institution instead of in equipment. The long-term savings rate of 10.2% was used. Second, the opportunity cost of the permit holders' labour (if they actively participated in trekking) was calculated as the wage they would receive if they worked in the pelagic line fishery. This being the sector in which trekkers would most easily find employment.

Furthermore due to permit holder's capital investment and skill as mariners the wage they would probably receive would be that of a boat owner. Third, crewmember's opportunity costs were calculated as the income that they would have received as crewmembers on pelagic line-fishing vessels. These figures are presented in table 7 below.

	Smitswinkel Bay	***Muizenberg/ Macassar***	***Muizenberg/ Strandfontein***	***Fishoek***
Capital Opportunity cost	R12 958	R20 612.2	R8 190.1	R13 289
Permit Holders Labour Opportunity Cost[18]	R 0	R54 600	R54 600	R54 600
Crew Members Labour Opportunity Cost[19]	R3 750	R7 500	R 7500	R7 500

Table 6. The annual opportunity costs which face trek fishermen during 2000. (McGrath *et.al* 1997)

The Smitswinkel Bay operator has no opportunity cost of labour as he is not physically involved in beach-seine net fishing and merely rents and maintains the equipment and permit. Similarly the Muizenberg and Macassar permits owner is 66 years of age and operates in a similar manner. However although these permits fall under one operator they are held under two names. The one partner is actively involved while the other supplies most of the equipment and is concerned with the upkeep. As equipment is shared it was not possible to assertion what belonged to whom. This paper combined the costs of the operation under one person and labour opportunity cost was included.

[18] McGrath *et.al.* (1997) showed that boat owners earn R460 per trip. Trek fishermen claimed to fish 98 days during the summer season and 156 days for the entire year. Thus the wage was multiplied by the number of days fished.

[19] McGrath *et.al.* (1997) showed that pelagic line boat crewmembers earned R63 per trip. This was multiplied by the number of days fished and labour opportunity cost was obtained.

The Fishoek operator treks during the summer but trekking is his sole source of income thus the full year's labour opportunity cost is used. All the Fishoek crewmembers interviewed had work during the 2001 winter but the income earned contributed less than 25% to annual income. Thus the full years labour opportunity cost was used.

6. Incomes Earned by Trek Fishermen in this Study.

This section examines the incomes that permit holders and crewmembers receive. It does this by explaining how revenue is divided within each crew, costs are subtracted to obtain income for the year 2000. Present feasibility is then commented on and the effects of new and proposed management decisions on income are examined.

6.1 Revenue Division

Like share cropping beach-seine net fishing does not pay a fixed wage but is based on a system of risk sharing between crews and permit holders. Crewmembers and permit holders only receive income if fish are caught. Table 8 below indicates how revenue is shared between the crewmembers. The revenue figure is total revenue less10% (loss due to "fry" and "fuzzies"). Transport costs of R600 per ton were subtracted from this total for the Smitswinkel Bay operation. The permit holders' revenue is calculated as 50% of this total except for the Muizenberg/Strandfontein and Macassar permit operation where 40% goes to the permit holder. Prices received for "fry" and "fuzzies" are on average 20% more than those received by I&J. Hence this value is 20% higher than the value of the loss to the permit holder. The crew's revenue is thus their share of total revenue (50% for all except for the Muizenberg/Strandfontein and Macassar permits operation where 40% is received) plus the value of the "fry" and "fuzzies". The crew's revenue is divided into shares with each member gaining shares in accordance with his function.

	Smitswinkel Bay	*Muizenberg/ Strandfontein and Macassar*	*Muizenberg/* **Strandfontein**	*Fishoek*
Total Revenue Generated from all catches less "Fuzzies" and "Fry"	R169 938.2	R540778.52	R266 192	R339 407
Permit Holders Revenue Share	R84 969.1	R216 311.4	R130 096	R169 703.5
Value of "fry" and "fuzzies"	R21 604.4	R72 103.803	R35 492.3	R45 254.3
Crews Revenue	R106 573.5	R288 415.2	R165 561.3	R214 957.8
Average crew size	8	18	15	15
Average number of shares	10	21	18	18.5
Value per share[20]	R10 657.4	R 13 734.1	R9 197.8	R11 619.4

Table 7. Total annual revenue division for beach-seine net fishermen.

The Muizenberg/Strandfontein permit holder receives comparatively little revenue when compared with the only other crew operating through out the year. Namely the Muizenberg/Strandfontein and Macassar operation that has the highest revenue and crew share. Furthermore these operators' crew shares are for the entire year while the other two crews share is for summer only. The Smitswinkel Bay crew share is relatively high due to their small crew.

[20] Share value is obtained by dividing crew revenue by the average number of shares.

6.2 Returns to Permit Holders

This section evaluates the returns that permit holders receive. It does this by first examining the accounting profit or income calculated as:
Income = Revenue – Total Annual Cost.

Secondly the economic or excess profit is calculated as:
Economic Profit = Income – Investment and Labour Opportunity Cost.
This gives an indication of how lucrative the operation is compared to the permit holder's next best employment alternative.

Finally the rate of return on initial capital investment is calculated. This is calculated according to Yater's (1982) method as:
Rate of Return = (accounting profit – labour opportunity cost) / investment cost.

The rate of return is measured against the long-term savings rate of 10.2% to see if the industry yields better returns than if the money was invested in a financial institution.
The results for all crews are presented in table 9 below. These results are then discussed with regard to the results presented in tables 2,3 and 4 (decline in income through regulations).

Permit Holders Return	**Muizenberg/ Strandfontein and Macassar**	**Muizenberg/ Strandfontein**	**Fishoek**	**Smitswinkel Bay**
Accounting or Income	R177 731.9	R107 926.1	R144 599.7	R69 310.9
Economic or Excess Profit	R95 851.1	R42 486.3	R72 411.36	R52 160.8
Rate of Return	60%	66%	69%	54%

Table 8. Returns received by permit holders for the year 2000.

From the table above it is clear that all permit holders are receiving more than their opportunity cost of participation and are receiving extremely high returns on their initial investment. Furthermore all permit holders (unlike crewmembers) fall into the upper two quintiles of South African incomes. This is particularly interesting when one considers that only two crews operate through out the year. The Smitswinkel Bay permit holder is the only operator who works during the rest of the year, the other permit holders rely solely on this income. It can therefore be concluded that under the present management policies all permit holders find the industry profitable.

To assess the impact of new and proposed management decisions this paper examined the fall in revenue required before each operator failed to cover his opportunity costs[21]. This was compared to the hypothetical loss of income through new and proposed regulations, the results are presented below.

Reduction of Income	**Muizenberg/ Strandfontein and Macassar**	**Muizenberg/ Strandfontein**	**Fishoek**	**Smitswinkel Bay**
Maximum Sustainable Loss	53%	39%	50%	75%
Loss of Revenue through loss of weekends and public holiday	14.5%	38%	24%	41%
Loss of Revenue due to loss of White steenbras catches	8%	2%	21%	0%
Loss of revenue due to loss of Kob catches	10.4%	12%	0%	0%

Table 9. The maximum sustainable loss and the fall in revenue associated with new and proposed management policies.

[21] This amount by which income had to fall before opportunity costs were covered is termed the maximum sustainable loss.

From the table above it is clear that from the permit holders perspective none of the regulations would cause them to reinvest their time and capital. Only the Muizenberg/Strandfontein operation would be in danger of collapsing if weekend and public holidays were removed. None of the other regulations would affect the permit holder's decision to be active in the industry. It should be noted that the Smitswinkel Bay permit holder has no opportunity cost of labour and would thus be able to sustain a far larger loss of income. The problem for the permit holders is thus not their personal loss due to regulations but rather that these regulations would affect their ability to hold a crew together.

6.3 Returns to Crewmembers.

The accounting profit, economic profit (excluding the opportunity cost of capital investment) and maximum sustainable loss of income were calculated for the crewmembers. These are presented in table 11 below. The values are calculated per share.

	Muizenberg/ Strandfontein and Macassar	**Muizenberg/ Strandfontein**	**Fishoek**	**Smitswinkel Bay**
Accounting Profit or Income	R13 734.1	R9 197.8	R11 619.4	R6 913.4
Economic or Excess Profit	R6 234.1	R 1 697.8	R 4 119.4	R3 163.4
Maximum Sustainable Loss	45%	18%	35 %	45%

Table 10. Returns to crew members and maximum sustainable loss in income they could endure per share.

The Muizenberg/Strandfontein and Macassar permits operation is the most sustainable. Crewmembers earn most here but income is for the entire year. Non of the regulations would result in a decrease of income below the R7500 opportunity cost mark. However the crews average earning places the bulk of its crewmembers in the second lowest income quintile in South Africa. Furthermore a quarter of the crewmembers are paid a half share. Thus their income is R6 867 per annum and economic profits are negative. Further losses in income would result in increased impoverishment and could decrease crewmembers' participation rate.

The Muizenberg/Strandfontein crew is closest to earning their opportunity cost of labour. The maximum sustainable loss this crew could endure would be 18% and the 38% fall in income due to weekend and public holiday exclusion would be disastrous. This crew operates through out the year and a 38% reduction in income would reduce annual income to R5 702.6 per share.

Fishoek crewmembers operate in summer; their maximum sustainable loss is 35%. A loss of 24% due to the exclusion of weekends and public holidays would result in a seasonal income of R8 830 and would cover their opportunity cost of labour. Crewmembers earning one share belong to the lowest income quintile in the country. The loss of white steenbras (21%) will impact heavily on this crew. It is not only the 21% loss of income but rather that this income is used as a "crutch" by this crew. That is this crew goes to the beach before sunrise and throws "blinde" treks which generally yield small quantities of white steenbras. These fish go to the crew as fry and provides income that crews use to cover costs while waiting on the beach. There are often periods of up to two weeks where nothing is caught and loosing the only source of income that tides crewmembers over lean catch periods will have a pronounced impact. Permit holders expressed concern about keeping crews together during fishless periods without this form of income.

Smitswinkel Bay crewmembers have higher costs as they supply their own transport. A loss of 41% of revenue due to the exclusion of weekends and public holidays could be fatal for this operation as they rely solely on yellow tail and fish only in the summer months. All crewmembers interviewed from this crew were white and had stable work during the winter months. Thus their opportunity cost of labour would most likely be higher than the estimated R3750 for the season. Hence their maximum sustainable loss may be an over estimate.

It should be noted that the above discussion makes reference to crewmembers earning one share. These crewmembers are the largest income group within a crew. Crewmembers earning more than one share will earn the accounting profit from one share plus the revenue from the remaining shares they receive.

The above discussion shows that any fall in income will effect crewmembers more than permit holders. Loosing weekends and public holidays could prove disastrous for two crews discussed. The loss of white steenbras will only effect the Fishoek operation, whether this loss is significant depends on how heavily the crew relies on the same consistent income flow white steenbras provide. Furthermore the three operations not included in this discussion also depend on white steenbras.

Hence this new regulation may have a profound impact on the False Bay trek fishermen. The loss of kob as a target species would not result in significant losses of income for any operation. However crewmembers are generally so poor that any loss of income regardless of its size has an impact.

7. Long Term Feasibility of the Operations in this Study.

The section above depicted the feasibility of each operation under static conditions. This section attempts to determine the feasibility of each operation over the long term under three sets of assumptions. Three models each based on a set of assumption are put forward and predict the net present value (NPV) of each permit over a 30-year period[22]. These models are based on renewable resource stock harvest and growth models.

7.1 The Models

The first set of assumptions is that the catch levels for each species for the year 2000 remain constant over the next 30 years. This assumes that all species are being harvested at the same rate they are growing, thus stocks and harvest remain constant. What this means in terms of income is that revenue will only increase due to an increase in fish prices and not harvest size. Costs are assumed to increase at the average rate of inflation for the last three years (i.e.8.2%, Reserve Bank)[23] . The discount rate used was the long-term savings rate of 10.2%[24].

Thus model 1 calculates the NPV of income for permit holders as:

$$\sum_{t=0}^{t=50}\left[\begin{pmatrix}\text{Kilograms of Fish (excluding fry)}\times\\ \text{Price of Fish}(1+\text{Annual Average Change in Price})^{t}\end{pmatrix}-\text{Total Cost}\times(1+\text{Inflation Rate})^{t}\right]\times\left(1/(1+\text{Discount Rate})^{t}\right)$$

The NPV of crewmember's income had to be calculated separately in order to incorporate the value of "fry". This was calculated as:

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[22] A period of 30 years was used due to the fact that the most expensive equipment namely the nets last approximately 30 years. Thereafter a major investment on the part of the permit holders is incurred. The changes in equipment prices are difficult to predict after this period as most of the equipment is hand made with imported material. Costs could therefore only be accurately estimated until a major reinvestment occurs.

[23] This was used due to the fact that the change in fish prices obtained from I&J includes only the last three years.

[24] The discount rate can be viewed as the preference of income now over income in the future. As fishermen live largely day to day it is justifiable to use a high discount rate.

$$\sum_{t=0}^{t=50}\left[\begin{pmatrix}(\text{Crew Share of Kilograms of Fish Caught}\times \\ \text{Fish Price}(1+\text{Change in Fish Price})^t)+ \\ (\text{Kilgrams of "Fry"}\times\text{Price of "Fry"}(1+\text{Change in Fish Price})^t\end{pmatrix}-(\text{Crew Costs}\times(1+\text{Inflation Rate})^t\right]\times(1/(1+\text{Discount Rate})^t)$$

This was performed for each species and each fish price.

The second set of assumptions is that all species continue along their current levels of stock decline. That is harvest is larger than growth and stocks continue to decline, there is no management intervention and fish stocks continue to decline. The Sea Fisheries Department considers a species sustainable under current levels of exploitation if its current stock levels are at least 40% of its stock levels in a pristine environment. All species in this model except yellow tail are below the sustainable level. Therefore yellow tail catch is held constant for all three models. White steenbras is no longer a target species as its stocks have fallen below the minimum threshold level. Hence it was included for year the 2000 and excluded thereafter. The trend depicting a decline in Kob stocks indicates a 90% decline over the last 30 years (Griffiths 1997). Thus a 90% change in catch levels is projected. Harder stock levels have not been researched however researchers feel that they are declining, a 5% reduction in catch per annum was assumed. Elf stocks are at 36% of their pristine level, the rate of decline in elf stocks is unknown, a 5% reduction in stocks and harvest is assumed. This was modelled for permit

$$\sum_{t=0}^{t=50}\left[\begin{pmatrix}(\text{Permit Holders Share of Kilograms of Fish}\times(1+\text{Change in Fish Stocks})^t \\ \times\text{Price of Fish}(1+\text{Change in Fish Price})^t\end{pmatrix}-(\text{Permit Holders Costs}\times(1+\text{Inflation Rate})^t)\right]\times(1/(1+\text{DiscountRate})^t$$

holders as:

Note that the change in fish stocks is negative hence catch falls at the rate of stock decline. The NPV of income for crewmembers was calculated as:

$$\sum_{t=0}^{t=50}\left[\begin{array}{l}\left(\begin{array}{l}(\text{Crew Share of Kilograms of Fish}\times(1+\text{Change in Fish stocks})^{t})\times\\(\text{Price of Fish }(1+\text{Change in Price})^{t})+\\(\text{Kilograms of Fry}\times(1+\text{Change in Fish Stocks})^{t})\\\times(\text{Fry Price}\times(1+\text{Change in Fish Price})^{t})\end{array}\right)-\\(\text{Crew Cost}\times(1+\text{Inflation Rate})^{t}\end{array}\right]\times(1/(1+\text{Discount Rate})^{t})$$

The third set of assumptions assumes that management policies result in stocks being restored to a sustainable level. Hence management policies force a decrease in effort, growth becomes larger than effort and stocks grow. These stocks continue to grow until the stocks reach the 40% level. Once this is reached, effort is allowed to increase such that harvest equals growth and stocks remain constant. The model does this by firstly assuming that current management policies result in stock growth for 10 years, hereafter stocks are held constant[25]. That is stocks grow for 10 years, reach a sustainable level[26], and for the next 20 years are held constant. Information pertaining to projected stock growth was not obtainable for harder, elf and kob, a 5% increase per annum was therefore assumed. Model 2's equation was used to calculate the NPV of income for the first 10 years (with positive population changes). Thereafter model 1's method (with scaled catch size) was used to calculate the remaining 20 years NPV.

[25] This is true for all significant species caught except yellow tail and white steenbras. Yellow tail catch is assumed to be constant for the 30-year period. White steenbras are excluded from the model for the first 10 years under the new management decision. Thereafter they are reintroduced at their historical catch levels. Thus effort is completely eradicated for 10 years, after this period the stocks have grown to a sustainable level and management allows effort to increase such that harvest equals growth.

[26] Sustainable catch levels were obtained by calculating the size of the catch in year 10. White steenbras sustainable catch levels were estimated from discussions with fishermen and management.

7.2 Results and Discussion

The values obtained for each operation and for each model are presented in the table below. Results obtained are highlighted and discussed thereafter.

	Model 1 (10 years)	***Model 1 (Total)***	**Model 2 (10 years)**	**Model 2** ***(Total)***	***Model 3 (Ten years)***	***Model 3 (Total)***
Muizenberg /Strandfontein and Macassar						
Permit Holder	R2 285 546	R8 465 420	R 1 564 777	R4 224 193	R2 510 574	R14 870 915
Crew	R2 508 765	R8 706 654	R2 018 778	R4 764 258	R3 151 854	R19 546 830
Total	***R4 794 311***	***R17 172 074***	***R3 583 565***	***R8 988 451***	***R5 662 428***	***R34 417 745***
Muizenberg /Strandfontein						
Permit Holder	R1 803 823	R6 492 400	R1 142 916	R 2 535 634	R2 256 574	R13 832 638
Crew	R1 915 664	R7 305 706	R1 032 808	R 1 854 623	R2 463 591	R17 859 622
Total	***R3 719 487***	***R13 798 106***	***R2 175 724***	***R4 390 257***	***R 4 720 165***	***R31 692 260***
Fishoek						
Permit Holder	R1 483 991	R5 104 840	R1 024 896	R2 897 240	R1 059 809	R13 996 489
Crew	R2 028 460	R6 955 440	R1 464 299	R4 240 063	R1 443 221	R18 210 717
Total	***R3 512 451***	***R12 060 280***	***R2 489 195***	***R7 137 303***	***R2 503 030***	***R32 207 206***
Smitswinkel Bay						
Permit Holder		R6 317 623.6				
Crew		R3 842 961				
Total	**N/A**	***R10 160 845***	***N/A***	***N/A***	***N/A***	N/A

Table 11. The NPV of operations, under 3 scenarios, for a period of 30 years.

This discussion uses model 1 as a reference point against which the outcomes from the other two models can be discussed. It does so by comparing the value obtained from this model against the values obtained from the other models. If the fall in income associated with model 2 and 3 is greater than the maximum sustainable loss (MSL)[27] permit holders or crews can endure, it is concluded that under the assumptions prevalent in that model, long term feasibility is questionable.

When model 1 is compared with model 2 there is a large decline in the NPV of income for all crews. The fall in income after 10 years for the Muizenberg/Strandfontein and Macassar permit holder and crewmembers is insignificant. However over 30 years crewmember's incomes fall by more than their MSL and the permit holders income falls by 50%. As his MSL is 53% this operator may reinvest his capital and time. However the crewmembers will have already left his employment before this happens. For the Muizenberg/Strandfontein operator and crew the loss in income after 10 and 30 years associated with model two is larger than their maximum sustainable loss. Thus under conditions prevailing in model two this operation would not survive. For the Fishoek operation the reduction in income associated with model two would be larger than the maximum sustainable loss for crewmembers for both 10 and 30 years. For the Fishoek permit holder the loss in income after 10 and 30 years is below his maximum sustainable loss. The Smitswinkel Bay crew relies almost solely on yellow tail, as yellow tail stocks are at a sustainable level this operation is unaffected by the assumptions of model 2 and 3. The only danger to this operations existence is the proposed regulation to prevent fishing on public holidays and weekends.

Model 3 represents a maximum operation value when examined over the 30-year period. Over a 10-year period it displays a decline in income of 29% for the Fishoek[28] operation. The reason for this is that the fall in income due to the loss of white steenbras is larger than the rise in income due to increased stocks of other species. This loss is however not significant as crewmembers have a MSL of 35%. Catches vary from one season to the next and it is likely that a crews MSL may fall enough to make this loss of income significant. It can therefore be argued that the new policy may endanger four of the seven operations in False Bay. These crews should therefore be are carefully monitored to ensure their survival over the long term.

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[27] The MSL is the amount by which income will have to fall until opportunity costs are not met.

8. Analysis of the Proposal to Buy Trek Fishing Permits in False Bay

Recreational fishermen have proposed that the Marine Resource Use Fund be used to buy the trek fishing permits in False Bay. This section uses the values placed on permits by the three models discussed earlier as a platform from which this proposal is examined.

The first point that must be noted is that these models are not accurate. There are numerous reasons for this lack of accuracy. These include:

- The prices of fish used were those paid by I&J, no small scale fish buyers prices were included and no accurate estimation of price elasticity was made.
- Costs are assumed to increase at the rate of inflation, all other factors attributing to increased costs were ignored.
- The rate of change in harvest is assumed to have a linear relationship with the rate of change in stocks. This may not be the case as harvest might rise exponentially as stocks become more abundant.
- The 30-year discount period was chosen due to an inability to accurately estimate changes in costs. As fishermen on average work for more than 30 years the totals presented may be underestimates.
- Stock assessment models that depict stock growth cannot regulate for all variables and are thus at best an estimation.
- Model 3 assumes that stocks will reach a sustainable level after 10 years, this is an assumption and is not connected to any scientific evidence.

The above discussion highlights some of the problems any model would have to deal with in order to be accurate. Furthermore many of these problems are not solvable as information is not available. Hence any model would not be entirely accurate and may result in fishermen receiving less than they deserve. That is not to say that the above models are useless but rather that they provide a rough estimate for three possible outcomes.

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[28] The crews excluded from this model have similar catch compositions to the Fishoek crew and will be effected in a similar manner

The models presented earlier show high, middle and low values for each permit. When individual permit values are combined for each of the models they come to R108 478 056, R53 191 305 and R30 676 856 respectively. The first problem with this proposal is that future outcomes are unpredictable, all 3 models present feasible future outcomes and it is unlikely that one would be more correct than another. Hence deciding which value to pay would be difficult.
Another issue is that even if the lowest values are taken the permits would cost over R30 million[29]. Purchasing these permits would be very costly and it seems ludicrous that Marine Resource Use Fund (that has many financial obligations to meet) be used to buy these permits. This is particularly true in light of Lamberth's (1994) study that showed trek fishermen were not having a significant impact on the marine environment[30]. Hence the fund that is aimed at financing the conservation of the environment would be used to purchase permits from a sector that is not damaging the environment.

Another problem with this proposal is that it neglects to include the value trek fishermen contribute to False Bay. They are a unique sector within the False Bay fishing community and add to the colourful atmosphere that is evident within False Bay. The trekkers are the oldest fishing sector in False Bay and still draw crowds of spectators to the beach. Furthermore they are the only providers of harders, which constitute a major source of protein for low-income families. The loss of this sector to False Bay would detract from the diversity and uniqueness of False Bay.

There are also several practical problems with this proposal. Firstly if permits were bought and one operator received more than another there would be a massive outcry. Similarly within crews the calculation of shares would be highly contentious issue[31]. Another point is that this proposal would have implications for the entire country's fishermen. Hutchings (2000) noted that within the Western Cape only the False Bay and Saldahna Bay beach-seine net fishermen were covering their opportunity costs. Thus operators not making a profit could demand that their permits be bought.

A final problem with this proposal is that it may not be constitutional to force trek fishermen to sell their permits. It is beyond the scope of this paper to go into a detailed legal argument. However one

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[29] Note that three crews have been excluded, hence these amounts are underestimates of what would have to be paid.
[30] Lamberth (1994) showed that trek fishermen were significantly impacting upon white steenbras stocks. However trek fishermen are no longer allowed to target this species.

[31] Crewmembers often share functions (one crew has four members who can row but only uses two per trek. Thus treks are shared between the rowers). Furthermore there are many part time fishermen whose claim on any payment could be contested by fulltime crewmembers.

argument that could be made is that section 31 of the Constitution of the Republic of South Africa, act 108 of 1996 is aimed at the protection of minority rights. Hence forcing fishermen to sell their permits may be infringing upon their rights.

It can therefore be concluded that this proposal should be dropped as it is not practical, will cause problems and will be expensive.

9. Conclusion

The examination into the present profitability of the False Bay beach-seine net fishery showed that even under the stringent management policies presently imposed all participants were earning above their opportunity costs. When the effects of removing white steenbras as a target species were investigated it was shown that only the Fishoek crew would be effected. However this decline in income was not considered significant. The proposal to restrict fishing to weekdays would result in the Smitswinkel Bay and Muizenberg/Strandfontein operations demise. Removing kob as a target species was shown to have no significant impacts for any of the operations. The analysis of the long-term feasibility showed that if stocks continue to decline and white steenbras remains a restricted species all operations except the Smitswinkel Bay operation will cease to operate. Furthermore if stocks improve but white steenbras remains a restricted species for 10 years, model 3 showed that the Fishoek operation may find it difficult to survive. It is the recommendation of this paper that all operations catching significant quantities of white steenbras be periodically monitored to assess the impact the new regulation is having on their ability to survive. Furthermore this paper showed that the proposal to buy trek fishing permits in False Bay is not a feasible solution to the conflict between recreational and trek fishermen. Policies that are solely aimed at reducing conflict should not be implemented. Furthermore the trek fishermen are a unique and valuable part of False Bay and Cape Town; their long-term survival should be a priority for management.

Appendix A.

List of recreational fishermen's allegations against trek fishermen:

- Large catches of adult and juvenile "angling" species have lead to the decline of angling fish stocks.
- Netting near river mouths has caused high mortality amongst juvenile fish entering and leaving the spawning area and on adult spawning concentrations.
- Nets used scrap the sea floor removing large quantities of benthic fauna and flora.
- Large scale removal of species results in ecological imbalances within False Bay
- Fishermen are intruding in marine reserves.

Appendix B.

Below is a list of regulations currently imposed on trek fishermen.

- The introduction of a non-transferable permit system allowing beach-seining in specific areas.
- Compulsory monthly catch returns recording daily catches in number and mass for each species must be completed. Non compliance can result in permit withdrawal.
- Permits were issued solely for the targeting of Harders and St Joseph's but the False Bay fishery is allowed to target Yellowtail and white steenbras (this species has been removed as a target species for 2001).
- Fishing is prohibited between sunset and sunrise.
- Seine net fishermen in the Strand had permits revoked and the future issue of new permits in False Bay was prohibited.
- Rope length and thus net access was restricted to 600m and mesh size was restricted to a minimum of 44mm.
- A closed season from 1May until 30th October was introduced. During this period only Harders and St Joseph's may be targeted.
- The limited use of Russman nets is allowed.
- Beach-seine net fishing is banned 500m on either side of a river mouth.
- Buffer zones between fishing areas and marine reserves exist.

Appendix C

Below is a list indicating how each replacement cost accruing to the permit holder is calculated.

- 252m net: meshing + rope + thread + weights + floats + labour. Cost were calculated as number or amount used multiplied by unit price. Labour was estimated as the number of hours it takes to make a net multiplied by the wage commercial net makers pay.

Cost of 252m net = (63.6kg *R172.57 per kg) + (600m @ R180 per 300m) + (6* R132.75) + (80kg *R20.88 per kg) +(1200 * R6.5)+ (480 hours *R20 per hour)
= (R 10 975 of mesh) + (R360 of rope) + (R796.5 of thread) +
(R1 670 of weights) + (R7 800) +(R9600)
= R31 201.5
Plus 14% vat =R35 570.

- 144m net. There was no accurate description of how much of each of the above inputs is used for a 144m net. Accurate measurements were only obtainable for the 252m net. However the net builder who was interviewed estimated that it would take 30% less time and inputs to make. Thus the above total was multiplied by 0.7 to yield a 30% lower cost of R 24 899.
- Vehicles: estimated as the present amount that would be needed to replace the vehicle.
- Trailers: estimated at the replacement cost for a new trailer.
- Storage facilities: estimated at the amount it would cost to build the facilities.
- Boats: replacement cost from commercial boat builders valued boats at R2500 for boats less than 4m and R3000 for boats longer than 4m.
- Oars: the commercial price of each set of oars is R1500.
- Wet suites: retail price of R400 each.
- Oil skins: retail price of R35.
- Life jackets: retail price of R150.
- Sun glasses: retail price of R600 a pair
- Binoculars: retail price of R 720.

Below are a list of the maintenance costs associated with the equipment.

- Nets (maintenance costs were not significantly different for the different net sizes): labour cost per season + thread cost per season + mesh replacement cost per season + rope replacement cost.

Maintenance cost = (50 hours* R20 per hour) + (one third of 8kgs of mesh at R172.57 per kilogram) + (one third of 1kg of thread at R132.75 per kg)+(50% of the replacement cost for 300m of rope).
=(R1000)+ (R57.52) + (R44.3) +(R90)
=R1 191.77 per net.

- Boats: boats are repaired and painted every season at R250 per boat.
- Petrol and maintenance costs for vehicles: Calculated by multiplying the monthly kilometres travelled by the AA's per kilometre rate that includes petrol and tyre and engine depreciation.
- Trailers maintenance cost was estimated as R 400 per season.
- There is no maintenance cost for equipment that has to be replaced annually or at the most biannually.

The list below indicates the costs of permits and licences to the permit holders.

- Boat survey fees: all crews at R125 for each boat.
- Boat licence fees: all crews at R65 per boat.
- Municipal storage fees: Fishoek crews Pay R800 per year to store equipment on the beach.
- Beach access fees: Muizenberg and Maccassar operators pay a R440 annual fee for driving vehicles down to the beach.

The table that follows is a complete beak down of each operator's costs as are presented in the study.

Equipment[1]	**Muizenberg and Maccassar**	**Muizenberg**	**Fishoek**	**Smitswinkel Bay**
Boats (20)				
Number	2	1	2	4
Replacement cost	R6000	R3000	R5 500	R12 000
Depreciation cost	R300	R150	R275	R600
Maintenence cost	R500	R250	R500	R1000
Total annual cost	**R800**	**R400**	**R775**	**R 1600**
Nets (30)				
Number of 252m nets.	4	1	2	2
Replacement cost	R142 280	R35 570	R71 140	R71 140
Depreciation cost	R4742.7	R1185.7	R2371.1	R 2371.1
Maintenence cost	R4766.8	R1191.7	R2383.6	R2 383.6
Total annual cost	**R9509.5**	**R2377.4**	**R4 754.7**	**R4 754.7**
Number of 144m nets.	0	0	1	2
Replacement cost			R24 899	R49 798
Depreciation cost			R829.9	R1659.9
Maintenence cost			R1191.7	R2383.6
Total annual cost			**R2021.6**	**R4 043.5**
Vehicle (20)				
Number of vehicles	2	1	2	**N/A**
Replacement cost	R24 000	R19 000	R20 000	
Depreciation cost	R19 500	R11 700	R9750	
Total annual cost	**R19 500**	**R11 700**	**R9750**	
Oil Skins (2)				
Number	**0**	15	15	**N/A**
Replacement cost		R525	R525	
Depreciation cost		R262.5	R262.5	
Maintenence cost		R0	0	
Total annual cost		**R262.5**	**R262.5**	
Wet suites(2)				
Number	3	4	3	**N/A**
Replacement cost	R1200	R1600	R1200	
Depreciation cost	R600	R800	R600	
Maintenence cost	0	R0	0	
Total annual cost	**R600**	**R800**	**R600**	

[1] The number proceeding the equipment type is the average life span by which equipment is divided to yield total costs.

Life Jackets (2)				
Number	4	4	4	**0**
Replacement cost	R600	R600	R600	
Depreciation cost	R300	R300	R300	
Maintenence cost	R0	R0	R0	
Total annual cost	**R300**	**R300**	**R300**	
Sun glasses(2)				
Number	**0**	**0**	2	**0**
Replacement cost			R1200	
Depreciation cost			R600	
Maintenence cost			0	
Total annual cost			**R600**	
Binoculars(2)				
Number	**0**	**0**	1	**0**
Replacement cost			R720	
Depreciation cost			R360	
Maintenence cost			0	
Total annual cost			**R360**	
Trailers (10)				
Number	2	1	**0**	**N/A**
Replacement cost	R16 000	R8000		
Depreciation cost	R1 600	R800		
Maintenence cost	R800	R400		
Total annual cost	**R2400**	**R1200**		
Storage Facilities (50)				**N/A**
Number	1	1	**0**	
Replacement cost	R 7500	R 7500		
Depreciation cost	R150	R150		
Maintenence cost	R0	R0		
Total annual cost	**R150**	**R150**		
Liscence and Permit fees	**R820**	**R630**	**R1180**	**R 760**
Oars (1)				
Number of oars	3	3	3	3
Replacement cost	R4500	R4500	R4500	R4500
Depreciation cost	R4500	R4500	R4500	R4500
Maintenence cost	R0	R0	R0	R0
Total annual cost	**R4500**	**R4500**	**R4500**	***R4500***
Total Investment Cost	**R202 080**	**R80 295**	**R130 284**	**R127 038**
Total Annual Cost	**R38 579.5**	**R22 169.9**	**R25 103.8**	**R15 658.2**

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