THE COMMERCIAL AND RECREATIONAL MARINE SKIBOAT LINEFISHERIES IN RICHARDS BAY, KWAZULU-NATAL

by

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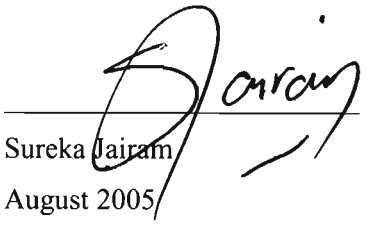
ABSTRACT

In order to assess and improve their management, a survey of the commercial and recreational marine linefisheries in Richards Bay was conducted from June 2002 to July 2004. The ultimate aim of this survey was to develop a sound management framework for the commercial and recreational marine linefisheries in Richards Bay. Skippers on both commercial and recreational skiboats were all white males in their mid-40s whom were fairly experienced. There were twice as many crew on commercial than recreational skiboats. The crew on commercial skiboats were mostly black males while on recreational skiboats, crew were mostly white males. Slinger was the most important species caught by commercial fishermen off Richards Bay, accounting for the vast majority of catches by number and mass. The total contribution by sparids to commercial catches amounts to approximately 93 % by number and 81 % by mass. Recreational catches comprised a greater variety of species (73 recreational species versus 54 commercial species), signifying a less focussed targeting approach compared to commercial skiboat fishermen. Although slinger also numerically dominated recreational linefish catches, catface rockcod were most important by mass. Although there were five times more recreational outings during the study, total catch by commercial skiboat fishermen was five times higher than that of recreational fishermen. This was expected, as the average duration of each commercial outing is more than twice that of recreational outings and the crew numbers are higher. Commercial skiboat fishermen in Richards Bay are also more effective, as the average number of fish caught per man per hour on commercial skiboats was approximately 4 times greater than that on recreational skiboats. Total estimated catch for the commercial sector was 28 tonnes and 173 tonnes for the recreational sector. Comparison of data between this survey and commercial data available on NMLS showed similar species composition, although the dominance of slinger was 20 % higher in this survey compared to NMLS data. Similarly, within the recreational sector, there was a close similarity in catch composition between this survey and that of EKZNW catch inspections. The profit (excluding the costs of fixed assets) that each commercial fisherman earns per month was estimated to be in the region of R8 500. However, if one examines the value of the commercial linefishery as a whole, it appears that there is a net loss of R90 000 per year, excluding the costs of fixed assets. The discrepancy stems from the disparity between the recorded number of launches and the number reported by skippers. Most of the commercially caught fish are not sold in Richards Bay, but are exported to Gauteng. The average monthly linefish catch by commercial fishermen was less than half the average estimated consumption of linefish in Richards Bay, and the difference appears to be made up from recreational catches, with many consumers indicating that they either caught their own fish or were given it. Knowledge of and compliance with fishing regulations by commercial and recreational skiboat fishermen in Richards Bay was reasonably good. The main recommendations emanating from this study include continuous monitoring of the Richards Bay commercial and recreational linefishery in order to determine the efficacy of the new regulations, the development of area-based commercial linefishing permits and the possible introduction of restrictions on the sale of fish outside of the Richards Bay area.

PREFACE

The experimental work described in this dissertation was carried out in the School of Biological and Conservation Sciences, University of KwaZulu-Natal and Oceanographic Research Institute (ORI), Durban from August 2003 to July 2004, under the supervision of Professor Rudy van der Elst and Dr. Sean Fennessy.

These studies represent original work by the author and have not otherwise been submitted in any form for any degree or diploma to any tertiary institution. Where use has been made of the work of others, it is duly acknowledged in the text.



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1. INTRODUCTION

Richards Bay, on the north east coast of South Africa (SA), has developed from a small settlement in the 1960s to a rapidly growing urban and industrial town. The main reason for the rapid development of Richards Bay has been the establishment of a deepwater port in the estuarine embayment. Consequently, paper pulp and wood chip industries such as Mondi, Sappi, aluminium-ore industry Alusaf and Indian Ocean Fertilisers have been established, and the port therefore functions primarily for the export of coal, wood pulp, wood-chip, aluminium and fertilizer.

Since the establishment of the port in the 1970s, smaller craft have had easy, safe and year-round access to the fishing grounds of the northern KwaZulu-Natal (KZN) coast. Consequently, a commercial marine linefishery[1] was established and still provides fresh fish to the rapidly growing population of Richards Bay and further afield. To date, inadequate attention has been given to the management of this fishery from either a catch or socio-economic perspective.

There is also increasing demand for recreational activities in Richards Bay as a direct result of the ever-increasing population size driven in turn by the expansion of industry in the area. Furthermore, the warm subtropical climate and proximity to the sea encourages outdoor pursuits in the Richards Bay area. It is therefore not surprising that a large recreational fishery has also developed. This fishery consists of skiboats, which launch in the harbour and which venture offshore to target reef and game fish. Consequently, various retailers supplying fishing equipment tackle and bait, as well as boat building and boat maintenance businesses have also been established to cater for the needs of the skiboat community. At present little is known about the marine recreational skiboat fishery in Richards Bay with the exception of limited catch data from Ezemvelo KwaZulu-Natal Wildlife (EKZNW) law enforcement boat inspections.

The South African Marine Living Resources Act (No. 18 of 1998) is aimed at utilizing marine resources in a sustainable manner. However, in order to achieve sustainability of any resource, three key components need to be evaluated. These are biological, social and economic components with the latter two often being clumped as socio-economics. Ultimately, the goal of any management policy is to conserve all resources especially those which are exploited.

[1] Fishing with a hook and a line, but within this document refers specifically to marine skiboat linefishing.

However, in order to achieve this goal, knowledge of fishery parameters fundamental to fishery science is required. These include effort rates (in terms of number of launches), how much fish is being caught, what species are being targeted as well as the size distribution and seasonality of catches. These parameters are essential to understanding the population dynamics of fish species and hence to the management of fish resources.

Socio-economic factors have in recent years also featured prominently in the formulation of management plans for marine resources, including issues such as equitable distribution of and access to the linefish resource by all sectors (van der Elst, 1993; McGrath *et al.*, 1997). In addition, issues such as poverty alleviation and equity have become important considerations in national policy formation.

The South African commercial and recreational line fishery is a major contributor to the local economy of coastal areas (van der Elst, 1993; McGrath *et al.*, 1997). Recreational angling has proven to be an important component of many fisheries since it is the fastest growing sector in terms of the number of participants (van der Elst, 1993). With the exception of a regional study at Port Alfred in the 1980s (Hecht & Tilney, 1989), studies on South African linefisheries have either been broad-scale spatial studies (i.e. national or provincial), or species directed. In the latter case for example, there have been studies on the life history of geelbek *Attractoscion aequidens* off the east coast of Southern Africa by Griffiths & Hecht (1995) and the management of South African dusky kob *Argyrosomus japonicus* by Griffiths (1997).

Examples of broad-scaled studies on provincial linefisheries in SA, include studies in Transkei (Fennessy *et.al.*, 2003), KZN (Mann *et al.*, 1997) and the Eastern Cape (Smale & Buxton, 1985). The study undertaken by Fennessy *et al.* (2003) in the Transkei is one of the few published studies providing specific provincial information on recreational and commercial marine linefisheries, but on the whole, most published studies are on a national basis. For example, Pilfold & Pampallis (1993) provided an evaluation of the whole Natal commercial linefishery but this was a superficial study. Penney *et al.* (1999) provided substantial but generalized information on long-term trends (spanning more than a decade) on nearshore linefisheries in the whole of South Africa, but specific information on localized trends in marine linefisheries was lacking. The national marine linefish survey in 1995-1996 also provided information on various sectors of the South African linefishery as a whole, including skiboat fishing (Sauer *et al.*, 1997), shore fishing (Brouwer *et al.*, 1997) as well as an overall economic assessment (McGrath *et al.*, 1997).

As stated previously, inadequate attention has been given to the Richards Bay commercial and recreational marine linefishery. In addition, Richards Bay is one of two ports in KZN which provides relatively sheltered, easy, year round access to launch sites for commercial and recreational marine linefishermen. It is therefore not surprising that skiboat fishing has increased in popularity with the second highest number of skiboat launches in KZN occurring in Richards Bay (Mann *et al.*, 1997). Consequently, this study aims to provide insight into the biology and socio-economics of what can be regarded as a microcosm of the South African linefishery.

The aims of the study were to determine how much fish is being caught in the Richards Bay region and to assess the economic and other benefits this catch provides for people in the area. In addition, the project involves monitoring and providing management recommendations for recreational and commercial marine linefisheries from a biological and socio-economic perspective in the Richards Bay region.

The overall objectives may be summarized as follows:

i. To determine the extent of participation in the commercial and recreational marine linefisheries in Richards Bay.
ii. To determine levels of fishing effort, total catch and catch per species by commercial and recreational fishers in Richards Bay.
iii. To undertake a basic socio-economic assessment of the Richards Bay commercial and recreational marine linefisheries.
iv. Make recommendations for the development of a management framework for the commercial and recreational marine linefisheries in Richards Bay.

2. HISTORICAL BACKGROUND OF SKIBOAT LINEFISHING IN KZN

2.1. Commercial marine linefishery

Offshore commercial linefishing in KZN began in the late1800s (van der Elst, 1984) when large steam powered boats operated out of Durban harbour. Over time, these boats were replaced by diesel-powered vessels which were usually operated by 20 crew, ranged in length from 10 to 35 m and extended their operational range to 1 000 nautical miles. Initially, most boats fished in shallower reefs along the central KZN coast but effort increased southwards to the Transkei coast as catch rates in the central region declined (Mann-Lang *et al.*, 1997).

After the Second World War, a number of factors contributed to changes in the nature of the commercial linefishery in KZN. The most important was the development of the skiboat initially designed for recreational use. However, the high operating costs and lack of versatility of the larger vessels led to the increased popularity of skiboats in the commercial sector. The early skiboats were designed to specifically launch in surf with relatively unrestricted movement (Garratt, 1984). This facilitated the rapid expansion of effort along the entire KZN coast. By 1979 the total number of commercial skiboats registered in KZN exceeded 1 000 boats (van der Elst, 1984).

Skiboat design has since changed to improve fishing efficiency. Nowadays, skiboats are equipped with sophisticated equipment such as Global Positioning System (GPS) and three dimensional fish finders with colour displays to help in the location of reefs and shoals of fish. Boats with sophisticated equipment and experienced skippers are therefore extremely capable of catching large numbers of fish. However, despite this increased efficiency, there appears to be a decreasing trend in catch per unit effort (Penney *et al.*, 1999). This suggests that fish stocks are being over-exploited and that current management strategies may not be sufficient to ensure sustainable utilization. This is supported by a recent review of the status of linefish species in SA, which indicates that many species are over-exploited (Mann, 2000).

Dramatic changes in species composition of KZN commercial linefish have also caused concern regarding the state of the fishery. Catches began to decline in the 1970's and the once abundant species such as *Polysteganus undulosus* (seventyfour) and *Petrus rupestris* (red steenbras) quickly became scarce. Consequently, fishermen began targeting less desirable species such as *Chrysoblephus puniceus* (slinger) and *Cheimerius nufar* (soldier). These have remained the target reef species, comprising 70 – 80 % of total reef catch (Garratt, 1984; Mann-Lang *et al.*, 1997).

2.2. Recreational marine linefishery

Offshore recreational linefishing started in the early 1900s when harbour tugs were chartered for daily fishing trips. This activity ceased during World War I but resumed in 1923. The earliest skiboats were wooden vessels powered by one or two 5 hp engines (Mara, 1986). Due to their design, these boats were restricted to the relatively calm waters off Durban.

The popularity of recreational linefishing began to grow after the advent of the skiboat in the mid 1950s. In order to provide some form of control over the growing sport, several clubs were formed in the Durban area. By 1961, the Durban Skiboat Club had more than 60 registered boats (Mann-Lang *et al.*, 1997). Although Durban remained the centre of the recreational skiboat fishery, the versatility of the skiboat enabled anglers to operate on beaches north and south of Durban. By 1995, the Natal Deep Sea Angling Association had 38 affiliated clubs with over 2 000 registered boats.

While the development of skiboats allowed for the relatively unrestricted movement through the surf, the lack of relatively sheltered launch areas restricted fishing effort. Previously, prevailing weather conditions were an important factor that determined whether a boat would launch or not. However, with the construction of the Port of Richards Bay for example, launching of skiboats was made much easier in that region.

3. STUDY AREA

The KZN continental shelf is very narrow (3 – 11 km wide) to the north of Richards Bay (Latitude 28 ° 48' S and Longitude 32 ° 02' E) and south of Durban, but between these two areas the shelf widens to 45 km opposite the Tugela River (Schumann, 1988). The coastline is relatively straight with few protected bays and is generally a rough, high-energy coastline. Shelf circulation varies in close association with the topography of the continental shelf. The Agulhas Current is the dominant oceanographic feature of the east coast of South Africa. It transports warm tropical, and subtropical water in a poleward direction along the shelf, and has major influence on the oceanography of the region (Shillington, 1993). Where the shelf widens between Richards Bay & Durban, the Agulhas Current continues to follow the shelf break and moves farther offshore. Two main reef zones which are accessed by KZN skiboats have been recognised, the first consisting of a long zone of scattered reefs, approximately 50 m in depth extending along the entire coast, while the second consists of deeper reefs south of Durban and to the north of the Tugela River, around 100 – 200 m in depth (Figure 1; Garratt, 1984).

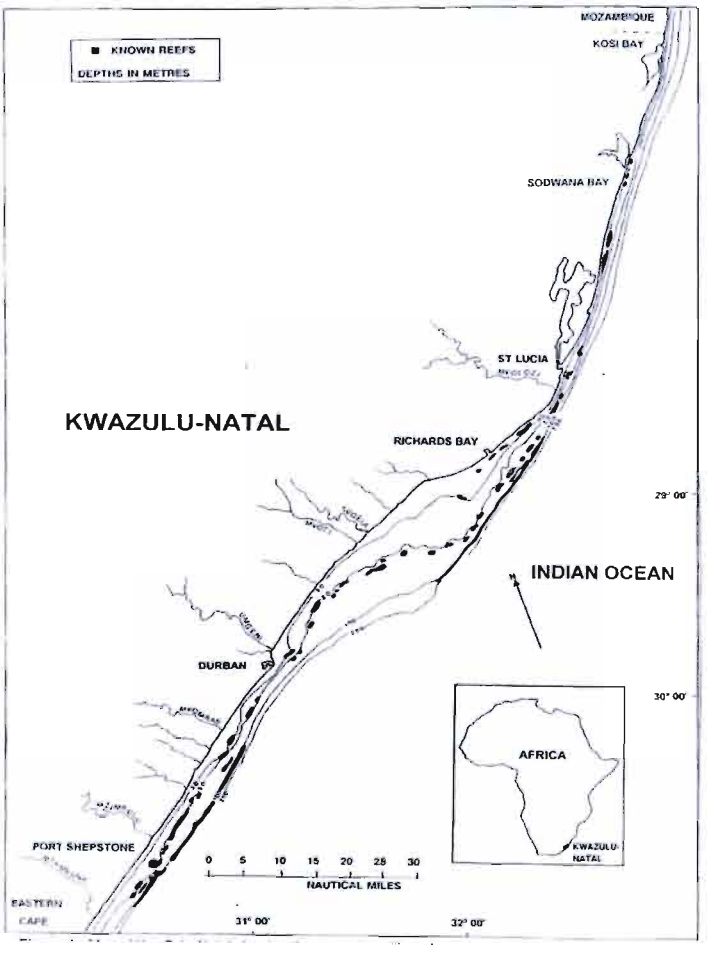

Figure 1: Map of the KwaZulu-Natal coastline showing the study area, bathymetry and known reefs (adapted from Mann-Lang *et al.*, 1997).

The Richards Bay climate is sub-tropical with warm to hot summers with a relatively low diurnal temperature range. Mean maximum and minimum atmospheric temperatures during summer are approximately 29°C and 21°C respectively (Figure 2). Winters are mild with mean maximum and minimum atmospheric temperatures of approximately 23°C and 13°C respectively (Figure 2).

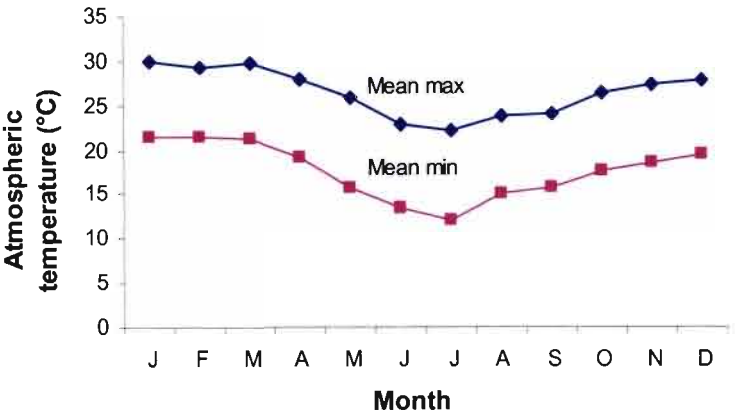

Figure 2: Mean daily maximum and minimum air temperatures (°C) in Richards Bay between 2002 and 2004 (Data kindly supplied by the South African Weather Bureau).

Mean maximum and minimum sea surface temperatures during summer are approximately 24°C and 22°C respectively (Figure 3). Winters are mild with mean maximum and minimum sea temperatures of approximately 20°C and 19°C respectively (Figure 3).

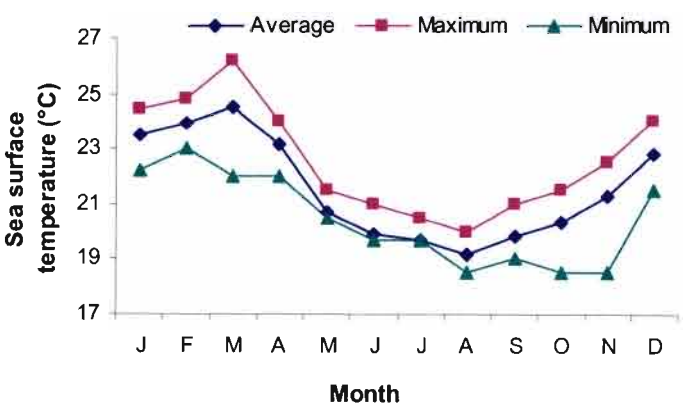

Figure 3: Mean, minimum and maximum sea surface temperatures (°C) off Richards Bay between June 2002 and July 2004 (Data kindly supplied by the Natal Sharks Board).

South-westerly and north-easterly winds are usually a common feature in Richards Bay. Mean summer and winter wind speeds are approximately 6.0 $m.s^{-1}$ and 4.5 $m.s^{-1}$ respectively (Figure 4).

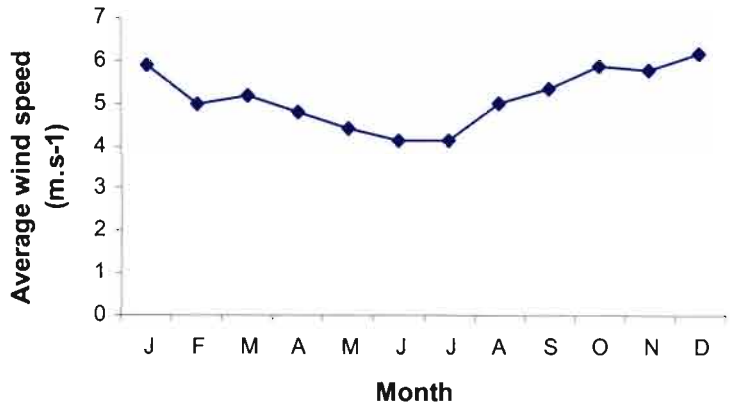

Figure 4: Average wind speed ($m.s^{-1}$) in Richards Bay between 2002 and 2004 (Data kindly supplied by the South African Weather Bureau).

4. METHODS

Several angler survey methods were considered prior to the commencement of this study (Pollock *et al.*, 1994). Preliminary investigations revealed that an access point survey (APS) was the most suitable survey method since recreational skiboats could only be launched from two demarcated slipways in the Richards Bay harbour, making it easy to encounter them. Similarly, commercial skiboats could only be launched from a single commercial slipway.

A two-year study between June 2002 and July 2004 was carried out on the commercial and recreational skiboat linefishery off Richards Bay. The study was comprised of two phases, the first involving an APS to obtain catch and effort data as well as socio-economic and management information for the commercial and recreational linefisheries. The second phase of the study involved a series of interviews with consumers, wholesale/retail outlets and restaurants to determine the supply and demand for linefish in Richards Bay.

4.1. Commercial marine linefishery

4.1.1. Commercial skiboat interviews

Once-off interviews with licensed commercial operators were conducted using a detailed questionnaire (Appendix A). The questionnaires were used to obtain generalised catch and effort information, demographics within the fishery, socio-economic information and the skipper's attitude to management and economic value of the fishery.

4.1.2. Access point survey (APS)

An "observer" was employed and stationed in Richards Bay area to conduct catch inspections during the APS. The observer was trained in the practicalities of catch inspections, including species identification and sampling methodology. Commercial skiboats launched from a slipway independent of recreational skiboat launch sites. The observer was stationed at this commercial slipway from about 17:00 and waited for commercial skiboats to return with their catches. The observer would then follow the skiboats to the wholesalers where the catch inspection occurred.

The observer was instructed to conduct inspections of 30 outings per month, spread randomly throughout the month. This information was used to determine catch composition, total catch, catch per unit effort (kg/hour and kg/outing), spatial distribution of fishing effort (see below), length frequency distribution, amount of bait (sardine and squid) used and fuel consumption. (Appendix B). Catch rates (kg/hour or kg/outing) are based on gutted fish weights. Results are reported as totals, means and associated standard errors. All fish landed in catches were counted and measured (Total length, TL or Fork length, FL) to the nearest cm. Catch weights

per species were estimated by converting individual lengths to weights, using length-weight relationships (Mann, 2000 or www.fishbase.org) and summing the individual weights. If no length-weight relationship was available for a particular species, then that of a similarly proportioned species was used. Total catch for the fishery was estimated by using total effort from the port launch records (see below) and catch per unit effort (kg/outing) from the observer catch inspections.

4.1.3. Total effort

Portnet (the port management authority) keeps a record of commercial boats leaving and entering the port of Richards Bay on a daily basis. Information recorded by Portnet authorities includes boat name, boat number, fishing area, crew size, time leaving port and time entering the port. The fishing area is designated by a numerical grid system (see results), and port records were therefore used to estimate total effort and spatial distribution of fishing effort for the commercial fishery.

4.1.4. Comparisons with National Marine Linefish System (NMLS)

The National Marine Linefish System (NMLS) is a national database that records reported catch and effort data from the commercial linefisheries. In KZN, it also records catch and effort data for the recreational linefishery based on catch inspections by EKZNW (Pradervand & Govender, 1999). Up until 1994, the then Department of Sea Fisheries maintained an office in KZN and their observers monitored commercial landings at several sites, including Richards Bay. Although historical commercial catch per outing data are not available on the NMLS, historical length frequency data for individual species are available. The Kolmogorov-Smirnov Two-Sample Test was used to examine differences between length-frequency distributions distributions for the period 1992-1994 and for current catches (2002-2004). This information was extracted from the NMLS for commercial boats launching in Richards Bay between July 2002 and June 2004, and was used to compare the size structure of catches for the period 1992 – 1994 and for current catches (2002 – 2004). In addition, commercial skippers are also required to submit catch returns to Marine and Coastal Management (MCM). This information was extracted from the NMLS for Richards Bay for boats between July 2002 and June 2004, and compared to the information obtained in the current survey.

4.2. Recreational marine linefishery

4.2.1. Recreational skiboat interviews and access point surveys (APS)

There are two skiboat clubs in Richards Bay, i.e. Richards Bay Skiboat Club (RBSC) and Meerensee Skiboat Club (MSC) each with their own launch site. Both clubs keep compulsory and comprehensive launch records, which contain information such as boat name, boat number, crew size, area fished, time of launch and time back from launch.

Preliminary investigations of launch records showed that most (70 %) of recreational launches occurred on weekends and the distribution of launch and return times indicated that most recreational skiboats (approximately 70 %) operate between the hours of 10:00 and 16:00. Therefore, in order to encounter as many recreational anglers as possible, twice per month on randomly selected weekend days, fieldtrips were undertaken between the hours of 10:00 and 16:00. The APS procedure involved waiting for skiboats to return to shore. The skippers were then interviewed and catches inspected while their boats were being washed. The interview process included a wide spectrum of participants, including local and visiting fishermen and as many skippers as possible were interviewed on a random basis.
This information was used to determine catch composition, spatial distribution of fishing effort, length frequency information, demographics within the fishery, and socio-economic information (Appendix C). Results are reported as totals, means and associated standard errors. Catch per unit effort by weight was determined by converting all individual fish lengths to weights using length-weight relationships (see commercial methods). Catch per unit effort (kg/hour and kg/outing) were estimated from catch inspections, and the overall average catch per unit effort was scaled up to estimate total catch using total effort (number of fishing hours) from the club launch records. If skippers had already been previously interviewed, only catch and effort information was recorded (Appendix D).

4.2.2. Total effort

As mentioned previously, both recreational skiboat clubs keep a record of daily launches. These records were therefore used to estimate total effort and spatial distribution of fishing effort using the numerical grid system for the recreational fishery.

4.2.3. Comparison with NMLS

Catch comparisons and determination of trends in catch composition were undertaken using catch and effort data collected during the APS, and historical catch and effort data available on the NMLS.

4.3. Economic importance of the linefishery in Richards Bay

4.3.1. Economic value of the linefishery

Data obtained from interviews of commercial skiboat skippers were used to determine the viability of the commercial fishery in Richards Bay. The average amount spent monthly on bait, fishing tackle, boat fuel and crew was converted to an annual amount. This value was added to the annual amount spent on boat maintenance and rods and reels. Running expenses were determined by finding the sum of all of the individual costs. The cost of fixed assets was determined by taking the average value for skiboats, tow/launch vehicle and fishing gear. Total catch was estimated by taking the product of the number of launches and the average catch per outing. The Rand value of the catch was estimated by using the proportion of large, medium and small fish caught (from total catch) and the average price per kg of linefish in each size category (Appendix H, Table 2). The economic value of the commercial fishery was thus determined by subtracting the cost of running expenses from the Rand value of the catch. For the recreational sector, only the costs of fishing (running expenses and fixed assets) were estimated (Appendix I) because recreational fishers are not allowed to sell their catch.

4.3.2. Consumer survey

Interviews with consumers were conducted at the largest shopping centre in Richards Bay to assess the local demand for linefish. This shopping centre was chosen because it was the largest source of potential linefish consumers. Interviewees were asked about preference, source and availability of particular species of marine linefish (Appendix E). Interviews were conducted during a weekend as it was expected that more consumers would be out shopping at this time. All interviewees were approached randomly to include both sexes, members of all ethnic groups and people of all age groups over 18 years of age. Consumer demand for linefish was estimated using population census data (www.statssa.gov.za) and information from consumer interviews (Appendix J).

4.3.3. Wholesale/retail outlet survey

The owner and/or managers of wholesale/retail outlets were interviewed to determine the value and fate of commercial catches from Richards Bay, as well as to assess the local supply and demand for linefish in Richards Bay (Appendix F). These outlets were identified by asking commercial fishermen whom they sold their catch to as well as by examining the Richards Bay telephone directory.

4.3.4. Restaurant survey

Telephone surveys with restaurant outlets were also conducted to assess customer preference, source and availability of linefish in Richards Bay (Appendix G). Restaurants potentially serving linefish were identified from the Richards Bay telephone directory.

5. RESULTS

5.1. Commercial marine linefishery

5.1.1. Commercial skiboat interviews

A field trip was undertaken in July 2004 to interview skippers of commercial skiboats. At that time there were 11 licensed commercial skiboats operating of which eight skippers were interviewed. The remaining skippers could not be contacted. Table I summarises the responses obtained to the catch and effort section of the interviews conducted during the survey. The skippers indicated that the top five species targeted were *Chrysoblephus puniceus* (slinger), *Cheimerius nufar* (soldier), *Epinephelus* sp. (rockcod), *Argyrosomus* spp. (kobs) and *Atractoscion aequidens* (geelbek). Overall, skippers had a minimum of 4 years and maximum of 32 years experience in the fishing industry but a minimum of 4 years and a maximum of 16 years experience fishing at Richards Bay.

Table 1: Summary of commercial skiboat interview information (n = 8) carried out at Richards Bay in July 2004

Parameters	Average	SE
Total crew size (including the skipper)	6.8	0.7
Black males	5.6	0.8
White males	1	0
White females	0.1	0.1
Number of fishing trips per year	131.0	10.5
Number of night fishing trips per year	14.6	5.0
Distance (km) travelled to the local fishing grounds	22.6	5.9
Monthly catch (tonnes)	2.0	0.2
Number of years fishing	13.5	3.0
Number of years fishing at Richards Bay	10.8	1.4
Age of skipper	46.8	4.4

Skippers were also questioned about the effectiveness of current regulations for managing fish stocks (Table 2). All skippers knew the minimum size limits for their target species. Half of the skippers (n = 4) said their catch had not been inspected by EKZNW in the last 12 months. For the remaining skippers, the average number of inspections was four during the last 12 months.

Table 2: Percentage of commercial skippers from Richards Bay (n = 8) that agree on the effectiveness of current regulations for managing fish stocks

Current regulations	Number	Percentage
Minimum size limits	6	75
Closed seasons	7	87.5
Bag limits	6	75
Marine reserves	7	87.5

Table 3 summarises the cost commercial linefishermen incur to fish off Richards Bay. All skippers claimed that commercial fishing was their only form of income and stated that crew were employed on a full time basis. All skippers paid their crew on a R3/kg commission basis except one who paid crew on a profit-sharing basis which was not quantified. The crew also received other benefits such as contributions to the unemployment fund, medical expenses, funeral expenses, building supplies, accommodation, transport, food, and an annual bonus. These were ad-hoc contributions and values could not be assigned to them.

Table 3: Average amount in Rands that commercial skippers (n = 8) expend to fish off Richards Bay

Parameter	Average expenditure (Rands)	SE
Monthly		
Bait	2 856	614
Boat fuel	6 375	1372
Fishing tackle (hooks, lines and sinkers)	1 350	329
Crew	7 214	1794
Annual		
Rods and reels	6 083	1196
Boat maintenance	6 857	748
Value		
Tow/launch vehicle	68 000	34 427
Boat and accessories	185 000	32 950
Fishing gear	20 712	6 399

5.1.2. Access point survey

There were 554 individual commercial skiboat inspections carried out between July 2002 and June 2004 with an average of 22.6 (SE = 2.6) per month. There was a total of 1 918 launches (1 739 launches based on Portnet records plus 179 launches from NMLS - see Table 3 in section 5.1.4) during the same period. Therefore, approximately 30 % of total launches were inspected during this study. The minimum number of interviews carried out per month was 5 and the maximum was 51. On average, there were 5.6 crew (SE = 0.1) fishing for 7.6 hours (SE = 0.1) per skiboat outing.

The most frequently visited fishing areas by commercial fishermen were within 15 nautical miles of the harbour (grid references 4-8 and 7-6), but longer trips were also undertaken (Figure 5).

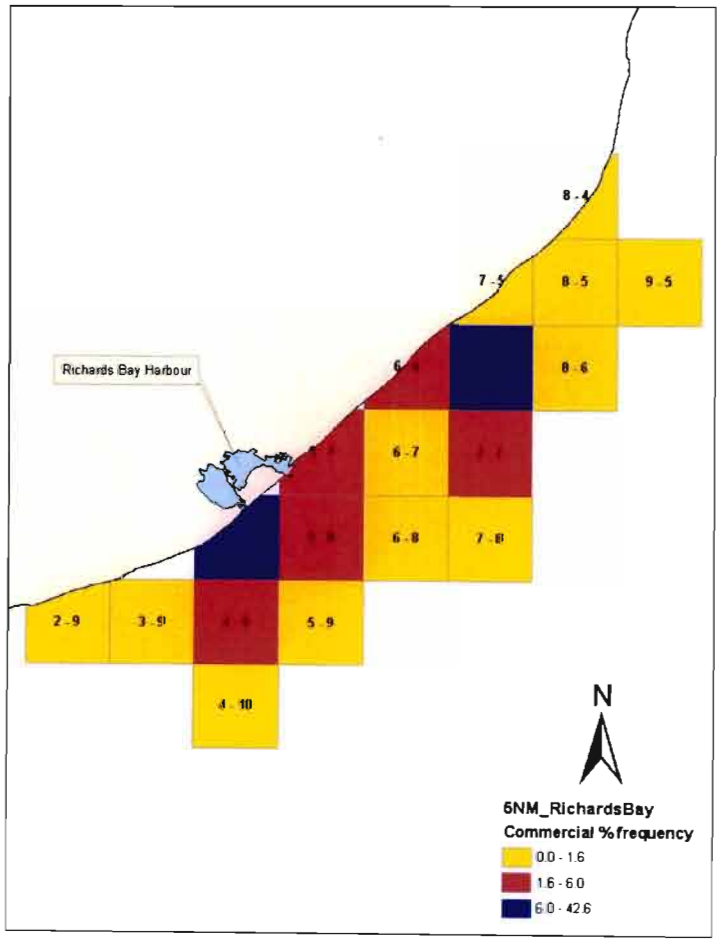

Figure 5: Spatial distribution of commercial fishing effort by Richards Bay boats based on reported frequency (%) of fishing area used during 554 outings between July 2002 and June 2004. Grid blocks are 5x5 nautical miles and 3.8 % of outing destinations could not be positively identified.

A total of 131 608 individual fish, with a combined mass of 90.7 tonnes was inspected between June 2002 and July 2004. The average catch per skiboat outing was 157.3 kg (SE = 5.5), average catch per hour was 20.2 kg/hr (SE = 0.6) and average catch per hour per man was 3.7 kg/hr/man (SE = 0.1). The total number of outings recorded by Portnet in this period was about 1800 (section 5.1.4 below), which means that total catch was about 280 tonnes. The average mass of sardines utilised was 11.6kg/outing (SE = 0.2) and squid 8.6kg/outing (SE = 0.2). An average of 125 L (SE = 1.5) of fuel was consumed per outing. There was a very weak positive relationship between the total catch per outing and fuel consumption, but this was not significant ($P > 0.05$). This finding was reinforced by a very low R^2 value of 0.0176 (Figure 6).

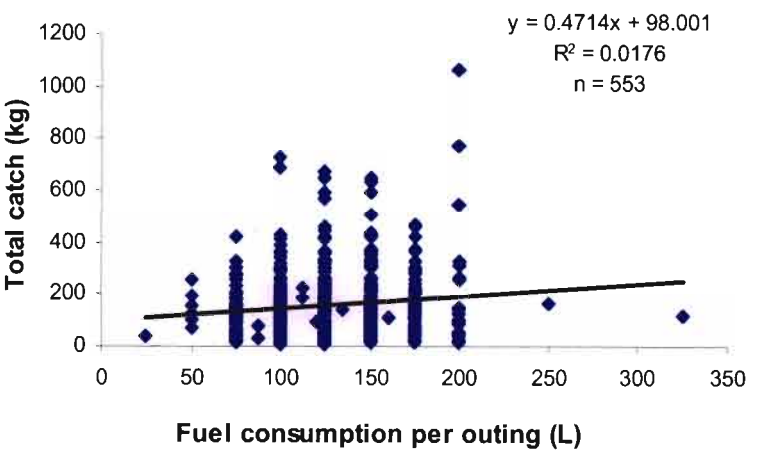

Figure 6: Total commercial catch per outing as a function of fuel consumption in Richards Bay between July 2002 and June 2004.

The commercial skiboat catch in Richards Bay was dominated by *Chrysoblephus puniceus* (slinger), which contributes approximately 80 % by number and 70 % by mass to the overall catch (Table 4). Length frequencies will be presented in the section: comparisons with the NMLS (below).

Table 4: Overall catches by number and mass of fish retained by commercial skiboats in Richards Bay based on 554 catch inspections (individual fish lengths converted to weights) between July 2002 and June 2004.

Species name	Common name	Number	% contribution	Mass (kg)	% contribution
Chrysoblephus puniceus	Slinger	109 873	83.49	62 288.53	68.68
Cheimerius nufar	Soldier	8 391	6.38	6 845.04	7.55
Epinephelus rivulatus	Halfmoon rockcod	3 609	2.74	1 201.84	1.33
Porcostoma dentata	Dane	2 179	1.66	808.11	0.89
Epinephelus andersoni	Catface rockcod	1 689	1.28	3 482.75	3.84
Lethrinus nebulosus	Blue emperor	1 544	1.17	889.35	0.98
Chrysoblephus anglicus	Englishman	846	0.64	1 628.77	1.80
Pachymetopon aeneum	Blue hottentot	637	0.48	925.75	1.02
Dinoperca petersi	Cave bass	559	0.42	942.81	1.04
Epinephelus albomarginatus	Captain fine rockcod	401	0.30	750.12	0.83
Atractoscion aequidens	Geelbek	357	0.27	2 012.15	2.22
Argyrosomus thorpei	Squaretail kob	343	0.26	264.12	0.29
Epinephelus marginatus	Yellowbelly rockcod	200	0.15	995.46	1.10
Pristipomoides filamentosus	Rosy jobfish	198	0.15	235.92	0.26
Polyamblydon germanum	German	121	0.09	334.96	0.37
Pachymetopon grande	Bronze bream	107	0.08	855.29	0.94
Parapeneus rubescens	Blacksaddle goatfish	88	0.07	31.13	0.03
Diagramma pictum	Sailfin rubberlips	73	0.06	182.11	0.20
Polysteganus coeruleopunctatus	Trawl soldier	46	0.03	51.89	0.06
Coryphaena hippurus	Dorado	38	0.03	172.19	0.19
Polysteganus praeorbitalis	Scotsman	38	0.03	176.92	0.20
Cephalopholis sonnerati	Tomato rockcod	38	0.03	32.11	0.04
Scomberomorus commerson	King mackerel	34	0.03	4 860.33	5.36
Epinephelus malabaricus	Malabar rockcod	26	0.02	60.39	0.07
Priacanthus cruentatus	Glass bigeye	22	0.02	10.12	0.01
Argyrosomus japonicus	Dusky kob	26	0.02	281.93	0.31
Otolithes ruber	Snapper kob	15	0.01	3.26	< 0.01
Pomadasys kaakan	Javelin grunter	14	0.01	46.15	0.05
Chrysoblephus lophus	False englishman	12	0.01	13.21	0.01
Cymatoceps nasutus	Poenskop	11	0.01	143.10	0.16
Argyrops spinifer	King soldierbream	9	0.01	2.06	< 0.01
Epinephelus flavocaeruleus	Yellowtail rockcod	8	0.01	15.96	0.02
Rhabdosargus holubi	Cape stumpnose	7	0.01	3.99	< 0.01
Scorpaena scrofa	Bigscale scorpionfish	6	< 0.01	1.59	< 0.01
Diplodus cervinus hottentotus	Zebra	6	< 0.01	4.34	< 0.01
Argyrosomus sp.	Unidentified kob	5	< 0.01	164.33	0.18
Plectorhincus chubbi	Dusky rubberlips	4	< 0.01	11.94	0.01
Sarda orientalis	Striped bonito	4	< 0.01	7.15	0.01
Thunnus albacares	Yellowfin tuna	4	< 0.01	49.05	0.05
Cephalopholis miniata	Coral rockcod	3	< 0.01	15.58	0.02
Euthynnus affinis	Eastern little tuna	3	< 0.01	9.95	0.01
Chrysoblephus cristiceps	Dageraad	2	< 0.01	6.77	0.01
Epinephelus tukula	Potato bass	2	< 0.01	9.15	0.01
Lobotes surinamensis	Tripletail	2	< 0.01	3.87	< 0.01
Umbrina robinsoni	Baardman	1	< 0.01	2.53	< 0.01
Rhabdosaragus thorpei	Bigeye stumpnose	1	< 0.01	0.43	< 0.01
Lutjanus sanguineus	Blood snapper	1	< 0.01	1.64	< 0.01
Auxis thazard thazard	Frigate tuna	1	< 0.01	6.81	0.01
Alectis sp.	Mirrorfish	1	< 0.01	2.18	< 0.01
Pomacanthus striatus	Old woman	1	< 0.01	0.33	< 0.01
Elagatis bipinnulata	Rainbow runner	1	< 0.01	3.30	< 0.01
Katsuwonus pelamis	Skipjack tuna	1	< 0.01	4.08	< 0.01
Sparodon durbanensis	White musselcracker	1	< 0.01	5.65	0.01
Seriola sp.	Yellowtail	1	< 0.01	0.23	< 0.01
Unidentified sp.		3	< 0.01		
Total		**131 608**	**100.00**	**90 694.40**	**100.00**

Chrysoblephus puniceus (slinger) was caught consistently throughout the year in very high proportions (Figure 7). Other species such as *Cheimerius nufar* (soldier), *Epinephelus rivulatus* (halfmoon rockcod), *Porcostoma dentata* (dane) and *Epinephelus andersoni* (catface rockcod), were caught relatively consistently but in small proportions throughout the year (Figure 7).

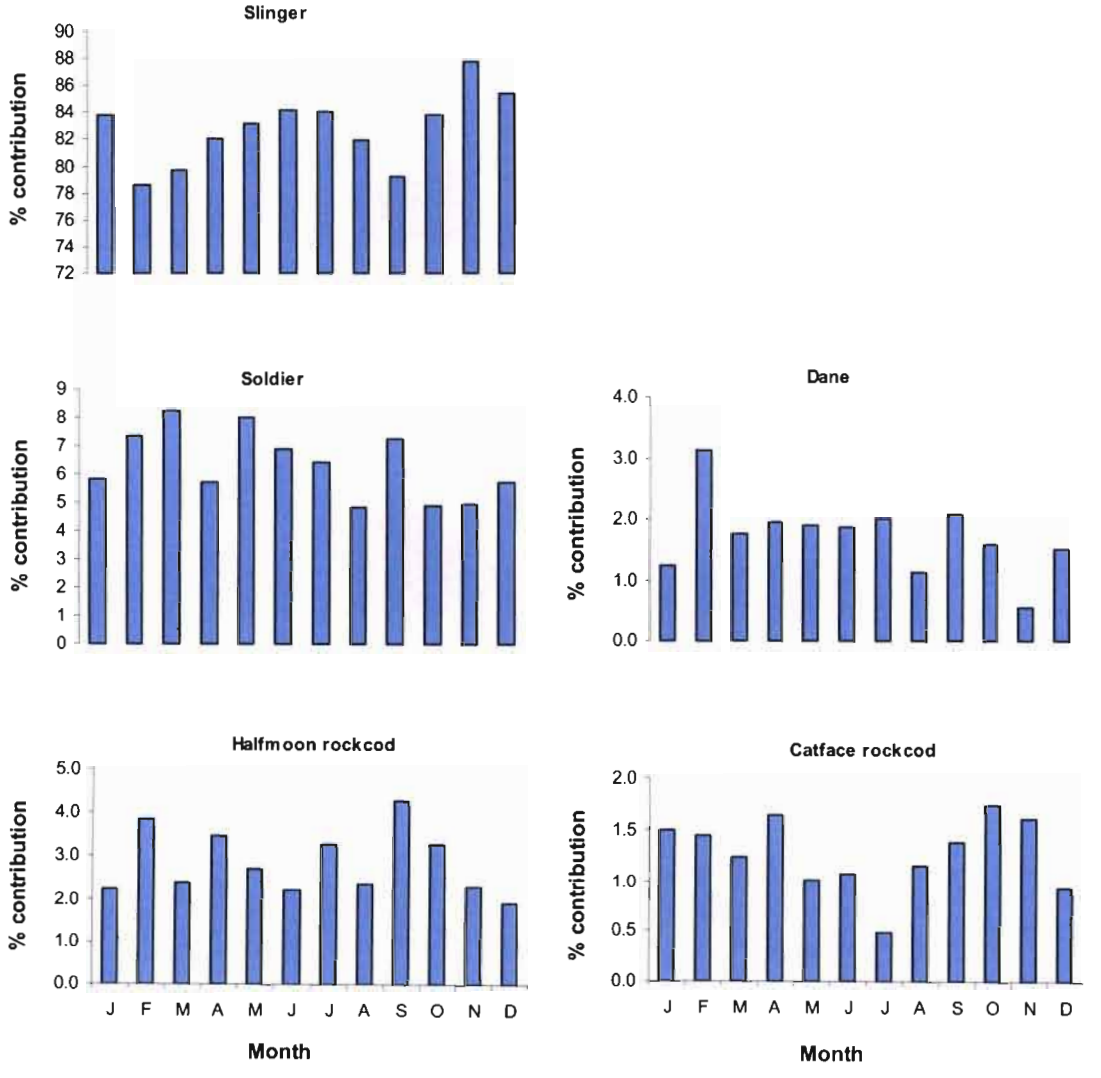

Figure 7: Relative contribution to catches by the five most frequently caught species in terms of number by commercial skiboats in Richards Bay for the period July 2002 and June 2004.

By mass, *Chrysoblephus puniceus* (slinger) was again consistent throughout the year in very high proportions, while *Cheimerius nufar* (soldier) was also relatively consistent but in far smaller proportions throughout the year (Figure 8). *Epinephelus andersoni* (catface rockcod) catches declined during winter (Figure 8). *Atractoscion aequidens* (geelbek) catches by mass were increased during the winter months probably due to their annual spawning migration to KZN (Figure 8). *Scomberomorus commerson* (king mackerel) was only caught in March and April during two outings, but these were large fish and contributed approximately 5 % to total mass (Figure 8).

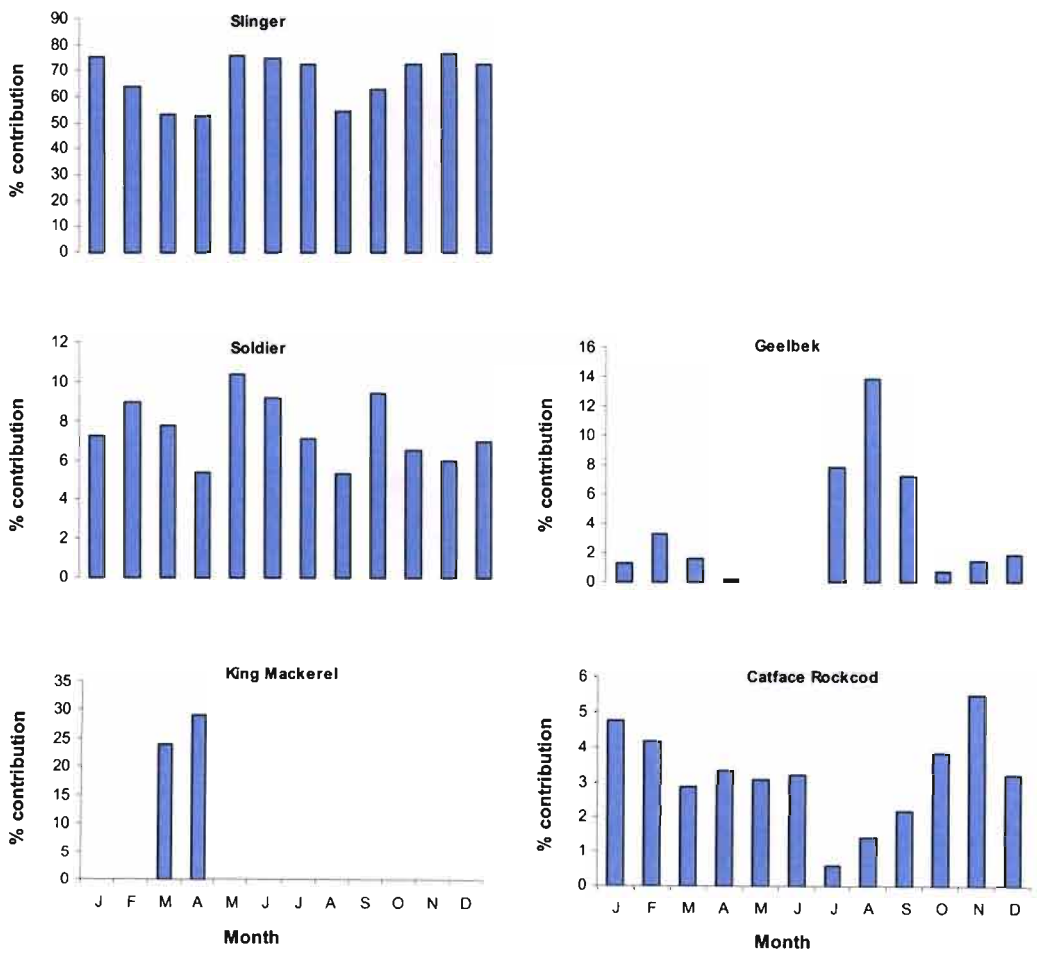

Figure 8: Relative contribution to catches by the five most frequently caught species in terms of mass by commercial skiboats in Richards Bay for the period July 2002 and June 2004.

5.1.3. Total effort

Launch records were available for the period 1992 to 2004 but some data were missing or misplaced by Portnet. Consequently, full interpretation of temporal trends in effort was confounded. For analysis, data for 2004 were omitted because it was not a complete year of sampling. There was no clear trend in the number of launches from 1992 to 2003 (Figure 9). However, from 2000, there appears to be a decrease in the number of launches (Figure 9) From a seasonal perspective, there is a decrease in fishing effort from September to November, possibly due to unfavourable weather conditions (Figure 10).

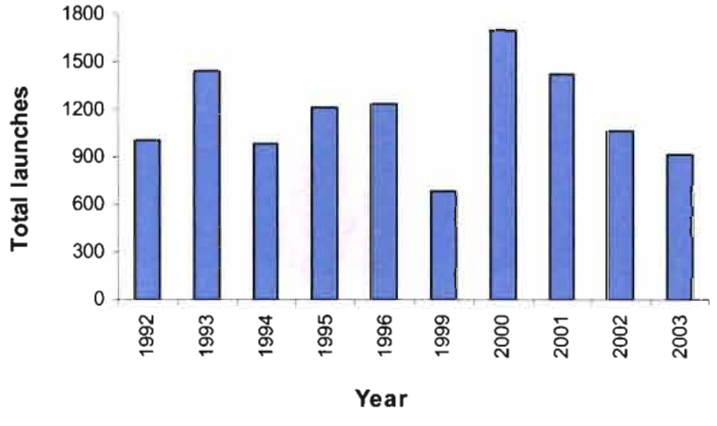

Figure 9: Total number of commercial skiboat launches per year in Richards Bay between 1992 and 2003 (based on data recorded by Portnet.) Data are missing for the following periods: July to September 1994, December 1996, January to December 1997 and 1998, January to May 1999 and December 2003.

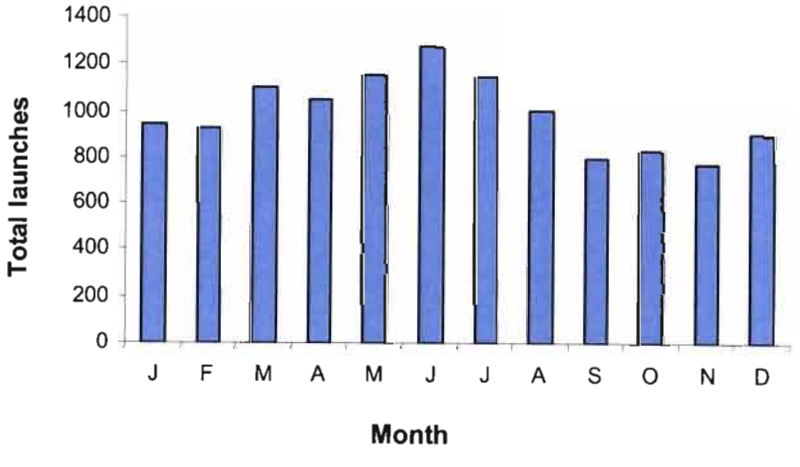

Figure 10: Total number of commercial skiboat launches per month in Richards Bay between 1992 and 2003 (based on data recorded by Portnet.) Data are missing for the following periods: July to September 1994, December 1996, January to December 1997 and 1998, January to May 1999 and December 2003.

Commercial skiboat fishermen reported the areas they fished using an alphanumerical grid system which was only effectively introduced in 1999. Data for 2004 were omitted because it was not a complete year of sampling.

From 1999 to 2003, there appears to be little change in the spatial distribution of fishing effort. The four most frequently visited sites were 7-6, 7-8, 4-8 and 5-8 (Figure 11), amounting to between 50 – 60 % of all sites. However, the grid system used was fairly coarse (5 x 5 nautical miles), so this masks finer-scale changes in the distribution of effort.

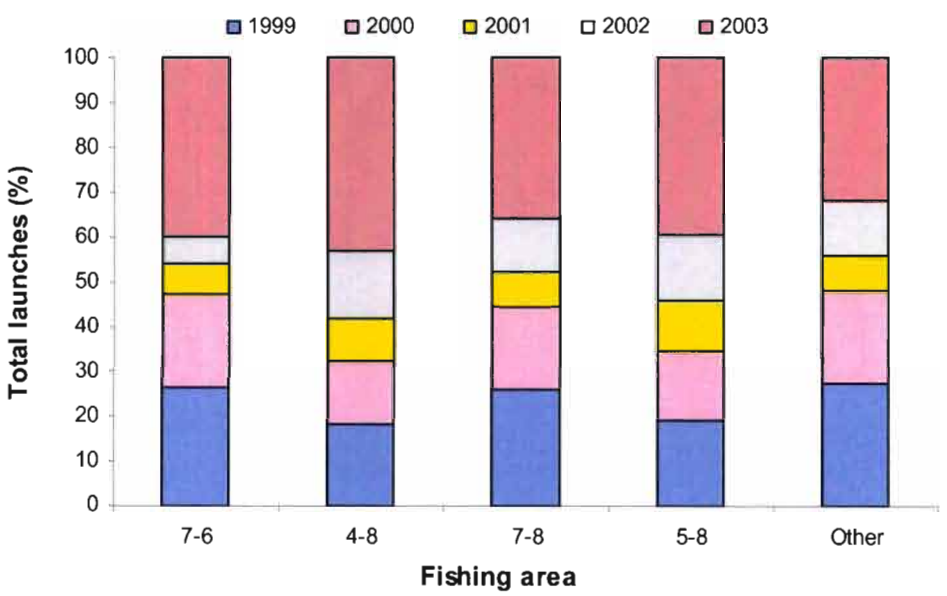

Figure 11: Spatial distribution of commercial fishing effort in Richards Bay based on reported frequency (%) of fishing area used during 1627 outings from 1999 to 2003.

5.1.4. Comparisons with NMLS

Currently, the commercial component of the NMLS in KZN relies on data submitted by the skippers and is not verified. Consequently, there are difficulties with species identification, for example unidentified kob as reported by the skippers on the NMLS was probably a mixture of *Argyrosomus thorpei* (squaretail kob) and *Argyrosomus japonicus* (dusky kob). However, this exercise does provide information on what is reported by skippers.

Chrysoblephus puniceus (slinger) was found to be the dominant species by mass during this survey and in data from the NMLS, although the extent of dominance was 20 % higher in this survey (Table 2). There was an almost four-fold difference in mass of *Cheimerius nufar* (soldier) recorded on the NMLS compared to this survey which cannot be accounted for (Table 2). *Atractoscion aequidens* (geelbek), *Argyrosomus thorpei* (squaretail kob) and other *Argyrosomus* (kob) species did not contribute much (2.8 %) to the total mass during this survey although they were comparatively more common in the NMLS. This is partly due to the fact that night sampling was very limited during this survey and *Atractoscion aequidens* (geelbek) and *Argyrosomus japonicus* (dusky kob) are mainly caught at night. The relatively high proportion of *Argyrosomus thorpei* (squaretail kob) recorded on the NMLS could not be accounted for. In addition, there is a four-fold difference in *Epinephelus* (rockcod) species (excluding *Epinephelus andersoni* (catface rockcod) recorded on the NMLS compared to this study (Table 5). The average catch by mass in this survey was 157.3 kg (SE = 5.5) per outing compared to 213.8 kg recorded on the NMLS during the same period (July 2002 to June 2004).

Table 5: Comparison of catches (by mass) of fish retained by commercial skiboats in Richards Bay: data obtained from skipper catch returns submitted to the NMLS (n = 1 955 outings) and this study from July 2002 to June 2004 based on catch inspections and individual fish lengths converted to weights; n = 554).

		This study		NM LS		
Species name	**Common name**	**Mass (kg)**	**% contribution**	**Mass (kg)**	**% contribution**	**% difference**
Chrysoblephus puniceus	Slinger	62 289	68.68	87 175	49.59	+19.09
Cheimerius nufar	Soldier	6 845	7.55	27 447	15.61	-8.07
Scomeromorus commerson	King mackerel	4 860	5.36	348	0.20	+5.16
Epinephelus andersoni	Catface rockcod	3 483	3.84	6 473	3.68	+0.16
Atractoscion aequidens	Geelbek	2 012	2.22	10 124	5.76	-3.54
Chrysoblephus anglicus	Englishman	1 629	1.80	2 135	1.21	+0.58
Epinephelus rivulatus	Halfmoon rockcod	1 202	1.33			
Epinephelus marginatus	Yellowbelly rockcod	995	1.10			
Dinoperca petersi	Cave bass	943	1.04	176	0.10	+0.94
Pachymetopon aeneum	Blue hottentot	926	1.02	202	0.11	+0.91
Lethrinus nebulosus	Blue emperor	889	0.98	150	0.09	+0.89
Pachymetopon grande	Bronze bream	855	0.94			
Porcostoma dentata	Dane	808	0.89	65	0.04	+0.85
Epinephelus albomarginatus	Captain fine rockcod	750	0.83			
Polyamblydon germanum	German	335	0.37	678	0.39	-0.02
Argyrosomus thorpei	Squaretail kob	264	0.29	4 120	2.34	-2.05
Pristipomoides filamentosus	Rosy jobfish	236	0.26	284	0.16	+0.10
Diagramma pictum	Sailfin rubberlips	182	0.20			
Polysteganus praeorbitalis	Scotsman	177	0.20	446	0.25	-0.06
Coryphaena hippurus	Dorado	172	0.19	553	0.31	-0.12
Argyrosomus sp.	Unidentified kob	164	0.18	11 743	6.68	-6.50
Cymatoceps nasutus	Poenskop	143	0.16	1 064	0.61	-0.45
Argyrosomus japonicus	Dusky kob	118	0.13			
Epinephelus malabaricus	Malabar rockcod	60	0.07			
Polysteganus coeruleopunctatus	Trawl soldier	52	0.06	631	0.36	-0.30
Thunnus albacares	Yellowfin tuna	49	0.05	85	0.05	+0.01
Pomadasys kaakan	Javelin grunter	46	0.05	2 368	1.35	-1.30
Epinephelus sp.	Unidentified rockcod**	(3 049)	(3.36)	5 959	3.39	
Pomadasys sp.	Unidentified grunter			861	0.49	
	Seabasses			6 766	3.85	
	Bottom fish			5 472	3.11	
	Other*	209	0.23	459	0.26	-0.03
Total		**90 694**	**100.00**	**175 784**	**100.00**	

* Other refers to all species amounting to < 0.05kg in total, which were excluded from table but were included to calculate total mass.

** Figures in parentheses indicate total mass of all rockcods except catface rockcod and were not included in calculations.

Between 1992 and 2003, based on Portnet records, the number of boats that launched regularly (i.e. at least 10 times in two or more years) remained fairly constant between 18 and 22. In July 2003, following the national rationalisation of commercial linefishing effort (see discussion) the number of boats declined to 11. This supports the observation that during 2002 and 2003 there were substantially fewer launches reported on the NMLS compared to data recorded by Portnet, whereas in 2004 this trend is reversed (Table 6).

Table 6: Comparison of total number of commercial launches per month in Richards Bay from June 2002 to July 2004 as recorded by Portnet and the NMLS.

	Portnet	**NMLS**	**Difference**
Launches 2002			
Month			
June	112	62	-50
July	99	53	-46
August	106	54	-52
September	71	62	-9
October	56	49	-7
November	42	35	-7
December	85	65	-20
Total	**571**	**380**	**-352**
Launches 2003			
Month			
January	113	50	-63
February	91	53	-38
March	123	53	-70
April	119	75	-44
May	135	57	-78
June	102	31	-71
July	94	35	-59
August	15	10	-5
September	33	29	-4
October	34	34	0
November	56	62	+6
December	*	42	
Total	**916**	**531**	**-385**
Launches 2004			
Month			
January	*	59	
February	*	78	
March	50	67	+17
April	65	62	-3
May	46	83	+37
June	53	67	+14
July	38	43	+5
Total	**252**	**459**	

* Denotes missing data

Length frequencies of *Chrysoblephus puniceus* (slinger), *Cheimerius nufar* (soldier) and *Epinephelus andersoni* (catface rockcod) were compared between the 1992-1994 (NMLS) and 2002-2004 (this survey) periods. These species were chosen because they were most abundant by number and mass in this study and comparative data were available on the NMLS. The NMLS data are only available as numbers of fish per size class interval i.e. individual lengths are not obtainable, so overall means could not be calculated. Instead, a Kolmogorov-Smirnov test was used to test for significant differences in the length-frequency distributions between the 1990-1992 and 2002-2004 data sets.

There was larger *Chrysoblephus puniceus* (slinger) (50 cm size class) being caught in the 1992-1994 period compared to 2002-2004 period (Figure 12). However, there has been no shift in the mode with approximately half the *Chrysoblephus puniceus* (slinger) caught in the 1992-1994 period and 2002-2004 period being in the 25 cm FL category (Figure 12). $D_{calculated}$ (0.162) > $D_{critical;\ 0.05}$ (0.017) indicates there is a significant difference in the length frequency distribution of *Chrysoblephus puniceus* (slinger) between the two periods.

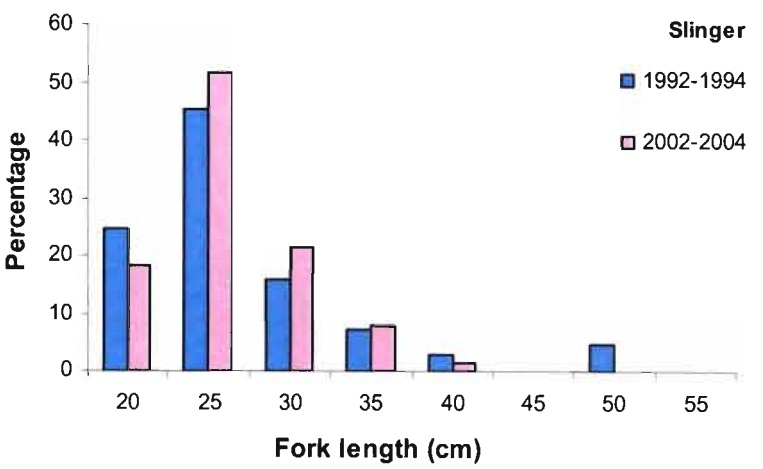

Figure 12: Length frequency distribution of slinger caught on Richards Bay commercial skiboats between the 1992-1994 (n = 6 41) and 2002-2004 (n = 109 873) period.

There was a relatively higher contribution of *Cheimerius nufar* (soldier) in 1992-1994 to the larger size classes (Figure 13). The mode is still the same but there is a higher proportion of smaller fish (25 cm size class) in recent catches (Figure13). $D_{calculated}$ (0.186) > $D_{critical;\ 0.05}$ (0.086) indicates there is a significant difference in the length frequency distribution of *Cheimerius nufar* (soldier) between the two periods.

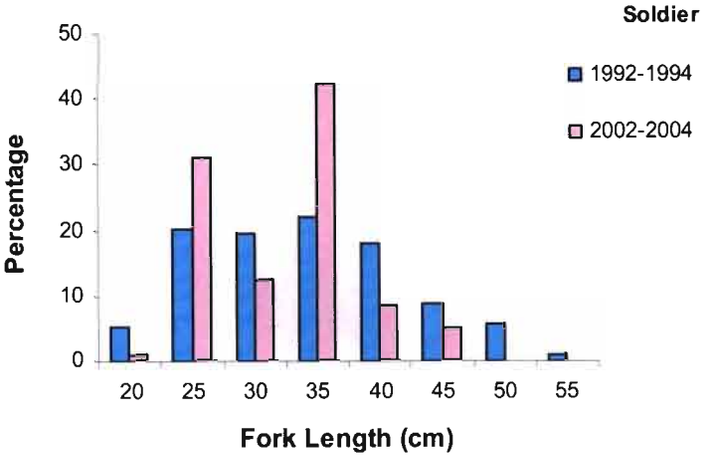

Figure 13: Length frequency distribution of soldier Richards Bay commercial skiboats between the 1992-1994 (n = 258) and 2002-2004 (n = 8 391) period.

In contrast, the comparative length frequencies of *Epinephelus andersoni* (catface rockcod) present a confused picture (Figure 14). The mode has shifted to the right, and although there are proportionately fewer larger fish, there were many more, smaller fish caught in the 1992-1994 period (Figure 14). $D_{calculated}$ (0.418) > $D_{critical;\ 0.05}$ (0.083) indicates there is a significant difference in the length frequency distribution of *Epinephelus andersoni* (catface rockcod) between the two periods.

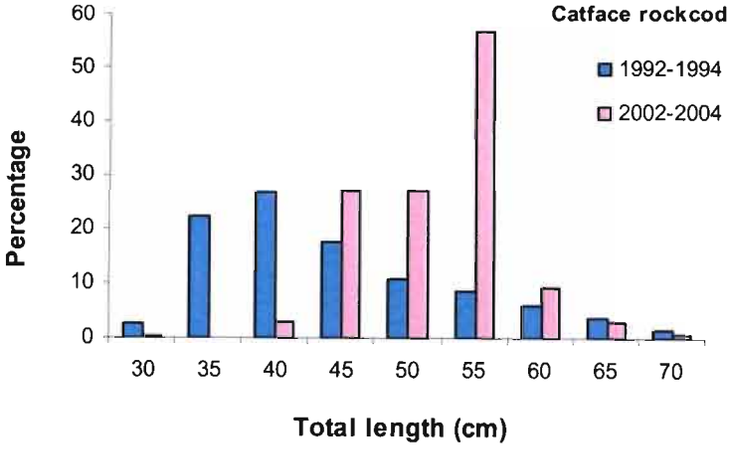

Figure 14: Length frequency distribution of catface rockcod Richards Bay commercial skiboats between the 1992-1994 (n = 322) and 2002-2004 (n = 1 504) period.

5.2. Recreational marine linefishery

5.2.1. Recreational skiboat interviews and access point surveys (APS)

Twice per month on randomly selected weekend days, fieldtrips were undertaken between the hours of 10:00 and 16:00 from July 2002 to June 2004, in which members of the RBSC and MSC were interviewed. There were approximately 521 skiboats registered with both clubs during this period and 197 interviews were completed. It is likely that the remaining boats were not encountered because they belonged to up country visitors or were not frequently used. Skippers that had already been interviewed were treated as "recaptures" (n = 383) and only catch and effort data were recorded on subsequent encounters with them.

On each outing, approximately 50 % of fishing effort was spent bottom fishing and 40 % game fishing (Table 7). However, many skippers said that it was difficult to quantify this, as they would often utilise a "trap stick" [2] for pelagic species while bottom fishing.

Table 7: Average time (%) recreational anglers spent fishing for bait, bottom fishing and game fishing per outing in Richards Bay between July 2002 and June 2004.

Type of fishing	Bait	Bottom	Game
Average time (%)	2.2	57.2	40.6
SE	0.7	2.77	2.72

The method of fishing was with bait and/or lures. *Sardinops sagax* (pilchards) were used as bait by approximately 70 % of anglers, *Loligo* sp. (squid) by 60 % while *Penaeus* sp. (prawn) was used by less than 1 % of anglers. Other types of bait used were *Pomatomus saltatrix* (shad), *Pomadasys olivaceum* (pinkies), *Etrumeus* sp. (redeye sardine) and *Scomber japonicus* (mackerel).

The average number of crew fishing (including the skipper) per skiboat was 3.1(SE = 0.1) using an average of 4.5 rods (SE = 0.11) per outing. The majority of crew were males (96 %) with women only contributing 4 % to the total crew size (Table 4). The majority of anglers were between the ages of 31 and 45 (Table 8).

Table 8: Percentage contribution of male and female crew in various age categories.

Age category (yrs)	< 15	16 -30	31 - 45	46 - 60	> 60	Total
Males	5.7	18.3	45.9	25.3	0.8	96
Females	0.5	1.5	1.3	0.7	0	4

[2] A trap stick is a fishing rod rigged with tackle suitable for catching pelagic fish usually using a whole drift bait(e.g. pilchard) while the crew are targeting demersal reef fish.

The average duration of each outing was 5.01 hours (SE = 0.1). The species most targeted by fishermen were king mackerel, unspecified rockcod and slinger (Table 9). A high proportion of fishermen had no specific target species.

Table 9: Species of fish targeted by recreational anglers in Richards Bay between July 2002 and June 2004 (Other = species comprising less than 5 % of total).

Species	Common Name	No. of skippers	%
Scomberomorus commerson	King mackerel	53	20.7
	No preference	43	16.8
Epinephelus spp	Unspecified rockcod	41	16.0
Coryphaena hippurus	Dorado	24	9.4
Chrysoblephus puniceus	Slinger	21	8.2
	Bottom fish	14	5.5
	Other	60	23.4
	Total	**256**	**100.00**

Recreational skiboat fishermen fished an average of 21.3 times per year (SE = 1.4). Approximately 40 % of skippers had a night rating but only 18.8 % (n = 37) of skippers actually fished at night. The average age of the skippers was 42.9 (SE = 0.68) years. The skippers had been fishing for an average of 15.4 years (SE = 0.7) with a minimum of 0.1 years and maximum of 45 years experience. The average number of years these skippers had been fishing at Richards Bay was 8.5 years (SE = 0.5) with a minimum of 0.1 years and a maximum of 34 years experience. Most (97.5 %) skippers stated that they chose to fish at Richards Bay because they lived in the area, fishing was good in the area and because of the sheltered launch.

Table 10 summarises the responses of recreational linefishermen to current fisheries management regulations. When questioned about the effectiveness of current regulations for managing fish stocks, 70 % (n = 138) of skippers knew the minimum size limits and 83.8 % (n = 165) knew the bag limit for their target species while 3.5 % (n = 6.8) admitted to selling their catch. The average number of catch inspections per boat by EKZNW during the last 12 months was seven (SE = 0.83).

Table 10: Percentage of recreational skippers from Richards Bay (n = 197) that agree on the effectiveness of current regulations for managing fish stocks

Current regulations	Percentage
Minimum size limits	81.7
Closed seasons	89.3
Bag limits	84.3
Marine reserves	85.3

Table 11 summarises the cost recreational linefishermen incur to fish off Richards Bay. The majority of skippers stated that they fish for either recreational or competition purposes. Only 3.5 % admitted they also took charters.

Table 11: Average amount in Rands that recreational skippers (n = 197) expend to fish off Richards Bay

Parameter	Average expenditure (Rands)	SE
Per outing		
Bait	54	4
Boat fuel	207	11
Monthly		
Fishing tackle (hooks, lines and sinkers)	433	53
Annual		
Rods and reels	5 240	660
Boat maintenance	5 185	912
Value		
Tow/launch vehicle	121 994	6 345
Boat	110 824	7 737
Fishing gear (rods & reels)	26 539	2 226

There were 580 individual recreational skiboat inspections carried out between July 2002 and June 2004. According to the skiboat club records, there were 10 700 launches during the same period. Therefore, only 5.4 % of launches were inspected. On average, there were 3.1 crew (SE = 0.1) fishing for 5 hours (SE = 0.1) per skiboat outing.

A total of 5 011 individual fish were measured, with a combined weight of 7.3 tonnes from 580 outings. The average retained catch per skiboat outing was 16.2 kg (SE = 0.7), average catch per hour was 2.8 kg/hr (SE = 0.3) and average catch was 0.9 kg/hr/man (SE = 0.1). As there are about 10 700 launches during this period, the total retained catch was was about 173 tonnes. Although skippers were questioned about species which they released, on inspection it was decided not to present this data owing to their poor quality.

This figure shows that fishing effort is greatest along areas closest to the coast (Figure 15).

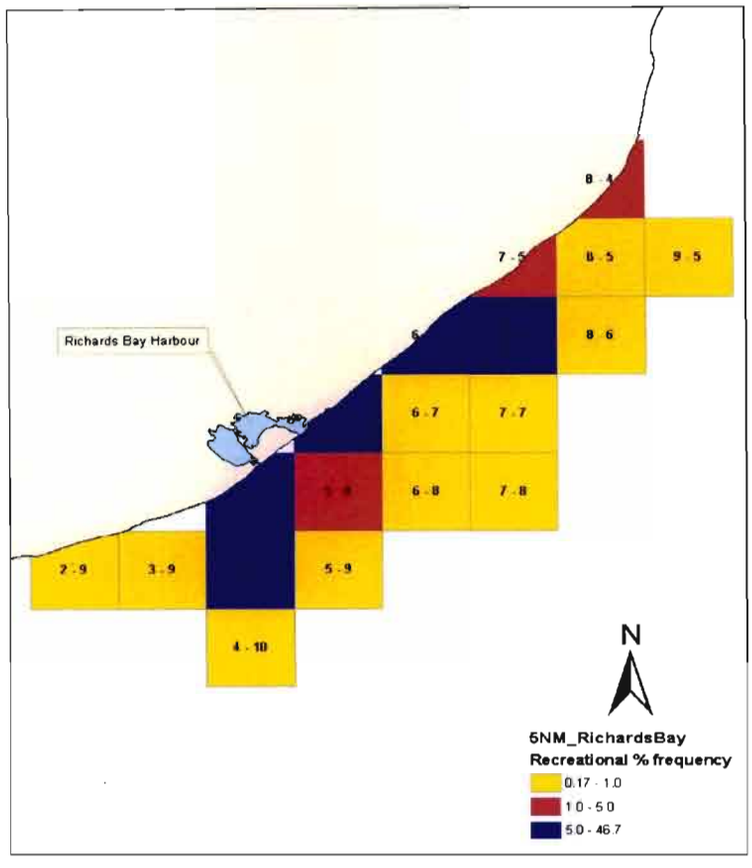

Figure 15: Spatial distribution of recreational fishing effort by Richards Bay based on reported frequency (%) of fishing area used during 580 outings between July 2002 and June 2004. Grid blocks are 5x5 nautical miles and 5 % of outing destinations could not be positively identified.

Chrysoblephus puniceus (slinger) and *Epinephelus andersoni* (catface rockcod) each contributed one-fifth of the total retained catch by number (Table 6). *Lethrinus nebulosus* (blue emperor), *Argyrosomus thorpei* (squaretail kob) and soldier are also significant contributors to overall catch by number (Table 6). The five species contributing most to the overall mass of the catch are *Epinephelus andersoni* (catface rockcod), *Scomberomorus commerson* (king mackerel), *Chrysoblephus puniceus* (slinger) and *Argyrosomus thorpei* (squaretail kob) and *Dinoperca petersi* (cave bass) (Table 12).

Table 12: Overall retained catches by number and mass of fish retained by recreational skiboats in Richards Bay based on 580 inspections between June 2002 and July 2004.

Species name	**Common name**	**Number**	**% contribution**	**Mass (kg)**	**% contribution**
Chrysoblephus puniceus	Slinger	1408	28.10	971.20	12.62
Epinephelus andersoni	Catface rockcod	1033	20.61	2097.34	27.26
Lethrinus nebulosus	Blue emperor	550	10.98	272.66	3.54
Argyrosomus thorpei	Squaretail kob	417	8.32	477.07	6.20
Cheimerius nufar	Soldier	349	6.96	74.63	0.97
Dinoperca petersi	Cavebass	174	3.47	310.42	4.03
Pomadasys kaakan	Javelin grunter	164	3.27	244.60	3.18
Epinephelus rivulatus	Halfmoon rockcod	89	1.78	50.68	0.66
Scomberomorus commerson	King mackerel	65	1.30	1263.50	16.42
Pomadasys olivaceum	Pinky	65	1.30	8.77	0.11
Galeichthys sp.	Barbel	60	1.20	101.34	1.32
Euthynnus affinis	Eastern little tuna	48	0.96	197.78	2.57
Pomatomus saltatrix	Shad	48	0.96	24.27	0.32
Porcostoma dentata	Dane	45	0.90	24.26	0.32
Thunnus albacares	Yellowfin tuna	40	0.80	1.11	0.01
Epinephelus marginatus	Yellowbelly rockcod	39	0.78	0.20	< 0.01
Plectorhinchus chubbi	Dusky rubberlips	36	0.72	127.13	1.65
Ablennes hians	Barred needlefish	33	0.66	15.86	0.21
Coryphaena hippurus	Dorado	33	0.66	62.68	0.81
Diplodus cervinus hottentotus	Zebra	33	0.66	0.53	0.01
Chrysoblephus anglicus	Englishman	28	0.56	52.29	0.68
Atractoscion aequidens	Geelbek	26	0.52	162.24	2.11
Polyamblydon germanum	German	21	0.42	34.23	0.44
Otolithes ruber	Snapper kob	21	0.42	111.83	1.45
Polysteganus praeorbitalis	Scotsman	20	0.40	20.44	0.27
Priacanthus cruentatus	Glass bigeye	14	0.28	7.50	0.10
Katsuwonus pelamis	Skipjack tuna	12	0.24	70.49	0.92
Pachymetopon grande	Bronze bream	11	0.22	17.27	0.22
Scomberomorous plurilineatus	Queen mackerel	11	0.22	9.03	0.12
Rhabdosargus thorpei	Bigeye stumpnose	10	0.20	6.10	0.08
Caranx sem	Blacktip kingfish	10	0.20	44.13	0.57
Epinephelus albomarginatus	Captain fine rockcod	8	0.16	9.46	0.12
Rhizoprionodon acutus	Milkshark	8	0.16	6.74	0.09
Epinephelus malabaricus	Malabar rockcod	7	0.14	16.06	0.21
Epinephelus flavocaeruleus	Yellowfin rockcod	5	0.10	124.22	1.61
	Other*	70	1.40	675.52	8.78
Total		**5011**	**100.00**	**7301.75**	**100.00**

*Other refers to the sum of all species contributing < 0.1 % to total number. For a complete list, see appendix J.

Chrysoblephus puniceus (slinger) were caught in fairly consistent proportions throughout the year (Figure 16). Catches of *Epinephelus andersoni* (catface rockcod) were proportionately higher prior to and just after winter when compared to all other months (Figure 16). *Lethrinus nebulosus* (blue emperor) were caught mainly in the warmer months, *Argyrosomus thorpei* (squaretail kob) catches were very low during the latter four months of the year, and catches of *Cheimerius nufar* (soldier) fluctuated throughout the year (Figure 16).

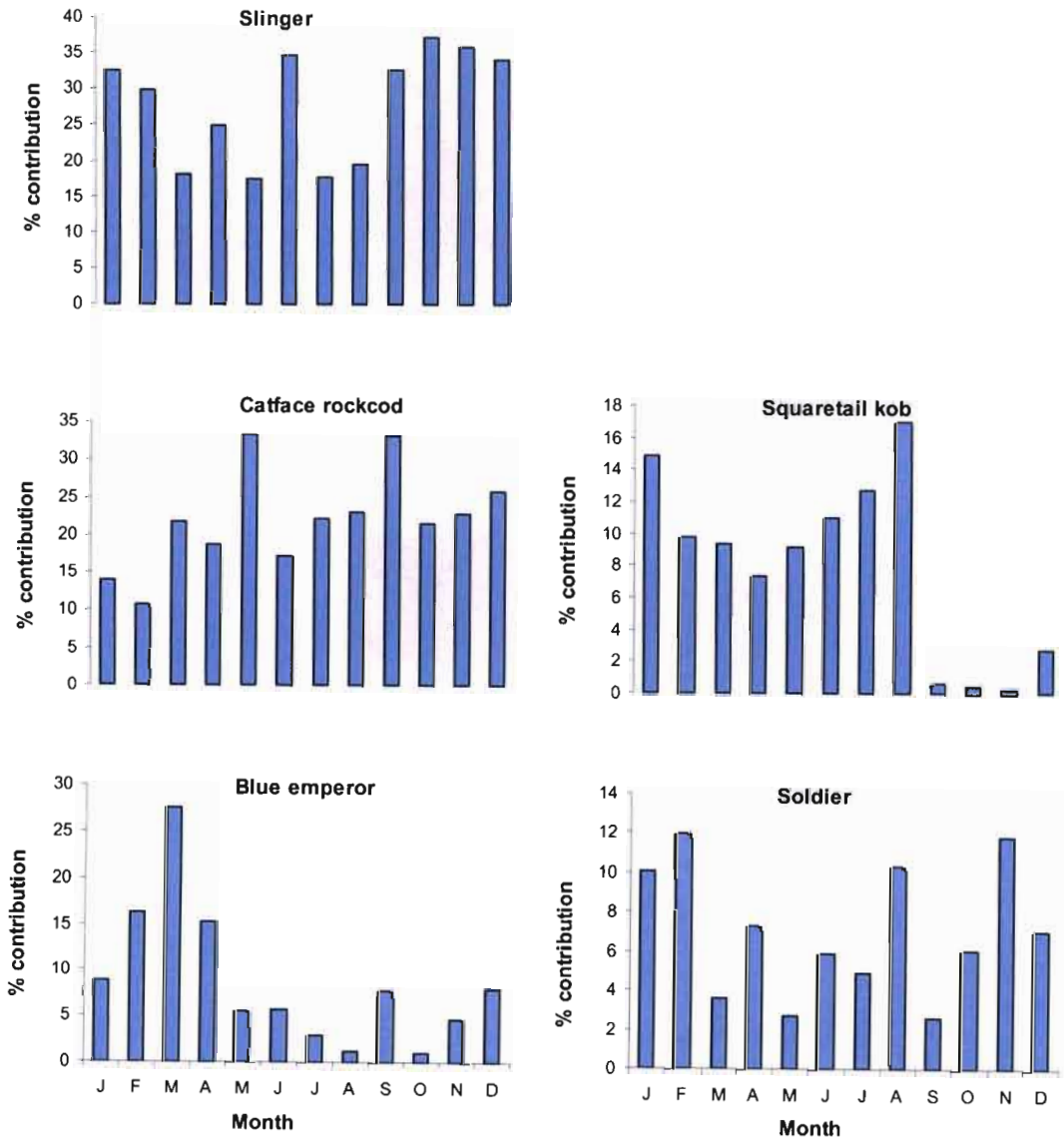

Figure 16: Relative contribution by the five most frequently caught species in terms of number by recreational skiboat anglers in Richards Bay for the period July 2002 to June 2004.

Epinephelus andersoni (catface rockcod) were relatively consistent by mass throughout the year and in high proportions (Figure 17). *Scomberomorus commerson* (king mackerel) were caught in relatively small proportions within the first six months of the year, with a high percentage contribution in April coinciding with the holiday season. The relative contribution of *Chrysoblephus puniceus* (slinger) to total catch by weight was greater during the spring and summer months compared to the rest of the year. There was a relatively high contribution by weight of *Argyrosomus thorpei* (squaretail kob) in summer and winter. By weight, *Dinoperca petersi* (cave bass) were generally consistently caught throughout the year.

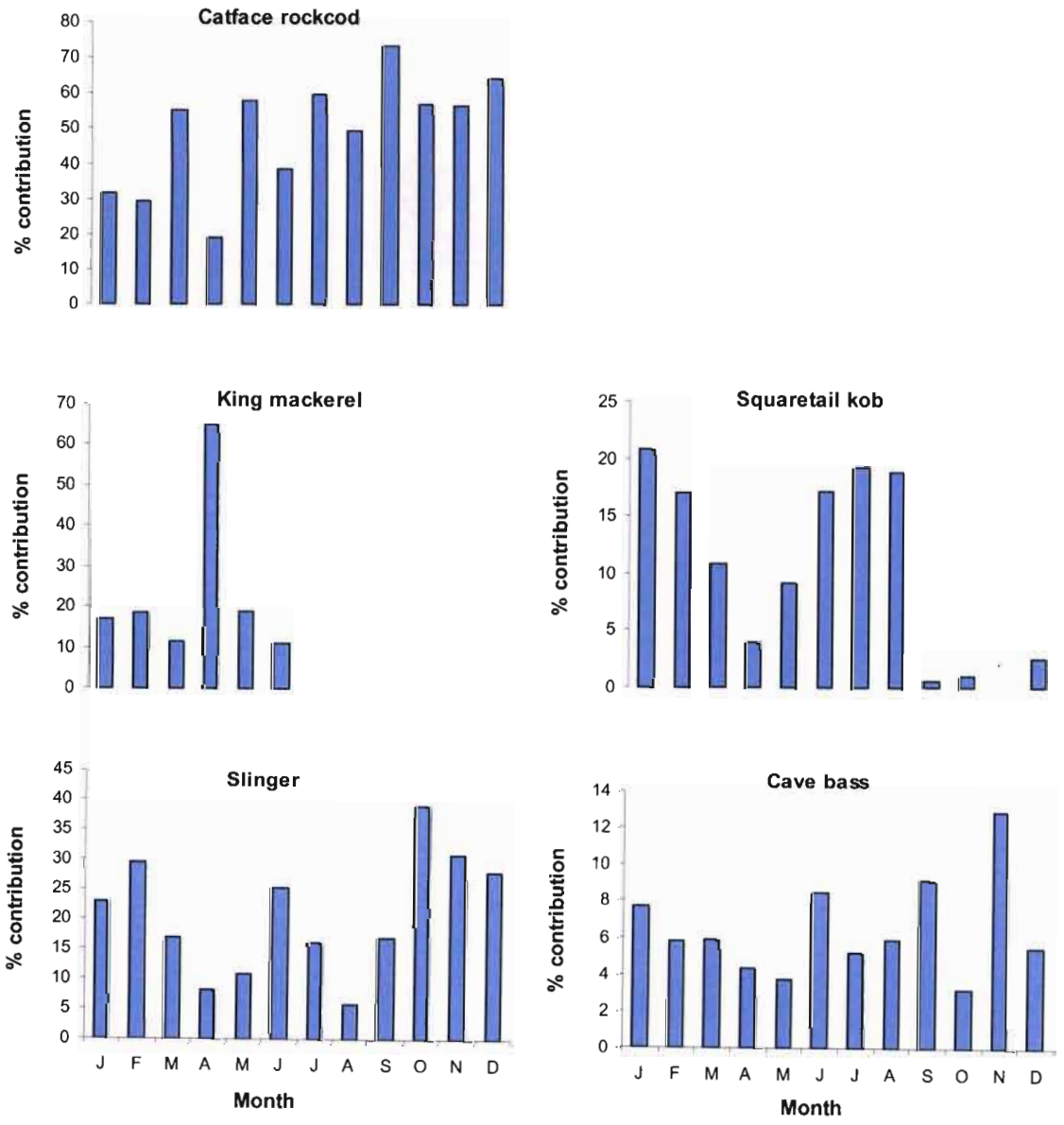

Figure 17: Relative contribution by the five most frequently caught species in terms of mass by recreational skiboat anglers in Richards Bay for the period July 2002 to June 2004.

Length frequencies of *Chrysoblephus puniceus* (slinger), *Epinephelus andersoni* (catface rockcod) and *Lethrinus nebulosus* (blue emperor) were compared between the commercial and recreational catches. These species were chosen because they were most abundant by number in this study, and a Kolmogorov-Smirnov test was used to test for differences.

There was a significantly greater number of smaller *Chrysoblephus puniceus* (slinger) in recreational catches than commercial catches (Figure 18, $D_{calculated}$ (0.224) > $D_{critical;\ 0.05}$ (0.036). There was a significantly higher proportion of larger *Epinephelus andersoni* (catface rockcod) in commercial catches than recreational catches, probably because commercials often fished at greater depths (see below). However, $D_{calculated}$ (0.034) < $D_{critical;\ 0.05}$ (0.055) indicates there is no significant difference in the length frequency distribution of *Epinephelus andersoni* (catface rockcod) between commercial and recreational catches (Figure 18). Both commercial and recreational fishermen caught relatively small *Lethrinus nebulosus* (blue emperor) but commercials also caught more large *Lethrinus nebulosus* (blue emperor). $D_{calculated}$ (0.98) > $D_{critical;\ 0.05}$ (0.072) indicates there is a significant difference in the length frequency distribution of *Lethrinus nebulosus* (blue emperor) between commercial and recreational catches.

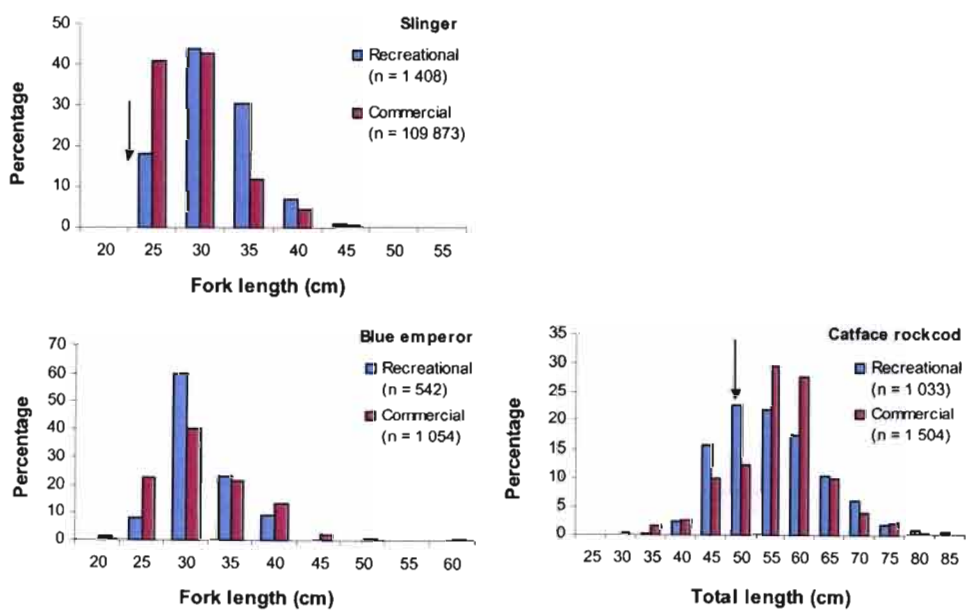

Figure 18: Comparison of the length frequency distribution of slinger, catface rockcod and blue emperor in commercial and recreational catches off Richards Bay from July 2002 to June 2004. Arrows indicate size at sexual maturity.

5.2.2. Total effort

Launch records from RBSC and MSC were only readily available from 2000 to 2004. In 2004, approximately 4000 launches were recorded within the first seven months in 2004, which shows that Richards Bay has experienced a recent increase in popularity as a launch site for the recreational skiboat fishery (Figure 19). From a seasonal perspective, there was a relatively even distribution of fishing effort but with peaks in fishing effort in December and April coinciding with the holiday season (Figure 20). In addition, the number of launches decreased between August and November, coinciding with the windy season (Figure 20).

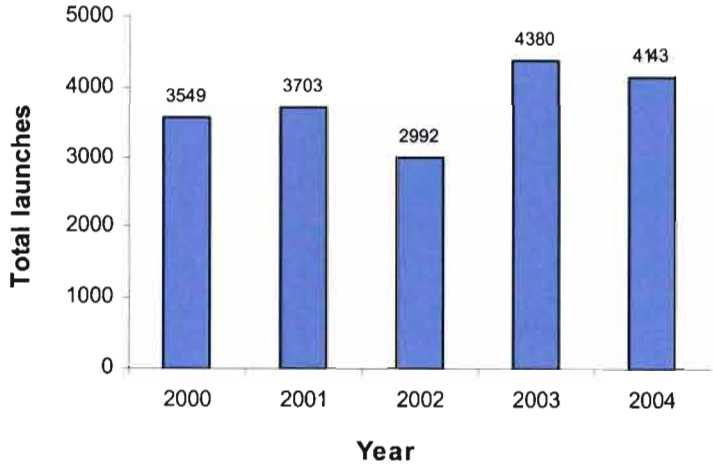

Figure 19: Total number of recreational skiboat launches per year in Richards Bay between January 2000 and July 2004 based on Richards Bay Skiboat Club and Meerensee Skiboat Club launch records.

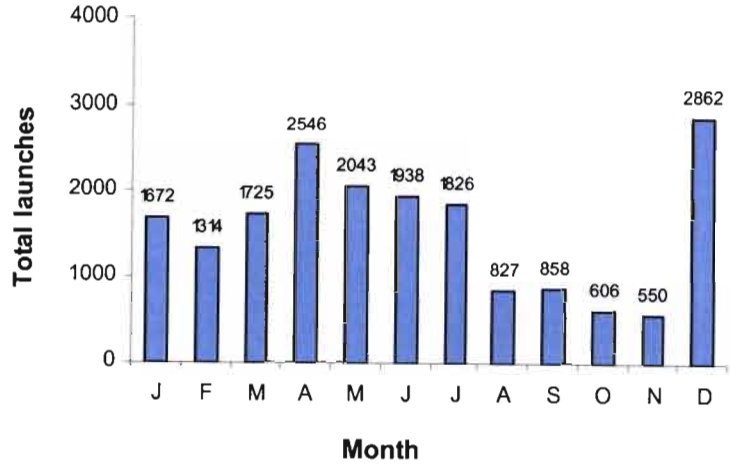

Figure 20: Total number of recreational skiboat launches per month in Richards Bay between January 2002 and July 2004 based on Richards Bay Skiboat Club and Meerensee Skiboat Club launch records.

5.2.3. Comparisons with NMLS

There were 10 700 recreational skiboat launches between July 2002 and June 2004, but only 18.3 % were inspected (n = 1955) by EKZNW. There was a close similarity in catch composition between this survey and the EKZNW catch inspections, both in terms of relative contribution and relative importance (Table 7). The main discrepancy is the non-appearance of less desirable species (pinky and barbel) in the NMLS catches (Table 13).

Table 13: Comparison between the relative contribution of species between this survey (n = 580 inspected outings) and data recorded on the NMLS (n = 1955 inspected outings) for the period July 2002 and June 2004 in Richards Bay.

		THIS SURVEY		NM LS	
Species name	**Common name**	**Number**	**% contribution**	**Number**	**% contribution**
Chrysoblephus puniceus	Slinger	1408	28.11	4676	30.64
Epinephelus andersoni	Catface rockcod	1033	20.62	2682	17.57
Lethrinus nebulosus	Blue emperor	550	10.98	1370	8.98
Argyrosomus thorpei	Squaretail kob	417	8.33	912	5.98
Cheimerius nufar	Soldier	349	6.97	762	4.99
Dinoperca petersi	Cave bass	174	3.47	594	3.89
Pomadasys kaakan	Javelin grunter	164	3.27	559	3.66
Epinephelus rivulatus	Halfmoon rockcod	89	1.78	199	1.30
Scomberomorus commerson	King mackerel	65	1.30	303	1.99
Pomadasys olivaceum	Pinky	65	1.30	0	0
Galeichthys sp.	Barbel	50	1.00	0	0
Euthynnus affinis	Eastern little tuna	48	0.96	195	1.28
Pomatomus saltatrix	Shad	48	0.96	214	1.40
Coryphaena hippurus	Dorado	33	0.66	263	1.72
Argyrosomus sp.	Unidentified kob sp.			146	0.96
Rhizoprionodon acutus	Milkshark			214	1.40
	Other*	516	10.30	2173	14.24
Total		**5009**	**100.00**	**15262**	**100.00**

*Other refers to the sum of all species contributing < 1 % to total number on the NMLS and < 0.6 % in this survey.

The relative contribution of the most frequently caught species by number remained reasonably consistent from 1992 to 2003 (Figure 21), but catch per unit effort has declined steadily since 1992 (Figure 22).

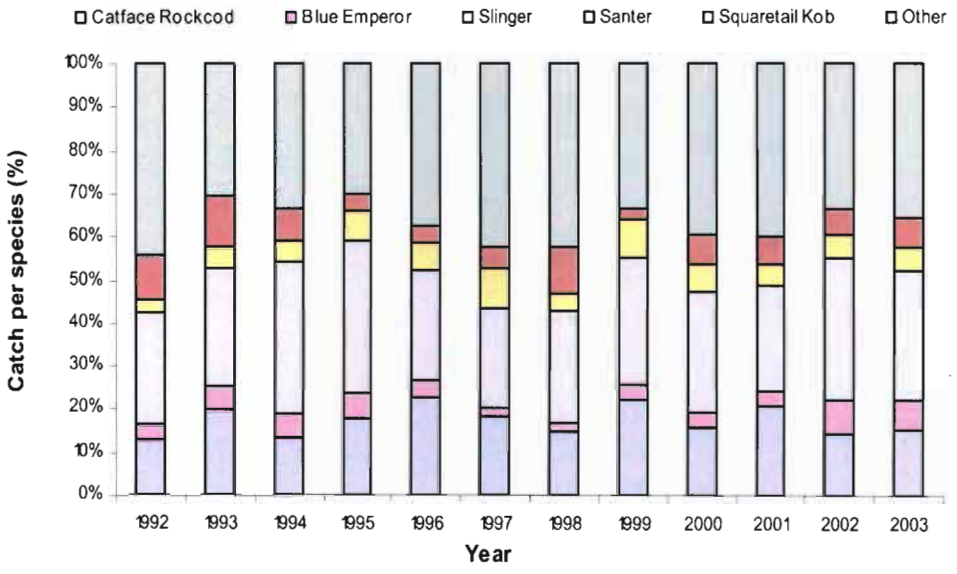

Figure 21: The relative change in species contribution by number to recreational skiboat catches from 1992 to 2003 based on data recorded on the NMLS

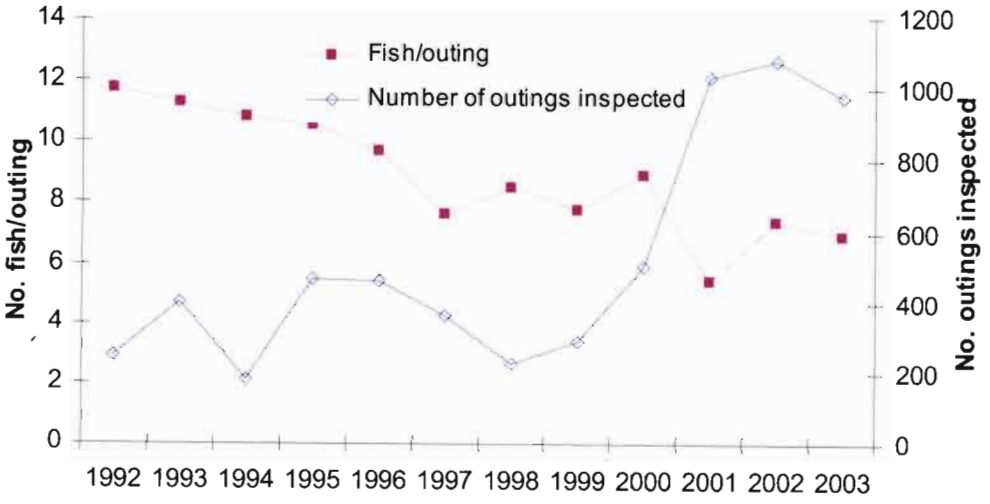

Figure 22: Catch per unit effort (numbers of fish per outing) in recreational skiboat catches from 1992 to 2003 based on data recorded on the NMLS.

5.3. Economic importance of the linefishery in Richards Bay

5.3.1. Economic value of the linefishery

Economic valuation of the commercial fishery was only based on the period August 2003 to July 2004, in order to reduce the confounding effects of the discrepancies between reported and recorded numbers of launches by this sector (see Table 6 and below). Based on calculations and estimates presented in Tables 13 & 14, the annual running expenses for the Richards Bay commercial fishery exceed the total annual catch value by about R1 million i.e. the fishery makes an overall loss, which when shared between the current 11 operators, translates to an individual annual loss per skipper of about R90 000. Note that this does not include the cost of fixed assets (e.g. loan repayments on boats and tow vehicles). In contrast, the calculations for an individual boat suggest that there is a monthly profit of about R9 300 per skipper (Tables 15 & 16). The figures used in both the individual and total fishery calculations are essentially the same, with the exception of the annual number of launches. Based on skipper interviews, the average number of annual launches is 131, whereas based on Portnet records, the number is about 569 launches between August 2003 and July 2004 divided by 11 skippers, equals 47 launches). There is therefore a large discrepancy between the number of outings that skippers say they undertake and what is recorded by Portnet, which complicates the drawing of a clear conclusion about the viability of this fishery.

Perusal of the Portnet records does not suggest that there is substantial under-reporting therein. Of all the APS catch inspections by the observer in 2003-2004, only 10% of these outings were not reported in Portnet records i.e. Portnet potentially under-reports commercial outings by 10% (for reasons which are not clear), which means that annual catches are probably close to 100 tonnes (as opposed to the 89 tonnes estimated in Table 13). This is still not sufficient to account for the theoretical (and unlikely) losses incurred by commercial skippers. Another possibility is that skippers are over-stating their running costs. For example, crew costs are the largest item in their running costs, totalling about R950 000 in a year for all 11 skippers, based on interview data (Table 13). If, as they claim, they launch 11 times per month, this would result in 1 452 total launches per year for the 11 skippers. The average catch per outing catch is 157 kg (observer data, section 5.1.2), so total annual catch is potentially about 228 000 kg, which means that, at a crew payment rate of R3 per kg (section 5.1.1), total crew wages for the year is around R684 000 – far less than the R950 000 they claim to pay. Furthermore, this estimated figure of 228 tonnes is far higher than the amount of fish bought from Richards Bay commercial boats by the two wholesalers (section 5.3.3 below), which also casts doubt on the catch quantities claimed to be caught by skippers in interviews. Validation of other calculated values was not possible, but the afore-going indicates that there is some doubt as to the veracity of the data obtained in the interviews.

Table 13: Estimated expenditure and revenue of the commercial fishery in Richards Bay from Aug 2003 – July 2004 based on data from Portnet launch records, access point surveys and interview data (n = 11 skippers). For simplicity, costs of transport to the launch site have been excluded.

Running expenses (from interview)	Average amount per skipper per month (Rands)	Average amount per skipper per year (Rands)	Average amount per year for all skippers in total (x11)
Bait	2 856	34 272	376 992
Boat fuel	6 375	76 500	841 500
Tackle	1 350	16 200	178 200
Crew	7 214	86 568	952 248
Rod & reels		6 083	66 913
Boat maintenance		6 857	75 427
Total	**17 795**	**226 480**	**2 491 280**

Fixed assets (from interviewees)	Average value per skipper (Rands)	Value for all skippers in total (x11)
Tow/launch vehicle	68 000	748 000
Boat & accessories	185 000	2 035 000
Fishing gear (rods & reels)	20 713	227 843
Total	**273 713**	**3 010 843**

Number of outings... A	569	(From Portnet data:Aug 2003 -July 2004)*
Average catch (kg) per outing ... B	157.3	(From access point survey)
Total catch (kg)... C	89 504	(A*B)
Total annual running expenses (Rands)	2 491 280	
Total annual value of the catch (Rands)	1 447 933	(From table 14 below)
Total annual profit of the fishery (Rands)	-1 013 347	(Rand value - running expenses)

Table 14: Breakdown of total Richards Bay commercial catches by fish size category and value (Aug 2003 –Jul 2004)..

Size category	Mass (kg) (from APS) June 2002-July 2004	% contribution	Derived total catch per size category (kg)	Price skippers receive per kg	Derived value of total catch (Rands)
Large	13 331	28	25 061	19.25	482 424
Medium	21 667	45	40 277	17.25	694 778
Small	10 465	22	19 691	11.75	231 369
Other	2 539	5	4 475	15.50	69 362
Total	**48 012**	**100**	**89 504**		1 477 933

*For months with missing Portnet data (December 2003, January and February 2004), commercial NMLS data were used (see Table 3 in section 5.1.4.)

Table 15: Estimated expenditure and revenue an individual commercial fisherman in Richards Bay earned based on data from Portnet (launch records), access point survey and interview data collected between August 2003 and July 2004.

Running expenses (from interviews)	Average amount per skipper per month (Rands)	Average amount per skipper per year (Rands)
Bait/month	2 856	34 272
Boat fuel/month	6 375	76 500
Tackle/month	1 350	16 200
Crew/month	7 214	86 568
Rod & reels/year		6 083
Boat maintenance/year		6 857
Total	**17 795**	**226 480**

Fixed assets (from interviews)	**Average value per skipper (Rands)**
Tow/launch vehicle	68 000
Boat & accessories	185 000
Fishing gear	20 713
Total	**273 713**

Number of outings per year… A	131	(From interviews)
Average catch (kg) per outing... B	157.3	(From access point survey)
Total catch (kg) per year... C	20 606	(A*B)
Total annual running expenses (Rands)	226 480	
Total annual value of the catch (Rands)	328 764	(From table 4 below)
Total annual profit per boat (Rands)	102 284	

Table 16: Breakdown of individual commercial skipper's average monthly catches by fish size category and value.

Size category	Mass (kg) (from APS) June 2002-July 2004	% contribution	Derived total catch per size category (kg)	Price skippers receive per kg	Derived value of total catch (Rands)
Large	13 331	28	4 739	19.25	91 225
Medium	21 677	45	8 448	17.25	145 728
Small	10 465	22	6 182	11.75	72 638
Other	2 539	5	1 237	15.5	19 173
Total	**48 012**	**100**	**20 606**		**328 764**

The average annual expenditure on running costs by a recreational skiboat skipper is much less than a commercial skipper, at about R22 500 (Appendix H). Of the 521 registered skippers (section 5.2.1), 197 skippers were interviewed, and they launched on average 20 times per year. This figure should not be applied to all 521 skippers, as many of these are upcountry visitors or less avid anglers i.e. they would launch much less frequently and therefore incur lower running expenses. To provide an upper estimate though, these 521 anglers potentially spend R11.7 million per year on running expenses (521 boats multiplied by R22 500 annual expenses). A lower estimate is obtained from only using the 197 interviewed skippers, which provides an estimate of about R4.4 million per year on running expenses (197 boats multiplied by R22 500 annual expenses). The likely figure is in between these two estimates. In contrast, the total expenditure on running costs by the commercial sector is about R2.5 million (Table 13).

5.3.2. Consumer survey

A total of 170 consumers were interviewed at a large shopping centre on the 24th and 25th July 2004. There were slightly more female than male interviewees (Figure 23). About half the number of interviewees was white (n = 89), with black (n = 43) and Indian (n = 36) making up the other half. Coloured interviewees comprised less than two percent (n = 2) of the total. This breakdown of ethnic groups was reasonably representative of the current population of Richards Bay (Figure 24).

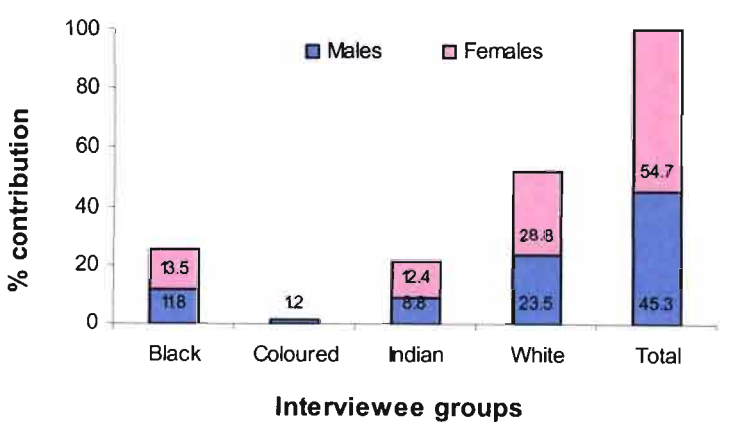

Figure 23: Percentage contribution of male and female interviewees of different ethnic groups during the consumer interviews in Richards Bay in July 2004 (n =170).

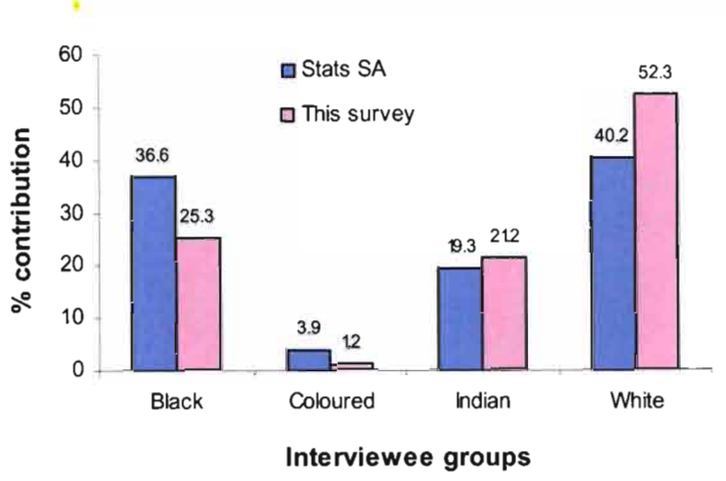

Figure 24: Comparison between population ethnicity statistics in Richards Bay (excluding the settlements of Esikhawini and Nseleni – www.statssa.gov.za) and this survey for different ethnic groups.

Approximately a third of interviewees (n = 58) indicated that their monthly household income was less than R10 000, about one-fifth (n = 35) of households earned between R10 000 – R15 000 and one-fifth more than R25 000 per month (n = 21; Figure 25). The selected income categories used in this survey do not correspond with those used by Statistics South Africa (www.statssa.gov.za), so comparisons cannot be drawn between them. The average household consisted of 4.1 people (SE = 0.1).

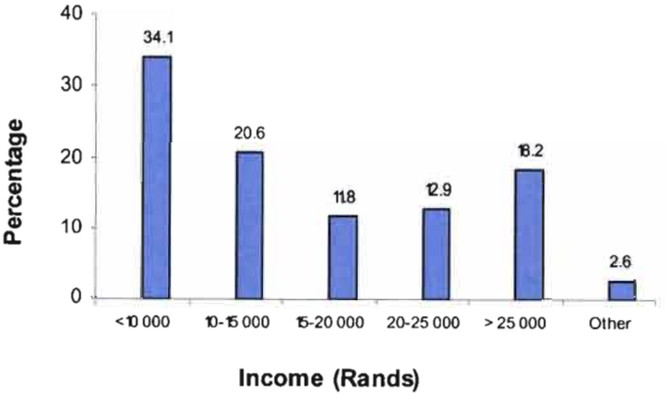

Figure 25: Percentage of interviewees per monthly household income category (Other = interviewees who did not answer this question).

An average of 1.1 people (SE = 0.1) per household fished in the sea or estuaries and an average of 3.6 people (SE = 0.2) per household ate fish of some type. Five percent (n = 8) of interviewees said their households did not consume any fish while 28 % (n = 48) said their households did not consume linefish. Careful distinction between "any fish" and "linefish"

was made when questioning consumers about their preferences, for example, by naming some of the most commonly caught linefish. Some reasons why people did not eat fish were because of allergic reactions, some were vegetarians and others did not like the taste.

Almost half the interviewees (n = 78) said that their household consumed fish two to five times per month whilst less than seven percent (n =11) did not know the monthly frequency of fish consumption (Figure 25). One-fifth (n = 38) of households either did not consume any form of linefish or consumed linefish one or two times per month, whilst less than eight percent did not know the monthly frequency of linefish consumption (n = 13) (Figure 26).

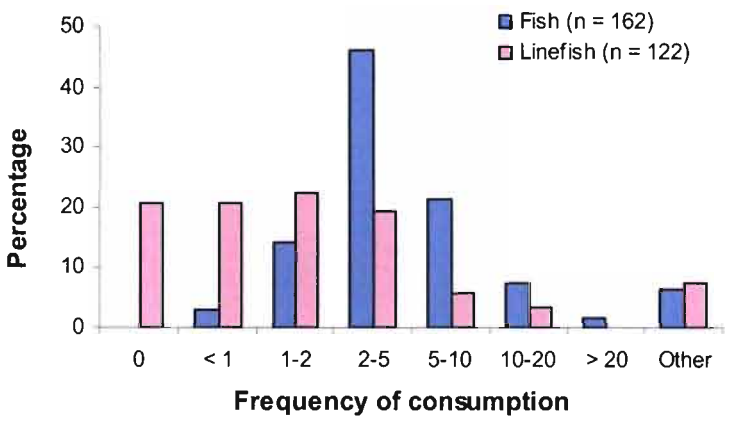

Figure 26: Percentage of interviewees per fish and linefish consumption category per month (Other = Interviewees did not know how many times fish and linefish was consumed per month).

Of the 122 interviewees whose households ate linefish, and based on the occasions where linefish was consumed as a meal, approximately half the interviewees (n = 86) said that their households consumed between 0.1 kg and 1 kg of linefish per meal whilst about a third of interviewees (n = 46) did not know the quantity of linefish consumed per meal (Figure 27).

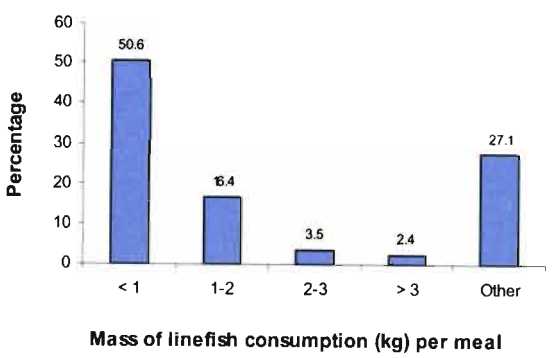

Figure 27: Percentage of interviewees per linefish consumption category (Other = Interviewees did not know what quantity of linefish was consumed per meal).

Of the 122 respondents who said that they ate linefish, 110 (90 %) said that they mostly or sometimes bought their linefish from supermarkets or fish shops, 63 (52 %) said that they mostly or sometimes caught their own linefish, and 47 (39 %) said that they were mostly or sometimes given linefish. Only 16 (13 %) said that they mostly or sometimes bought their fish from recreational anglers. Note that interviewees often answered in the affirmative for more than one category.

The majority of interviewees (n = 110, 65 %) did not know the average price paid per kg of fish while 24 % (n = 40) said they paid between R20 – R40 per kg (Figure 28). Reasons given as to why interviewees did not buy more fish include taste, availability, price, freshness and convenience.

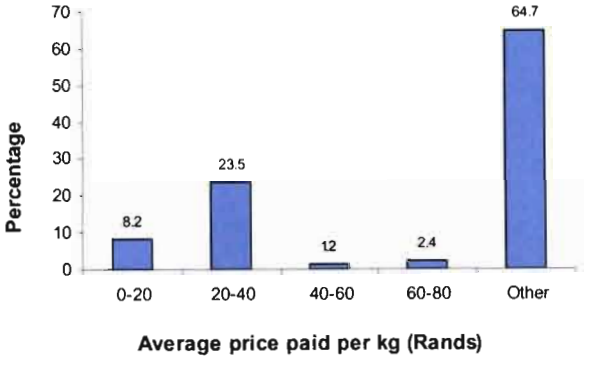

Figure 28: Percentage of interviewees per linefish price category (Other = interviewees did not respond to this question).

Approximately 60 % (n = 103) of interviewees households preferred their bought linefish to be processed in some way, either filleted, as cutlets or cooked while 27 % (n = 46) preferred their linefish whole. Approximately 35 % (n = 70) interviewees did not have any specific linefish preference (Table 17). The species most preferred by interviewees were rockcod, kob, king mackerel, and the sparids slinger and soldier. The average predicted demand for linefish based on consumer interview information was approximately 23 tonnes per month (Tables 6 & 7, Appendix I).

Table 17: Species of fish preferred by interviewees (Other = fish species contributing less than two percent to total preference).

Species	Number	Percentage
No preference	70	34.7
Other	35	17.4
Rockcod	22	10.9
Kob	21	10.4
King mackerel	18	8.9
Slinger & soldier	14	6.9
Grunter	11	5.4
Shad	11	5.4
Total	**202**	**100**

5.3.3. Wholesale/retail outlet survey

By questioning the main wholesaler, it was established that only three businesses in the area were marine linefish outlets. Two of these were a mixture of wholesale and retail outlets and the third was a large supermarket.

An interview conducted with the fresh foods manager at a large supermarket in the Richards Bay revealed that the annual turnover was in excess of R100 million. However, the proportion of revenue that came from the sale of marine linefish was negligible (0.2 %). All (approximately 5 tonnes per year) of the marine linefish was purchased from a wholesaler in Durban with "good service" being cited as the main reason for this choice. Rockcod was the fish preferentially requested by customers but the species of linefish available at this outlet was driven by what was being supplied by the wholesaler. Linefish was available all year round with medium-sized linefish being the preferred option purchased by this outlet. Linefish was purchased from the wholesaler at R38 per kg (regardless of size) and retailed at about R46 per kg after the value of the fish was increased by scaling, slicing and removing the head.

The owner of one of the other linefish outlets (wholesaler one) stated that the company's annual turnover was in excess of R200 000. All of the revenue came from the sale of linefish and all of their linefish was obtained from Richards Bay commercial boats. There was a permanent staff complement of eight black males and one white male. The staff were also crew on commercial skiboats. About 60 tonnes of linefish was sold annually to retailers but it was stated that more linefish could be sold if more were available. Retailers preferentially

request large (> 950 g) fish but this size was not always available. The period August to October was cited as the time of year where linefish was in short supply. Sixty percent of the linefish caught off Richards Bay is exported to retailers in Gauteng, 35 % to Durban and only 5 % remains in Richards Bay and is retailed on the premises. Fish exported to Gauteng retailers sold for R1.50/kg more than in Richards Bay and Durban (Table 18)

Table 18: Comparative prices of commercially caught linefish paid and charged by wholesaler one in Richards Bay.

Fish category	Large (> 950 g)	Medium (450 g –950 g)	Small (< 450 g)	Geelbek/ kob
Price/kg paid to commercial boats	19.50	17.50	11.50	15.50
Price/kg charged to retailers in Richards Bay and Durban	23.50	21.50	14.00	19.50
Price/kg charged to retailers in Gauteng	25.00	23.00	16.50	21.00
Price/kg charged to consumers	32.95	25.95	17.95	25.95

The other linefish wholesale outlet (wholesaler two) at Richards Bay also showed an annual turnover in excess of R200 000 although only 10 % of the revenue came from the sale of linefish. The sources of linefish were from Richards Bay, Mtunzini and St Lucia commercial boats and the permanent staff complement for linefish processing and sales was five black males and one white male. Rockcod was the fish preferentially requested by customers but the species of linefish available was driven by what was supplied. About 96 tonnes per year was sold to retailers, 80% (i.e. 75 tonnes) of which was purchased from Richards Bay boats. Seventy percent of the marine linefish was exported to Gauteng, with retailers from Stanger, Durban and Richards Bay sharing the remaining 30 % in equal proportions. The fish remaining in Richards Bay was sold to restaurants and their own retail outlet. Fish sold to Gauteng retailers cost R2.50/kg more than that sold to KZN retailers (Table 19).

Table 19: Comparative prices of commercially caught linefish paid and charged by wholesaler two in Richards Bay.

Fish category	Large (> 950 g)	Medium (450 g –950 g)	Small (> 950 g)
Price/kg paid to commercial boats	19.00	17.00	12.00
Price/kg charged to retailers in Richards Bay and Durban	22.50	17.50	13.50
Price/kg charged to retailers in Gauteng	25.00	20.00	16.00
Price/kg charged to consumers	30.00	24.00	19.00

Thus, the survey established that all the fish caught by commercial boats in Richards Bay was purchased by two wholesalers, and the amount they purchased was about 135 tonnes per year. This figure is reasonably similar to that estimated to have been caught based on catch per outing and number of outings (about 100 tonnes, section 5.3.1), but substantially lower than that claimed to be caught by skippers (228 tonnes, section 5.3.1).

5.3.4. Restaurant survey

Of the 18 restaurants identified in the Richards Bay area, a total of 14 restaurant owner/managers could be contacted and were interviewed telephonically. A major problem encountered was that interviewees were reluctant to answer questions relating to their business. Only 30 % of restaurants (n = 4) included linefish on their menus. Of those who did not offer linefish stated that this was because of franchise agreements, lack of demand from customers and inconvenience. Two of the owners stated that their restaurants had an annual turnover of between R100 000 and R200 000 while the other two were not prepared to give such information. One restaurant bought fish exclusively from Durban and the remaining three bought fish from the two wholesalers in the Richards Bay area. Restaurants preferred to buy linefish as either filleted or cutlet portions but sometimes bought them whole. Two of the restaurants bought an average of 100 kg of linefish per month while the other two could not give an estimate. Rockcod, king mackerel, Cape salmon, geelbek and *Seriola lalandi* (yellowtail) were the fish specifically requested by customers but restaurants would buy fish according to availability as well as pricing. One of the restaurants stated they paid R29/kg for large linefish, R25/kg for medium-sized linefish, and R20/kg for small-sized linefish. Restaurants however preferred to buy fish in the large and medium size category.

6. DISCUSSION

After the development of the deepwater port in Richards Bay in the 1970s, pressure mounted on the port authorities to permit the launching of commercial skiboats. There are no records of when commercial linefishing commenced in Richards Bay, but it was probably in the mid-1980s, after 1982 (Garratt, 1984). In addition, the demand for recreational activities increased as a result of the growing population of Richards Bay. This, coupled with the warm subtropical climate, lead to the development of a recreational fishery, which pre-dated the harbour development, but the date of its commencement is also not well documented.

Currently, Richards Bay experiences the highest number of commercial launches and the second highest number of recreational launches in KZN (Mann-Lang *et al.*, 1997). This study focused on the extent of participation in the commercial and recreational marine linefisheries in Richards Bay, an analysis of trends in fishing effort, catch composition and catch per species and a basic socio-economic assessment of both marine linefisheries. The overall aim of the study was to develop a management framework for the commercial and recreational marine linefisheries in Richards Bay, which can be regarded as a microcosm of the South African linefishery.

The South African linefishery exploits over 200 fish species (Mann 2000) and is the third most economically valuable fishery in South Africa (Cochrane & Payne, 1998). The fishery includes recreational, commercial and subsistence components. In 1995, the commercial component comprised about 3 000 boats, while the recreational skiboat sector comprised some 3 500 boats and in the region of 12 800 anglers (Sauer *et al.*, 1997).

Demographics and participation

After shore angling, commercial and recreational marine skiboat fishing is the second largest linefish sector in KZN in terms of number of participants (Mann *et al.*, 1997). There are currently 70 commercial permits in KZN, down from 143 in 2000 (Mann *et al.*, 2001) and in 1997, there were approximately 8 849 participants in the recreational skiboat fishery (Mann *et al.*, 1997). There are 33 launch sites in KZN where these boats may launch (Celliers *et al.*, 2003). Subsequent to the rationalisation of the linefishery in July 2003, only 11 skiboats based in Richards Bay were given permits. Of the eight interviewed, skippers were white males and boats had an average crew size of about seven, most of who were black. The skippers were mostly in their mid-40s, and on average, had about 11 years experience of commercial fishing in Richards Bay. The average number of recreational crew was much smaller (about 3) compared to the commercials and most were white males in their mid-40s.

They were mostly fairly experienced, having an average of eight years experience of recreational skiboat fishing in Richards Bay. There were very few women (< 5 %) involved in skiboat fishing off Richards Bay. These results are comparable with other studies, such as that by McGrath *et al.* (1997), who showed that white, male anglers predominated in skiboat activities in South Africa, with an average of 16 years skiboat angling experience and Mann *et al.* (2001) who showed that the majority of commercial skippers were white males, employing mostly black crew.

Catch and effort: 2003-2004

Since the start of the KZN marine linefishery at the beginning of the 20th century, commercial fishermen have targeted primarily reef dwelling species endemic to the region, particularly sparids and serranids (Penney *et al.*, 1999). This remains the case, as this study shows that slinger was the most important species caught off Richards Bay, accounting for the vast majority of the catch by number and mass. It is not known if this predominance was as high at the commencement of the fishery in the 1970s (see historical trends in catch and effort below). If other members of the sparid family are added, the total contribution by sparids amounts to approximately 93 % by number and 81 % by mass. However, both commercial and recreational fishermen mostly caught demersal species. The high overall proportion of sparids in both commercial and recreational catches was similar to that recorded by Mann *et al.* (1997) in KwaZulu-Natal, Lichucha *et al.* (1999) in Mozambique and Brouwer (2002) in the eastern Cape from Stil Bay to Kei Mouth. The next most important contributor to commercial catches by number (5 %) and mass (7 %) were the serranids, primarily rockcods such as halfmoon, catface, captain fine and yellowbelly. The sciaenids, geelbek, squaretail kob, dusky kob and snapper kob contributed 0.6 % by number and 3 % by mass to the overall catch composition. Species in the family Scombridae contributed less than one percent by number but were higher by mass (5 %). There was some degree of bias in catch composition, because species such as geelbek and squaretail kob are mostly caught at night (Griffiths, 2000) and the observer was seldom able to encounter skiboats which returned in the early hours of the morning.

As mentioned previously, the climate on the east coast of South Africa is subtropical. This explains the high species diversity off Richards Bay waters compared to the west coast and south coast of SA where species diversity is relatively low. For example, Hecht & Tinley (1989) recorded no more than 30 species in the Port Alfred commercial fishery while Brouwer & Buxton (2002) reported 36 teleost species and 12 elasmobranch species caught off the South African eastern Cape coast. In contrast, Penney *et al.* (1999) recorded more than 50 species of linefish regularly caught off the KZN coast. Most of the effort by the commercial

skiboat sector in Richards Bay was directed at demersal fish. In contrast, recreational fishing effort was distributed between pelagic and demersal fish (see below).

The relative contribution of species to catches by recreational skiboats off Richards Bay differed substantially from that in commercial catches. Recreational catches comprised a greater variety of species (73 recreational species versus 54 commercial species), signifying a less focussed targeting approach compared to commercial skiboat fishermen. Although slinger also numerically dominated recreational linefish catches, catface rockcod were most important by mass. Squaretail kob, javelin grunter and blue emperor made a far higher contribution to recreational catches than commercial catches, probably because these species mainly occur on shallower reefs, whereas commercial skiboat fishermen mainly fish on deeper reefs (see below). Despite the high proportion of time that recreational skiboat fishermen spent targeting gamefish, few were caught (< 6 % by number). As mentioned previously, it is probable that the proportion of geelbek and dusky kob is higher in both commercial and recreational catches.

Although there were six times more recreational than commercial outings during the study total estimated catch by weight by commercial skiboat fishermen was approximately one and a half times greater than that of recreational fishermen (280 tonnes versus 173 tonnes). This was expected, as the average duration of each commercial outing is more than twice that of recreational outings and the crew numbers are higher. Commercial skiboat fishermen in Richards Bay are also more effective, as the average catch in numbers of fish for commercial skiboat fishermen was approximately five times greater than that of recreational skiboat fishermen. This may partly be explained by the fact that commercial skiboats seldom target pelagic species, whereas recreational skiboat fishermen spent a large amount of time on this activity, which can be unproductive.

During this study, the 8 interviewed commercial skippers indicated that they each launched on average about 130 times a year, with monthly variation depending on prevailing weather. This amounts to a potential of 1 430 launches per year for all 11 skippers. However, notwithstanding missing data from Portnet records, this appears to be an over-estimate of effort, as this number of launches is only approached in 1993, 2000 and 2001 (Figure 9), and in those years, the number of commercial boats was double the current level. The discrepancy could be a result of inaccurate launch record-keeping by Portnet, but perusal of these records does not suggest this. Comparing the commercial observer records with Portnet records, it was found that on about 10 % of occasions there was a discrepancy, with Portnet records not reflecting an outing which was inspected by the observer. Instead, it is more

likely that the skippers over-estimate the number of times they launch (through avidity bias) or because they deliberately over-inflate this figure in order to suggest they are using their permits optimally (see below: comparison with NMLS).

Apart from the enforced reduction in the number of licensed operators in 2003, temporal trends in fishing effort for the Richards Bay commercial skiboat sector have remained fairly consistent in the last decade (Figure 9), while there has been a recent increase in fishing effort for the recreational sector with approximately 4 000 launches already recorded in the first seven months of 2004. Fishing effort declined in the windy months (August to November) for both commercial and recreational sectors. However, fishing effort by recreational fishermen was much higher during the months of April and December coinciding with the holiday season. Spatial trends in fishing effort for commercial and recreational linefisheries indicate that effort is fairly consistently concentrated in specific areas. Most fishing trips by both commercial and recreational skiboats reportedly took place within 15 nautical miles of the harbour, although long trips were also undertaken, particularly by commercials who sometimes travelled up to 30 nautical miles to get to their fishing grounds. Similar observations were made by Mann *et al.* (2001). However there did not appear to be a substantial advantage in travelling further, supported by the fact that there was a very weak positive relationship between the average fuel consumption and total catch per outing for commercial fishermen. The distribution of outings was skewed northwards, since the southward-flowing Agulhas current permits boats to fish for reef fish while gradually drifting toward the port (i.e. home).

Catch and effort: Historical trends

Since the decline in catches of seventy-four in the early 1960s, slinger has become the most important species in commercial catches in KZN (Penney *et al.*, 1999). The slinger caught in the early years comprised a higher proportion of larger fish and more were males (Garratt, 1993). Since then, the mean size of slinger has decreased steadily, and small fish, primarily females, now make up much of the catch (Garratt, 1993). Interestingly, this author suggested that slinger caught off Richards Bay in the early 1990s exhibited these trends to a lesser extent than elsewhere in KZN and ascribed this to the act that there was far more reef available in the Richards Bay area.

Comparison of length frequency of commercially caught slinger from Richards Bay between the periods 1992-1994 and 2002-2004 indicates that there are fewer large fish being caught currently, but there has not been a substantial change in population size structure. A similar trend is observed for soldier. This suggests that catches of these two species are sustainable,

as a substantial decline in size would suggest over-exploitation. In the case of the catface rockcod, there appears to have been an increase in size since 1992-1994. However these observations need to be interpreted in the light of changes in fishing patterns. Anecdotal reports suggest that the large numbers of smaller fish in 1992-1994 were a result of commercials fishing on shallower reefs (45-58 m), and there has since been a shift to deeper reefs (72-90 m; Len Harvey, commercial fisherman, Richards Bay, pers. comm.). Thus the shift to deeper reefs has probably provided larger fish. This reported shift would therefore have provided an increase in size of slinger and soldier, so that signs of over-exploitation of these species (i.e. a decline in the size) would be masked. This emphasizes the fact it is unrealistic to only rely on length frequency data when assessing the exploitation status of a species. It is probably better to use sex-ratios to assess exploitation status of slinger (Govender *et al.*, 1998).

The number of commercial boats operating out of Richards Bay harbour since the mid-1980s is not formally recorded, apart from indirectly in the Portnet records, which are only available from 1992. Consolidation of these suggests that the number of commercial skiboats which fished regularly remained fairly consistent at between 18 and 22. However, with the rationalisation of the commercial linefishery by the national management agency (Marine and Coastal Management) in July 2003, this number dropped to 11. The reported shift in fishing location by commercial skiboats is not reflected in the analysis of fishing locality information obtained from the Portnet launch records (Figure 11). However, data are only available from 1999 and the shift in location appears to have occurred prior to this. The scale of the grid reporting system (5x5 nautical mile blocks) is also too coarse to enable identification of fine-scale changes in fishing locations.

Historical records of recreational skiboat effort in Richards Bay are also not available prior to 2000. The annual number of launches has remained fairly consistent in that time, until 2004, when a sharp increase was recorded (despite incomplete data for that year). Recreational catches in KZN reportedly show higher inter-annual variation in species composition than commercial catches (Penney *et al.*, 1999). These variations result from the fluctuations in annual migration of species such as geelbek and dusky kob (Griffiths, 1997). However, an examination of species composition of recreational catches off Richards Bay, based on EKZNW catch inspections, shows that the relative contribution by the most commonly caught species has remained fairly consistent in the last decade (Figure 21). At a simplistic level, this suggests that the recreational fishery is sustainable, as a persistent change in species composition can signify that some of the species are over-exploited. However, the time series

is rather short (12 years). Also, the gradual decline in CPUE for this sector (Figure 22) over this period, despite advances in fishing efficiency, suggests that the fishery is under pressure.

Catch and effort: Comparison with NMLS

The phenomenon of under-reporting of effort characterised the commercial skiboat sector prior to August 2003. During 2002 and 2003, there were substantially fewer launches reported on the NMLS compared to data recorded by Portnet whereas from August 2003, this trend is reversed (Table 3). Under-reporting is possibly a result of skipper's reluctance to submit their catch returns for fear of having their catches limited or incurring heavier taxes, based on income earned from the sale of fish. However, in 2003, following the rationalisation of the national commercial linefishery by Marine and Coastal Management (MCM) skippers were made aware that renewal of permits would be subsequently subject to the submission of accurate returns, which possibly explains the reversal in the trend of under-reporting. It is also possible that there is some over-reporting, i.e. inflating of actual number of launches by skippers in order to ensure they receive permits in future.

Under-reporting of commercial catches has been reported in other surveys (Penney *et al.*, 1997; Sauer *et al.*, 1997; Fennessy *et al.*, 2003). For example, Sauer *et al.* (1997) reported that commercial catches of slinger in KZN underestimated actual catches by about one-third. However, average NMLS catches reported per outing for Richards Bay are about one-third higher than those observed in this study, which, if authentic, is difficult to account for. The discrepancy may be due to a combination of inaccurate catch returns and the nature of sampling by the observer. The observer seldom encountered catches from night outings, so species such as geelbek and dusky kob, which are large fish and are mostly caught at night (Griffiths, 2000), were probably inadequately sampled.

Although under-reporting of commercial data on the NMLS has been recognised (Sauer *et al.*, 1997), the system is often assumed to provide a useful means of assessing relative catch composition, although Fennessy *et al.* (2003) showed that this is not always the case. In this survey too, there were considerable differences between observed catches and those reported to the NMLS. Some differences may be expected, since only 30 % of outings were inspected, plus the lack of inspections of night-time catches means that dusky kob and geelbek would be less common in observed catches than reported catches. The other discrepancies are difficult to account for, although it should be noted that the quality of reporting by skippers is poor in terms of species identification, with rockcods and kobs mostly being clumped, and 7 % of species not being identified at all. In contrast, for the recreational sector, there was close agreement with observed catches and those based on EKZNW

inspections, although only 5 % of catches were inspected in this study and 18 % were inspected by EKZNW. The implications of these findings will be discussed further under management of the Richards Bay skiboat linefishery (below).

Socio-economic aspects of the Richards Bay skiboat linefishery

From a socio-economic perspective, the average annual expenditure on running expenses (bait, boat fuel, fishing tackle, crew, rods and reels and boat maintenance) by a commercial fisherman was R225 000 (Table 13) whilst a recreational fisherman spent an average of R22 500 annually (Appendix H). Excluding the average annual amount a commercial skipper spends on crew (R86 568), it appears that the typical commercial skipper spends about six times more on running expenses than his recreational counterpart. This can be partly explained by the fact that on an annual basis, commercial skiboat fishermen launched on average, six times more frequently than recreational skiboat fishermen. In contrast and although not directly comparable, McGrath *et al.* (1997) showed that, on a national basis, when payments to crew are excluded, recreational skiboat anglers incur higher daily costs than commercial skiboat fishermen.

The average value of fixed assets (boats, vehicles and fishing gear) for a commercial and recreational skiboat fisherman were similar at R259 359 and R273 713 respectively. To apply a blanket figure for the annual costs of these assets is possibly misleading, but assuming an overall depreciation value of 20 % for commercial and 10 % for recreational skiboat fishermen, this would mean an additional annual expenditure of R52 000 and R55 000 per fisherman for these two sectors respectively.

All commercial skiboat skippers stated that commercial fishing was their only source of income although Mann *et al.* (2001) suggested that commercial skiboat fishermen sometimes had alternative employment to supplement their income from skiboat fishing. Based on responses made by the skippers interviews, the profit (excluding the costs of fixed assets) that each commercial fisherman earns per month was estimated to be in the region of R9 300 (Tables 15 & 16,). This figure is slightly higher than the 2001 figure which commercial skippers in KZN said they earned (Mann *et al.* (2001). However, if one examines the value of the commercial linefishery as a whole, it appears that there is a net loss per skipper of R90 000 per year, excluding the costs of fixed assets (Tables 13 & 14). This discrepancy appears to be partly due to the difference between the average number of times commercials say they launched per year and the actual number of commercial launches recorded by Portnet. The Portnet data appear to be fairly accurate as there is only a 10 % discrepancy

between the number of launches recorded by the observer compared to those recorded by Portnet.

It is also apparent that at least some of the data on running expenses obtained from skipper interviews is inflated, which prevents the assessment of the viability of the commercial fishery. Consequently, it appears that commercial skippers are not always reliable sources of information as they may simply be forgetful, or may be intentionally over-estimating the number of times they launch per year, in order to prove they are making optimal use of their permits (see discussion on discrepancy between NMLS records and Portnet records above). It is improbable that skippers would continue to fish while making a loss, so it is possible that they have alternative employment to supplement their income from fishing.

The average annual amount commercial skiboat fishermen spent on crew was R 86 568. All commercial skippers stated that they paid their crew R3/kg except one who paid crew on a profit sharing basis. This figure is similar to that recorded by Mann *et al.* (2001) for commercial skiboats in KZN. On average, crew size is about six (excluding the skipper). This translates to an average salary of about R1200 per crew per month. The crew also received other benefits such as contributions to the unemployment fund, medical expenses, funeral expenses, building supplies, accommodation, transport, food, and an annual bonus. These were ad-hoc contributions and values could not be assigned to them. Consequently, the absolute package paid to the crew could not be established.

The commercial and recreational linefishery not only provides direct employment and revenue but also provides indirect or secondary opportunities for businesses in Richards Bay. The exact proportion of expenditure, which is spent in Richards Bay itself, is difficult to determine precisely, as some of the boats belong to upcountry visitors, and some of the fishing equipment is purchased elsewhere. However, fuel and bait are mostly purchased locally and contributed substantially to costs in both sectors. Together with the commercial crew costs, a large proportion of overall expenditure therefore occurs in Richards Bay itself and obviously represents a fairly substantial injection to the local micro-economy.

Regarding the provision of linefish to the local market, a large supermarket in Richards Bay revealed that their annual turnover was in excess of R100 million, although the revenue that came from the sale of locally-caught marine linefish was negligible. According to one of the other wholesalers, the company's annual turnover was in excess of R200 000 with all of the revenue coming from the sale of locally caught linefish. In contrast, although the other wholesaler also had an annual turnover in excess of R200 000, only 10 % of the revenue came

from the sale of linefish. Most of the staff that worked with linefish at these wholesalers were black males, some of whom were also crew on commercial boats. According to the two wholesalers, approximately 65 % of linefish sold annually was exported to Gauteng, as there was greater profit to be made in Gauteng than locally.

The consumer survey was useful to assess both the socio-economic breakdown of the population and the demand for linefish in Richards Bay. The breakdown of ethnic groups in this survey was reasonably representative of the current population of Richards Bay, with slightly more female than male interviewees. Two-thirds of households in Richards Bay consumed linefish. Based on calculations of the average demand for linefish, it was estimated that the people of Richards Bay eat approximately 23 tonnes of linefish per month (Tables 2 & 3, Appendix I). However, based on an average commercial catch of 157 kg per outing and an annual total of 569 (from Portnet records) launches, it would appear that the total monthly catch was roughly 7.5 tonnes. Clearly, there is a discrepancy between supply and demand of linefish in Richards Bay. This is further exacerbated by the fact that both linefish wholesalers in Richards Bay stated they sold most (about 70 %) of their linefish to Gauteng retailers. Although 90 % of consumers said they mostly or sometimes bought linefish from supermarkets or fish shops, only one of these outlets imported linefish from outside Richards Bay, totalling about five tonnes per year. Much of the demand for linefish appears to be met by recreational fishing, with many consumers indicating they either caught their own fish or were given it. Only a few (13 %) said they bought linefish from recreational skiboat fishermen.

The response from the restaurant survey did not add to the overall assessment of demand for linefish in Richards Bay. In most cases (70 %), owners and/or managers were reluctant to answer questions relating to their business. Only a third of restaurants that were contacted included linefish on their menus. Of those who did not offer linefish stated that this was because of franchise agreements, lack of demand from customers and inconvenience. Two of the owners did give an estimate of how much linefish they bought per month, but neither could estimate what percentage of their annual turnover came from the sale of linefish.

Management of the Richards Bay skiboat linefishery

Despite a long history of management, the first comprehensive management framework for the South African linefishery was introduced in 1985 (Griffiths *et al.*, 1999). Owing to the lack of biological and fisheries data, the level of protection afforded to individual species was largely subjective rather than being based on quantitative evaluations. Furthermore, the absence of clear management guidelines lead to considerable compromise between managers

and fishermen regarding the implementation of management action for certain species (Griffiths *et al.*, 1999). Rebuilding stocks and maintaining fish populations at levels consistent with sustainable utilisation, is a requirement of the Marine Living Resources Act (Act 18 of 1998; Government Gazette No. 18930), as well as the 1982 international Convention on the Law of the Sea and the Code of Conduct for Responsible fishing (Glazewski, 2000). Failure to reduce effort on over-exploited and collapsed stocks is therefore a contravention of the Act as well as international conventions to which South Africa is signatory.

Prompted by the over-exploitation of "resilient" species (e.g. geelbek and kob), ineffective regulations and the introduction of the Marine Living Resources Act (MLRA) the Linefish Management Protocol (LMP) was developed for the linefishery in 1999 (Griffiths *et al.*, 1999). In this protocol, regulations are based on clearly defined management objectives and quantifiable biological reference points (Griffiths *et al.*, 1999). The LMP requires management plans for all linefish species, with stock status evaluated using biologically based stock assessments and historical trends in catch and effort.

Globally, increasing effort has lead to an increase in exploitation of many fish species and in some instances, led to the collapse of many stocks worldwide (Garcia & Newton, 1997; Jennings & Kaiser, 1998). These declines have also been noted in linefish stocks from the United States of America (Ault *et al.*, 1998; Vaughn & Prager, 2002), New Zealand (Harley *et al.*, 2000), Australia (Samoilys, 1997) and South Africa (Mann, 2000). While in some areas such as New Zealand linefish stocks are managed by allocating a Total Allowable Catch (TAC) (Annala, 1996), commercial linefishing in SA is controlled by limiting the number of participants (i.e. permits) with unlimited catches of exploitable species whereas recreational fishing is controlled by means of individual bag limits with no limitation on effort (Mann, 2000). Standard minimum size limits based on sizes at 50 % maturity have been set for many species, and closed seasons and closed areas were established for certain species that were considered to be over-exploited.

Of the 70 commercial linefishing permits issued to KZN, 11 have been issued to the Richards Bay area. This number was determined by who applied and whether they met specified criteria, including the number of launches per year and total catch per boat. However, currently no specific legislation exists that prohibits commercial fishermen based elsewhere in KZN from moving to other areas, e.g. Richards Bay, and fishing there. This has already happened (December 2004) as one boat from Park Rynie and two from Tugela are now launching in Richards Bay. As mentioned previously, the recreational fishery is an open-

access fishery and it has been shown that Richards Bay has the highest number of annual launches in KZN (Mann-Lang *et al.*, 1997).

Many of the species caught by Richards Bay boats are over-exploited. For example, slinger has been shown to be the most important species caught in the commercial linefishery off KZN (Garratt, 1984) and Southern Mozambique (Lichucha, 1999) but Punt *et al.* (1993) demonstrated the exploitation of this species off KZN waters. Similarly, catface rockcod is also commonly caught off the KZN coast but has also been over-exploited (Fennessy, 2000). Dusky kob has been an important part of commercial and recreational catches in KZN but catches have dramatically declined (Griffiths, 1997). Similarly, geelbek are particularly vulnerable due to their annual adult spawning aggregations in KZN, and catches have also declined (Hutton *et al.*, 2000). However, with this in mind, the sustainability of the Richards Bay fishery has not been investigated. There are also limited historical data available to undertake the assessment. Commercial effort data are only available from the early 1990s, and they are of poor quality. Recreational catch composition and CPUE information is only available from 1992.

As mentioned previously, the number of commercial boats that launched regularly (10 times or more in two years since 1993) at Richards Bay has remained fairly consistent at between 18 and 22. Ostensibly, a figure of about 20 boats could therefore be assumed to represent the effort level at which viable catches can continue to be made. However, viability over time is influenced by an increase in fish prices and improved fishing efficiency, as a result of improved technology such as GPS (Mann-Lang *et al.*, 1997). In addition, commercial skippers are known to supplement their income by taking work in other employment sectors (Mann *et al.*, 2001), which would permit a greater number of boats at a supposedly economically viable effort level. Consequently, this figure of 20 boats may represent an over-estimate of the level of effort which would be biologically sustainable.

The sustainability of the Richards Bay fishery could also be assessed by examining changes in size structure of catches over time. For example, a reduction in the number of size classes in catches and/or a substantial decline in mean size can suggest that the stock is under pressure (Yemane *et al.*, 2004). Interpretation of changes in size structure of the three most commonly caught species in Richards Bay over a ten-year period appears straightforward. For slinger and soldier, there are currently fewer larger fish than in the 1990s, but the mode has not shifted, while for catface rockcod, smaller fish were more common in catches in the 1990s, and the mode has shifted to the right. This does not suggest that these species are over-exploited. However, commercial skippers acknowledge that they are now fishing on deeper

reefs than in the 1990s, and since many species exhibit an increase in length with water depth, this masks the detection of the effects of fishing on the observed size structures. Consequently, it is difficult to determine whether these species are over-fished or not, although the fact that commercials are now fishing on deeper reefs suggests that the inshore reefs have been depleted (at least from a commercial point of view).

Despite the over-exploited status of slinger (Mann, 2000), the observation that it still makes such a high contribution to commercial catches off Richards Bay after 20 years of fishing, requires comment. Examination of other linefish studies in SA showed that there are no other instances in South Africa where a single species dominates a linefishery to such an extent. However, the continued dominance of this species is possibly a reflection of the extensive reef area available off Richards Bay (Garratt, 1993) i.e. skipper are able to access "new" reef on a regular basis. The close proximity of the St. Lucia and Maputaland nature reserves (approximately 100 km north of Richards Bay), where shoals of spawning slinger are known to occur (Garratt, 1993; Punt *et al.*, 1993), is also likely to play a role in helping to sustain catches.

From a recreational perspective, the relative contributions to catches by the main species show very little change over the past ten years, but there has been a steady decline in CPUE. Since recreational fishers mainly concentrate on inshore reefs (Figure 22), this supports the conclusion that these reefs have been depleted of species such as slinger, catface rockcod and soldier. This is of particular concern since it appears that recreational fishing effort is increasing (Figure 19) and is likely to continue to increase with the development of the port and its associated industries.

Changes in the national legislation governing linefishing are imminent. One of these changes, the reduction in the number of commercial permits, has already been implemented (July 2003). Other changes to be introduced will be substantial reductions in the recreational bag limits for many species which are commonly caught off Richards Bay, and significantly, a total maximum bag limit of 10 fish per person per day will be introduced for recreational skiboat fishermen. For species such as dusky kob, there will be reductions in commercial bag limits, and an increase in minimum size limits for species such as catface rockcod. The suite of regulations will have substantial effects on recreational fishing off Richards Bay and have already reduced commercial fishing effort by 50 %. This survey showed that both commercial and recreational skiboat fishermen were in agreement that the linefish management options available (bag limits, size limits and closed seasons) are effective for the management of linefish. Catches off Richards Bay by recreational skiboat fishermen are

regularly inspected by EKZNW, and this survey has shown that these inspections are of good quality i.e. there should be good compliance with the new regulations, provided that the quality and quantity of inspections is maintained. The inspections will also provide good baseline data for future assessments of this sector. Regarding the commercial skiboat fishery, it is feasible that there will be improved compliance with the reporting requirements, since the submission of accurate returns will be a pre-requisite for future renewals of these permits. However, it is imperative that monitoring of the commercial skiboat fishery continues, and this responsibility needs to be met by MCM. Results of the monitoring of both sectors will enable the assessment of the effectiveness of the new regulations and assist in the ultimate aim of achieving sustainability of this important component of the linefishery of KZN.

In conclusion, the following recommendations are proposed for the Richards Bay commercial and recreational skiboat fisheries:

- The new daily bag limits and increased size limits will reduce catches by recreational skiboaters. The effect of these regulations needs to be monitored, and the current level of EKZNW inspections needs to be maintained.
- There are currently 11 commercial skiboat fishing permits in Richards Bay. This number is possibly economically viable and biologically sustainable, but continuous monitoring of the fishery is recommended to determine this.
- Commercial skiboat fishing rights should be area-based. In other words, commercial linefishing permits should be issued for specific areas along the coast, so that, for example, permits issued for Richards Bay would not be able to be used elsewhere. This would allow the establishment of a cohesive group of commercial fishermen in Richards Bay who would "own" the resource that they exploit, and there would be less incentive to over-exploit it. Ultimately, the ability to control and monitor the Richards Bay commercial linefishery will be significantly improved.
- The imminent imposition of tighter catch limits for recreationals means that it is likely that consumers in Richards Bay will not be able to obtain as much linefish as before. This study suggests that much of the linefish that they consume is obtained from the recreational fishery. Henceforth there is likely to be greater demand for fish caught by commercials, particularly since the population of Richards Bay will increase as the port develops. Consideration should therefore be given to limiting the "export" of commercially-caught fish out of the greater Richards Bay area, and an adapted monitoring system will need to be developed to accommodate this.

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APPENDIX A

RICHARDS BAY COMMERCIAL BOAT QUESTIONNAIRE 2002-2004

Section A:

Date:_____ Boat Name and Reg No:_____

Own boat? Yes/No Details (individual(s), trust, close co.) _____

Type of commercial permit _____Boat length: _____ Motor HP: _____ Year of construction_____

Skipper code :_____ Number of crew:____ Crew composition: B W I C M F

Section B: (Catch and effort)

What type of fish do you target (list 3 main species)? _____

On average, how many days do you fish per week? _____ month?____ year ?____

On average, how far do you travel to your fishing grounds? _____

How many times per year do you fish at night? _____ What is your average monthly catch (t) _____

How many years have you been commercial fishing? _____ How many years in Richards Bay? _____

How old are you? _____ Have you ever caught a tagged fish? Yes / No If YES, what happened to the tag?

Section C: (Management)

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

Minimum size limits?_____ Bag limits?_____ Closed seasons?____ Marine Reserves_____

Knowledge of regs	Target 1	Target 2
Species:		
Minimum size:		

How often has your catch been inspected by EKZNW in the last 12 months?___

Section D: (Socio-economics)

How many km do you travel to the launch site? _____What transport did you use (model, cc)_____

How much do you spend each month on

Bait? _____Boat fuel?_____ Terminal tackle?_____Crew? _____

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

What is the estimated value of your ski-boating equipment? (what would they sell it for?)

Launch/tow vehicle: _____Boat (all accessories):_____ _____Fishing gear:_____Insured? _____ Insured? _____

Insured? _____

What do you spend on maintenance (include storage, safety gear) of your skiboat per year? _____

Why do you fish to make a living?

_____

Why do you choose to fish in Richards Bay?

_____

What is your average annual turnover excluding VAT?

R1000-10000_____ R10-20000_____ R20-50000_____ R50-100000_____R100-200000_____

Is the outlet registered as a cc, pty ltd, sole proprietor? _____

Post-school qualifications? _____Do you earn money in any other way? _____

If employed skipper, are you on commission or fixed pay? _____ If commission, what is the rate?

_____

Do you receive any benefits? _____

On average how much do you pay your crew per person per month (use categories above)? _____

Commission or fixed pay? _____ If commission, what is the rate? _____

Do they receive any benefits? _____

Are they full-time, part-time or casual? _____ Do any of them have any qualifications? _____

Apart from gutting, do you increase the quality/value of your catch? (e.g. icing, filleting, scaling)

_____

What % of your fish do you sell to wholesalers _____ retailers _____ restaurants _____ public _____ other

_____

(get name and contact details)

Do you ever take fishing charters? YES / NO If YES, how many times in the last 12 months?

_____

On average, how many fishermen do you take?_____ What do you charge per person?_____

APPENDIX B

RICHARDS BAY COMMERCIAL SKIBOAT CATCH AND EFFORT INFORMATION

						Total catch per boat per size category							
Date	Boat name	Boat number	Total crew	Fishing area	Fishing hours	Large		Medium		Small		Other	
						Crates	kg	Crates	kg	Crates	kg	Crates	kg

RICHARDS BAY COMMERCIAL SKIBOAT LENGTH FREQUENCIES

Date…….. Boat name…….. Boat number……

Liters of fuel …….. Type of bait and quantity ……..

Category (L,M, S, other)	**Species**	**Lengths (cm FL or TL)**														

Crates not measured……. Size category……..

Name of sampler

APPENDIX C

RICHARDS BAY RECREATIONAL BOAT QUESTIONNAIRE 2002-2004

Section A

Locality *Richards Bay Skiboat Club* Date .... / .... / 2002 Time ____:____ Boat name/no:.....

Boat type: Skiboat / Rubber duck / Other.....

% time spent Bait fishing: ..... Bottom fishing: ..... Gamefishing: .....

Method: Bait / Lure / Fly Bait: Pilchard / Squid / Prawn / Other .....

Interviewee: Male / Female Code:..... Crew size (including interviewee):..... Family outing: Yes / No

Number of crew fishing:.....(give estimated ages below) Number of rods?..... .....

Ages: < 15 16-30 31-45 46-60 >60 Ages: < 15 16-30 31-45 46-60 >60

Males..... ....(code). Females .... (code)

Section B: (Effort)

What time did you start fishing?..... When did you stop?..... Where did you fish? .....

What type of fish were you trying to catch today?

.....

Where do you usually fish? 1.....2. .....

How many times have you fished in Richards Bay in the past week?..... month?..... 12 months?.....

Do you have a night rating? Yes / No

Do you ever fish off Richards Bay at night? Yes / No. How often in the last 12 months .....

Which fishing club do you belong to? (full name).....

How many years have you been skiboat fishing? ..... Years skiboat fishing in Richards Bay?..... Age?.....

Why do you choose to fish in Richards Bay? .....

Have you ever fished from the shore in Richards Bay? Yes / No. If YES, how many times in past 12 months? .....

Section C: (Management)

Which of the following regulations, in your opinion, are effective in managing our fish stocks?

Minimum size limits? Yes / No Bag limits? Yes / No Closed seasons? Yes / No Reserves/MPAs? Yes / No

Have you ever sold the fish you caught off Richards Bay? Yes / No. If YES, how many times in the past year?.....

What is the minimum size for _____?..... What is the bag limit ?.....

Do you have a marine angling licence? Yes/ No. When did you buy it? Year?..... Month?..... Where?.....

In the past month, how many times has your skiboat catch been inspected at Richards Bay?..... In the past 12 months?.....

Have you ever caught a tagged fish? Yes / No If YES, what happened to the tag?.....

Do you participate in any other form of fishing? Shore estuarine / Rock & Surf / Fly / Freshwater / Other.....

Section D: (Socio-economics)

What is your occupation?..... If unemployed / retired, last occupation? .....

Where do you live? (City / Suburb/ Code)

.....

Are you on an overnight, weekend, or longer trip / holiday? (i.e. staying away from home) Yes / No If Yes PTO.

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

.....

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

.....

(If own vehicle) Specify number of passengers: ..... How many of this group are fishing?.....

R spent on bait this outing? **R**..... boat fuel ?.....**L** spent on skiboat angling terminal tackle in the past month?.....

Expenditure on skiboat angling equipment i.e. rods, reels etc. in past 12 months ?

.....

How much would you sell all your skiboat fishing equipment for?..... Insured? Yes/ No

Boat?..... Insured? Yes / No Tow vehicle?..... Insured? Yes / No

How much do you spend on boat maintenance (+ license, membership, safety equipment) per year?.....

Why do you fish? Recreation / Competition / Food / Subsistence/ Other? (specify)

……..

Do you ever take charters? Yes / No **If Yes answer Section F**

Do you eat your catch? Yes / No Have you caught anything? Yes/ No **Indicate catch below.**

What transport did you use to come on this trip? (describe vehicle type, model, cc)…….

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

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

……..

How many days of this trip / holiday will you spend fishing in Richards Bay?

……

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

……..

Section E: Catch

Retained catch			**Released catch**	
Species	**Number**	**Length**	**Species**	**Number**

Section F: Charters

Is this outing a charter? Yes / No

How many times have you chartered in the last 12 months?……..

On average how many people do you take on an ounting?……

What is the average cost per person? R……..

APPENDIX D

RICHARDS BAY SKIBOAT LINEFISHERY SURVEY (RECAPTURES) 2002-2004

Sampling locality: Meerensee BC / Richards Bay SBC

Date: ___/___/04 Time: ___:___ Sampler: SF / BE / ___

Boat name/no: _____ Total crew: _____

Fishing area: _____

Start time: ___:___ Stop time: ___:___

Retained Species	Lengths (Fl or TL)																		

Released Species	No

Released Species	No

Released Species	No

APPENDIX E

RICHARDS BAY CONSUMER QUESTIONNAIRE 2004

NB Linefish = rockcod, kob, Cape salmon, snapper, barracuda, musselcracker, dorado, tuna, slinger (swordfish, hake, sole, butterfish, angelfish, skate, salmon, trout are not linefish)

Adults only

Interviewer name: _____ Date _____ Place: _____ Interviewee sex:_____ Race: _____

How many members of your household fish in the sea or estuaries? _____ How many of them eat fish? _____

If none, why not? Taste, availability, price, inconvenience, freshness, other

_____

How many people in your household? _____

What is your household income group? Low - 0 to 22,000 Middle - 22,001 to 60,000 High - 60,001 and above

How often does your household consume fish per month? < 1 , 1 – 2, 2 – 5, 5 – 10, 10 – 20, > 20

How often does your household consume linefish per month? < 1 , 1 – 2, 2 – 5, 5 – 10, 10 – 20, >20

How much linefish (kg) does the household consume per meal? _____

Who do you buy/obtain your linefish from?

	Mostly	Sometimes	Never
Supermarket			
Fish shop			
Commercial fishermen			
Recreational fishermen			
Spearfishermen			
Hawker			
Given			
Self caught			

What is the average price you pay per kg of linefish? _____

Why don't you buy more linefish? Taste, availability, price, inconvenience, freshness, other

_____

Are there specific types of linefish you prefer? _____ Why?

_____

Do you prefer your linefish whole ____ cutlets ____ filleted ____

APPENDIX F

RICHARDS BAY FISH WHOLESALER/RETAILER QUESTIONNAIRE 2004

NB Linefish = rockcod, kob, Cape salmon, snapper, barracuda, musselcracker, dorado, tuna, slinger (swordfish, hake, sole, butterfish, angelfish, skate, salmon, trout are not linefish)

Date:_____ Name and category of company _____ _____Interviewees position _____

(Telephone survey) Do you sell linefish? ____ If not, why not?

_____

Permanent staff composition for linefish: B W I C Is the outlet registered as a cc, pty ltd, sole proprietor? _____

M

F

What is your annual turnover (excluding VAT)?

R1000-10000_____ R10-20000_____ R20-50000_____ R50-100000_____R100-200000_____

What % of this is from linefish? _____ Do you increase the value of your linefish? (e.g. icing, filleting, scaling) _____

How much does this increase your selling price by?

_____

Who do you buy linefish from (% of each)? (ask about recreational skiboaters and spearfishers)

Average annual % of linefish bought from - specify Fresh (F), Iced (I) or Frozen (FF); **Why do you buy from them?**

Richards Bay ____ Mtunzini ____ St Lucia ____ Rest of KZN_____ Rest of SA ___Mozambique _____Other_____

How much linefish do you buy per year? < 1 t, 1 - 2 t, 2 - 5 t, 5 - 10 t, 10 - 50 t, > 50 t

How much other edible fish do you buy per year? < 1 t, 1 - 2 t, 2 - 5 t, 5 - 10 t, 10 - 50 t, > 50 t

Are there types of linefish that are specifically requested by customers? _____

Do you preferentially buy certain types of linefish (which)?

_____

Could you sell more linefish if more was available? _____ Fresh - how much more? (%, 2X) _____

Frozen - " " " _____

Is linefish available to you all year round or is it in short supply in some months?

_____

Are you satisfied with the quality of the linefish you buy? _____ If not, how could it be improved?

_____

What size of linefish do you prefer to buy (L, M, S, other)? _____ Is this size normally available?

_____

N/A TO SUPERMARKETS

What % of your linefish do you sell to:

Other wholesalers _____ Other retailers _____ Supermarkets _____ Restaurants _____ Public _____ Other (specify) ____

Get contact details

What % of your linefish do you sell in Richards Bay area? _____Durban ? _____ Stanger? _____ outside KZN?_____

Price/kg paid for linefish (may need to distinguish between categories (frozen, fresh, etc)

Large _____ Medium _____ Small _____ Other

_____

Wholesale price/kg charged for linefish

Large _____ Medium _____ Small _____ Other

_____

Retail price/kg charged for linefish

Large _____ Medium _____ Small _____ Other

_____

Name two fish which may not legally be sold_____

Give the minimum size limits of two the linefish species that you preferentially buy_____

Any other comments?

APPENDIX G

RICHARDS BAY RESTAURANT QUESTIONNAIRE 2004 -Telephone survey

NB Linefish = rockcod, kob, Cape salmon, snapper, barracuda, musselcracker, dorado, tuna, slinger (swordfish, hake, sole, butterfish, angelfish, skate, salmon, trout are not linefish)

Date: _____ Name of restaurant_____

Interviewees position _____ Do you specialise in seafood? _____

Do you sell linefish? ____ If not, why not?

_____

Is the restaurant registered as a cc, pty ltd, sole proprietor? _____

What is your annual turnover (excluding VAT)?

R1000-10000_____ R10-20000_____ R20-50000_____ R50-100000____R100-200000____

What % of this is from linefish? _____

Who do you buy linefish from (% of each)? (ask about recreational skiboaters and spearfishers)

Average annual % of linefish bought from - specify Fresh (F), Iced (I) or Frozen (FF)

Richards Bay ____ Mtunzini ____ St Lucia ____ Rest of KZN_____ Rest of SA ___Mozambique _____Other_____

What % of your linefish do you buy whole ____, filleted ____ other _____

In what form do you prefer to buy your fish? _____

How much linefish do you buy on average per month? < 1 t, 1 - 2 t, 2 - 5 t, 5 - 10 t, 10 - 50 t

How much other fish do you buy on average per month? < 1 t, 1 - 2 t, 2 - 5 t, 5 - 10 t, 10 - 50 t

Are there types of linefish that are specifically requested by customers? _____

Do you preferentially buy certain types of linefish (which ones and rate them 1 - 3)?

_____

Price/kg paid for linefish (may need to distinguish between categories (frozen, fresh, etc)

Large _____ Medium _____ Small _____ Other

_____

Could you sell more linefish if more was available? _____ Fresh - how much more? (%, 2X) _____

Frozen - _____

Do you offer linefish dishes all year round or is it in short supply in some months?

_____

Are you satisfied with the quality of the linefish you buy? _____ If not, how could it be improved?

_____

What size of linefish do you prefer to buy (L, M, S, other)? _____ Is this size normally available? ____

Price range and species for linefish dishes

APPENDIX H

THE ESTIMATED ANNUAL COSTS OF RECREATIONAL FISHING

Table 1: The estimated cost of recreational fishing in Richards Bay based on recreational interview data. For simplicity, costs of transport to the launch site have been excluded.

Running expenses	**Average amount per skipper (Rands)**	**Average amount per skipper per year**
Bait	54	1 080*
Boat fuel	208	4 160*
Tackle		5 196
Rods and reels		5 185
Boat maintenance		6 857
Total		**22 478**

Fixed assets	**Average value (Rands)**
Value of gear (rods & reels)	26 539
Value of boat & accessories	110 825
Value of tow vehicle	121 995
Total	**259 359**

*Based on 20 outings per year, which is approximately the average number of times that interviewees said they fished per year.

APPENDIX I

THE PREDICTED MONTHLY DEMAND FOR LINEFISH IN RICHARDS BAY

The total number of households in Richards Bay = 12 200

The total number of linefish meals per month [C] = [B] * midpoint of [C] * 12 200

Table 2: Total number of linefish meals per month in Richards based on census data (www.statssa.gov.za) and information from the consumer interviews.

Frequency of linefish consumption per month (on a per household basis) [A]	**Proportion of household linefish consumption per month [B]**	**Total number of linefish meals per month [C]**
0	0.21	0
0 – 1	0.21	1 281
1 – 2	0.22	4 026
2 – 5	0.19	8 113
5 – 10	0.06	5 490
10 – 20	0.03	5 490
Unknown	0.08	
Total	**1**	**24 400... [D]**

Maximum number of linefish meals [G] = [F]* [D]

Maximum mass (kg) of linefish meals (H) = [G] * midpoint of [E]

Table 3: Predicted monthly demand for linefish in Richards Bay (based on Table 2)

Mass category of linefish consumption per meal [E]	**< 1 kg**	**1 – 2 kg**	**2 –3 kg**	**3 – 4 kg**	**Unknown (assumed to be 1 kg)**
Proportion of households per linefish category [F]	0.51	0.15	0.035	0.025	0.28
Maximum number of linefish meals [G]	12 444	3 660	854	610	6 832
Maximum mass (kg) of linefish [H]	6 222	5 490	2 135	2 135	6 866

Therefore, the predicted monthly demand for linefish in Richards Bay = (sum of [H])

= 22 814 kg.

APPENDIX J

OVERALL SPECIES RETAINED BY RECREATIONAL FISHERMEN IN RICHARDS BAY

Species name	Common name	Number	% contribution	Mass (kg)	% contribution
Chrysoblephus puniceus	Slinger	1408	28.10	971.20	12.62
Epinephelus andersoni	Catface rockcod	1033	20.61	2097.34	27.26
Lethrinus nebulosus	Blue emperor	550	10.98	272.66	3.54
Argyrosomus thorpei	Squaretail kob	417	8.32	477.07	6.20
Cheimerius nufar	Soldier	349	6.96	273.12	0.97
Dinoperca petersi	Cave bass	174	3.47	310.42	4.03
Pomadasys kaakan	Javelin grunter	164	3.27	244.60	3.18
Epinephelus rivulatus	Halfmoon rockcod	89	1.78	50.68	0.66
Scomberomorus commerson	King mackerel	65	1.30	1263.50	16.42
Pomadasys olivaceum	Pinky	65	1.30	8.77	0.11
Galeichthys sp.	Barbel	60	1.20	101.34	1.32
Euthynnus affinis	Eastern little tuna	48	0.96	197.78	2.57
Pomatomus saltatrix	Shad	48	0.96	24.27	0.32
Porcostoma dentata	Dane	45	0.90	24.26	0.32
Thunnus albacares	Yellowfin tuna	40	0.80	302.44	0.01
Epinephelus marginatus	Yellowbelly rockcod	39	0.78	0.20	< 0.01
Plectorhinchus chubbi	Dusky rubberlips	36	0.72	127.13	1.65
Ablennes hians	Barred needlefish	33	0.66	15.86	0.21
Coryphaena hippurus	Dorado	33	0.66	62.68	0.81
Diplodus cervinus hottentotus	Zebra	33	0.66	0.53	< 0.01
Chrysoblephus anglicus	Englishman	28	0.56	52.29	0.68
Atractoscion aequidens	Geelbek	26	0.52	162.24	2.11
Polyamblydon germanum	German	21	0.42	34.23	0.44
Otolithes ruber	Snapper kob	21	0.42	111.83	1.45
Polysteganus praeorbitalis	Scotsman	20	0.40	20.44	0.27
Priacanthus cruentatus	Glass bigeye	14	0.28	40.30	0.10
Katsuwonus pelamis	Skipjack tuna	12	0.24	70.49	0.92
Pachymetopon grande	Bronze bream	11	0.22	17.27	0.22
Scomberomorous plurilineatus	Queen mackerel	13	0.22	16.14	0.12
Rhabdosargus thorpei	Bigeye stumpnose	10	0.20	6.10	0.08
Caranx sem	Blacktip kingfish	10	0.20	44.13	0.57
Epinephelus albomarginatus	Captain fine rockcod	8	0.16	9.46	0.12
Rhizoprionodon acutus	Milkshark	8	0.16	6.74	0.09
Epinephelus malabaricus	Malabar rockcod	7	0.14	16.06	0.21
Epinephelus flavocaeruleus	Yellowfin rockcod	5	0.10	7.53	1.61
Carcharhinus obscurus	Dusky shark	4	0.08	33.41	0.43
Pristipomoides filamentosus	Rosy jobfish	4	0.08	5.61	0.07
Lobotes surinamensis	Tripletail	4	0.08	17.45	0.23
Parapeneus rubescens	Blacksaddle goatfish	3	0.06	1.69	0.02
Rhabdosargus sarba	Natal stumpnose	3	0.06	0.98	0.01
Umbrina canariensis	Baardman	2	0.04	7.24	0.09
Makaira indica	Black marlin	2	0.04	305.68	3.97
Pachymetopon aeneum	Blue hottentot	2	0.04	2.68	0.03
Chrysoblephus lophus	False englishman	2	0.04	2.29	0.03
Cymatoceps nasutus	Poenskop	2	0.04	41.29	0.54

Species name	Common name	Number	% contribution	Mass (kg)	% contribution
Rhabdosargus sarba	Sailfin rubberlips	2	0.04	4.08	0.05
Argyrops filamentosis	Soldierbream	2	0.04	1.40	< 0.01
Scomberoides commersonnianus	Talang queenfish	2	0.04	20.60	0.27
Alectis sp.	Mirrorfish	2	0.04	3.42	0.04
Cephalopholis sonnerati	Tomato rockcod	2	0.04	2.75	0.04
Acanthocybium solandri	Wahoo	2	0.04	21.44	0.23
Sphyrna lewini	Scalloped hammerhead	2	0.04	27.70	0.36
Platycephalus indicus	Bartail flathead	1	0.02	1.16	0.02
Myripristis berndti	Blotcheye soldierfish	1	0.02	0.75	0.01
Scomberoides lysan	Doublespotted queenfish	1	0.02	0.13	< 0.01
Argyrosomus japonicus	Dusky kob	1	0.02	1.71	0.02
Argyrops spinifer	King soldierbeam	1	0.02	0.94	0.01
Plectorhincus flavomaculatus	Lemonfish	1	0.02	0.60	< 0.01
Trachurus delagoae	Maasbanker	1	0.02	0.32	< 0.01
Sparodon durbanensis	Musselcracker seabream	1	0.02	2.77	0.04
Mustelus mustelus	Houndshark	1	0.02	5.45	0.07
Oplegnathus robinsoni	Natal knifejaw	1	0.02	2.77	0.04
Pomacanthus striatus	Old woman	1	0.02	0.21	< 0.01
Lutjanus argentimaculatus	River snapper	1	0.02	0.04	< 0.01
Lutjanus rivulatus	Speckled snapper	1	0.02	0.98	0.01
Charcharinus brevipinna	Spinner shark	1	0.02	1.36	0.02
Sarda orientalis	Striped bonito	1	0.02	1.54	0.02
Trichiurus lepturus	Walla walla	1	0.02	0.20	0.28
Acanthurus xanthopterus	Yellowfin surgeon	1	0.02	1.11	1.61
Total		**5011**	**100.00**	**7301.75**	**100.00**