Responsible Fisheries Alliance - Benchmarking SA Fisheries

Part 1: Exploitation status

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Introduction

The overall aim of this project was to assess the status of exploitation of the most important South African fisheries in relation to regional and global averages.

Fourteen of the local fisheries were examined and these included the South African hake fishery, the small pelagic fishery, Patagonian toothfish, the KZN prawn trawl fishery, the horse mackerel fishery, seaweeds, the West coast and the South East coast rock lobster fisheries, squid, linefish, netfish, tuna pole and line, the white mussel, demersal shark longline and abalone fisheries. In 2012 these fisheries comprised 96% of the total catch (698,869 t) for that year (FAO 2014a). Therefore, collectively the exploitation status of these fisheries would be a fair reflection of the overall national state of marine fisheries exploitation and the calibre of management.

The data used for this assessment of South African stocks in particular were drawn from various sources. Total catch data on a species basis, where possible, was obtained from the FAO FishStat database (FAO 2014a), on the assumption that the data submitted by South Africa to FAO for 2012 were correct and precise. Disaggregated data for deep and shallow water hake were obtained from DAFF. Global state of exploitation data (including South Africa) were obtained from FAO (2011, 2012, 2014b) and from DAFF (2012) and exploitation status of linefish species were obtained from Mann (2013).

The definitions of the three categories of exploitation as used in this study are those developed by Ye 2011 and as used in the "Global overview of marine fishery resources" by Ye and Cochrane (2011), viz. non-fully exploited, fully exploited and overexploited. As stated in Ye and Cochrane (2011) the definitions reflect the fact that the data currently available to FAO for most stocks do not provide sufficient information for the differentiation between recovery and depleted and between underfished and moderately exploited. The category of "fully exploited" represents stocks with an abundance that falls within a band around the level that can produce MSY. In comparison with the five categories used in the previous FAO assessments, the underfished and majority of the "moderately exploited" stocks have been merged and now roughly correspond to the new "non-fully exploited" category. Parts of the "moderately exploited" and "over exploited" stocks under the earlier approach may have been classified as "fully exploited" in this new approach and merged with those classified as "fully exploited" by both the old and new methods. Finally, both "depleted" and "recovering" stocks are merged into "over exploited" (for details, see Ye 2011).

By definition, fully exploited stocks produce catches that are at or close to their MSY and spawner biomass is at B_{MSY} or fishing mortality is at F_{MSY}. Hence, there is no room for further expansion in catches and in some instances stocks may even be at risk of further decline or collapse, unless properly managed. Over-exploited stocks produce lower yields than their biological and ecological potential and hence require carefully considered management plans to rebuild them and to restore sustainable productivity (FAO 2014b). The Johannesburg Plan of Implementation that resulted from the World Summit on Sustainable Development (Johannesburg 2002) required that all fish stocks be

restored to a level that can produce maximum sustainable yield by 2015. Clearly, this was not really possible but at least there was a resurgence of political will, globally, to manage fisheries on a sustainable basis. Non-fully exploited stocks have some potential to increase production; however, these stocks often do not have a high production potential and the likelihood for increase in catch may be generally limited. Nevertheless, robust management plans should be established before increasing the exploitation rate of non-fully exploited stocks in order to avoid following the same trajectory as has been the case for most global fish stocks (Ye and Cochrane 2011).

The status of global fisheries

The world's marine capture fisheries production has increased from 16.8 million tonnes in 1950 to a peak of 86.4 million tonnes in 1996, where after it has been fluctuating around 80 million tonnes. In 2010, the recorded global fisheries production was 77.4 million tonnes and in 2012 total world catch was 79.7 million tonnes. The proportion of non-fully exploited stocks has decreased gradually since 1974 when the first FAO assessment was completed (FAO 2011). On the other hand between 1974 and 1989, the percent of over exploited stocks has increased from 10% to 26% of assessed stocks. After 1990, the number of over exploited stocks has continued to increase, albeit at a slower rate (FAO 2011, 2012).

Based on the FAO FishstatJ database (FAO 2014a), the declining global catch over the last few years together with the increase in the proportion of over-exploited fish stocks and the decrease in the percent of non-fully exploited stocks indicates that the state of world marine fisheries is declining (FAO 2014b). Over exploitation not only has negative ecological consequences, but also reduces fish production, which has negative social and economic impacts. To increase the contribution by marine fisheries to food security and economies, effective management plans must be implemented to rebuild overexploited stocks.

The fraction of globally assessed stocks fished within biologically sustainable levels (under and fully exploited stocks) has shown a decreasing trend, declining from 90 % in 1974 to 71.2 % in 2011. In other words by 2011, 28.8% of globally assessed stocks were regarded as over exploited. Of the total number of global stocks for which assessments were available in 2011, fully exploited stocks accounted for 61.3 % and non-fully exploited stocks 9.9 %. This is illustrated in Figure 1. The non-fully exploited stocks decreased continuously from 1974 to 2011, while fully exploited stocks first decreased from 1974 to 1989, and then increased to 61.3 % in 2011 (FAO 2012, 2014b). Correspondingly, the percent of over exploited stocks increased, especially in the late 1970s and 1980s, from 10 % in 1974 to 26 % in 1989. After 1990, the number of over exploited stocks continued to increase, albeit more slowly, and peaked at 32.5 % in 2008 before declining slightly to 28.8 % in 2011 (FAO 2012, 2014b). In other words, the fraction of fish stocks that were fished sustainably decreased from 90% in 1974 to 71.2% in 2011 (FAO 2014b).

However, in spite of the global trend, progress is being made regionally in reducing exploitation rates and restoring over-exploited fish stocks and marine ecosystems, through effective management actions.

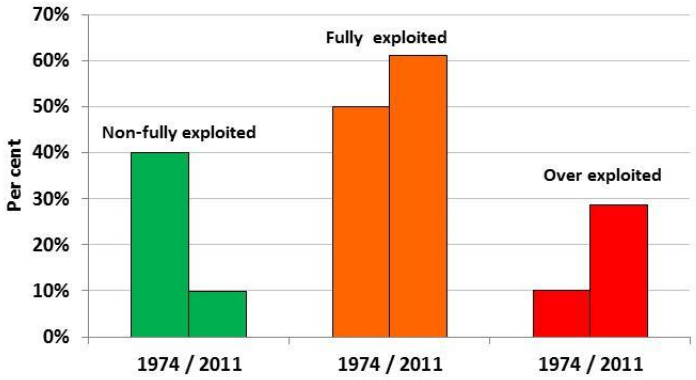

Figure 1. Change in the percent of assessed global fish stocks that were over exploited, fully exploited and non-fully exploited between 1974 and 2011 (FAO 2014b).

The ten most important global fish stocks that contributed about 24% (19.82 million tonnes) to global catches in 2011 are, in the main, fully or over exploited (Table 1) and according to FAO (2014b) there is no room for increased production. The overall biologically sustainable exploitation status of these stocks, except for Atlantic cod in the NW Atlantic, has been achieved through rigorous management initiatives in the last twenty years (FAO 2014b).

Table 1. Exploitation status of the ten most important global fish stocks in 2011.

Fish stock Common name	**Scientific name**	**FAO Statistical Areas**	**Exploitation status**
Anchoveta	*Engraulis ringens*	SE Pacific (N)	Fully exploited
Anchoveta	*Engraulis ringens*	SE Pacific (S)	Fully exploited
Alaska pollock	*Theragra chalcogramma*	N Pacific	Fully exploited
Atlantic herring	*Clupea harengus*	NE & NW Pacific	Fully exploited
Atlantic cod	*Gadus morhua*	NE Atlantic	Fully exploited
Atlantic cod	*Gadus morhua*	NW Atlantic	Over exploited
Chub mackerel	*Scomber japonicus*	E & NW Pacific	Fully exploited
Skipjack tuna	*Katsuwonus pelamis*	Global	Fully to non-fully exploited

In 2011, the catch of tuna was around 4.5 million tonnes, made up mainly of albacore, bigeye, bluefin (3 species), skipjack and yellowfin tuna. This catch level has been fairly steady since around 2003. Skipjack was the most important species contributing around 58% of the total tuna catch for 2011 and 2012 (FAO 2014a), followed by yellowfin (27%) and bigeye tuna (8%). Among the seven most important tuna species 34.8 % of the stocks were over exploited, while 65.2% were either non-fully or fully exploited.

The general state of exploitation of fish stocks in the FAO Fisheries Statistical Areas are summarized in Table 2 (FAO 2011) and shown graphically in Figure 2. The data show that;

1. Atlantic Ocean stocks, except in FAO Areas 27 and 48, were exploited mainly at unsustainable levels.
2. There was an equal proportion of sustainable and unsustainable fish stocks in the Mediterranean and the Black Sea.
3. Most Indian Ocean fish stocks were exploited on a sustainable basis.

4. In comparison to the fish stocks in other oceans the Pacific Ocean stocks are fished on the most sustainable basis.
5. Unsustainable exploited tuna stocks in the Atlantic include the North Atlantic Albacore and the Atlantic and Southern Bluefin stocks, the Southern Bluefin stock in the Indian Ocean and in the Pacific the Northern Pacific albacore stock, as well as the Pacific Bluefin and Southern Bluefin stocks.

Table 2. The levels of exploitation of assessed fish stocks in the FAO Statistical Areas (FAO 2011).

FAO Statistical Area sector	FAO Statistical Area	No of assessed stocks	Stocks exploited at biologically sustainable levels*	Stocks exploited at biologically unsustainable levels**
NW Atlantic	21	28	17.9%	82.1%
NE Atlantic	27	26	69.2%	30.8%
W Central Atlantic	31	13	30.8%	69.2%
E Central Atlantic	34	27	40.7%	59.3%
Med and Black Sea	37	24	50%	50%
SW Atlantic	41	16	31.3%	68.8%
SE Atlantic	47	20	35%	65%
S Atlantic	48	4	75%	25%
W Indian	51	15	73.3%	26.7%
E Indian	57	37	78.4%	21.6%
S Indian	48	3	66.7%	33.3%
NW Pacific	61	16	88.2%	11.8%
NE Pacific	67	16	87.5%	12.5%
W Central Pacific	71	34	85.3%	14.7%
E Central Pacific	77	32	87.5%	12.5%
SE Pacific	87	11	72.7%	27.3%
S Pacific	48	3	100%	0%
Tuna	All	23	65.2%	34.8%

*includes under and fully exploited stocks, **equivalent to over exploited.

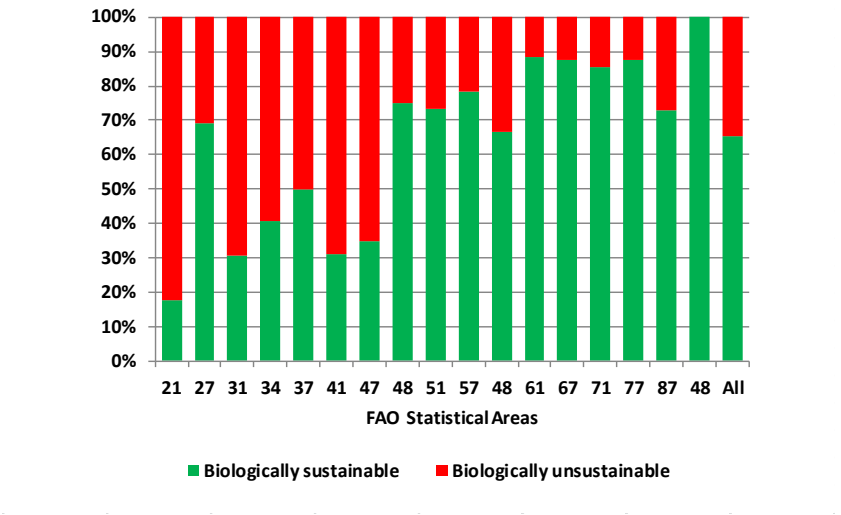

Figure 2. The status of exploitation of fisheries resources in the FAO Fisheries Statistics Areas (FAO 2011).

Of particular interest are the changes that have taken place in the SE Atlantic (FAO Statistical Area 47) fisheries, which includes almost all of South Africa's most important fish stocks. Catches in the

South East Atlantic have declined by over 63% from 3.3 million tonnes in the early 1970's to 1.2 million tonnes in 2011 (FAO 2014a). More recently, the percent variation in total catches between 2003 and 2012 was -10% and between 2011 and 2012 the variation was +23.7%. The upswing in catches from 2011 to 2012 was largely due to a three-fold increase in South African anchovy landings and an approximately 100 fold increase in Cunene horsemackerel landings by Russian Federation vessels in the Area.

The "Review of the State of World Marine Fishery Resources (FAO 2011) provides the most recent detailed assessment summaries for fish stocks in the FAO Statistical Areas. The summary tables in Part D of the FAO (op cit.) review and the FAO catch statistics (FAO 2014a) were used as the primary data sources to obtain a global view of the exploitation status of assessed stocks and the contribution by weight to these categories. The global picture is illustrated in Figure 3, and shows that the bulk of fish is from fully exploited stocks. Given the relatively high proportion of over exploited stocks (nearly 29%) but the relatively smaller contribution by weight suggests that these stocks are either severely depleted or comprise smaller, less productive, stocks than those in the fully exploited category.

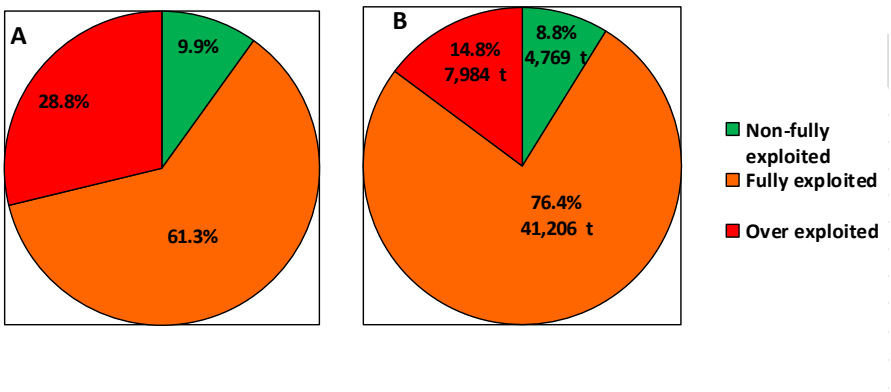

Figure 3. (A) The proportion of assessed global stocks in the over, fully and non-fully exploited categories and (B) the percent contribution by weight (x1000 t) of the three exploitation categories (FAO 2011,2014a, 2014b).

The exploitation status of SA fisheries

The proportion of South African fish stocks that are non-fully, fully or over exploited are illustrated in Figure 4. Of the 30 assessed stocks in the 14 fisheries, twelve are over exploited and 14 are fully exploited (Table 3). Three of the four non-fully exploited resources are marginal resources, in which significant increases in landings are unlikely. Whiteheads round herring clearly has potential for higher catches but given its subordinate role in the small pelagic management complex this is hardly possible.

Except for the deep water hake resource, the stocks that make up the over exploited component are relatively small fisheries (e.g. KZN prawn trawl, Southern Bluefin tuna, Indian Ocean swordfish and soupfin shark) or severely depleted stocks (e.g. Abalone and Patagonian toothfish).

Of the total 2012 catch of 698,869 tonnes, 83% could be attributed to fully and non-fully exploited stocks. However, the recovery of the deep water hake stock will no doubt push the contribution by under and fully exploited stocks to over 95% in 2015.

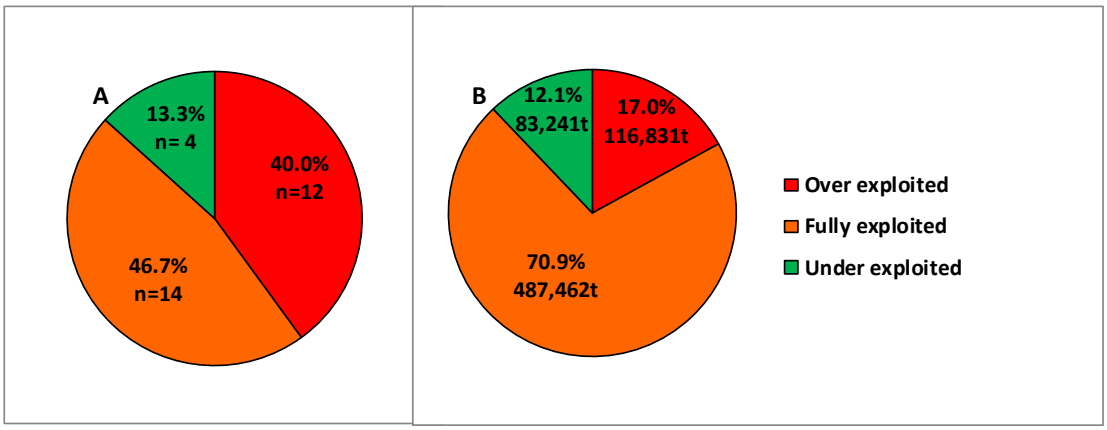

Figure 4. (A) Number and percent of fish stocks in the over, non-fully and fully exploited categories in 2012 (refer to Table 3) and (B) the contribution by weight of fish to the three categories.

Table 3: The state of exploitation of assessed fish stocks in South Africa in 2011/2012.

	Resource	Exploitation status	Reference
1	Whitehead round herring	Non-fully exploited	FAO 2011, DAFF 2012, FAO 2014b
2	Skipjack tuna	Non-fully exploited	FAO 2014b
3	White mussel	Non-fully exploited	DAFF 2012
4	Seaweeds	Non-fully exploited	DAFF 2012
1	Shallow water hake	Fully exploited	FAO 2011, DAFF 2012, FAO 2014b
2	Horse mackerel	Fully exploited	DAFF 2012, FAO 2014b
3	Pilchard	Fully exploited	DAF 2012, FAO 2014b
4	Anchovy	Fully exploited	DAF 2012, FAO 2014b
5	Snoek	Fully exploited	Mann 2013
6	Panga	Fully exploited	Mann 2013
7	Yellowtail (Line and net)	Fully exploited	DAFF 2012, Mann 2013
8	Bigeye tuna	Fully exploited	IOTC
9	Swordfish (Atlantic)	Fully exploited	IOTC
10	Squid	Fully exploited	DAFF 2012
11	South coast rock lobster	Fully exploited	DAFF 2012
12	KZN prawn trawl (deep water)	Fully exploited	DAFF 2012
13	Smooth hound shark	Fully exploited	Mann 2013
14	St Joseph shark (Net)	Fully exploited	DAFF 2012, Mann 2013
1	Deep water hake	Over exploited	DAFF 2012, FAO 2014b
2	Patagonian toothfish	Over exploited	DAFF 2012
3	Linefish (Remainder)	Over exploited	Mann 2013
4	Mullet (Net)	Over exploited	Mann 2013, DAFF 2012
5	Albacore	Over exploited	ICCAT
6	Southern Bluefin tuna	Over exploited	CCSBT
7	Yellowfin tuna	Over exploited	ICCAT
8	Swordfish (Indian Ocean)	Over exploited	IOTC
9	Soupfin shark	Over exploited	DAFF 2012
10	Abalone	Over exploited	DAFF 2012, FAO 2014b
11	West coast rock lobster	Over exploited	DAFF 2012
12	KZN prawn trawl (inshore)	Over exploited	DAFF 2012

The exploitation status of SA fisheries in relation to similar global fisheries

Hake

The hake fishery is undoubtedly the most important and most valuable South African fishery. The resource comprises two species, the shallow-water Cape hake, *Merluccius capensi*s and the deep-water Cape hake, *M. paradoxus*. Deep-water hake are distributed from northern Namibia to East London, while shallow-water hake are distributed from southern Angola to northern KwaZulu-Natal (Payne and Punt 1995).

The 2010 baseline assessment for both Cape hake species as reported by (DAFF 2012) and as conveyed by FAO (2011, 2012, 2014), showed that the shallow water *M. capensis* stock was exploited above sustainable levels. However, the deep water *M. paradoxus* stock remained in an overfished state. An OMP for deep water hake was first developed on the basis of a species disaggregated assessment in 2006 (Rademeyer et al. 2008a and b). The South African hake trawl fishery was among the first in the world to implement an OMP as a management tool, in fact the first OMP was implemented in 1990. The OMP provided TAC recommendations for the period 2007–2010. Its aim was to rebuild the deep-water hake resource to 20% of its pre-exploitation level over a 20-year period, while restricting year-to-year fluctuations in the TAC to a maximum of 10%, in order to ensure stability in the industry (DAFF, 2012). Implementation of the OMP led to substantial reductions in the TAC from 2007 until 2009, but TACs subsequently increased as the resource responded positively. A revised OMP was developed in 2010 and was used to provide the TAC recommendations for 2011 and 2012 (DAFF, 2012). The 2012 assessment results indicated that the *M. paradoxus* was approaching the MSY more rapidly than was projected for the previous two years and it was anticipated that this target level would be attained by about 2014 (Smith and Japp 2013, 2014). The most recent stock assessment (2014/2015) has shown that deep water hake has recovered and is now considered to be fully exploited (D.Japp, pers.comm. February 2015).

The South African hake fishery, as a whole, is a Marine Stewardship Certified fishery. On a global basis it is the only gadid fishery that is MSC certified and is also the only fishery in Africa that is MSC certified. This attests to the implementation of, and adherence to good management plans developed jointly by DAFF, the South African Deep Sea Trawling Industry Association (SADSTIA), the Responsible Fisheries Alliance and a responsible and responsive industry.

The hake trawling industry has implemented several of its own management measures to maintain the long-term sustainability of the hake resources. These include the implementation of an on-board scientific observer program and the introduction of Precautionary Catch Limits (PCL) and seasonally closed areas for bycatch species. Measures to reduce damage on benthic habitats have also been introduced such as ‘ring-fencing’ of existing trawling grounds to reduce the amount of habitat affected (Smith and Japp 2014).

Four large hake stocks make up 82% of the reported world hake landings of approximately 956 000 tonnes (FAO 2011). The largest, by volume, is the Argentine hake fishery in the SW Atlantic (FAO Area 41), which is over exploited. By weight, the Cape hake stocks contribute around 35 % to the global hake landings. From a management perspective, five of the 11 stocks are considered over exploited, one is fully to over exploited and five are fully exploited. The North Atlantic populations of offshore, red and silver hake, North Pacific hake and the South African deepwater and shallow water hake appear to be the best managed stocks and were either fully recovered or in the process of recovering (FAO 2011).

Small pelagics

The second most important South African fishery, but the largest by volume, is the small pelagic fishery, centred around the western, southern and SE Cape. Anchovy, *Engraulis encrasicolus*, sardine *Sardinops sagax* and round herring *Etrumeus whiteheadi* are the three main species that make up this fishery. South Africa's pelagic resources are managed by catch control through an Operational Management Procedure (OMP) to make recommendations regarding separate annual TAC levels for anchovy and sardine and sets Precautionary Upper Catch Limits (PUCL) for round herring (Fairweather et al. 2006). Small pelagic fish are characterised by highly variable recruitment levels that results in large fluctuations in population size and catches. Pilchard abundance has declined considerably and is now fully to over exploited (DAFF 2012, FAO 2014b). On the other hand, Southern African anchovy abundance has continued to improve and in 2011 it was considered fully exploited and Whitehead's round herring was non-fully exploited (DAFF 2012,FAO 2014). Globally, 14 of the 15 most important small pelagic fisheries are fully exploited and only one, the Japanese pilchard fishery, is considered over exploited (FAO 2011).

Prawn trawl fishery

The KwaZulu Natal is a very small fishery with crustacean catches of just over 200 tonnes in 2012. It consists of two components: a shallow-water fishery (on the Thukela Bank and off St Lucia) and a deep-water fishery between Cape Vidal and Amanzimtoti. The target species in the shallow-water trawl fishery are *Fenneropenaeus indicus* (80% of the prawn catch), brown prawns, *Metapenaeus monoceros* and tiger prawns *Penaeus monodon*, while the deep water fishery targets mainly *Haliporoides triarthrus.* The fishery, like all prawn fisheries, is characterised by high levels of bycatch (Forbes and Demetriades 2005). Of the 31 shrimp and prawn stocks that have been assesses globally, 17 are fully exploited, 9 are over exploited, 3 are fully to over exploited, and 1 each are non-fully exploited and under to fully exploited (FAO 2011). The South African fishery, which is based on shared stocks with Mozambique, is very small and only contributes 0.03% to total global production. The South African inshore prawn stock is currently severely depleted, although the stocks are expected to recover with the opening of the St Lucia estuary, upon which the fishery is heavily dependent. The offshore stocks are fully exploited (DAFF, 2012). A total of 31 shrimp and prawns stocks have been assessed globally. Of these 17 are fully exploited, 9 are over exploited, 3 are fully to over exploited, and 1 each are non-fully exploited and under to fully exploited (FAO 2011).

Horse mackerel

The Cape horse mackerel, *Trachurus trachurus capensis*, occurs on the continental shelf off southern Africa from southern Angola to the Wild Coast. Historically, large schools of adult Cape horse mackerel occurred on the West Coast and supported a substantial purse seine fishery. These large schools have since disappeared from the South African west coast, but still occur off Namibia where they are the most abundantly harvested fish. In South Africa, adult horse mackerel are currently more abundant on the South Coast than off the West Coast (DAFF, 2012). Adult Cape horse mackerel are taken as by-catch by the demersal trawl fleet and as a targeted catch by the mid-water trawl fleet (mainly on the South Coast). In addition, the pelagic purse-seine fleet on the West Coast takes juveniles as by-catch (DAFF, 2012). Work in 2011 indicated a 20% increase in horse mackerel abundance over the last five years, primarily because of good recruitment in recent years. In 2013, the TAC was increased by 10% and another 10% for 2014. The horse mackerel stock in South Africa is fully exploited (DAFF 2012), but over exploited in Namibia and Angola (FAO 2014). The South African contributes around 7% to global horse mackerel catches. Nine horse mackerel stocks have been assessed globally. The Pacific jack mackerel fishery is considered non-fully exploited, while the Atlantic horse mackerel fishery, the Japanese horse mackerel fishery and the South African horse mackerel fisheries are fully exploited, while the stocks in the Eastern Central Atlantic and in the SE Pacific are over exploited.

Seaweed

The South African seaweed industry is based mainly on the commercial harvesting of kelp and the red seaweeds, *Gelidium a*nd *Gracilaria.* All commercially exploited seaweeds are found between the Orange River on the west coast and the Mtamvuna River on the east coast. In the Western and Northern Cape, the industry is based on the collection of beach-cast kelp and the harvest of fresh kelp. Collection of beach-cast gracilarioids in Saldanha and St Helena Bay stopped in 2007. *Gelidium* species are harvested from the intertidal zone in the Eastern Cape (Anderson et al. 2003, DAFF, 2012). Yields have remained stable over the past few years at between 10,000 and 15,000 tonnes (wet weight). On the basis of the evidence provided by DAFF (2012) the seaweed resources are non-fully exploited. In comparison to global seaweed fisheries South Africa's seaweed fishery is minute. Globally, most seaweed fisheries seem to be fully to non-fully exploited.

The rock lobster fisheries

There are two important rock lobster fisheries in South Africa. The West Coast rock lobster (Jasus lalandi) fishery is the most important and valuable rock lobster fishery. The species is widely distributed from Walvis Bay in Namibia to East London on the east coast. Currently, 20% of the resource is harvested by hoop nets in the near shore region up to one nautical mile offshore, and 80% by offshore trap vessels. There has been an eastward shift in lobster distribution (Cockcroft et al. 2008). The fishery on the West Coast, which historically landed 60% of the lobster catch, now lands only 40% of the total annual catch. Currently lobster catches vary around 2000 tonnes per annum, a far cry from the 18,000 tpa catches in the 1950s and 10,000 tpa catches in the 1960s. An OMP was implemented in 1997 to increase resource abundance to 20% above the 1996 levels by

2006. However, by 2006 resource abundance had decreased again dramatically to 18% below the 1996 level. This decline was due to recruitment failure and an increase in the number of near shore right-holders. A revised OMP was adopted in 2011 that aims to rebuild the resource by 35% by 2021 (DAFF 2012). The biomass of the West Coast rock lobster (above the 75mm minimum size limit) is currently at 3.5% of pristine levels. The fishery is considered to be over exploited but there are some signs of recovery. Reducing illegal harvesting is critical to ensure that stock rebuilding is not compromised (DAFF 2012).

The South Coast rock lobster, *Palinurus gilchristi*, is endemic to the south and south east coast of South Africa, where they occur at depths of 50–350m. The fishery operates between East London and Cape Point and up to 250 km offshore, along the outer edge of the Agulhas Bank. Fishing gear is restricted to long lines with traps and it is the second largest rock lobster fishery in South Africa (Pollock and Augustyn 1982, Groeneveld 2003). The fishery is managed through an OMP that was introduced in 2008 and modified in 2010. The objectives of the OMP are to keep the inter-annual TAC change restricted to 5% and to increase the spawning biomass of the resource by 20% over the next 20 years. Fishing takes place year round and is controlled by a TAC and TAE. The TAC is based on an annual resource assessment, whereas the TAE is measured in fishing days allocated to each vessel. A vessel may fish until its fishing days expire or its quota is filled, whichever occurs first (DAFF, 2012). The fishery is considered to be fully exploited (DAFF 2012).

The biggest and fully exploited rock lobster fishery and one of the best managed is the American lobster fishery in the NW Atlantic. Of the world's six assessed rock lobster fisheries, three are considered poorly managed and over exploited (the South African Cape rock lobster fishery falls within this category). The southern spiny lobster fishery on South Africa's south coast, although fully exploited, is considered well managed. The best managed lobster fishery is the fishery in Western Australia and many lessons can be learnt from the manner in which this fishery is managed (FAO 2011, 2012).

Squid

Squid, *Loligo vulgaris reynaudii* occurs around the coast from southern Namibia to the Wild Coast of the Eastern Cape. It is caught mainly off the Eastern Cape coast (Glazer & Butterworth, 2006). Squid are fast growing and reach a reproductive size in approximately 12 months or less and have a lifespan of less than two years (Augustyn et al. 1994). Two fisheries exploit this resource, the commercial jigging fishery that targets squid directly (Glazer & Butterworth, 2006) and the inshore trawl fishery in which squid is a by-catch. Although the fishery is quite stable, inter annual abundance and catches fluctuate widely, owing to various factors such as spawning distributions, mortality rates and environmental factors such as temperature, currents, turbidity and El Niño events. Since the advent of the jig fishery in 1984 annual landings have fluctuated between 2000 and just under 13 000 tonnes (FAO 2014a). The fishery is effort controlled is capped at a maximum of 2 422 crew or 136 vessels. In addition, closed seasons have been implemented with the intention of protecting spawning squid and improving recruitment for the following year. In 2009 the fishery was considered over exploited (FAO 2011), but is now classified as fully exploited (DAFF 2012). The largest squid fishery is the Japanese flying squid fishery in FAO area 61, accounting for over 40% of

total global squid landings. The Japanese flying squid fishery is well managed and non-fully exploited. The South African squid fishery was considered over exploited (FAO 2012) but has now recovered (DAFF 2012). All other assessed global squid stocks are considered fully exploited.

Linefish

Globally, linefish or coastal fisheries are arguably the most complex fisheries to manage. This is mainly due to the multi species nature of the fisheries, longevity of many species and complex reproductive styles and migrations, as well as multiple participants. In South Africa, the linefishery includes three sectors (commercial, recreational and subsistence), and collectively targets between 95 and 200 fish species (Mann 2013). Many of the target species also form important components of the catch or by-catch of other fisheries (DAFF, 2012). By the last quarter of the 20th century most linefish species were over exploited and some had collapsed (Griffiths 2000). In December 2000, the responsible Minister for Fisheries declared the fishery to be in a State of Emergency. In response the commercial effort was reduced such that the total catch would be reduced by at least 70%. In addition, there was a reduction in recreational fishing pressure through the implementation of realistic species-specific daily bag and size limits (Palmer et al. 2011). Based partly on the implementation of the Linefish Management Protocol (LMP) and other management interventions, the linefishery has undergone a number of changes in the past decade. Changes have included a national licensing system for recreational fishers, a ban on beach driving in 2002, the recognition and registration of subsistence fishers in 2003, the implementation of medium and long term fishing rights and the proclamation of an additional six marine protected areas (Mann, 2013). Very little is known about most species. Mann (2013) showed that nothing is known about 61% of the 139 species profiled and that the stocks of 19 species have collapsed, of 11 species are over exploited, 19 species are fully exploited and the stocks of 7 species are non-fully exploited (Figure 5).

Linefish resources range from heavily depleted to non-fully exploited. The emergency management measures implemented in 2000 have resulted in a positive response (increased CPUE) of some species to. However, given the low population sizes of many of the over exploited linefish species, e.g. silver kob, present management measures need to remain in place for sufficiently long so as to allow stock sizes to increase (DAFF 2012).

The FAO database for 2012 (FAO 2014b) records a total linefish catch of 13,464 tonnes, to which snoek contributed 77.2%, panga 6.6% and yellowtail 3.2%. In other words the fully exploited component of the linefishery makes up 87% of the total recorded linefish catch for 2012 (FAO 2014b) and see Figure 6. The rest, comprising 1751 tonnes has been put into the over exploited category and includes species such as silver and dusky kob, geelbek, dageraad, red and white steenbras. Given the absence of detailed catch data for most other species this action was considered to be justified.

The underexploited species listed by Mann (2013) include Black sea barbel *Galeichthys ater*, Largespot pompano *Trachinotus botla*, Halfmoon rockcod *Epinephelus rivulatus*, Streepie *Sarpa salpa* and skipjack tuna *Katsuwonus pelamis*. Except for skipjack tuna there are no catch statistics for the other species. Collectively therefore, except for snoek, panga, yellowtai and skipjack tuna,

the linefishery is considered to be over exploited. The WWF's SASSI programme lists 4 species as green, 12 as orange and 32 are red listed.

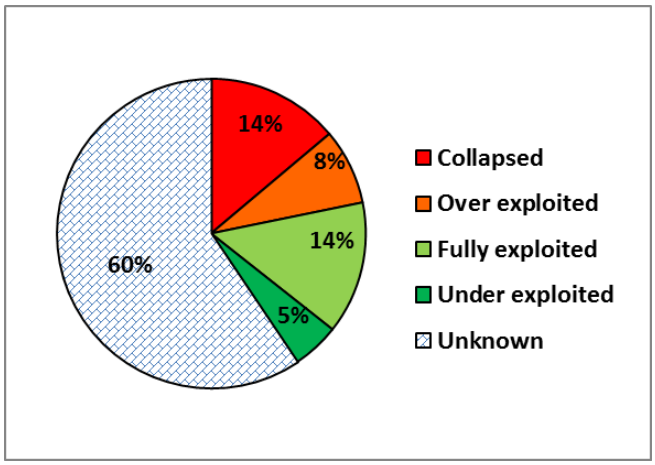

Figure 5. The exploitation status of 139 South African linefish species (Mann 2013).

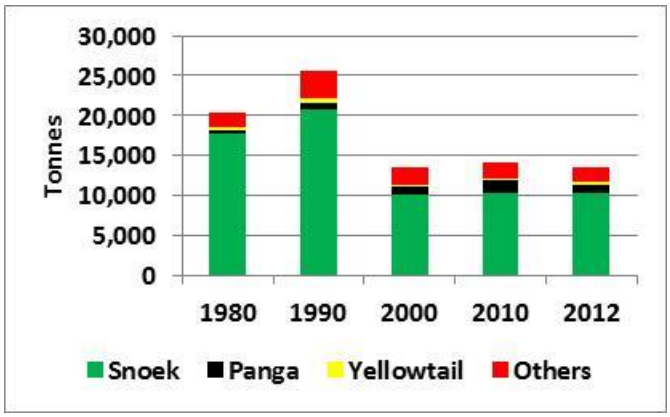

Figure 6. Total catch and composition of linefish catches 1980 to 2012 (FAO 2014b).

Abalone

The commercial abalone fishery began in 1949 as an open access fishery. Landings rose to a record high of 2800 tonnes in 1965 (Fig. 2), but then plummeted. The first catch regulations and a TAC were imposed in 1968. The TAC and total catch remained fairly stable and fluctuated around 700 tonnes until the early 1980s. During the mid-1980s the TAC was decreased and remained at about 615 tonnes until the mid-1990s (Fig. 2). From 1986 onwards, the commercial fishery area was subdivided into seven fishing zones; each designated with its own TAC based on past yields from commercial diver statistics. At this stage, the management measures in place appeared to be successful with

divers reporting improved CPUE. The recreational sector has also targeted abalone for many years, but due to the decline in the resource, this component of the fishery was suspended in 2003/2004. After a decrease in the TAC to a mere 75 tonnes for the 2007/8 season, the DEA&T declared an immediate suspension of all commercial abalone fishing prior to the start of the 2008 fishing season. This decision was based on concerns expressed by scientists, over the continued impact of high level poaching on the abalone resource. All indicators showed that the continued decline of the abalone resource during the period 2000 to 2010 was due to unsustainable harvesting and the ecosystem shift, brought about by the migration of West Coast rock lobster into two of the most productive abalone fishing areas (Raemakers et al. 2011). The history and ultimate closure of the legal abalone fishery in South Africa in 2008 illustrates that the various fisheries management strategies and anti-poaching measures implemented, were ultimately insufficient and ineffective to protect the resource and halting the black market trade in abalone. Raemaekers et al. (2011) provide an excellent overview of developments in the fishery up to and including its closure in 2008 and also provide good recommendations for the future management and rebuilding of the resource. The commercial fishery for abalone was reopened in 2010 but the resource continues to decline due to continued poaching, and remains in a depleted to heavily depleted state.

Most abalone fisheries around the world are over exploited and all have a poaching problem. A rapid global increase in the illegal exploitation of abalone has contributed to population crashes and in some cases, to the complete de-commercialization of abalone fisheries (Cook & Gordon, 2010). In 2008 the illegal catch represented more than 60% of the total legal catch of all abalone fisheries (Figure 7).

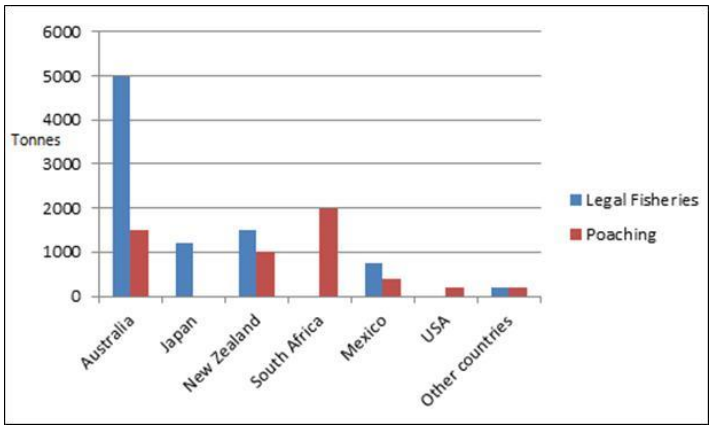

Figure 7. Estimated abalone fisheries landings and illegal catches in 2008 (Cook and Gordon, 2010).

Tuna (Pole and line)

South Africa has three commercial fishing sectors that target tuna and swordfish in the Atlantic and Indian Oceans. These are the longline fishery, the pole fishery and the rod and reel fishery. There is also a recreational sport fishery for large pelagics. Target species include albacore *Thunnus alalunga*, yellowfin *T. albacares*, bigeye *T. obesus*, Southern bluefin *T. maccoyii*, and swordfish *Xiphias gladius.* Regional Fisheries Management Organisation (RFMOs) are responsible for management and setting international catch limits / quotas for these highly migratory species.

Stock assessments and country allocations for the Atlantic and Indian Ocean stocks of tuna and tuna-like species are the responsibility of ICCAT and the IOTC, while stock assessments for southern bluefin tuna are conducted by the Commission for the Conservation of the Southern Bluefin Tuna. A stock assessment for yellowfin tuna conducted by ICCAT in 2011 indicated that the stock in the Atlantic Ocean was over exploited. High catches in the Indian Ocean between 2003 and 2006 led to a decline in the biomass of the Indian Ocean yellowfin tuna stock and a stock assessment conducted in 2014 revealed that the stock is fully exploited and possibly over exploited. The last Southern Atlantic albacore stock assessment conducted by ICCAT and suggests that the stock is both over exploited and experiencing overfishing. Swordfish stock assessments were conducted by ICCAT (2014) and IOTC (2011) and indicated that the stock in the Atlantic Ocean are non-fully exploited. The latest stock assessment of bigeye tuna in the Atlantic Ocean was conducted in 2014 and indicated that the stock is optimally exploited. The status of the Southern bluefin stock is overexploited and the latest stock assessments indicate that the spawning stock biomass is at 4.6% of its original biomass and well below levels that could produce MSY. To summarise, in South African waters yellowfin, southern Albacore and southern bluefin tuna are over exploited in the Atlantic, while swordfish and bigeye tuna are fully exploited. In the Indian Ocean yellowfin tuna are fully to over exploited, as is swordfish.

Net fisheries

There are a number of active beach-seine and gillnet fisheries in South Africa, but the biggest is for haarder / mullet, *Liza richardsonii*. The haarder trek net fishery is managed by TAE and a now fixed number of permits are issued solely for the capture of mullet, St Joseph shark, *Callorhynchus capensis*, and other species that appear on the 'bait list'. The exception is False Bay where right-holders are also allowed to target linefish species that were traditionally exploited (Hutchings and Lamberth 2002).

It is generally accepted that the mullet resource is overexploited, although there is some evidence to suggest that a recovery may be taking place. However, sector conflict and a substantial illegal catch, which may in some years equal or exceed legal catches of mullet and bycatch, negates attempts to rebuild these stocks. The status of the St Jospeh shark resource is unknown and for this exercise has been placed in the fully exploited category.

In 2010, almost 60% of global mullet landings were from the Western Central Pacific (Area 71) with ca. 50,000 tonnes per annum and the Eastern Indian Ocean (Area 57) with 40,000 tpa. The South Africa mullet net fishery is insignificant in terms of catch volumes. As with the South African net fishery, mullet net fisheries in those areas where they have been assessed (FAO Statistical Areas 31, 34, 71 and 81) are also fully to over exploited.

Patagonian toothfish

Patagonian toothfish occur in the southern Ocean area and are managed by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). As an original member of CCAMLR, South Africa has generally applied the CCAMLR fishery measures within its EEZ (DAFF 2012).

Regulation of the fishery was initiated in 2000/2001 by means of a TAC restriction of 2 250 tonnes. Difficulties with setting appropriate catch limits led to a reduced TAC of 450 tonnes for the 2004/2005 season. The annual TAC was maintained at this level until the 2010/ 2011 season when a reduction to 400 tonnes was implemented. Annual catches have been below the TAC and only in the 2010/2011 seasons did the annual catch approach the TACs (DAFF 2012). From the mid 1990's to the mid 2000's, IUU fishing for toothfish throughout its range was a very serious problem. In recent years, however, IUU fishing has been reduced to a fraction of its former levels due to a combination of increased surveillance, high-profile apprehensions and prosecutions and strict port and market regulations. Estimates of IUU catches are built into the toothfish stock assessment process, and allowable catches for legal boats have been reduced accordingly.

The most recent analysis of the SA resource was conducted in September 2011, and incorporated additional catch data from 2007 to 2010.The analysis indicates that the resource is in a depleted state and that abundance may be dropping further. All the other Patagonian toothfish stocks are considered fully exploited with intermediate levels of uncertainty (FAO 2011).

Demersal shark longline

Approximately 2000-2500 tonnes of elasmobranchs are landed by SA fisheries per annum. Sixty-six percent is landed as bycatch of the tuna and swordfish longline fishery (Petersen et al. 2009) and the remainder is targeted. Target fisheries for sharks include demersal longline, pelagic longline, bather protection/ shark net, commercial handline, gillnet and recreational fisherie. Both the demersal shark longline and the commercial handline fisheries target smoothhound sharks *Mustelus mustelus* and *M. palumbes*, soupfin shark *Galeorhinus galeus*, bronze whaler shark *Carcharhinus brachyurus*, dusky shark *C. obscurus*, hammerhead sharks *Sphyrna* spp., cow sharks *Notorynchus cepedianus* and St. Joseph shark *Callorhinchus capensis* (Japp 1999)

Permits for the directed catching of sharks using demersal longlines were issued in 1990. Prior to 1998, over 30 permits were issued to target demersal sharks. Due to poor fishery performance in this fishery, the number permits was reduced to 11 in 2004. Since 2008, only six permits remain. Owing to the higher biodiversity along the east coast of South Africa, demersal shark longline vessels may not fish north of East London (DAFF, 2012).

There is a lack of data on life-history characteristics, movements and migrations for most South African shark species. Stock assessments for Atlantic blue and mako sharks conducted by ICCAT have been inconclusive due to poor data and high levels of under reporting. Despite the difficulties encountered, stock assessments on the smoothhound and soupfin sharks, indicate that the stocks are in fully exploited and over exploited, respectively (Da Silva & Burgener, 2007). In 2010 the two species each contributed around 38% to the shark demersal longline catch (FAO 2014). Nothing is known of the status of the other species that contribute towards the demersal longline shark fishery.

White mussel

The white (or sand) mussel, *Donax serra*, occurs from northern Namibia to the Eastern Cape of South Africa. Abundance is highest along the West Coast on account of higher primary productivity. The

harvest, exclusively for bait, is restricted to the West Coast, although recreational harvesting on sandy beaches in the intertidal zone spans the entire distribution range (DAFF, 2012).

Since 2007, the commercial sector has been managed by means of a TAE of seven right-holders each harvesting within only one of seven commercial fishing areas along the West Coast. The fishery is relatively insignificant when compared to fisheries such as the Atlantic surf clam, striped venus clam and the Japanese carpet shell fisheries. Most of the FAO listed clam fisheries (besides the Japanese carpet shell fishery) appear poorly managed, are either in decline or are currently fully exploited. The local demand for white mussels for bait is small and the mussels are not harvested for human consumption. Comprehensive fishery-independent surveys are required for each area to provide a meaningful assessment data (DAFF, 2012). Uncertainty therefore remains high regarding the status of the white mussel resource on the west coast. On the basis that sand mussels are only harvested for bait and not harvested commercially on the east coast the resource is most likely non-fully exploited.

Regional and global comparisons of exploitation status

In this section comparisons have been made with the exploitation status of global fish stocks and stocks in South Africa, Australia, New Zealand, the US and Canada. By comparing the exploitation status in South Africa to those in these regions, which are widely recognised for their fisheries management expertise and science based management protocols, would provide a good measure of where we are in South Africa. Data for each of the regions has been obtained from the annual or biennial fish stocks status reports published by the responsible bodies, being the Ministry of Primary Industries in New Zealand (2015), The Fisheries Research and Development Corporation in Australia (Flood et al. 2014), NOAA Fisheries (2015) in the USA and the Department of Fisheries and Oceans, Environment, in Canada (2015).

To undertake these comparisons it was necessary to combine several groups into the “fully exploited” and “over exploited” categories, as used and defined in this study. The fully exploited category comprises the Australian categories “Sustainable” and “Transitional recovering”, the New Zealand category “above soft and hard limits”, the American “not overfished” category and the Canadian “healthy” and “cautious” zones. The over exploited category comprises the Australian “overfished”, “transitional depleting” and “environmentally limited” groups, the New Zealand “below the hard limit”, the American “overfished” and the Canadian “critical” categories. For the sake of conformity, the non-fully exploited category was not used in this comparison. All non-fully exploited stocks and or catch volumes were added to the fully exploited data. Undefined stocks or stocks for which no status data were available were excluded.

The proportion of stocks that are either fully or over exploited in the various countries and the global average are shown in Figure 8, while Figure 9 shows the proportion by weight of fish obtained from fully and over exploited stocks in New Zealand, Australia, South Africa and the global average.

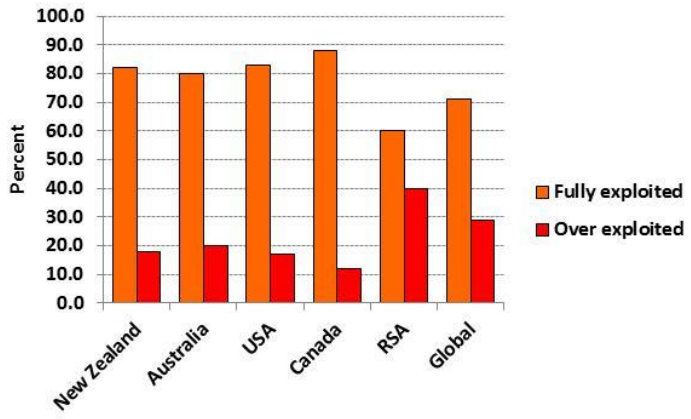

Figure 8. The proportion of assessed stocks that comprise the fully and the over exploited categories in New Zealand, Australia, the USA, Canada, South Africa and the global average.

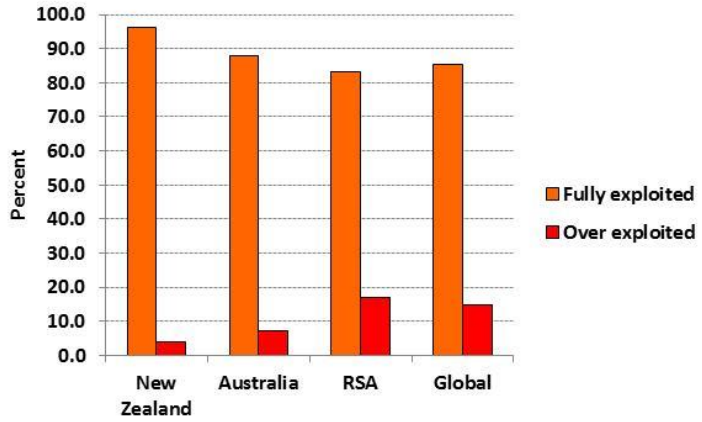

Figure 9. The proportion by weight of fish harvested from fully and over exploited fish stocks in New Zealand, Australia, South Africa and the global average.

The USA has been concerned about its fish stocks for a long time. In 1976 the Magnuson–Stevens Act created a mandate to put overfished stocks into restoration. Though not very successful in its first 20 years of existence, the subsequent implementation of amendments to the act in 1996 and 2006 have yielded positive outcomes. In 2013, 83% of the 478 stocks that could be assessed were classified as fully exploited and 17% were considered over exploited (NOAA Fisheries 2015).

The status review of the Australian fisheries was undertaken on the basis of examining 238 stocks of 68 species that collectively made up 85% and 90% by volume and value respectively, of the annual catch in 2014 (Flood et al. 2014). There was sufficient data upon which to assess 170 of the 238 stocks. Of the assessed stocks, 34 are over exploited and 136 are fully exploited. Many of the over exploited stocks comprise smaller fisheries and hence 92.7% of the total annual catch for 2014 was obtained from fully exploited stocks and just over 7% from over exploited stocks.

The over exploited stocks in Australia include 15 bony fish species and 1 shark species, viz. Bigeye tuna in the Pacific Ocean, Southern Bluefin tuna, 2 stocks of Southern whiting, 1 stock of *Lutjanus johnii*, 4 stocks of *Pagrus auratus*, 2 stocks of southern garfish *Hyporhamphus melanochir*, Mulloway

(Dusky kob) *Argyrosomus japonicus* in NSW, Eastern stock of Gemfish *Rexea solandri*, Northern Territory stock of black jewfish *Protonibea diacanthus,* Banded morwong, *Cheilodactylus spectabilis* in Tasmania and the southern Australian School shark (soupfin shark) *Galeorhinus galeus*. Two crustacean species, the Gulf of St Vincent stock of western King prawn *Melicertus latisulcatus* and the Southern Australian Giant crab *Pseudocarcinus gigas* and three 12 stocks of molluscs, viz. Pale octopus in Tasmania *Octopus pallidus,* 3 stocks of greenlip abalone *Haliotis laevigata* and 8 stocks of blacklip abalone *Haliotis rubra* (Flood et al. 2014).

It was interesting to note that the make-up of the over exploited stocks are quite similar to those in South Africa, consisting mainly of several stocks of linefish, and abalone species and the soupfin shark.

The most recent assessment of fisheries in New Zealand showed that 114 of the 139 stocks that have been assessed to be fully exploited and only 25 stocks were considered over exploited. Of the 25 over exploited stocks 11 where considered to be in a collapsed state. The over exploited stocks include;

- Southern and Pacific bluefin tuna;
- three stocks of black cardinalfish *Epigonus telescopus*;
- five stocks of bluenose *Hyperoglyphe antarctica*;
- six stocks or sub-stocks of orange roughy;
- three stocks or sub-stocks of snapper, *Pagrus auratus*;
- two stocks or sub-stocks of scallops; and
- one stock or sub-stock each of oyster, abalone, John dory (*Zeus faber*) and rig shark, *Mustelus lenticulatus*.

The proportion of available fish in New Zealand that originates from fully exploited resources exceeds 95% and less than 4% comes from over exploited stocks.

In all cases where fisheries in New Zealand are over exploited or have collapsed, corrective management action has been, or is being, put in place to rebuild the stocks. For example, fisheries on three previously-collapsed orange roughy stocks were closed (industry has a voluntary catch limit of zero) to maximise the rate of rebuilding. Two of these have since been re-opened. In 2010, the industry Deepwater Group voluntarily agreed not to fish for orange roughy on the northwest Chatham Rise. The Tasman Bay scallop fishery has also been voluntarily closed by the fishing industry to commercial fishing since 2006. Bluenose stocks were identified as being in need of rebuilding in May 2008, and Total Allowable Commercial Catch levels have subsequently been reduced with further reductions introduced in 2012 to ensure the stocks rebuild to target levels (Ministry of Primary Industries, New Zealand 2015) .

In Canada 88% of fish stocks are fully exploited and only 12% are regarded as over exploited. For those stocks in the healthy zone (i.e., above the "upper stock reference point", which is determined by the productivity objectives of the fisheries), fisheries management decisions and harvest strategies as determined by the Sustainable Fisheries Framework Policies, are designed to maintain fish stocks within this zone, while providing sustainable economic, social and cultural benefits. For fish stocks in the cautious zone (i.e., between the "upper stock reference point" and the "limit reference point"), decisions and strategies promote stock rebuilding to the healthy zone. In the critical zone (i.e., below the "limit reference point", which is the stock level below which productivity

is sufficiently impaired to cause serious harm to the resource but above the level where risk of extinction becomes a concern), stock growth is promoted and catches are kept to the lowest possible level (Environment Canada 2015). The status of the major Canadian fish stocks is shown in Figure 10.

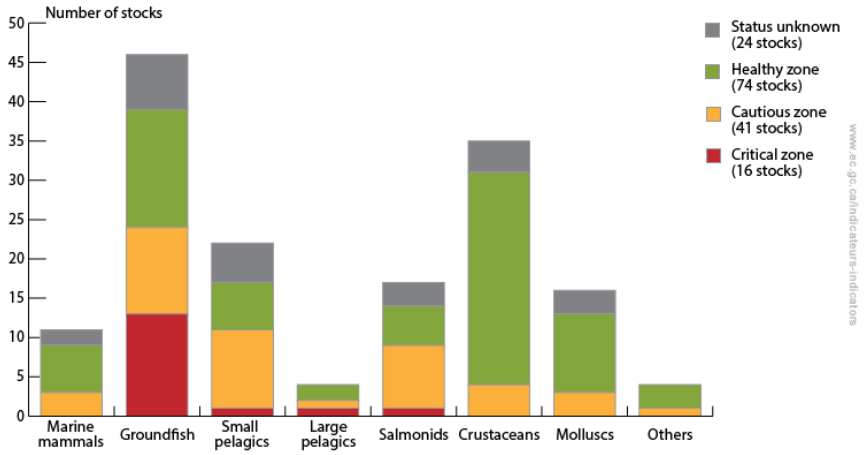

Figure 10. Status of major fish stocks, by stock group, Canada, 2013 (Environment Canada 2015).

In the EU area of member states up to 70% of assessed fish stocks have either shown a decrease in fishing rates or an increase in stock abundance (FAO 2014b).

The average global state and the South African proportion of fully and over exploited fish stocks are more similar to each other than the averages shown for the USA, Canada, New Zealand and Australia. However in all instances for which there is comparable data the available fish from fully (sustainable) exploited stocks exceeds 80%. South Africa's average for 2012 is the lowest at 83%. However, the successful rebuilding of the deep water hake resource will push the percent of available fish from fully exploited resources to over 95% for 2015.

Despite the currently comparable status of management of the fisheries resources among the various countries considered here, there remains serious concern for several over exploited local resources. These are the West Coast rock lobster, the abalone, and the traditional linefish stocks. All of them are traditional fisheries that have sustained coastal communities for generations. Under the previous and the current dispensations these fisheries have become highly politicised and have been further aggravated by the failure of the post-Apartheid fishery reform process to accommodate many traditional fishers in a legal fishing rights framework. To a large extent this has resulted in poaching and operations outside the formal fishery management system (Raemaekers et al. 2011). To rebuild these fisheries to anything near their former levels is clearly no longer possible. However to secure and ensure the future of fishing communities and access to these valuable commodities it is unquestionably pivotal to rebuild these resources to sustainable levels. This goal can only be reached through dialogue that must focus on finding middle ground between political expediency and scientific pragmatism. If one is allowed to overrule the other then these fisheries will decline further into marginal activities.

Conclusion

South Africa has a long history of international excellence in marine science, including research and applied research relating to the management of marine living resources. However, over the last two decades the country's capacity in fisheries science and management has been severely eroded. This

has led to conflict between industry and the responsible department, pertaining particularly to the inability of the department to undertake the necessary research for the setting of the TAC and TAE for several fisheries for certain periods. The marine resources of SA can only be managed successfully if management recommendations are based on excellent science, generated by a dedicated core of scientists and technicians. Fortunately, there have been some encouraging signs of rebuilding the necessary capacity of the Department and this must be supported vigorously by all role players. Nevertheless, despite these temporary setbacks many of the fisheries examined here are at this point in time exploited on a sustainable basis and from a global perspective are well managed.

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