DWESA-CWEBE STATUS REPORT AND SCIENTIFIC RECOMMENDATIONS

FINAL REPORT

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MARINE AND COASTAL MANAGEMENT
Dwesa-Cwebe Status Report and Recommendations

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PREFACE AND ACKNOWLEDGEMENTS

This report was commissioned as a result of a proposal by Marine and Coastal Management to change the management of the Dwesa-Cwebe Marine Protected Area to allow controlled catch and release and/or extractive subsistence fishing in a part of the MPA. The proposal was the result of previous promises extending back several years to re-visit the ban on fishing in certain areas in the MPA that come into force after the Dwese-Cwebe MPA was re-proclaimed under Section 43 of the Marine Living Resources Act in December 2000.

Mr Bruce Mann of the Oceanographic Research Institute in Durban provided much valuable input and undertook the unenviable task of editing and quality control. Mr Jan Venter, Chief Scientist at East Cape Parks also provided valuable comment and input, particularly with regard to the new fishing research project in the MPA. Mr Grant Millar, Manager of the Haven Hotel, provided a much needed community and tourism perspective of the Dwesa-Cwebe issues. I would also like to thank Mr Mulenga Kayulo (Kapanto Trust Project Manager), Mr Ron Begbie (Begbie Professional Management) and Mr Vuyani Dudula (East Cape Development Corporation) for their input.

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EXECUTIVE SUMMARY

Introduction and general context

The Dwesa-Cwebe Marine Protected Area (MPA) is located approximately 120 km north-east of East London on the east coast of South Africa. The MPA incorporates approximately 19 km of mainly rocky shore coastline and extends 6 nautical miles out to sea. The MPA was first proclaimed in 1991 under the Transkei Environmental Decree, then reverted back to South Africa in 1994, maintaining its status as an MPA under the Sea Fisheries Act. It was re-proclaimed under Section 43 of the Marine Living Resources Act in December 2000. The MPA is adjacent to the Dwesa-Cwebe Nature Reserve which was the subject of a successful land claim by the communities of the area. The communities received title deed to the land of the terrestrial reserve, and in return for a Settlement Agreement valued at about R14 million they agreed that the land would be reserved in perpetuity for conservation purposes, with provisos relating to sustainable use of some resources and the implementation of co-management arrangements for the reserve. A Land Trust representing all the communities involved was formed to act on behalf of the communities to ensure the effective use of the allocated restitution funds and form a link between the communities and other institutions.

Before its proclamation under the MLRA, shore angling by tourists was permitted between the Mbashe River and the western bank of the Mbanyane River in the Cwebe MPA, and between Humans Rock and the western bank of the Khobole River in the Dwesa MPA. After proclamation under the MLRA, the Dwesa-Cwebe MPA was made a complete no-take MPA. The Haven Hotel is situated close to the Mbashe River and its management has long maintained that the angling ban was implemented with no consultation and has adversely affected its operations because the hotel was primarily a fishing destination. Occupancy has apparently declined since fishing was prohibited. Local subsistence fishers also claimed a right to access the fish resources of the MPA because of a clause in the settlement of the land claim. As early as 2005, Marine and Coastal Management indicated that the fishing ban might be reconsidered. In 2009, in response to continued pressure from the hotel and communities, the Directorate: Protected Areas produced a proposal to re-open part of the MPA to catch and release fishing for tourists and possibly extractive fishing for subsistence fishers. The marine science community expressed severe reservations because of the possible negative conservation and fisheries impacts of such an action. In addition, the actual benefits that might accrue had not been carefully evaluated. This report examines the significance of MPAs and particularly the Dwesa-Cwebe MPA in relation to national biodiversity conservation targets. It also describes the role that MPAs play in the management of fisheries, and the status and importance of the fish resources in the Dwesa-Cwebe area.

In addition, the report determines the economic value of the Dwesa-Cwebe MPA as a recreational asset, and the value of adult, juvenile and larval fish exported to surrounding areas is estimated. The rate at which the population of protected fish stocks would decline to the levels of adjacent exploited areas if a part of the MPA was opened to fishing, and the economic benefits that might accrue, are calculated. Integral parts of the management equation are the social and political dynamics of the Dwesa-Cwebe area and these are examined in some detail.

International biodiversity conservation context

South Africa is a signatory to several conventions and commitments that oblige the government to conserve biological diversity, maintain ecological integrity and use resources sustainably. Protected Areas contribute to the conservation of all levels of biodiversity. In addition, they allow the natural functioning of processes critical to the environment, help to protect endangered species and critical habitats, play a major role in the restoration of depleted populations, allow the development of representative populations, and help to maintain productivity and sustainable resource use. They also provide critical benchmark areas against which change can be measured. In a world facing potentially large environmental shifts brought about by climate change, the ability to measure change is crucial to management. As part of the Government's international commitment to the conservation of biodiversity, The National Spatial Biodiversity Assessment Programme has developed a twenty year strategy to ensure the conservation and management of biodiversity and the sustainable and equitable benefits to the people of South Africa. Internationally recommended minimum targets of ≥ 20% of the extent of habitats or biodiversity features should be conserved in no-take zones. The National Biodiversity Framework sets a target of 20% of South Africa's marine territory under protection by 2012. The South African government has publicly committed itself to increasing the marine areas under protection of MPAs to 20% of the Exclusive Economic Zone. Internationally, representative MPA networks have been identified as a critical component of marine biodiversity conservation and sustainable marine resource use.

National biodiversity conservation context

The Dwesa-Cwebe MPA is located in the transition zone between the Agulhas and Natal bioregions, two of five principal inshore biogeographic zones along the South African coast. Only 10.5% of the coastline in the Agulhas bioregion and 8.8% of the coastline in the Natal bioregion falls within fully protected no-take areas. These values fall well short of the required target of at least 20%. Because of its location within a transition zone, the Dwesa-Cwebe MPA must be considered an important and sensitive bio-zone that is not replicated elsewhere on the coast. As a unique biozone it should be managed as a no-take sanctuary

area. In addition, the MPA contains the Mbashe estuary which is ranked 2nd in conservation importance out of all estuaries along the Wild Coast. Estuaries and the near-shore marine environment are critically interlinked habitats in the lifecycles of a number of invertebrates and fish species. The removal of protection from an already proclaimed section of coast by opening the Dwesa-Cwebe MPA to any kind of extractive resource use is a step backwards in achieving the goal of conserving 20% of marine habitats.

MPAs and fisheries management

Because of their protected status, populations of fish and invertebrates inside MPAs increase in size, and individuals live longer, grow larger and develop increased reproductive potential, which significantly improves the reproductive potential of a stock as a whole. Adults and reproductive material are exported out of the MPA, improving the stocks in adjacent areas. Critically, MPAs can assist with the protection of the genetic integrity of fish stocks which can be altered in heavily fished populations. Extensive national and international research supports these conclusions. In South African waters, the stocks of at least 20 species of linefish have collapsed (i.e. less than 25% of breeding stock is left), and a further 10 or more are considered to be over-exploited (i.e. 25-40% of breeding stock left). Linefish stocks generally are considered by Marine and Coastal Management to be in a state of crisis. Fishing is considered to be the most significant threat to marine biodiversity in South Africa. MPAs play a critical role in the re-building of South African linefish stocks. The Mbashe River and near-shore environment of the Dwesa-Cwebe MPA have particular fisheries sensitivities because they include one of only two known white steenbras spawning sites, and are home to resident dusky kob populations. These are two of the most threatened of all South African linefish. The Dwesa-Cwebe MPA also contains extensive high quality reef fish habitat, a high diversity of resident reef fish species which are particularly vulnerable to over-exploitation, as well as a large estuarine fish nursery habitat. An estimated 66% of the shallow subtidal area in the MPA consists of rocky reefs, which are one of the most threatened habitats within the shallow inshore environment. Reducing the extent of fully protected area in the Dwesa-Cwebe MPA would constitute poor management practice, from both the biodiversity conservation and fisheries management perspectives. Once fishing is resumed in marine reserves, stocks of animals which have accumulated over time are very rapidly depleted.

Economic values

The economic value of the Dwesa-Cwebe MPA and Reserve as a recreational facility has been estimated at around R6 million per annum, with about R2 million annually being directly related to the marine environment. It has not been possible to calculate the changes in recreational value associated with the possible re-introduction of fishing in the MPA. There is an increasingly strong public sentiment that MPAs should be no-take zones which might

cause some visitors to stay away. However, this loss in recreational use value would be balanced to some degree by anglers visiting the area to take advantage of the legendary good fishing. An earlier survey of visitor activities on the Wild Coast indicated that probably less than 35% of hotel guests consider fishing an important activity in their holiday. Thus the importance of fishing to hotel occupancies should not be over-rated.

The recreational fisheries value of adult fish and recruits exported out of the Dwesa-Cwebe MPA varies between R2.5 million and R8.5 million annually (depending on the model used). Estimates of the subsistence fisheries value of adult fish and recruits exported out of the MPA range between R1.4 million and R4.5 million. These are sustainable values. Allowing subsistence fishers access to a 4 km stretch of the MPA coast would have very short-term benefits for the fishers, and catch rates in the newly opened fishing areas would decline to those of the adjacent exploited areas within four months and quite possibly within three weeks for some species. The once-off economic benefit realised from opening a 4 km stretch of previously protected area to fishing would be somewhere between R223 000 and R1.1 million. For all sectors, the current status of the MPA would appear to have more economic value than relaxing the fishing regulations. Catch and release fishing by visitors to the Haven Hotel would realise about R66 000 annually for community fishing guides at current hotel occupancy rates.

Socio-political issues

There are historical and current serious social and political problems in the Dwesa-Cwebe area, which has resulted in the formation of two opposing Land Trusts and a complete suspension in decision-making functionality. The duplication in Land Trusts and the suspension in decision-making functionality has had, and will continue to have, major economic consequences in terms of the future development of the hotel and tourism in the area. Conflict resolution experts should be contracted in. The money allocated to the Dwesa-Cwebe communities as part of the Land Rights Settlement Agreement appears to be largely unused and there is no implementation of a detailed Development Plan that was formulated to guide sustainable development in the area. The Settlement funds have significant development potential and access to these funds should be investigated immediately.

Future investment in the Dwesa-Cwebe area, and the Haven Hotel in particular, depends on the speedy resolution of the Land Trust issue, which is currently before the courts. The hotel appears to require significant investment to upgrade it and increase occupancies. There is conflict surrounding the recent tender process to select a developer for the hotel. Kapanto Trust, the preferred bidder is willing to invest R10 – R13 million in the hotel but the current hotel management maintains the tender process was unlawful and has negotiated a new

eight year lease with a newly formed Land Trust that does not as yet have legal sanction. There are numerous potential tourism attractions in the Dwesa-Cwebe Nature Reserve and MPA, so despite the historic good angling reputation enjoyed by the area, it appears doubtful that fishing is the only realistic tourism driver in the area.

Management issues

Management and enforcement capacity in the Dwesa-Cwebe MPA is very limited and needs to be increased urgently. The proposal to allow fishing in the MPA would reduce the extent of the no-take protected area by 30%. Management authorities would need to review their professed commitment to both national and international conservation and fisheries management principles if such a reduction was approved, since there is a considerable shortfall in the extent of existing no-take protected areas relative to conservation planning targets. Because of the regulatory limits on subsistence fisher catches and sales and the very short term economic benefits that would be realised, opening up parts of the Dwesa-Cwebe MPA to subsistence fishing cannot be recommended. Although catch and release fishing is promoted as a relatively impact free fishing activity, there are always mortalities associated with catch and release, particularly when fishing from a rocky shore and when anglers are not skilled in the handling of live fish. In view of other potential tourist activities available in the Dwesa-Cwebe Nature Reserve and MPA, catch and release fishing is not a recommended management option.

The economic development of the Dwesa-Cwebe area is greatly constrained by conflict and a lack of institutional cooperation and coordination at all levels. Conflict resolution, the re-constitution of the co-management structure, the establishment of communication channels and relationships of trust with management authorities, the development of education programmes that help local communities understand settlement fund opportunities, investment opportunities, conservation issues, co-management processes, and alternative livelihood issues, are some of the areas on which the Dwesa-Cwebe Nature Reserve and MPA management authorities should focus. Opening up parts of the MPA to fishing is a poor substitute for addressing the real development problems of the area.

1 INTRODUCTION

1.1 Background: Location and extent of the Dwesa-Cwebe Reserve and Marine Protected Area

The Dwesa and Cwebe Nature Reserves together with their contiguous Marine Protected Area (MPA) are located on either side of the Mbashe River approximately 120 km north-east of East London (Figure 1). The Mbashe River is one of the major rivers on the Wild Coast and effectively isolates the two terrestrial reserves from each other, as the river can only be crossed by boat. However, there is radio communication across the river and the two reserves and the MPA are managed as a unit. The Dwesa and Cwebe Reserves and MPA effectively occupy a narrow coastal strip of approximately 19 km long that is between 2 and 4 km wide on the terrestrial side and extends 6 nautical miles out to sea on the marine side (Figure 1). The boundaries of the Dwesa-Cebe MPA are marked by the western bank of the mouth of the Suku River in the north (approx. 32.205459S; 28.946712E) and Human's Rock (approx. 32.312779S; 28.827291E), just north of Nqabara Point in the south. The MPA also includes the tidal portion of the Mbashe River.

Figure 1. Map of Dwesa-Cwebe showing locations referred to in the text.

1.2 Proclamation of Dwesa-Cwebe MPA

The Dwesa-Cwebe MPA was first proclaimed on 24 October 1991 (Transkei GN No. 107) and gazetted under the Transkei Environmental Decree 10 of 1992. In 1994 the MPA and terrestrial reserve reverted back to the Republic of South Africa, and the MPA then fell under the Sea Fisheries Act (No. 12 of 1988). In 1998 the Marine Living Resources Act (No. 18 of 1998) was proclaimed and the Dwese-Cwebe MPA was re-proclaimed under Section 43 of the Marine Living Resources Act in December 2000 (Government Gazette No. 6978). During the time that the MPA was proclaimed under the Transkei Decree and Sea Fisheries Act, shore angling by tourists spending at least one night in the Reserve was allowed between the Mbashe River and the western bank of the Mbanyane River in the Cwebe MPA, and between Humans Rock and the western bank of the mouth of the Khobole River in the Dwesa MPA. In actual fact the residency clause was not enforced and anyone visiting the reserve could fish (Lemm and Attwood 2003). When the Dwesa-Cwebe MPA was proclaimed under the MLRA it was made a complete no-take MPA [Section 42 (2) (a)], although enforcement of this regulation was not strict until after about 2005 (Jim Feely pers. comm.). The initial lack of enforcement has been attributed to the lack of consultation between MCM and the East Cape management authorities of the time.

1.3 Demographics and Socio-political history of Dwesa-Cwebe

The Dwesa-Cwebe communities are situated within the boundaries of the Amatole District Municipality and Mbashe Local Municipality. There are about 2 382 households (±15 000 people) that comprise the communities of Hobeni, Mendwane, Ntlangano, Mpume, Ngoma, Ntubeni and Cwebe. These communities partially lived within the area of the Dwesa/Cwebe Nature reserve up until the 1900's, and had access to the reserves' resources. During the period 1900 – 1950 the communities were removed from the state forest and relocated to land adjacent to the reserve. Again, from 1970 to 1989, the communities were dispossessed of land rights through "betterment planning". In the early 1990s a long and complicated struggle began for the return of land to the communities. Local people had always believed that the Reserves were excluding them from a significant part of their ancestral lands, and that they were not receiving any benefits that could compensate for this exclusion. Levels of antagonism between the communities and Nature Reserve authorities rose and in 1994 the communities staged a land invasion and also destroyed a significant proportion of the intertidal resources in the MPA. In 1996 a formal land claim for the restitution of land rights according to the Restitution of Land Rights Act No. 22 of 1994 was lodged with the Regional Land Claims Commission. A long and complex negotiation based on the rights to land demarcated as the Dwesa and Cwebe Nature Reserves eventually (2001) resulted in a Settlement Agreement that gave title to the land to the Dwesa-Cwebe Land Trust (Dwesa-Cwebe Nature Reserve Management Plan).

The settlement agreement consisted of 3 components:-

- The Dwesa/Cwebe Reserve, including the Ntlonyana cottages situated at the northern end of the MPA
- The Haven Hotel which is situated in the middle of the joint protected area of Dwesa/Cwebe,
- Development for the seven communities of Dwesa/Cwebe

The original Land Trust represented Communal Property Associations of the communities of Ntubeni, Mpume, Ngoma, Ntlangano, Mendwana, Hobeni and Cwebe. The Land Trust comprised one member from each CPA and seven representatives from various government departments (DWAF, ECPB, Local and District Municipalities, DLA). The Trust was formed to act on behalf of the communities to ensure the effective use of the allocated restitution funds and form a link between the community, Mbashe Municipality, Amatola District Municipality and other institutions. The settlement agreement is discussed in more detail below.

1.4 Purpose of this Report

The purpose of this document is to evaluate various management options for the Dwesa-Cwebe MPA. Very broadly, relevant issues include the following:

1. Communities situated adjacent to the Dwesa-Cwebe Nature Reserve and MPA feel that they ought to benefit more than they currently do, from the direct utilisation of the natural resources of the coast and terrestrial environment.
2. Before the proclamation of the Dwesa-Cwebe MPA and during the time when fishing was allowed within the MPA, the Haven Hotel was a choice destination for anglers. The current hotel management believes that without the custom of rock and surf anglers, the hotel is economically unviable, since historically the hotel clientele has consisted principally of anglers.
3. Limited fishing in the Dwesa-Cwebe MPA may promote socio-economic development in an impoverished area.
4. Opening the MPA to fishing directly contradicts the South African national and international commitment to the conservation of marine biodiversity.
5. Opening the MPA to fishing may have negative impacts on fish stocks that are considered to have collapsed or to be over-exploited.

1.5 Terms of Reference for this Report

The Terms of Reference for the report require:

- A description and evaluation of the fisheries management and biodiversity arguments related to keeping the MPA as a no-take zone, or opening it to limited catch and release recreational and/or subsistence fishing.

- An evaluation of the economic arguments related to keeping the MPA as a no-take zone, or opening it to limited catch and release guided recreational fishing and/or subsistence fishing.
- The development of recommendations regarding potential management measures (e.g. areas, bag limits, permit conditions) that could be used to minimize impacts if recreational and /or subsistence fishing is allowed.

1.6 Methodology

This report is essentially a desktop study and has been compiled from reports relevant to local and international MPA management, available literature relating to the Wild Coast in general and the Dwesa-Cwebe MPA in particular, and discussions with various stakeholders in the fields of tourism, MPA management, and utilisation of marine resources along the South African coastline.

1.7 Assumptions and Limitations

The report is limited to some degree in its inability to provide an economic valuation of the Dwesa-Cwebe MPA as detailed as that provided for the Garden Route MPAs (Turpie *et al*. 2006). The data, the resources and the budget were simply not available for the short time given for the preparation of this report (one month). One of the most difficult and critical aspects of this report has been to provide a true reflection of community issues in the Dwesa-Cwebe area. The situation appears to be very fluid and outlooks and opinions tend to be extremely subjective.

2 BENEFITS OF MPAS

This chapter provides a summary of the general benefits of MPAs and the national and international contexts for biodiversity conservation

2.1 Benefits of MPAs

Historically, human activities have had mainly negative impacts on terrestrial and marine environments. Impacts generally take the form of exploitation of renewable and non-renewable resources, pollution, disturbance, and habitat modification. The results are loss of biodiversity, and unsustainable resource use, and sometimes ecosystem changes. One of the most effective counters to human environmental impacts is the proclamation and implementation of Protected Areas that conserve biodiversity at all levels (genetic, species and ecosystem), allow the natural functioning of processes critical to the environment, provide refuges for exploited species, allow the development of representative populations, and help to maintain productivity and sustainable resource use. The conservation of biodiversity and the sustainable use of natural resources are fairly well accepted concepts, but the provision of benchmark areas and populations against which change can be measured is a critical management feature in a world facing potentially large environmental changes brought about by climate change. One cannot evaluate the changes to systems and populations unless one can measure how much the current situation deviates from the past.

2.2 Specific benefits of MPAs to fisheries

MPAs are slightly different from terrestrial Protected Areas because the marine boundaries are always open (i.e. not closed by fences). In the marine environment, currents, winds and waves move nutrients, pollutants, plants, animals and their food, waste, and reproductive outputs in and out of the MPA boundaries. Thus linkages are often complex and occur at much larger scales than on the land. This means that events that take place far from the MPA can have a major impact on the MPA and equally, events occurring within the MPA can have an impact on the environment far from the MPA. This means in effect that MPAs are both more robust than terrestrial Protected Areas and more vulnerable.

In common with terrestrial Protected Areas generally, the main objectives of most legally designated MPAs are biodiversity conservation, and the protection or restoration of depleted populations, endangered species and critical habitats. Internationally, representative MPA networks have been identified as a critical component of marine biodiversity conservation and sustainable marine resource use (Convention on Biological Diversity 2004, World Summit Sustainable Development Resolutions).

Over and above this, it has become clear that the proclamation and maintenance of MPAs actually functions as a valuable fisheries management tool for a wide range of harvested organisms from widely varying habitats (Roberts and Poulinin 1993, IUCN Protected areas Programme 1998; Roberts and Hawkins 2000, Halpern and Warner 2002, Branh and Odendall 2003; Gell and Roberts 2003, 2005; Halpern 2003; Kenchington *et al*. 2003). Apart from protecting ecosystem elements and processes that are not protected by other forms of fisheries or environmental management, research has indicated that MPAs almost certainly benefit adjacent fisheries through two mechanisms: net emigration of adults and juveniles across borders, termed 'spillover', and export of pelagic eggs and larvae and increased settlement of juvenile animals outside the boundaries termed 'seeding'. Moreover, inside reserves, fish and invertebrate populations increase in size, and individuals live longer, grow larger and develop increased reproductive potential, which significantly improves the reproductive potential of a stock as a whole (see BOFFFF Hypothesis in Berkeley *et al*. 2004). In cases where the reproductive potential has been massively reduced by exploitation this can be a very significant factor in the survival of a fishery. Furthermore, MPAs can assist with the protection of the genetic integrity of fish stocks which can be altered in heavily fished populations (e.g. size at maturity, size at sex change, etc.). In short, well enforced marine reserves have great potential to maintain or enhance both vertebrate and invertebrate fishery catches and increase sustainability (Attwood *et al.* 1997a,b, Roberts and Hawkins 2000, Gell and Roberts 2003, 2005, Martin *et al.* 2007). Given the developing crisis in the oceans and their fisheries, the significance of MPAs as fisheries management tools becomes increasingly important. Other functions of MPAs include education and tourism, which play and important role in improving the popular and financial support of biodiversity conservation and improving the public understanding of the need for and purpose of, fisheries regulations.

2.3 International context for the Conservation of Biodiversity and Sustainable Resource use in South Africa.

Because of perceived threats to the environment, a series of international agreements and conventions, declarations and mandates have been developed internationally over the past few decades. Governments that are signatories to these agreements and conventions take on the responsibility to ensure that they are implemented within their own areas of jurisdiction. South Africa is a signatory to several of these conventions and commitments that oblige the government to conserve biological diversity, maintain ecological integrity and use resources sustainably. These include;

- The Convention on Biological Diversity (CBD 1992) requires member States to establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity.

- *Nairobi Convention* for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region requires that signatory governments in the Western Indian Ocean establish a regional programme to select, establish, and manage MPAs with a view to creating a representative network of protected areas in the Eastern African region.
- The 2002 World Summit on Sustainable Development (WSSD) attempts to set time frames for the establishment of MPAs to the effect that by 2012 *a system of effectively managed, ecologically based MPAs that contribute to a permanent representative global network is established and maintained.* In addition, the WSSD calls for the restoration of fish stocks by 2015.
- The 2003 World Parks Congress calls on states to establish by 2012: "…a global system of effectively managed, representative networks of marine and coastal protected areas, consistent with international law and based on scientific information, such that it greatly increases the marine and coastal areas managed by MPAs … and the networks …. should include strictly protected areas that amount to at least 20 – 30% of each habitat….
- Ch 17 of Agenda 21 of the United Nations Conference on Environment and Development (UNCED) calls on states to identify marine ecosystems showing high levels of biodiversity and productivity and other critical habitat areas and provide necessary limitations on their use, and properly manage these areas through, amongst other things, the designation of MPAs.

The South African government is therefore committed to increasing the marine areas under protection of MPAs and to the restoration of overexploited fish stocks.

2.4 National context for the Conservation of Biodiversity and Sustainable Resource use

The importance of the conservation of biodiversity and sustainable resource use is recognised by the national government with the proclamation of the Protected Areas Act (2003) and the Biodiversity Act (2004) which form part of the suite of the National Environmental Management legislation. The Biodiversity Act gives effect to the International Convention on Biological Diversity. One of the requirements of the Biodiversity Act is the establishment of the South African National Biodiversity Institute (SANBI). SANBI co-ordinated South Africa's first National Spatial Biodiversity Assessment (NSBA; Driver *et al.* 2005) which resulted in the National Biodiversity Strategy and Action Plan (DEAT 2005), and guided the development of a National Biodiversity Framework (DEAT 2007) which is required by the Biodiversity Act. The NBSAP is a twenty year strategy, developed as part of South Africa's commitments to the CBD. Its goal is the conservation and management of terrestrial

and aquatic biodiversity to ensure sustainable and equitable benefits to the people of South Africa, now and in the future (Sink 2006). Establishing a network of conservation areas that conserve a representative sample of biodiversity and maintain key ecological processes is a key objective. Apart from promoting an integrated and uniform approach to the conservation of biodiversity, the National Biodiversity Framework sets a target of 20% of South Africa's marine territory under protection by 2012.

In South Africa, MPAs are proclaimed under Section 43 of the Marine Living Resources Act 18 of 1998. The Act allows the Minister to declare MPAs for the purposes of:

(a) *protecting fauna and flora or a particular species of fauna or flora and the physical features on which they depend;*

(b) *facilitating fishery management by protecting spawning stock, allowing stock recovery, enhancing stock abundance in adjacent areas, and providing pristine communities for research; or*

(c) *diminishing any conflict that may arise from competing uses in an area.*

In MPAs all extractive resource use activities (both renewable and non-renewable resources) are prohibited, as are any other activities that may adversely impact on the ecosystems of that area. The only exceptions are activities permitted by the Minister for the purposes of proper management. This is normally achieved by zoning the MPA.

3 DWESA-CWEBE MPA AND THE CONSERVATION OF BIODIVERSITY

3.1 Bioregions and conservation

The marine component of the NSBA outlines the division of the South African coastline into five main biogeographic zones. Subdivisions are based on based on large-scale biological variability and biogeography, and large-scale habitat differences related to different current systems with different temperatures and productivity (Lombard *et al*. 2004). The Agulhas bioregion, previously known as the warm temperate south coast, incorporates the area from Cape Point to the Mbashe River, the Mbashe River being considered as the boundary between the subtropical Natal bioregion to the north, and the warm temperate Agulhas bioregion to the south (Emanuel *et al.* 1992; Stegenga and Bolton 1992; Bustamante and Branch 1996). The Agulhas bioregion supports a number of important commercial fisheries in the south and out of all the bioregions on the South African coast it hosts the greatest number of endemics, including sparid reef fish, octocorals and algae (Smith and Heemstra 1986, Dai 1998, Branch *et al.* 1999, Sink 2006). This bioregion also includes spawning grounds and nursery areas for many species (Beckley 1993, Augustyn *et al.* 1994, Hutchings *et al.* 2002). The Mbashe River does not form a clearly defined “marine fence” north of which one set of species, habitats and oceanographic conditions occur and south of which another set occur. The entire area between Port Edward and East London is an area of transition between Agulhas bioregion and the Natal bioregion. However, the Mbashe River is a significant ecological boundary marker because a fixed strong inshore subsurface temperature front occurs there, upwelling cells are present to the south of the Mbashe system (Beckley and van Ballegooyen 1992) and the river marks the approximate northern distribution limit for abalone and southern distribution limit for east coast rock lobster (Fielding *et al*. 1994). There is also a clear break in estuarine fish communities at the Mbashe (Harrison 2002) and a clear difference in the species composition of linefish catches between the northern and southern Transkei (Fennessy *et al.* 2003).

As an area of transition, the Dwesa-Cwebe MPA must be considered an important and sensitive bio-zone that is not replicated elsewhere on the coast. As a unique bio-zone it should be managed as a no-take sanctuary area. In addition, such a transition zone is likely to be sensitive to changing ecological conditions. In view of probable large-scale changes resulting from global warming, the area will provide a number of early indicators of change. It is thus particularly important to maintain the area as a baseline or benchmark against which environmental change can be measured. The opening of the area to any kind of extractive resource use greatly devalues its function as a baseline or reference site, because it introduces unquantifiable impacts that have nothing to do with naturally changing ecological

conditions. Aside from being located in an area of transition, it is noteworthy that the Dwesa-Cwebe MPA is the only fully protected (no-take) area of any significance in the Agulhas bioregion east of Port Elizabeth (although this may change with the proclamation of the East London MPAs and the proposed extension of the Addo National Park).

The marine component of the NSBA outlines the contributions that existing MPAs make to South Africa meeting its biodiversity conservation targets (Lombard *et al*. 2004). In the Agulhas bioregion, 19% of the coastline falls within category 1-3 MPAs (some kind of protection), but only 10.5% of the coastline falls into fully protected no-take areas. Similarly, 20% of the coastline of the Natal bioregion falls into category 1 – 3 MPAs but only 8.8% falls into fully protected areas.

Internationally recommended minimum targets of ≥ 20% of the extent of habitats or occurrences of species (biodiversity features) should be conserved in no-take zones (World Parks Congress 2003). Mapping the protected length of coastline as a surrogate for biodiversity features, at 10.5%, the Agulhas bioregion and 8.8% of the Natal bioregion falls well short of the required target of at least 20%. The South African government has publicly committed itself to increasing the marine areas under protection of MPAs to 20% of our Exclusive Economic Zone (EEZ) by 2012. Given the importance of existing MPAs in contributing towards this target of at least 20% of marine territory under protection, removing protection from an already proclaimed section of coast would seem to be a step backwards and would not constitute good management practice. Removing protection is particularly illogical given that currently less than 1% of the total area of our EEZ enjoys MPA protection (Lombard *et al.* 2004).

3.2 Biozones, Habitats and Conservation

The proportion of protected coastline relative to unprotected coastline is a relatively coarse measure of the extent of biodiversity conservation. At a finer scale, the proportion of particular biozones (i.e. intertidal, shallow subtidal, deep subtidal etc.) within each bioregion is highly relevant, and within each biozone the proportion of individual habitats (e.g. rocky shores, sandy shores, sub-tidal rocky reefs, estuaries etc.) protected is also highly relevant. The NSBA indicates that less than 10% of the shallow subtidal biozone in the Agulhas bioregion is protected in no-take MPAs (Lombard *et al*. 2004). Dwesa-Cwebe MPA forms a significant proportion of this protected area and it makes little sense to remove protection if national government is committed to double the existing area under protection in the space of two years.

Generally there are far less data to assess conservation status of habitats because the extent of the different habitats and particularly subtidal habitats (e.g. high profile rocky reefs, low profile reefs, sandy bottom, muddy bottom, mixed sand and rock, etc.) along the coast of South Africa is poorly documented. Clarke and Lombard (2007) have rectified this to some extent by a detailed coastal habitat mapping exercise and interviews with expert resource users familiar with various parts of the coastline. Intertidally, the Dwesa coast has high habitat diversity. Of greater relevance to this report, is however, the extent of good linefish habitat in the Dwesa-Cwebe area. Almost the entire Dwesa coast has a high linefish habitat rating (based on reef fish abundance scores in Clark and Lombard 2007), which generally reflect structurally complex rocky reefs. Subtidal rocky reefs support a high diversity of fish species but are one of the most threatened habitats within the shallow inshore environment. This habitat is listed as both vulnerable and endangered along the Wild Coast (Lombard *et al*. 2004).

International practice, recommends targets of 20 - 30% of the extent of each habitat in each of the biozones should be fully protected (United Nations 2002; IUCN 2004). Only about 9% of good quality linefish habitat (i.e. only 46% of the target) is currently protected in no-take MPAs if targets are set at 20% of habitat (Clarke and Lombard 2007). If targets are set at 30% of the habitat, then only about 6% (i.e. only 31% of the target) is protected in no-take MPAs (Clarke and Lombard 2007). It make no sense in terms of South Africa's conservation planning programme which is currently being driven by highly reputable management authorities (including SANParks, Cape Nature, Cape Action Plan for the Environment, WWF-South Africa, Eastern Cape Parks, Ezemvelo KZN Wildlife) to further reduce this figure by opening up a protected area of high quality linefish habitat to fishing. Apart from its bio-regional context, such an action flies in the face of South Africa's international commitments to biodiversity conservation. There is a clear and urgent need to add to the extent of no-take network rather than to reduce it.

3.3 Estuarine environments and conservation

Including the Suku estuary on the northern boundary, the Dwesa-Cwebe MPA contains 11 estuaries. All of them except the Mbashe estuary are small and classified as temporary open/closed estuaries. The Mbashe is large (132 ha), permanently open, and is ranked 2nd in conservation importance out of all estuaries along the Wild Coast, and 25th out of about 250 estuaries in South Africa as a whole (Turpie and Van Niekerk 2005). It is also included as one of a minimum set of estuaries required in a protected area network to represent 100% of estuarine species in South Africa. Estuaries in general are poorly protected (Turpie 2004, Driver *et al.* 2005), but the Mbashe has recently been accorded some degree of protection in that no fishing is allowed in the tidal portion of the estuary due to the fact that it is

incorporated into the Dwesa-Cwebe MPA. Conservation importance of the estuary is assessed on size of the estuary, rarity of physical type, functional importance (input of detritus, nursery function for invertebrates and fish, bird feeding, etc.), habitat diversity in the estuary, and biodiversity importance relative to plants, invertebrates, fish and birds. The Mbashe estuary scores highly on diversity of fish, invertebrates and habitats (Turpie and Van Niekerk 2005). However, estuaries and the near-shore marine environment are critically interlinked habitats in the lifecycles of a number of invertebrates and fish species. A number of these fish species are considered as collapsed or endangered stocks (e.g. dusky kob *Argyrosomus japonicus* and white steenbras *Lithognathus lithognathus*). Activities in the adjacent marine environment can play a big role in both processes and the biodiversity of the estuary. Thus it is regarded as poor management practice to protect an estuary and then allow extractive resource use activities in the near-shore marine environment immediately adjacent to the estuary, particularly when the issues at stake are highly threatened fish species (see Fishery Management Issues below).

3.4 Species conservation and the Dwesa-Cwebe MPA

The Agulhas and Natal bioregions support a high diversity of seaweeds, intertidal and subtidal invertebrates and fishes (Bolton and Anderson 1990, Branch e*t al.* 1994, Bustamante and Branch 1996, Turpie *et al*. 2000, Bolton and Stegenga 2002; Lombard *et al.* 2004; Anderson *et al.* 2009). Many endemic (occur only in South Africa) invertebrate species (including amphipods, isopods, crabs, echinoderms, ascidians, octocorals, chitons, bivalves, gastropods, polychaetes, lobsters and nudibranchs, are represented in the Dwesa-Cwebe MPA (Branch e*t al.* 1999, Bustamante and Branch 1996; Awad *et al.* 2002). Endemism for molluscs in the Agulhas bioregion is particularly high (70-90%; Dai 1998), over 300 species of algae have been recorded in the area around Dwesa (Anderson *et al.* 2009) and fish endemicity is particularly high along the south eastern Cape coast (Turpie *et al*. 2000; Mann 2001, Mann and Celliers 2005, Mann *et al*. 2006). In view of this high diversity, the Dwesa-Cwebe MPA plays a key role in preserving biodiversity at a species level and must be considered extremely important component of South Africa's conservation estate and a major role player in the national implementation of South Africa's international conservation commitments.

A great deal of research that provides invaluable detail of the biota and processes of the Dwesa-Cwebe MPA was undertaken in the 1980s and 1990s by Arthur Dye and Theresa Lasiak, both individually and in conjunction with other scientists. Publications include assessments of intertidal shellfish stocks, evaluation of the population dynamics, reproductive and recruitment processes of a wide arrange of molluscs, studies aimed at

understanding primary production, succession and re-colonisation processes, and natural changes in rocky shore community structure. Several studies document the extent of intertidal harvesting activities around Dwesa-Cwebe, and the differences in rocky shore community structure between protected and harvested areas (See Appendix 1: A. Dye and T. Lasiak Research Publications). The MPA thus plays a major role in strengthening our understanding of benchmark communities in the Agulhas and Natal bioregions.

It must be understood that these benchmark communities are the result of all the various supratidal, intertidal, shallow subtidal and offshore biotic elements that interact together and with the oceanographic processes of the area, to form a unique system that needs to be conserved in its entirety. It is no good protecting the intertidal and the offshore biozones and allowing exploitation of the near-shore marine biozone, because this will impact on all the zones, introduce unquantifiable impacts, and thus reduce the value of the standard.

There is very little information about subtidal communities in the Dwesa-Cwebe MPA. Fielding *et al*. (1994) evaluated stocks of abalone (*Haliotis midae*), oyster (*Striostrea margaritaceae*), mussels (*Perna perna*) and spiny lobsters (*Palinurus homarus*) and there have been some fairly comprehensive seaweed collections in the general area (Bolton and Stegenga 1987; Bolton and Stegenga 2002; Bolton *et al*. 2004; Anderson *et al*. 2009). Inshore fish communities are the subject of a recently instituted study to evaluate the role the MPA plays in protecting fish stocks (Venter 2009). In the first year of the project 694 fish from 25 species have been recorded in the MPA. These are listed in Table 1 below. The area is also home to a large number of other fish species that occur in the Agulhas and Natal bio-regions and that certainly receive protection in the Dwesa-Cwebe MPA (see Table 2).

Table 1. Fish species occurring in the Dwesa-Cwebe MPA that have been captured in the first year of a long-term project to gauge the impact the MPA has on fish stocks in the area (Venter 2009). The stock status as far as it is known is shown with corresponding references cited in the last column with species of concern in bold. Endemic species (E), Threatened (T) taxa as listed in Lombard *et al.* (2004) and priority (P) linefish for conservation (Lamberth and Joubert 2000) are indicated. Those species where the breeding stock is reduced to less than 25% ([1]- less than 10%, [2]– less than 25%) are considered as collapsed fisheries. Overexploited species have less than 40% breeding stock remaining. (Table format from Sink 2006)

Family	Species	Common name	Status and notes on protection in Dwesa-Cwebe MPA	E	T	P	References
Dasyatidae	*Dasyatis chrysonota chrysonota*	Blue ray	Unknown, commercial value has increased recently. Potentially vulnerable due to increased fishing pressure	+			Cowley 1990
Rhinobatidae	*Rhinobatos annulatus*	Lesser sandshark	Unknown, often caught by surf anglers, requires estuaries for pupping	+			Rossouw 1983, 1984 Heemstra and Heemstra 2004
Odontaspididae	*Carcharius taurus*	Ragged tooth shark	Population stable but significant decline in mean size caught in shark nets. Considered very vulnerable because of low fecundity. MPAs provide important refuges				Mann 2000; Cliff NSB Unpublished, Dicken et al 2008

Family	Species	Common name	Status and notes on protection in Dwesa-Cwebe MPA	E	T	P	References
Triakidae	*Triakis megalopterus*	Spotted gulley shark	Unknown but resident behavior, low reproductive capacity and late maturity make it very vulnerable to over-exploitation. MPAs provide important refuges	+			Goosen 1997, Mann 2000
Ariidae	*Galeichthys feliceps*	White seabarbel	Unknown, previously undesirable by-catch species now becoming more important as other linefish species decline	+			Tilney 1990, Mann 2000
Soleidae	*Austroglossus pectoralis*	East coast sole	Unknown mainly trawl fishery Catches have declined significantly. Benefit from offshore MPAs	+			Heemstra and Heemstra 2004
Dichistiidae	**Dichistius capensis*	Galjoen	Collapsed[2]. Nomadic but benefits greatly from MPAs. Evidence of spillover into adjacent fished areas from De Hoop MPA	+		+	Bennett 1988, Bennett and Attwood 1993, Attwood and Bennett 1993, 1994, 1995
Dichistiidae	**Dichistius multifasciatus*	Banded galjoen	Unknown but there have been declines in CPUE and catch composition. Benefit from MPAs	+			Mann 2000
Muraenidae	*Gymnothorax undulatus*	Leopard moray	Unknown generally considered a pest by fishermen. Not targeted				Heemstra and Heemstra 2004
Plotosidae	*Plotosus nkunga*	Eeltail barbel	Unknown, Generally undesirable by-catch species now becoming more important as other linefish species decline				Heemstra and Heemstra 2004
Pomatomidae	*Pmatomus saltatrix*	Shad	Over-exploited. Very high fishing pressure makes up very high %age of shore catches in KZN. MPAs provide sanctuary areas where fishing effort absent			+	Mann 2000
Sciaenidae	*Argyrosomus japonicus*	Dusky kob	Collapsed[1] stock rebuilding urgently needed and increased MPAs. Estuarine MPAs like the Mbashe are extremely important for this species		+	+	Griffiths 1997, Mann 2000
Sciaenidae	*Umbrina robinsoni*	Baardman	Collapsed[2] highly resident vulnerable species. Benefits greatly from MPAs				Mann 2000, Hutchings 2009
Scorpididae	*Neoscorpis lithophilus*	Stonebream	Optimally exploited, important shore fishing species especially for subsistence fishers	+			Mann 2000, Mann et al 2002
Serranidae	*Epinephelus andersoni*	Catface rock-cod	Collapsed[2] stock rebuilding needed and increased MPAs. MPAs are extremely important for this species	+		+	Fennessy & Radebe 2000 Fennessy 2000
Serranidae	*Epinephelus marginatus*	Yellowbelly rock-cod	Collapsed[2] Stock rebuilding needed and increased MPAs. MPAs are extremely important for this species This species is listed as Endangered on the IUCN redlist.			+	Fennessy & Radebe 2000 Fennessy 2000
Sparidae	**Cymatoceps nasutus*	Poenskop	Unknown probably collapsed, stock rebuilding needed and increased MPAs. MPAs are extremely important for this species.	+	+	+	Buxton and Clarke 1989 Hecht and Buxton 1993 Penney et al. 1999, Booth 2000
Sparidae	**Diplodus cervinus hottentotus*	Zebra	Unknown. Slow growth and high residency require precautionary approach. MPAs considered the best option for management.				Mann and Buxton 1992, 1997, 1998. Mann 2000
Sparidae	**Diplodus sargus capensis*	Blacktail	Unknown, Slow growth and high residency require precautionary approach. Important indicator species. Protected in several MPAs.				Bennett and Attwood 1991, Mann and Buxton 1997, 1998 Attwood and Bennet 1995a, Gotz et al. 2008.
Sparidae	**Lithognathus lithognathus*	White steenbras	Collapsed[1]. Drastic management measures required for rebuilding stock. Protection of spawning aggregation in Dwesa-Cwebe MPA critical for	+	+	+	Bennet 1993, Attwood and Bennett 1995, Lamberth 2000

Family	Species	Common name	Status and notes on protection in Dwesa-Cwebe MPA	E	T	P	References
			management of this species.				
Sparidae	**Pachymetopon grande*	Bronze bream	Unknown probably collapsed, sharply declining CPUEs. Highly resident slow growing species. Important in subsistence and recreational fishery. MPAs considered the best option for management			+	Booth 2000d, Cowley et al 2002, Gotz et al 2008
Sparidae	**Sparodon durbanensis*	White musselcracker Brusher	Unknown, probably collapsed Declining CPUE in Port Elizabeth area. Resident as juveniles, slow growth and late maturity suggest a conservative management approach.	+		+	Buxton and Clark 1991 Booth 2000f Gotz et al 2008
Tetraodontidae	Arothron hispidus	*Whitespotted puffer*	Unknown, unlikely to be threatened. Considered a nuisance by anglers				Heemstra and Heemstra 2004

Table 2. Additional linefish species not yet captured in the Dwesa-Cwebe linefish monitoring project that almost certainly receive protection in inshore and/or offshore biozone of the Dwesa-Cwebe MPA (data from Sink 2007; Mann 2009). The stock status as far as it is known is shown with corresponding references cited in the last column with species of concern in bold. Endemic species (E), Threatened (T) taxa as listed in Lombard *et al.* (2004) and priority (P) linefish for conservation (Lamberth and Joubert 2000) are indicated. Those species where the breeding stock is reduced to less than 25% ([1]- less than 10%, [2]– less than 25%) are considered collapsed fisheries. Overexploited species have less than 40% breeding stock remaining. (Table format from Sink 2006)

Family	Species	Common name	Status and notes on protection in Dwesa-Cwebe MPA	E	T	P	References
Carcharhinidae	*Carcharhinus obscurus*	Dusky shark	Unknown, but increasing fishing pressure for shark fins. Decline in CPUE				Mann 2000 Hussey *et al.* 2009
Carcharhinidae	*Mustelus mustelus*	Smooth-hound	Unknown, targeted by recreational and commercial fishers and by long lining and trawling				Goosen and Smale 1999 Mann 2000
Dinopercidae	*Dinoperca petersi*	Cavebass	Unknown, important recreational and commercial fish and vulnerable to spearfishers. Highly resident and receives protection in MPAs				Mann 2000
Haemulidae	*Plectorhinchus chubby*	Dusky rubberlip	Unknown resident reef fish therefore potentially vulnerable. Transkei forms southernmost limit of distribution				Heemstra and Heemstra 2004
Haemulidae	*Pomadasys comersonnii*	Spotted grunter	Optimally exploited. Very high recreational and subsistence fishing pressure in estuaries. Juveniles highly resident in estuaries. Requires more protected estuaries and adjacent inshore marine MPA			+	Mann 2000 Fennessy unpublished data
Haemulidae	*Pomadasys olivaceum*	Pinky/Piggy	Under-exploited. Abundant shore angling species, important for subsistence. Decreasing CPUE and catch composition in KZN indicate possible over-fishing				Mann 2000
Lutjanidae	*Lutjanus argentimaculatus*	River snapper	Unknown, but declining CPUE cause for concern. Estuarine dependent, degradation of estuaries may affect juveniles. Needs protection in estuaries and on shallow inshore reefs				Mann 2000
Serranidae	*Epinephelus malabaricus*	Malabar rockcod	Unknown. Transkei is southernmost limit of distribution. Estuarine dependent juveniles. Tropical MPAs are important for this species				Fennessy 2000
Serranidae	*Epinephelus rivulatus*	Halfmoon rockcod	Unknown. No rend in catches. Highly resident species. MPAs are extremely important for this species	+			Fennessy & Radebe 2000 Fennessy 2000

Family	Species	Common name	Status and notes on protection in Dwesa-Cwebe MPA	E	T	P	References
Sparidae	*Argyrozona argyrozona*	Carpenter	Collapsed[2]. Possible that the Dwesa-Cwebe MPA protects part of the adult stock	+			Griffiths and Mann 2000 Griffiths and Brouwer 2005a,b
Sparidae	*Boopsoidea inornata*	Fransmadam	Unknown. Increased targeting Lower mean size outside of MPAs	+			Buxton and Smale 1984 Götz 2006
Sparidae	**Cheimerius nufar*	Santer	Unknown, extremely important commercial species, increasing importance in catches. MPAs important for future management				Coetzee & Baird 1981, Garratt 1985, Griffiths & Wilke 2002 Cowley et al. 2004
Sparidae	**Chrysoblephus anglicuss*	Englishman	Collapsed[2]. Heavily skewed sex ratios. Stock rebuilding and more MPAs required. The Dwesa-Cwebe MPA is at the southern limits of distribution for this species.	+	+	+	Mann 2000 Mann et al 2005
Sparidae	**Chrysoblephus cristiceps*	Dageraad	Collapsed[1]. Critical stock rebuilding and more MPAs required. Likely that the Dwesa-Cwebe MPA is very important for this species.	+	+	+	Buxton and Smale 1989, Buxton 1990, 1992, 1993 Crawford and Crous 1982 Hecht and Tilney 1989
Sparidae	*Chrysoblephus gibbiceps*	Red stumpnose	Unknown, probably collapsed. Declines in the CPUE in the southern Cape suggest collapse. Adults benefit from protection in MPAs (e.g. TNP and De Hoop).	+	+	+	Crawford and Crous 1982, Booth 2000a Griffiths 2000
Sparidae	**Chrysoblephus laticeps*	Red Roman	Overexploited in most areas. Effective MPAs such as Tsitsikamma, Goukamma and De Hoop critical for management of this species.	+			Buxton and Smale 1989 Hecht and Tilney 1989 Buxton 1990, 1992, 1993 Kerwath et al 2007 a, b, Kerwath et al 2008, Gotz et al 2008
Sparidae	**Gymnocrotaphus curvidens*	Jan Bruin	Unknown. Nowhere abundant .Only occasionally caught on line	+			Heemstra & Heemstra 2004.
Sparidae	*Pachymetopon aeneum*	Blue hottentot	Unknown. Becoming increasingly important in commercial catches in southern KZN and E. Cape. MPAs provide a valuable management tool for this species	+			Buxton & Clarke 1986 Booth 2000c
Sparidae	*Pagellus bellotti natalensis*	Sand soldier, red tjor tjor	Unknown, abundant species caught as trawl bycatch. Not reef dependent and found on soft subtrata.				Wood *et a*l. 2000
Sparidae	*Polyamblyodon germanium*	German	Unknown, although not abundant is an important species off the Wild Coast. Protection in MPAs necessary	+			Heemstra and Heemstra 2004
Sparidae	*Petrus rupestris*	Red steenbras	Collapsed[1] stock has declined by more than 90%. Urgent stock rebuilding required. Desa-Cwebe and other Wild Coast MPAs critical for the protection of this species.	+	+	+	Smale 1988, 1990 Buxton and Smale 1989 Brouwer 2002 Smale & Punt 1991 Griffiths 2000,
Sparidae	*Polysteganus praeorbitalis*	Scotsman	Collapsed[2] Stock has declined by more than 65%. Urgent stock rebuilding required. Dwesa-Cwebe and other Wild Coast MPAs critical for the protection of this species	+	+	+	Garratt et al. 1994, Mann 2000, Mann et al 2005
Sparidae	*Polysteganus undulosus*	Seventy four	Collapsed[1] stock has declined by more than 95%. 15-year moratorium in place. Urgent stock rebuilding required, Dwesa-Cwebe and other Wild Coast MPAs critical for the protection of this species	+	+	+	Garratt 1996, Penney et al. 1999, Griffiths 2000, Mann 2007
Sparidae	*Pterogymnus laniarus*	Panga	Optimally exploited. Recovering from overexploitation by foreign trawlers in the 60's and 70's. Juveniles and adults present in TNP.	+			Booth and Buxton 1997 Booth *et al.* 1999 Booth 2000e Wood et. al 2000
Sparidae	*Porcostoma*	Dane	Unknown, becoming increasingly	+			Mann 2000

Family	Species	Common name	Status and notes on protection in Dwesa-Cwebe MPA	E	T	P	References
	dentata		important in linefishery				
Sparidae	*Rhabdosargus holubi*	Cape stumpnose	Unknown, juveniles abundant in estuaries in the E. Cape. Adults found in the surf-zone and on subtidal reefs.	+			Mann 2000
Sparidae	*Spondyliosoma emarginatum*	*Steentjie*	Not considered over-exploited. Increasingly caught as other sparids are depleted. May have benefited from overfishing of its predators.	+			Aitken and Mann 2000 Fairhurst et al. 2007..

Clearly the Dwesa-Cwebe MPA supports a high diversity of fish species. More significantly, a number of these species are endemic (i.e. if South Africa does not manage them properly no-one else can), priority linefish species and in many cases the stocks have collapsed (Tables 1 and 2). One of the key issues faced by South African line fisheries management is the declining stocks of many of the resources historically targeted by subsistence, commercial and recreational fishers. To date, in South African waters, the stocks of at least 20 species of linefish have collapsed (i.e. less than 25% of breeding stock is left), and a further 10 or more are considered to be over-exploited (i.e. 25-40% of breeding stock left) in terms of the Linefish Management Protocol; Griffiths *et al.* 1999; Figure 2). The previous Minister of Environmental Affairs and Tourism, Minister Vali Moosa, recognising the dangers facing stocks of many linefish species, went so far as to declare the line fishery in a state of emergency (Government Gazette, 29 December 2000 No. 21949, Notice 4727 of 2000). As a result of this declaration, drastic effort reductions were implemented in the commercial linefishery with the allocation of long-term rights in 2006 and a suite of strict regulations for recreational and subsistence fishers that was promulgated in April 2005. Fishing is probably the most significant threat to marine biodiversity in South Africa (Attwood et al. 2000). Thus the re-building of fish stocks is a key focus of fisheries management in South Africa.

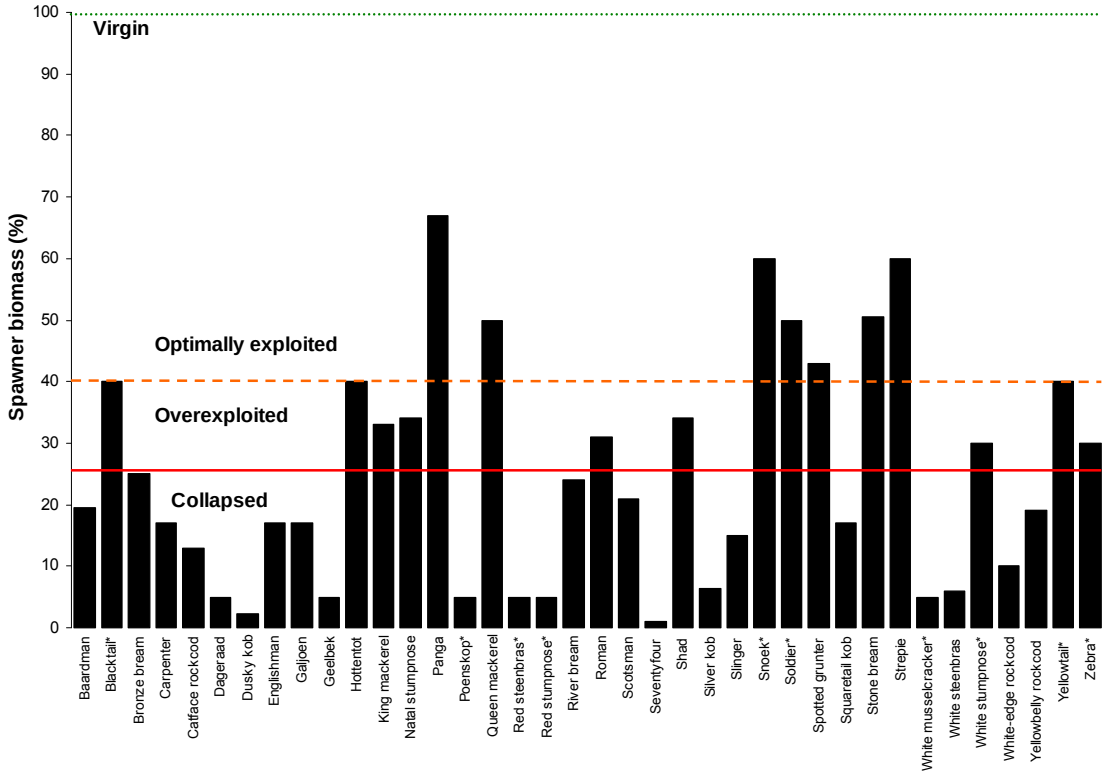

Figure 2. The status of important linefish species in South African waters in terms of published estimates of spawning biomass per recruit, or based on estimates in terms of available stock status indicators (extrapolated from Mann 2000 and later publications). Species marked with an asterix indicate estimated values.

3.5 MPAs and Fisheries Management

The peer reviewed literature abounds with publications that prove the effectiveness of no-take Marine Protected Areas in managing and re-building stocks. In Section 2.2 above, the role MPAs play as a fisheries management tool and the benefits that accrue from no-take MPAs have been described in general terms. Gell and Roberts (2003; 2005) provide excellent summaries and describe case studies from around the world where fishing closures have resulted in very significant positive impacts on fished stocks. Some of these processes are described in more detail below in order underline the importance of no-take MPAs in the management and survival of fisheries.

Protected areas allow fish to grow to their maximum size. Bigger animals produce many times more eggs than smaller ones. One ten kilogram red snapper *(Lutjanus campechanus)* produces over twenty times more eggs at a single spawning than ten one kilogram snappers. Big fish also spawn more frequently than small fish. On the Pacific coral reefs of Guam, half kilogram goatfish reproduce four to five times more often than goatfish half this size, and produces 100 times more eggs over a year (Gell and Roberts 2005). Therefore a few very large animals are much more valuable as egg producers than many smaller ones. This has

now become known as the BOFFFF hypothesis (Big, Old, Fat, Fecund, Female, Fish; Berkeley *et al*. 2004, Field *et al*. 2008). Apart from producing more eggs, older, larger fish produce eggs that are larger (Chambers and Legget 1996, Trippel 1998), contain more energy rich lipids, and have higher survival rates than smaller eggs. Basically this is because larger eggs produce larger larvae and larger larvae swim faster, escape predation more easily and survive periods of low food supply for longer (Wallace and Aasjord 1984, Vallin and Nissling 2000, Berckley *et al.* 2004a, b, Lewin *et al.* 2006).

Protected areas also allow fish densities to increase. By increasing population densities, reserves can greatly increase the number of young spawned, because the rate of fertilisation is improved. Many of the eggs and larvae produced by fish in fully-protected reserves will drift outside the protected area and into adjacent fished areas thus helping to restock fisheries (known as seeding). In addition, when densities increase beyond a certain point, both adults and juveniles will emigrate out of the MPA and into adjacent fishing grounds (known as spillover). This benefits fishers in adjacent areas who experience higher catch rates. The rate of spillover varies among species and reserves, and depends on site fidelity of the fish, the degree of compliance with the reserve regulations, the length of time since the reserve was created, how much fishing takes place around the edge of the reserve, and whether or not habitat is continuous across reserve boundaries (Gell and Roberts 2003; 2005). There is circumstantial evidence for spillover from studies of the movements of exploited species, and direct evidence from a growing number of studies of increased catches close to reserve boundaries.

All forms of fishing can damage the marine environment in some way. Some fishing methods have less of an impact than others, but even rod and line fishing can disrupt bottom communities and produce litter (e.g. discarded fishing line) which can be harmful to marine life. Excluding such activities in MPAs is important for protecting ecosystems and the ecological processes they support (Gell and Roberts 2003; 2005).

Unfished communities have been shown to be remarkably different from fished communities simply because natural biological communities can be allowed to develop unimpeded. Apart from providing a benchmark that allows the extent of change to be measured, biodiversity is enhanced by allowing such communities to develop (Gell and Roberts 2003; 2005).

A number of fish species in the Sparid and Serranid families are highly resident species. In other words their movements are restricted to a particular area of reef or other underwater habitat. This makes them particularly easy to target, since they always remain in the same

place. The development of GPS systems has been particularly bad for resident reef fish communities and species, because it allows fishers to rapidly relocate areas where fishing was good on a past occasion, with the result that resident fish populations are quickly decimated. Including areas of good reef habitat inside MPAs is critical to the survival of highly resident fish species.

Furthermore, many fish species in the abovementioned families (i.e. sparid and serranids) undergo sex change once they reach a certain age/size or depending on environmental or social cues. Fisheries generally remove the large animals first, because they are dominant and monopolise the available food resources. In populations where size dependent sex change occurs it can readily be appreciated that when fishing pressure is heavy, most of the remaining small fish will be of one sex, and sex ratios become very skewed – to the detriment of breeding success. By protecting all fish, MPAs allow normal sex ratios to re-establish and so improve the reproductive potential of the stock. What is also often not appreciated by both fishers and managers is that apart from impacting biodiversity at the species, habitat and ecosystem levels, fishing can impact on both the genetic make-up and genetic diversity of fish populations. Fishing acts as a selective pressure removing the bigger, hungrier, more aggressive animals first, and this can act to change the age and size at which fish reach maturity, as well as affecting longevity and possibly fecundity (Hutchings 2004, Conover *et al.* 2005). By reducing genetic diversity, the ability of populations to cope with change (i.e. their resilience) is reduced and this of particular concern in view of the current concerns related to climate change.

Allowing fishing to take place in areas where there are fish spawning aggregations is probably the quickest and simplest way to cause stock collapse (Colin *et al*. 2003). In spawning aggregations, densities are often very high and between spawning bouts the fish often feed voraciously so that fishing on such aggregations can result in high mortality of adult spawning fish. The collapse of the fishery for seventy-four (*Polysteganus undulosus*) along the KwaZulu-Natal coast was precisely because fishers targeted spawning aggregations of these fish in places such as the Illovo Banks (Mann 2007). Similarly, throughout large areas of the Caribbean, the Nassau grouper has been all but eliminated because of fishing on spawning aggregations being (Colin *et al*. 2003; Gell and Roberts 2003).

3.6 South African MPAs and Fisheries Management

All of the processes and benefits outlined above for MPAs in general have been shown to occur in the South African context. As early as the 1990s Bennett and Attwood showed that catches of galjoen (*Dichistius capensis*) inside and outside De Hoop Nature Reserve were

markedly greater with respect to both catch rates and the size of fish caught (Bennett and Attwood 1991; 1993). They also showed that large tagged fish moved in and out of the reserve, providing some evidence for the spillover effect (Attwood and Bennett 1994, 1995). Catch-per-unit-effort (CPUE) for the threatened endemic sparid fish, *Petrus rupestris*, was 3000 times greater in the Tsitsikamma MPA compared to fished areas (Brouwer 2000). The Tsitsikamma MPA was established 1964, and underwater censuses indicated densities in the protected area were 42 times higher for the sparid fish *Chrysoblephus laticeps* compared to nearby fishing grounds off Port Elizabeth (Buxton and Smale 1989). Bennett and Attwood (1993) showed very large differences in the mean size and numbers of sexually mature galjoen inside and outside protected areas. Smith (2005) recorded very much larger mean sizes and higher catch rates of blacktail, zebra, roman, red steenbras and white musselcracker inside the Tsitsikamma MPA than in exploited areas outside the reserve. Fish catch rates on the boundary of the reserve were higher than further away, providing indirect evidence of spillover effect (King 2005). Tilney *et al.* (1996), Attwood *et al.* (2002) and Brouwer *et al.* (2003) have shown that currents within the Tsitsikamma MPA have the capacity to transport fish eggs and larvae outside of the MPA.

Buxton and Smale (1989) and Buxton 1993 showed that red roman (*Chrysoblephus laticeps*), dageraad (*C. cristiceps*) and red steenbras (*Petrus rupestris*) – all important and highly resident offshore reef fish species, were more abundant, faster growing and larger inside the Tsitsikamma MPA than in adjacent exploited areas. The catch rates of four important resident shore angling fish (viz. blacktail *Diplodus sargus capensis*, zebra *Diplodus cervinus hottentotus, b*ronze bream *Pachymetopon grande* and galjoen *Dichistius capensis*. were between 5 and 21 times higher in the Tsitsikamma MPA than in adjacent fished areas. The mean size of these fish was also significantly larger inside the MPA than outside (Cowley *et al.* 2002).

Brouwer and Griffiths (2005) showed that the carpenter *Argyrozona argyrozona,* an important linefish species, had a larger mean size, bred at larger sizes and spawned for longer inside the Tsitsikamma MPA compared to exploited areas outside the MPA. A 3kg carpenter produced five times more eggs per kg of body weight than a fish of 1kg.

Buxton (1993) found dageraad sex ratios of 3.8 females to 1 male in the Tsitiskamma MPA while outside ratios varied between 13:1 and 24:1. Dageraad change sex from female to male as they get larger, and clearly a large proportion of the male population has been caught in unprotected areas, which greatly affects breeding success.

More recently, results from the current St Lucia Marine Protected Area fish monitoring and tagging project also demonstrate very strongly the benefits that MPAs provide to fish populations. When this project was first implemented in November 2001, the overall CPUE in the exploited areas was less than half that recorded in the sanctuary areas. By January 2002 all shore fishing in the exploited areas stopped because of the ban on beach vehicles (GN Regulation 1399 - *Control of Vehicles in the Coastal Zone - amended in 2004).* Thus it was no longer possible to compare catches from exploited and unexploited areas and the project objectives were changed to monitor the possible recovery of a previously fished area using the no-take sanctuary as a benchmark. Results have shown that there has been a statistically significant increase in catch rates in the previously exploited areas compared with no significant trend in the sanctuary areas. This result is very strongly indicative of a recovery taking place in terms of the abundance of fish in the previously exploited areas. The mean size of speckled snapper (*Lutjanus rivulatus*) caught in the previously exploited areas has also increased significantly between 2002 and 2009, which translates to an increase in biomass in the previously exploited area once fishing ceased (B. Mann, ORI, unpublished data).

Since 2006, a reef fish monitoring project has been underway in the Pondoland MPA on the northern Wild Coast. The project has been designed to fulfil international obligations and standards for MPAs, and will help to evaluate whether the MPA is achieving its objectives. Inside and outside the MPA, species from the families Sparidae and Serranidae dominated catches but commercial linefish species such as slinger (*Chrysoblephus puniceus*), scotsman (*Polysteganus praeorbitalis*) and yellowbelly rockcod (*Epinephelus marginatus*) were more abundant on protected reefs than on exploited reefs, while the abundance of small prey fish species was considerably higher on the exploited reefs. This indicates that fishing is impacting on the overall fish community structure through removal of predators, with the resultant trophic imbalances (Mann 2009). Local ecosystem impacts from the removal of large predatory reef fish by linefishing have also been shown by Smale (1990), Attwood and Farquhar (1999) and Götz (2006). In the Pondoland MPA, CPUE data in the two no-take sampling areas was nearly double that of the two adjacent exploited sampling areas, indicating a higher abundance of reef fish species in the protected areas. Sizes of important commercial linefish species were generally larger in the no-take areas compared to the exploited areas (Mann 2009). More than 25% of the 1429 fish that have been tagged have been recaptured. This is an extraordinarily high recapture rate and provides very strong evidence that many species of reef fish are highly resident. Because they move around very little these reef fish are extremely vulnerable to fishing pressure, especially when using technology such as GPS. Tagging has also shown that a certain percentage of most

populations (even highly resident species) appear to wander further afield and may contribute to "spill-over" into the adjacent exploited areas. The results from this project have produced conclusive evidence of the value of the no-take area in protecting a greater abundance and biomass of commercially important linefish species (Mann 2009).

A project with similar objectives has been designed for the Dwesa-Cwebe MPA. Although the entire Dwesa-Cwebe coastline is technically a no-take area, in the past (and even today), fishing has occurred in the area north of the Mbashe River mouth (Haven site) because it is close to the Haven Hotel, holiday cottages and community areas. This is considered a previously/currently exploited site, whereas Mendu Point, immediately south of the Mbashe River, is fairly inaccessible and is almost unexploited. This monitoring programme has only been operating for a year but has already provided some noteworthy data. The mean sizes of important linefish species bronze bream (*P. grande*), kob (*A. japonicus*), catface rockcod (*E. andersoni*) and blacktail (*D. sargus capensis*) were larger at Mendu Point than at the Haven site. Catch rates for all these species were also higher at Mendu Point than at the Haven site. It is important to note that the stocks of three of these species are considered to have collapsed (see Tables 1 and 2). Although the data are limited, already there appear to be significant differences between the two sample areas - lower species diversity, lower numbers of certain fish species, smaller fish and lower catch rates at the Haven (exploited) site than at the Mendu Point (unexploited) site. Again, the importance of MPAs in conserving and rebuilding fish stocks is highlighted.

Smale (1988) showed the importance of the Tsitsikamma MPA in protecting juvenile red steenbras (*P. rupestris*). What is less well known is that when mature, red steenbras migrate up the east coast and their main spawning ground is on deep subtidal reefs along the Wild Coast (Garratt 1988, Brouwer 2002). The Dwesa-Cwebe MPA probably plays a critical role in protecting high quality offshore breeding habitat for this iconic species that is on the critical list as regards its management. Based on skiboat catches off the adjacent Kei River Mouth area, it is highly probable that offshore reefs in the Dwesa-Cwebe MPA will also provide an important refuge to other endangered reef fish species such seventy-four, black musselcracker and dageraad (B. Mann, ORI, pers. obs.).

The Dwesa-Cwebe MPA is also home to other important fish breeding populations, including kob (*A. japonicus*) and white steenbras (*Lithognathus lithognathus*) - two of the most commonly caught (and targeted) species in the vicinity of the Mbashe River. Both of these species are considered to have collapsed with less than 5% of the original spawning populations left (Bennett 1993a Griffiths 1997, Mann 2000; B. Mann ORI, pers. comm.). The

area immediately adjacent to the Mbashe river mouth is one of only two known spawning grounds for the white steenbras (Bennett 1993b). Adult white steenbras (also known as pignose grunter) are very vulnerable to capture during this breeding aggregation which occurs between July and September each year. In past years this spawning aggregation has resulted in anglers flocking to the Haven Hotel during this time of year to target this esteemed species.

The shallow inshore area around the Mbashe River mouth is also home to a significant dusky kob population and adults and large juveniles move in and out of the estuary. Recent acoustic telemetry work in other large Eastern Cape estuaries (i.e. Sundays River and Fish River) has shown that juvenile dusky kob appear to remain in these large estuaries and adjacent surf zone until they reach maturity (P. Cowley, SAIAB, pers. comm.). On reaching maturity the adults migrate northwards with spawning taking place on inshore reefs in KZN and the Eastern Cape (Griffiths 1996). Dusky kob are aggressive, piscivorous predators that are relatively easily captured by fishers. Because of their very low population numbers they urgently require protected areas that will provide refuges and undisturbed spawning grounds for adults and nursery areas for juveniles. Based on the above rationale, opening this area to any kind of fishing cannot be considered wise and responsible management.

It should be noted that many of the collapsed and over-exploited fish species listed in Tables 1 and 2 as being present in the Dwesa-Cwebe MPA are Sparids and Serranids. Many species in these Families are highly resident, they grow slowly, take a long time to reach maturity and several of them change sex (Mann 2000). All of these factors make them particularly vulnerable to heavy fishing pressure. By protecting their habitat some of the effects of over-fishing can be reversed. No detailed benthic survey maps exist for the Dwesa-Cwebe MPA, but of the shoreline habitat, 56% of the Cwebe coastline and 87% of the Dwesa coastline is mainly unimpacted, high profile rocky shore habitat and this is likely to extend subtidally, providing high quality reef habitat. These reefs can contribute significantly to the re-building of over-exploited reef fish stocks if natural biological communities are allowed to develop and they should therefore be protected from all extractive resource use.

3.7 Ecosystems and fisheries

In the past, fishery managers both in South Africa and elsewhere have treated species management on an individual basis and have not taken important links to other species or the habitats that they live in into consideration. Fishing is not just a process of removing the odd fish from an aquatic environment with an impact that is relevant only as the subtraction of a fish from the stock. Fishing impacts on habitats and entire ecosystems (Jennings and Lock 1996, Jennings and Kaiser 1998, Lewin *et al.* 2006). It has been stated above that

unfished communities are often remarkably different from fished communities, and virtually all the research work referred to above indicates that trophic changes that impact on entire shallow subtidal ecosystems take place when fish populations are subjected to fishing pressure. There is a loss or reduction in biomass of top predators and keystone species, trophic cascades often occur as a result of predator removal, incidental mortality of non-target species takes place, the benthic environment is often altered and changes in the gene pool can occur. Thus the current focus in fisheries management is to manage on a much more inclusive scale than to simply focus on the targeted fish population. No-take MPAs are an essential component of this ecosystem approach to fisheries management because they allow the natural functioning of at least a small part of the relevant system, and they protect aspects of the ecosystem that are not conserved by traditional fisheries management. They are also urgently needed because in many respects the ecosystem effects of fishing are still unidentified or not well understood.

3.8 Timescales and MPAs

There is absolutely no doubt that areas closed to fishing have a very significant positive benefit on fish stocks and Section 2.2 provides some key reference material. Within South Africa itself there are a significant number of studies that provide strong evidence that MPAs play a critical role in conserving, managing and rebuilding fish stocks, and particularly those resident sparid fish species that make up many of the collapsed fisheries listed in Tables 1and 2. When areas are closed to fishing, recovery in biomass and population densities can be very rapid (particularly in tropical systems) with a doubling or tripling in total biomass within three to five years of protection (Gell and Roberts 2003; 2005; Kenchington *et al*. 2003). In the Mombasa Marine National Park in Kenya, within three years of protection, fish biomass within the marine park was estimated to be five times higher than outside the park .(Roberts and Hawkins 2000). In the subtropical St Lucia MPA in South Africa, biomass (measured as catch rate) has almost doubled in the 8 years since fishing was stopped (Mann ORI, unpublished data). Within a few years of proclamation of the de Hoop MPA, stocks of galjoen, which had been dramatically reduced as a result of overfishing, had recovered enough so that an estimated 10-20 tonnes of galjoen emigrated out of the MPA every year (Attwood 2000).

Fishing has been allowed in some MPAs as a compromise to fishers who have questioned the rationale for protecting harvestable stocks. Once fishing is resumed in marine reserves, stocks of animals which have accumulated over time are very rapidly depleted. Catches in the short term are extremely good, but in a matter of literally months, they decline to the level of the surrounding unprotected areas. Animals which had the opportunity to grow really big in the reserves are usually cleaned out within a few months of opening the area to fishing. It was

estimated that the natural capital (fish stocks) accumulated over 40 years in the Tsitsikamma MPA would be fished down in approximately 33 fishing days if a section of the MPA was opened to fishing (WWF 2004). After this time catch rates would be the same as the surrounding areas that had never received any protection. When the big animals that are protected in a no-take reserve are lost, all the benefits provided by the reserve in terms of increased and improved egg production, biomass, sex ratios, spawning success also disappear (Roberts and Hawkins 2000). It is not possible to have production without producers and one cannot keep producers without a permanent commitment to protect them. Permanent closures maximize benefits and minimize costs, whereas rotations or temporary closures achieve nothing in the long term.

4 ECONOMIC VALUATION OF THE DWESA-CWEBE AREA

4.1 Introduction

Many of the fishery related benefits have been outlined in the preceding section of this report. Benefits also include a number of recreational benefits. However, the benefits of MPAs have seldom been quantified, even internationally. One of the first attempts to provide an economic valuation of MPAs was undertaken by Turpie *et al.* (2006) for the Tsitsikamma, Goukamma and Robberg MPAs along the Garden Route in the southern Cape. This was followed in 2009 by a report detailing the Recreational use and Value of the Garden Route Coast (Turpie and de Wet 2009), and Ecology, Value and Management of the Kogelberg Coast (Chalmers *et al*. 2009). These reports provided Rand value estimates of the services and facilities delivered by MPAs including those related to national fisheries, and allowed management options based on these economic valuations to be assessed. In this report an attempt is made to provide similar preliminary economic estimates of the benefits associated with the Dwesa-Cwebe MPA, and particularly to assess the economic implications of changes in protection status for the linefish resource within the MPA. Whether to allow angling or not in the South African MPA system is one of the more controversial issues in their management. There is currently pressure to open parts of the Dwesa-Cwebe MPA to fishing. The Dwesa-Cwebe MPA is shown in Figure 1. The proposed fishing areas are in line with the old fishing areas from the northern bank of the Mbashe River to the western bank of the Mbanyane River on the Cwebe side of theMPA (4 km), and between Humans Rock and the western bank of the mouth of the Khobole River in the Dwesa side of the MPA (1.7 km). This would comprise some 30% of the coastal extent of the reserve. Ideally a similar study as that undertaken for Tsitisikamma MPA is required. However, the funding and time for the necessary research is just not available, all relevant data are very limited, and the exercise must be conducted in a data poor environment in which extrapolations are made from other areas of the coast. The valuation for Dwesa-Cwebe is based on the format of the Garden Route MPAs valuation (Turpie *et al.* 2006) because other options are very limited.

The study of the Tsitisikamma MPA was designed to assess the Total Economic Value (TEV) which is made up of:

- **Direct use values** generated through consumptive (e.g. angling) and/or non-consumptive (e.g. diving) use of natural resources,
- **Indirect use values** generated by outputs from the ecosystem that form inputs into production by other sectors of the economy, or that contribute to net economic outputs elsewhere in the economy by saving on costs (mainly the export of fish to areas where they are exploited for recreational and commercial use in the case of MPAs),

- **Non-use values** which are made up of a) option values - of retaining an ecosystem for future use, and b) existence values - the wellbeing derived from knowing that something exists, expressed in terms of public willingness to pay.
- **Opportunity costs** - the value that would be gained from fishing if the MPA were to be de-proclaimed (Turpie *et al*. 2006).

The Dwesa-Cwebe MPA has been described in Section 1. For the purposes of this section of the report it must be noted that the MPA is bordered by a terrestrial nature reserve of approximately 3500 ha on the Dwesa side of the Mbashe and 2200 ha on the Cwebe side. It is necessary to isolate the expenditure attributed to the MPA from the expenditure associated with visiting the terrestrial attractions. It seems logical to assume that people who own seaside cottages in the Dwesa-Cwebe MPA come to the area specifically for the marine environment, and 100% of their direct and indirect expenses were thus assigned to the attraction of the MPA. The hotel manager indicated that hotel guests were largely attracted by the marine environment and spent most of their time in marine related activities so 90% of their expenses were allocated to the marine environment (G. Millar pers. comm.).

4.2 Recreational Use value

The recreational value of protected areas can be considered as the amount that visitors are willing to pay to use them. This can be broken down into: a) **On-site costs** – the turnover generated in the MPA such as entrance fees, accommodation and by sale of any goods or services within the MPA: b) **Off-site costs** includes the money spent on transport, en route accommodation, food etc incurred by a specific visit to that site and c) **Consumer's surplus** – the amount that visitors would have been willing to pay over and above their on- and off-site costs in order to use the area. This is particularly relevant in the case of protected areas that do not charge entrance fees, or where the entrance fees are low (Turpie *et al*. 2006).

Robertson and Fielding (1997) provided a profile of visitors to the Wild Coast. The Cape Provinces and former Transkei accounted for 79% of cottage owners, while (65%) of hotel guests came from Gauteng (Table 3).

Table 3. Proportion of visitors to the Wild coast from different regions in South Africa. Figures are percentages of those who declared a place of residence (data from Robertson and Fielding 1997).

Visitors	Gauteng	Cape	KZN	OFS	Transkei	Foreign	N
Cottage residents	8.1	30.1	11.0	0.7	49.4	0.7	136
Campers	50.0	20.0	16.6	3.4	0	10.0	30
Hotel guests	65.4	11.5	17.4	0	3.8	1.9	52

4.2.1 Estimated costs

(a) Dwesa-Cwebe Reserve

- Total on-site entrance and accommodation costs were taken as the annual revenue for the Dwesa-Cwebe Reserve and amounted to R375 000. This figure was virtually the same for 2008 and 2009. Slightly less than 5000 people visited Dwesa-Cwebe in 2008 (East Cape Parks Annual Report 2008-2009).

(b) Cottages

- There are 29 cottages inside the Dwesa-Cwebe MPA. Since a large proportion of cottage residents lived in the former Transkei (Robertson and Fielding 1997), a round trip of 350 km was estimated for each trip to the coast.
- Cottages are used for about 75 days a year, average party size is 7 people and about 5 trips a year are made to their cottages by cottage owners (Robertson and Fielding 1997).
- Fuel was costed at R7.80 per litre and a loaded SUV consumption of 7km per litre of fuel was estimated.
- Most cottage owners employ staff, so a single wage earner was allocated to each cottage (R60 per day for the days the cottage is occupied). This is probably an underestimate since many cottage owners employ full time staff and wages are often >R60/day (P. Fielding, pers. obs.).
- Offsite food expenditure was estimated at R50 pp. pd. and cottage occupants spend about R9 per day on sundries while at the coast (updated from R6 per day - Robertson and Fielding 1997).
- Each cottage will spend R1657 a year on purchasing seafood from local people (Robertson and Fielding 1997 but prices adjusted to 2010, P. Fielding, pers. obs.).
- An estimated 90% of cottage residents' activities and enjoyment are related to the marine environment.

(c) Hotel

- There are 80 beds available at the Haven Hotel, average occupancy is 20 - 25%, and although rates are technically between R435 (low season) and R550 (high season) actual rates for full board are around R350 pp per night once discounts and specials are accounted for (G. Millar, Hotel Manager, pers. comm.).
- Guests spend about R50 per day on drinks and sundries (G. Millar, Hotel Manager, pers. comm.).

- The majority of guests come from Gauteng, average party size is 4 (Robertson and Fielding 1997), and a return travel distance of 1500 km in a vehicle that travels 10 km on a litre of fuel, with a party consumption of R400 of food on the trip, is assumed.
- The hotel employs 25 staff at a weekly wage of R550 (G. Millar, Hotel Manager, pers. comm.). High season casual labour was not included.
- About 70% of hotel guests' activities and enjoyment are related to the marine environment (G. Millar, Hotel Manager, pers. comm.).

The recreational value of the Dwesa-Cwebe coast together amounts to almost R6 million rand (Table 4). This is the amount people spend to access the coast and coastal facilities and excludes the extra value that the forest and grassland biomes have in attracting people to the area. Off-site expenses for cottage residents are almost double the on-site expenses, but for hotel guests, on-site and off-site expenses are similar because of the high costs associated with staying in a hotel. The hotel accounts for almost five times the value associated with the cottage residents. The annual revenue generated by gate fees and the East Cape Parks facilities is about 6% of the total recreational value of the area (Table 4). There are no data to estimate consumer surplus for the Dwesa-Cwebe (the amount that visitors would have been willing to pay over and above their on- and off-site costs in order to use the area). The figure is important because gate fees for the Reserve are very low (R10 per car; Turpie *et al.* 2006). Consumer surplus for Tsitisikamma MPA is about 50% of the offsite costs (Turpie *et al.* 2006). If a similar figure applied to Dwesa-Cwebe, the consumer surplus would be of the order of R1.25 million.

Table 4. Estimated on-site and off-site costs associated with hotel guests and cottage residents in the Dwesa-Cwebe Reserve. The recreational value of the ECParks gate fees and facilities is also shown.

	Onsite Cost (R)	**% of costs attributed to MPA**	**Offsite Cost (R)**	**Total expenditure**
East Cape Parks	R375000			R375 000
Cottages				
Employee wages				R130 500
Expenses pp pd	R137 025			R137 025
Cottage Quitrent	R87 000			R87 000
Seafood costs	R48 059			R48 059
Travel to coast		90%	R56 550	R50 895
Food brought in		90%	R761 250	R685 125
			Cottage Total Onsite	**R402 584**
			Cottage Total Offsite	**R736 020**
Hotel				
Accommodation	R2 299 500			R2 299 500
Expenses pp pd	R328 500			R328 500
Travel to coast		70%	R1 921 725	R1 345 208
Travel food		70%	R657 000	R459 900
			Hotel Total Onsite	**R2 628 000**
			Hotel Total Offsite	**R1 805 108**
			Grand Total	**R5 946 712**

4.3 Activities undertaken by tourists to the Wild Coast.

The only data relating to visitor activities on the Wild Coast are from Robertson and Fielding (1997). They undertook a survey that included questions regarding the importance of various factors in a visit to the Wild Coast (Table 5) and the extent to which visitors undertook various activities (Table 6). It should be noted that the survey included the cottages at Ntlonyana and the Haven Hotel at a time when rock and surf fishing was allowed between the Mbashe River mouth and the Mbanyane River and also in the Mbashe River itself.

The unspoiled nature of the coast and uncrowded beaches received the highest rating from all groups of visitors with at least 70% of each group rating these factors as very important attractions. About 60% of hotel managers believed that fishing was very important in attracting visitors to the coast but visitors themselves contradicted this and only about 25% of campers and hotel guests rated it as very important and 42% of cottage residents (Table 5). In the context of this report, it is significant that more than a third of hotel guests rated fishing as an unimportant activity in their attraction to the Wild Coast.

Table 5. Responses of cottage residents, campers and hotel guests to questions regarding factors that attracted them to holiday on the Wild Coast. Hotel managers (HM) were asked to consider the importance of these factors in attracting guests to the hotel. Figures are % of respondents who answered the questions. N=169 cottage residents (Cot), 42 campers (Cmp), 53 hotel guests (HG) and 5 hotel managers (HM). (Data from Robertson and Fielding 1997).

Rating	**Not important**				**Of some consequence**				**Important**				**Very important**			
Factor	**Cot**	**Cmp**	**HG**	**HM**	**Cot**	**Cmp**	**HG**	**HM**	**Cot**	**Cmp**	**HG**	**HM**	**Cot**	**Cmp**	**HG**	**HM**
Fishing	8	33	34	0	21	17	14	0	28	26	26	40	42	24	26	60
Seafood	19	33	12	0	36	33	40	0	24	14	28	0	19	20	20	100
Unspoilt coast	1	2	0	0	3	0	4	0	9	2	12	0	87	96	84	100
No crowds	1	5	0	0	4	0	8	0	13	25	10	0	82	70	82	100
Hotel facilities	-	-	4	0	-	-	24	-	-	-	50	20	-	-	22	80

When examining holiday activities on the Wild Coast, the most popular activities amongst all groups of visitors were swimming, beach related activities and general lazing around. Fishing was most popular among cottage residents, but almost 50% of hotel guests said they never fished or only fished occasionally (Table 6) which supports the information in Table 5 that fishing is not an all-important activity for visitors to the Wild Coast.

Table 6. Frequency with which cottage residents, campers, and hotel guests engage in various activities while on the Wild Coast. Figures are % of respondents who answered the question. N=175 cottage residents (Cot), 42 campers (CMP), and 51 hotel guests (HG). (Data from Robertson and Fielding 1997).

Rating	Never			Occasionally			Often			Most of the time		
Activity	Cot	CMP	HG	Cot	CMP	HG	Cot	CMP	HG	Cot	CMP	HG
Fishing	4	31	29	13	19	20	43	26	35	40	24	16
Swimming/beach	0	2	2	12	17	10	38	43	33	50	38	55
Nature/birds	26	14	12	41	60	52	25	21	22	8	5	14
Lazing around	4	5	2	24	26	24	29	29	52	43	41	22
Boating	40	67	46	25	21	30	21	2	18	14	10	6
Collecting seafood	31	64	76	53	29	24	14	5	0	2	2	0

It is very difficult to assign a recreational value to the Dwesa-Cwebe MPA as a stand-alone facility. Turpie *et al*. (2006) obtained a value for the extent to which different attractions contributed to visitor enjoyment and used those associated directly with the marine environment to estimate the recreational value directly attributable to the MPAs along the Garden Route. However, attractions are seldom unrelated to other features – for instance an unspoiled coast and no crowds are partly the result of limited or no fishing. In Dwesa-Cwebe, an average of 31% of all visitors go fishing often or most of the time and 4% of them collect seafood often or most of the time (Table 6) so the MPA itself might be considered to account for 35% of activities. This would amount to a recreational value of about R2 million rand excluding any consumer surplus value. This is probably an extremely conservative estimate.

The values estimated above provide some indication of the recreational value of the Dwesa-Cwebe Nature Reserve and MPA. However, there are several factors that can impact on these estimates. These include annually changing visitor numbers; both to the East Cape Parks facilities at Dwesa and to the Haven Hotel, the dated nature of the visitor survey, and the difficulties in estimating a consumer surplus (see Turpie *et al*. 2006). It is even more difficult to assign a value to the Dwesa-Cwebe MPA as distinct from the Reserve as a whole. However, the figures indicate that the Reserve and the MPA have a recreational value that reaches several million Rand. Ideally the economic benefits or losses in recreational use value that might accrue if management regulations were changed and fishing was allowed in the MPA, should be quantified. These monetary values are difficult to determine. In the case of the Garden Route MPAs, visitor and the general public surveys delivered varied outcomes when attempting to determine opinions regarding extractive fishing, catch and release fishing, or no fishing options in MPAs. Some visitors and members of the public favoured fishing in MPAs, some felt that their activities would not be greatly affected and some said they would no longer visit the MPAs if fishing was allowed. It must be remembered that visitor losses because of a removal of the fishing ban at Dwesa-Cwebe will be balanced to a greater or lesser extent by increases in visitor numbers because of the tradition of good fishing that is associated with the Mbashe area. Along the Garden Route, changing the

fishing regulations resulted in visitor losses that translated into an annual economic losses of between 10% and 42% of the total recreational value (R1.2 million for Goukamma, R0.3 million for Robberg, and R4.7 million for Tsitsikamma; Turpie *et al.* 2006). The dynamics of the Dwesa-Cwebe MPA are very different to the Garden Route MPAs but there is an increasingly strong public sentiment that MPAs should be no-take zones. Thus changing the fishing regulations at Dwesa-Cwebe might result in some reduction in the total recreational value of the area but it is extremely difficult to assign a value to this.

4.4 MPA contributions to fisheries

The earlier section of this report stressed the contribution that MPAs make to fisheries in terms of increases in size and densities of adults, improved spawning capabilities and export of adults, juveniles and larvae to surrounding areas. This is of particular relevance in view of the collapsed state of so many of the fish stocks (See Tables 1 and 2). Evidence for positive impacts of MPAs on surrounding exploited areas is provided by tagging studies, higher catch rates and larger fish in fishing areas adjacent to MPAs. This enhancement of yield to adjacent fished stocks is often used as one of the justifications for MPAs, especially when anglers object to the loss of fishing areas and opportunities that comes with the implementation of an MPA. One of the persistent problems in this regard has been the lack of an economic value that can be attributed to the increases in production of exploited area fisheries as a result of an MPA. This has been addressed to some extent by Turpie et al. (2006) in their study in the Garden Route MPAs.

Based on the study by Turpie *et al.* (2006), an attempt is made in this report to attach a value to the enhancement of catches in exploited areas as a result of no fishing in the Dwesa-Cwebe MPA. Although the methods used closely follow those of Turpie *et al*. (2006), data relevant to Dwesa-Cebe MPA are used (Venter 2009; B. Mann, ORI, pers. comm.). The methods and calculations are described in detail in Turpie *et al*. (2006) and only a general outline is presented here. There are a number of assumptions and caveats associated with the method and these are discussed briefly below and in more detail in Turpie *et al.* (2006).

For recreational fishers, all fish are assumed to have the same value which is estimated as the entire amount of money spent on fishing in a year including travel, accommodation, tackle, rod, reel and bait divided by the total number of fish caught in a year (i.e. the value of a fish is estimated as the willingness to pay). The average expenditure values for linefishers were taken from McGrath *et al.* (1997) and catch rates for the Eastern Cape coast from Brouwer (1997) and Mann *et al*. (2003). Based on all the costs associated with fishing an average fish is worth approximately R140 to a recreational shore angler.

There are very limited estimates of the fish densities in MPAs that can be used to estimate total population. Burger (1990) provided densities of bronze bream, a popular recreational linefish species, from the Tsitsikamma MPA. For the purposes of this report, the assumption is made that similar densities apply in the Dwesa-Cwebe MPA. High quality rocky reef habitat was estimated to exist for 87% of the Dwesa coastline and 56% of the Cwebe coastline (based on the extent of rocky shoreline habitat). The total fish abundance was calculated as the product of density and length of shoreline with suitable habitat. Densities for white steenbras and kob are estimates based roughly on capture rates in the area (Venter 2009).

Long-term mark and recapture studies conducted in the De Hoop MPA and the St Lucia MPA indicate that around 5% of the resident galjoen population in De Hoop and 5% of the highly resident speckled snapper population in St Lucia move out of the MPA annually (Attwood and Bennett, 1993; Attwood, 2003, B. Mann, ORI, unpublished data). This figure of 5% has therefore been assumed for bronze bream which is also a largely resident reef fish. Where residency is not such a strong feature of a species' life history (i.e. white steenbras and dusky kob), slightly higher estimates of emigration rates were made (i.e. 10%).

There are very limited data on linefish fecundities but MPAs are a principal source of eggs and larvae for most collapsed fisheries, because the fish in the MPAs are protected, large and fecund. The contribution of eggs and larvae from the MPA to the surrounding area was estimated as the difference between the estimated spawner-biomass-per-recruit ratio as a percentage of the pristine ($SBPR_{current}$) for the exploited area (extracted from Mann 2000) and the $SBPR_{F=0}$ ratio for the MPAs (assumed to be 1, i.e. pristine; Turpie *et al*. 2006). Species specific catches for the Wild Coast were obtained from Mann *et al*. (2003), but catches were divided by two on the basis that the DwesCwebe MPA would contribute recruits mainly to the southern part of the Wild Coast.

The economic value of exports (adults and pre-recruits) was estimated as the value per recreational fish multiplied by the number of fish. For a subsistence fisher the value of a fish is what it can be sold for. The Haven Hotel buys fish for R15 – R17 per kg (G. Millar, Hotel Manager, pers. comm.) and holiday makers pay about R20/kg (P. Fielding pers. obs). For simplicity of the calculation, the price of a bronze bream was set at R50 per fish (minimum size = 30 cm) and of a white steenbras and/or dusky kob at R100 per fish (minimum size = 60 cm for both species). The extent to which a particular species contributed to catches in the Dwesa-Cwebe MPA was extracted from Venter (2009).

Using these data it is clear that the annual recreational economic value of fish that emigrate or are exported out of the MPA as a direct result of the existence of the MPA is very considerable. Figures range from R2.5 million for dusky kob to R8.5 million for bronze bream. Values are influenced to a large extent by the proportion of the total catch that a particular species makes up and the spawner-biomass-per-recruit ratio as a percentage of the pristine value. In this instance bronze bream make up 10% of the catch in the current monitoring programme (Venter 2009), but the $SBPR_{Current}$ is approximately 0.20 (unknown but assumed to be the same as galjoen), whereas kob make up 15% of the catch, but the $SBPR_{Current}$ is 0.023 (Griffiths 1997). White steenbras make up 0.07% of the catch (Venter 2009) and the $SBPR_{Current}$ of is estimated to be 0.06 (Bennett 1993).

Table 7. Estimates of the value of linefish export from Dwesa-Cwebe MPA to the recreational shore fishery (after Turpie *et al*. 2006).

Parameter Estimate		Bronze bream		W. steenbras		D. kob
Fish Density (No.km^{-1})		110		150		200
Area of habitat (km^2)		14		5		19
Total population		1540		750		3800
Export (% per year)	0.05	77	0.1	75	0.1	380
Value (R)	140	R10 780	140	R10 500	140	R53 200
MPA spawner contribution (number of fish per year)	0.20	5999	0.06	297	0.023	2368
Value (R)	140	R839 847		R52 117		R331 573
Total value (R per year)		R850 627		R185 500		R384 773
All species contribution to shore fishery based on catch composition (R per year)	**0.10**	**R8 506 275**	**0.007**	**R7 445 305**	**O.15**	**R2 565 151**
Subsistence value of export (R)	50	R3 850	100	R7 500	100	R38 000
Subsistence value of spawner contribution (R)	50	R299 950	100	R29 700	100	R236 800
Subsistence value of all species contribution (R)	75	**R4 557 000**	**75**	**R3 985 714**	**75**	**R1 374 000**

Of interest in the context of this report is the very considerable value attached to fish that might be available to subsistence fishers fishing outside the MPA, as a result of emigration and spawning activity within the Dwesa-Cwebe MPA (provided subsistence fishers can sell the fish). Frequently the argument is made that the beneficiaries of MPAs are very often not those most affected by the closure of the area. Table 7 provides some evidence that subsistence fishers, who will contribute by far the greatest proportion of anglers fishing outside the Dwesa-Cwebe MPA, will benefit very substantially from the existence of the MPA. The biggest constraints on subsistence fishers benefiting financially from the sale of fish caught anywhere in the region are the MLRA regulations as they apply to linefishers (see Section 6.3).

Turpie *et al*. (2006) provide a detailed discussion of the strengths and weaknesses of this model that is used to attach an economic value to the export of fish from an MPA. There are a number of assumptions and extrapolations that can be challenged. Some of these are:

- Fish life histories characteristics like residency and emigration rates differ significantly between species. The only existing data for emigration relate to galjoen and speckled snapper. Gotz (2005) and Kerwath 2007a,b suggest that this figure might be lower for some resident reef fish.
- There are very limited density data for all fish in all habitats.
- Densities in the Tsitsikamma MPA which has been closed since 1964 may differ from densities in the Dwesa-Cwebe MPA which has only been "closed" since 2000.
- Some of the fish that emigrate out of the MPA will be subject to natural mortality and some will never be caught, so Rand values of exports are likely to be inflated.
- Perhaps the biggest problem is that much of the proposed value derives from the export of eggs and larvae. Most linefish stocks are over-exploited and as a result, large fecund fish in MPAs very probably provide a significant proportion of eggs and larvae to surrounding areas, but supply is likely to be highly variable for a number of reasons. At the same time, the relationship between the number and size of spawning organisms in any population and the extent to which these spawners contribute to new recruits found in adjacent areas is not well understood for most fish and invertebrate populations. In addition, egg and larval survival depends very much on physical oceanographic conditions and is thus also highly variable, regardless of where the eggs and larvae originated.

The model thus presents a fairly crude estimate of the economic value of fish exports from the Dwesa-Cwebe MPA, and the Rand values are almost certainly inaccurate. However, it is a first attempt to attach an economic value to the export of fish products from an MPA. The model is based on fairly conservative estimates of export dynamics (Turpie *et al.* 2006) and even if the Rand values are an order of magnitude too high, they nevertheless indicate that there is significant economic benefit from maintaining a closed MPA with its associated large biomass of highly fecund fish. Moreover, it is important to note that this is a sustainable value and not just a once-off benefit, and it applies as much to subsistence fishers as it does to recreational anglers or any other angling sector.

4.5 Option values and Existence values

Further components of the economic value of an MPA are the non-use values termed option and existence values. The option value is quantified as the economic benefits that might arise from future use of the MPA and it can be calculated from the willingness of people to pay to keep the option open to having those benefits. The existence value is difficult to

separate from the option value but it can best be described as the wellbeing that comes from knowing that the MPA exists and that other people and future generations may benefit from the existence of the MPA, and again it is best measured by peoples' willingness to pay to maintain the MPA (Turpie *et al.* 2006). It is not within the scope of this report to derive a quantitative figure for option and existence values for the Dwesa-Cwebe MPA, because the data are derived from a detailed and complex survey of peoples' reactions to different possible environmental protection scenarios. Willingness to pay to prevent the loss of MPAs is positively correlated with income – poor people are much less willing to pay for the continued existence of a facility that would seem to provide no immediate benefit than are rich people. Very poor people like subsistence fishers often favour a decrease in environmental protection because they perceive an immediate benefit and in some cases, a simplification of their lives. Willingness to pay to prevent the loss of MPAs is also correlated with interest in, and an understanding of, nature and this differs markedly among income and cultural groups. On the Garden Route coast, approximately equal numbers of people interviewed in a survey were in favour of and against angling in MPAs, but almost all of them (93%) did not favour the removal of all protection from the marine environment. Based on the willingness to pay to prevent the de-proclamation of all the MPAs along the Garden Route, the existence value of the MPAs was estimated at R237 million and the loss in value if all protection was removed would amount to R196 million. If fishing was allowed along a 5 km stretch of the Tsitsikamma MPA the loss in value would be about R31 million (Turpie *et al.* 2006). A survey of the visitors and local population of the Dwesa-Cwebe area to gauge existence values would have to be structured very differently to that of the Southern Cape and may well yield very different results. However, the work of Turpie *et al*. (2006) does demonstrate that there may be significant economic value in non-use and this should be factored in when considering management options for any protected area.

4.6 Opportunity costs

The final factor in an estimate of the real economic value of a protected area is the calculation of the opportunity costs. In the case of an MPA it would be the value that would be gained from fishing if the MPA were to be de-proclaimed. For a no-take MPA, one of the opportunity costs of its proclamation could be considered as the loss in revenue derived from fishing activities that would otherwise have taken place in that area (Turpie *et al*. 2006). These might manifest themselves as a reduction in CPUE in areas adjacent to the MPA because there is a higher concentration of fishing effort. On the other hand there is quite likely to be an increase in CPUE in the medium term as fish are exported out of the MPA (see above).

When an MPA is already in existence the opportunity costs can be considered as being the net benefit of the next best alternative to having the MPA. This benefit can be estimated as the sum of the benefits of allowing fishing in that area. With respect to the Dwesa-Cwebe MPA this is of particular importance because of the proposed change in management regulations that would allow fishing along a stretch of coast to the north of the Mbashe River. Opening an area of MPA to fishing would clearly result in high catch rates to start with, a rapid increase in effort as news of the high catch rates spread, and then a very rapid decline to the previous catch rates of the surrounding area. Turpie *et al*. (2006) provides a detailed description of the net and cumulative benefits of this scenario, both of which become negative in the medium to long term.

Turpie *et al.* (2006) attempted to calculate the relative magnitude of the benefits and costs of changing the protection status of part of an MPA by examining population sizes, abundances and catch rates of fish in protected and exploited areas, and the resultant economic gain per fish caught. They could do this because of the detailed population biology data that exist for fish populations in the Tsitsikamma MPA and along the south coast. Limited data exists for Dwesa-Cwebe MPA, but an indication of the size of the benefits can be estimated by making some extrapolations and assumptions that are described below, and using appropriate catch rates for the Wild Coast.

It is not possible to evaluate benefits and costs for all species of fish so a generic resident reef fish is assumed for the Dwesa-Cwebe MPA. The model for galjoen developed by Turpie *et al.* (2006) uses the following parameters:

- 605 fish per km of shoreline inside the MPA and 50 fish per km of coastline outside the MPA;
- 4 km of coastline opened to fishing (proposed for Dwesa-Cwebe MPA);
- A permissible catch rate of 2 fish per day
- Ten subsistence fishers operating per day.
- A recreational fish value of R140.5 per fish (McGrath *et al.* 1997).
- A subsistence fish value of R50 per fish.

Under these conditions the population of fish in a newly opened area in the Dwesa-Cwebe MPA crashes to the level of exploited area populations in less than 4 months (111 days). A once off **recreational** fish benefit of R311 910 is realised for the generic fish. If this fish constituted 10% of the catch then the net economic benefit that would accrue from opening up 4 km of the shoreline to **recreational fishers** would be about R3.1 million rand. If 10 **subsistence fishers** were permitted to do the fishing and they sold their fish for R50 then

they would realise a once-off total benefit of R111 000 for the generic fish species alone and a total (all species) once off benefit of R1.1 million assuming all fish were sold for R50 each.

A much more likely scenario based on the monitoring programme currently being undertaken in Dwesa-Cwebe by Venter (2009) and using the following parameters for the Dwesa-Cwebe MPA is the following

- Bronze bream population of 110 fish per km of coastline inside the MPA (based on densities of 0.0011fish/m^2 to a depth of 10 m = 100 m offshore; Burger 1990).
- A population estimate of 10 fish per km of coastline outside the MPA
- 4 km of shoreline opened to fishing
- A permissible catch rate of 2 fish per day and catch composition of 10.3% bronze bream (Venter 2009)
- Ten subsistence fishers operating per day
- A fish sale value of R50 (modal size caught by Venter {2009} was 350 mm = 1.2 kg)

Under these conditions the bronze bream population in the newly opened area would be reduced to that of the previously exploited surrounding areas in 23 days, so effectively within three weeks there would be no benefit from higher catch rates in the newly opened area. The subsistence fishers would achieve a once off total income of R23 000 from bronze bream over this time and a total once off benefit of about R223 000 provided all fish were sold for R50. When these models are run with fish like white steenbras and dusky kob, with estimated populations of 200 and 300 respectively per km of coast, and the fish are sold for R100 each with catches limited to one fish per day, the populations crash within 3-4 months days. The fish specific (steenbras and kob) once-off economic benefits are R73 000 and R117 000 respectively.

There are certainly inaccuracies in the data input into these models but the data are not likely to be too far out. It is clear that opening an MPA to extractive fishing provides very short lived benefits and the newly opened area rapidly reverts to catch rates of the surrounding exploited areas. Thus in terms of providing a sustainable fishing resource for subsistence fishers it is very difficult to justify a reduction in the extent of the protected area as a means to address economic upliftment of the people of the area. It makes even less sense to open the MPA to fishing when these once-off economic benefits are compared with those estimated to arise annually (and therefore sustainably) from the export of fish and recruits out of the MPA (see Table 7). Apart from the sustainability issue, subsistence fishermen probably derive much greater economic benefit from the export of products out of the MPA than they do from the opening of the protected area to fishing. In addition, there are serious

legal constraints on the sale of fish by subsistence fishers, and these constraints severely limit the economic benefits arising from linefishing (see Management: Section 6.3).

4.7 Catch and release fishing options

One of the proposals made for generating economic benefits for the community members of the Dwesa-Cwebe area is the implementation of catch and release fishing for guests of the Haven Hotel. Local people would be trained to act as fishing guides for visiting anglers and each angler or angling party would have to employ a fishing guides. The following data can be used to derive an estimate of the economic benefits of catch and release fishing.

The Haven Hotel occupancy rate is 22.5% (6570 bed nights per year; G. Millar, Hotel Manager, pers. comm.), of which about 30% of guests (1971) either wish to go fishing or rate fishing as an important activity (Tables 5 and 6). Anglers normally fish in groups (e.g. 3 anglers per group), and so there might be 657 fishing trips a year. If a fishing guide was assigned to each trip at R100 per day, then the income generated would be R65 700 per year which would be largely sustainable. If occupancy increased then clearly this figure would rise. On the deficit side of would be some loss in the value of fish exports (adults and recruits) associated with the MPA, since there are always some mortalities associated with catch and release, particularly if the catching team is not highly trained in the handling of fish and if the anglers are fishing from a rocky shore. Tourists who stayed away because the area was no longer a fully protected MPA would be balanced by tourists who came because they were able to fish.

A catch and release fishing competition monitored by MCM was held in 2008 on the northern side of the Mbashe River. Such a competition would generate extra income to the Hotel. If 50 anglers stayed five nights at R350 per night and the hotel made a net profit of R50 on the drinks sold to each angler each night, the income from the competition would amount to about R100 000. MCM are only likely to approve one competition a year so the extra income would be about 4% of the annual accommodation turnover (Table 4).

5 SOCIAL AND POLITICAL DYNAMICS OF THE AREA

5.1 Dwesa-Cwebe Land Trust Issues

In the Dwesa-Cwebe area there is a long history of community conflict, both internal and with government and other stakeholders. The Dwesa-Cwebe Land Trust and the communities express distrust of local, provincial and national government as well as other external agencies working in Dwesa-Cwebe. There is also ongoing vigorous inter- and intra-community dissension and power manoeuvring. The original Land Trust representing the Communal Property Associations of the communities and formed to act on behalf of the communities to ensure the effective use of the allocated restitution funds has been subjected to a takeover by a new Land Trust (Mr V. Dudula; ECDC Manager, pers. comm.). The take-over has apparently been instigated by two headmen, one each from Dwesa and Cwebe, and supported by a number of community members. The issues of contention that instigated the takeover appear to be that the original Trust did not provide any transparent accounting of the management of the finances that were associated with the land settlement, and they were ineffective in bringing about development in the area. There were also apparently allegations of fraud and financial mismanagement by Trust members. The original Land Trust has legal status as the elected representative of all the various communities of the Dwesa-Cwebe area and still enjoys some support amongst the communities. It is difficult to get clarity on the status of the new Land Trust. It appears that the new Land Trust is probably registered as a trust but does not have status as the legal representative of the communities, because it is not certain how representative it is (Mr V. Dudula; ECDC Legal Dept. pers. comm.). The issue of which Trust is the legal representative of the Dwesa-Cwebe communities is before the courts, but has not as yet been resolved. East Cape Parks has been required to suspend working relations with both Trusts, pending resolution in the courts as to which Trust is the legal Dwesa-Cwebe Land Trust. This makes management rather difficult since the management is supposed to be a cooperative arrangement. At present there is no functional decision making body in the community, and it is not realistic for MCM to state that the Dwesa-Cwebe communities will engage in co-management of the access to fish resources in the MPA.

5.2 Dwesa-Cwebe Co-management

There has been a significant lack of progress in any co-management arrangement associated with the Dwesa-Cwebe communities since the signing of the Settlement Agreement in 2001. The Settlement Agreement stated that the land (terrestrial Nature Reserve) would be jointly managed by the Community (as represented by the Land Trust) and a Nature Conservation Agency, according to an approved Management Plan. There are several apparent causes for this lack of progress, and it is difficult to pin-point the problem.

Until about 2007 much of Dwesa-Cwebe was still registered as State forest and there was no formal agreement between DWAF and DEAET or East Cape Parks for the transfer of management responsibility. The management of the MPA remained the responsibility of MCM but MCM undertook no management activities, and did not sign a formal management agreement with East Cape Parks until 2008, despite the requirements of the Protected Areas Act (2003). As a management authority, East Cape Parks have had a difficult relationship with the communities of the area and there are accusations of breach of trust on both sides. The current situation is that on the part of community members, there is rife poaching of abalone, crayfish and other small marine organisms, there is illegal hunting using snares, dogs and guns, there is collection of building material from the indigenous forest, there is illegal grazing at Cwebe (by default - incomplete fencing) and veld burning, and there is considerable fishing within the MPA (See Appendix 2 G. Millar letter). On the part of the management authority (East Cape Parks) there is a commitment to improve co-management arrangements but a high rate of staff turnover at Reserve Manager level has greatly hampered the building of relationships and effective communication channels that are so important in the co-management process. The dual Land Trust issue has been in place for a year already and this has further reduced EC Parks ability to work with the communities. It is quite clear that any functional co-management arrangement is not going to happen in the short to medium term. With regard to fisheries management, it is probably naive to believe that any co-management agreements will be respected.

5.3 Hotel Lease Agreement

There are major problems with the lease agreement that confers management of the Haven Hotel on any management body. The Haven Hotel was part of the original land settlement agreement and its management was to be agreed jointly by the Dwesa-Cwebe Land Trust and the East Cape Development Corporation (ECDC). For the past 4 years the hotel has been managed by Mr Grant Millar in terms of a lease agreement signed with the original Land Trust and ECDC. The lease agreement with Mr G. Millar for the operation of the Haven Hotel expired in April 2009 and is apparently extended on a monthly basis. The operation of the hotel went out to tender in 2009 and a preferred operator was identified. The preferred operator (the Kapanto Trust, which consists of a consortium of Xhosa women based in Mthatha and currently operating a successful lodge there), is apparently in the process of negotiating a lease agreement with the Eastern Cape Development Corporation and the (old) Dwesa-Cwebe Land Trust. Clearly, there are problems relating to the decision making powers of the Land Trust. Moreover, the current lessee (Mr G. Millar) maintains that the tender process was illegal since it was re-opened to accommodate a bid from the Kapanto Trust. The ECDC maintains that the tender process was re-opened because no bid that satisfied the development requirements for the hotel as outlined in the TOR was received (Mr

V. Dudula; ECDC Manager, pers. comm.). The current lessee also claims that the tender process was illegal because the Land Trust was not consulted. The issue at stake is which Land Trust should have been consulted – the tender and preferred bidder selection process consulted with the original Land Trust, but Mr Grant Millar recognises the new Land Trust, which was not consulted in the tender process because it was deemed to have no legal standing. In the meantime Mr Millar claims to have negotiated a new eight year lease that has been endorsed by the new Land Trust and the High Court, but at this stage it would appear that this might not be true since there is as yet no legal decision on which Trust is the official representative of the Dwesa-Cwebe communities. Until it receives legal sanction as the representative of the Dwesa-Cwebe communities, the new Land Trust is not entitled to issue a lease for the operation of the hotel.

5.4 Future Investment in the Haven Hotel

One of the principal reasons advocated for the relaxation of the blanket ban on fishing in the Dwesa-Cwebe MPA is the assertion that the Haven hotel is not economically viable if fishing is not allowed, since historically the hotel clientele has consisted principally of anglers. The hotel currently operates at a very low occupancy rate (20 -25 %) and the communities and current lessee (Mr G. Millar) have proposed to MCM that permission to fish in the area adjacent to the hotel will markedly increase occupancy, and the local people will benefit as a result of increased operations in the hotel. Apart from the economic factors described in the previous section, the proposition that the hotel is not economically viable without fishing guests needs to be carefully evaluated. The Kapanto Trust has formulated a business plan for the commercial success of the hotel that aims to develop the Haven hotel as a "Destination Development". A destination development is one in which there are varying levels of accommodation and tourists are attracted to the destination because it is suitable for the whole family and there are a basket of activities available for a wide range and level of participants. The Land Trust has identified wide-ranging adventure and traditional tourism activities in the Dwesa-Cwebe area including coastal, grassland, and forest trails, local cultural tours, cycling trails, and the upgrade of the existing golf course. There is additional scope for horse riding, SCUBA diving in association with the sardine run, whale watching from Dwesa cliffs and a number of non-consumptive estuarine related activities. Fishing in the MPA is not one of the activities identified by the Kapanto Trust, who have indicated that satisfactory fishing activities can be accommodated outside the MPA. Satellite activities associated with the hotel would therefore appear to have much scope for community benefits. Examples of this kind of "Destination Development" are the Mngazi River Bungalows and the Mbotyi River Lodge. The Kapanto Trust have indicated in their business plan that they will invest R10 – R13 million in an immediate upgrade of the access to, and facilities and services of, the Haven Hotel (Mr Mulenga Kayula Project Manager; Kapanto

Trust, Mr Ron Begbie, Begbie Professional Management, pers comm.). There are current problems related to property rights and any development of the hotel (i.e. part of the hotel property is not yet made over to the community, the existing staff quarters are outside the surveyed boundaries, the Land Trust does not have any title deeds, and EIAs are required for expansion of the hotel footprint) that have temporarily curtailed a much larger investment in the hotel. It is of significance that the Kapanto Trust is raising its own funding to proceed with the development with some assistance in financing (through a higher debt:equity ratio) from the Industrial Development Corporation (Mr Mulenga Kayula, Project Manager; Kapanto Trust, Mr Ron Begbie, Begbie Professional Management, pers comm.). Despite the historic angling reputation enjoyed by Dwesa-Cwebe and the Mbashe River, it appears doubtful that fishing is the only realistic tourism driver in the area.

Without significant investment, the Haven Hotel will continue to operate as a fairly basic resort functioning at a low level of sustainability. Operating the hotel primarily as a fishing destination will probably increase occupancy with very little meaningful upgrade of the tourist facility, and very little real tourism development in the area. The question has to be asked as to why the new Land Trust should sign an 8 year lease with the current lessee, who would appear to have little financial backing to develop the hotel and local tourism initiatives, when a bidder with significant financial backing and a detailed business plan has indicated an interest in turning the hotel into desirable Destination Development. It should be noted that the only two financial institutions that will lend money for tourism developments on the Wild Coast are the Development Bank of South Africa and the Industrial Development Corporation. It is of considerable significance to this report that neither of these two institutions will approve loans for anything that is not a “Destination Development” (Mr Ron Begbie, Begbie Professional Management, pers. comm.).

The argument is often made that tourism initiatives such as trails, eco-adventures or cultural tours take too much time to put in place when the community needs immediate benefits. This is not true – if an economically viable medium to long term lease agreement is in place (necessary to justify investment in the area) then these activities can be instituted and marketed fairly quickly. One of the problems in the Dwesa-Cwebe area has been the historically refractory nature of the communities and the Land Trust – it takes so long to get agreement on anything that potential businesses lose interest and go elsewhere. The current stand-off between the two Land Trusts is a typical example of this lack of functionality in the communities. It is wrong to hold management authorities responsible for this, and communities have to address the issue. Every workshop or discussion tends to focus on the resources which lie within the Nature Reserves, and the authorities which stand in the way,

rather than moving forward on development proposals that will bring real socio-economic benefits. The project manager for the Kapanto Trust has indicated that the Trust has money to invest but will go elsewhere if the investment process becomes too drawn out and complicated. Decision makers should be reminded of the history of the Mkambathi tourism development initiative and the ultimate loss of local economic benefits associated with the withdrawal of the lead tourism groups from the investment initiative.

In terms of tourism development at Dwesa-Cwebe, note should also be taken of the Conservation Assessment Report which forms part of the GEF funded the Wild Coast Conservation and Sustainable Development Project that provides the strategic framework for development on the Wild Coast. The Report states "The Haven hotel …… was established during the last century, prior to the area being declared a protected area, and there would seem to have been very little effort made to apply any form of conservation compliance over the years since the area has been proclaimed a protected area. …..The Haven hotel would seem to be a thorn in the (Dwesa-Cwebe) reserve manager's side and concessions contrary to sound conservation management principles are made to accommodate the functioning of the hotel. These include access at night, unacceptable waste and alien vegetation management, and uncontrolled staff accommodation and behaviour. The average visitor to the hotel has no regard for the protected area status of the reserve and would seem to be solely occupied with fishing, golfing and ski-boating as the recreational purpose of his visit. Cattle freely graze in the area and are regularly seen on the golf course" (see also Appendix 2; G. Millar, Hotel Manager, letter).

5.5 Settlement agreement

The parameters stipulated in the Memorandum of Agreement on the transfer of funds and final administration for the settlement of the Dwesa-Cwebe Community Restitution Claim included the following:

The total funding available to the beneficiaries amounted to R14 276 080. This funding comprised four main components:-

- Consideration funds (R2 100 000) – which can be used for development in terms of an approved development plan;
- Compensation funds (R1 600 000) – for the development of community and the area;
- Restitution Discretionary Grants (R7 146 000) – for agricultural, educational and development projects; and
- Settlement Planning Grants (R3 430 000) – for settlement planning, infrastructure, land survey, tenure reform etc.

As a continuation of the development process associated with the Dwesa-Cwebe area after the settlement of the land claim, the seven communities involved in the Land Claim undertook the preparation of a Development Plan intended to direct development and inform the expenditure of the Development Funds administered by the Land Trust. The communities were assisted by the Amatole District Municipality, Mbashe Municipality, the Traditional Authorities (Chiefs and Headmen), the Dwesa-Cwebe Land Trust, the Land Claims Commission and numerous other stakeholders (e.g. Amanz'Abantu, the Development Bank of South Africa, the European Union, RULIV & GTZ (Rural Livelihoods Programme Authorities), the Eastern Cape Development Corporation, the Department of Housing and Local Government. Clearly, there was no shortage of participation, input and capacity to construct a meaningful development plan. The plan was formalised by a team of consultants (Tshani Consulting cc. *et al*. 2003) after a lengthy and detailed participatory process. The Development Plan incorporated the setting of objectives, the identification of strategies to achieve the objectives, the identification of projects whose implementation would be directed by a spatial development plan, the identification of possible additional funding sources, and the identification of necessary institutional arrangements necessary to achieve all of the above and ultimately the development potential of the area (Tshani Consulting *et al*. 2003).

Since the finalisation of this Development Plan, little seems to have happened in the way of implementation. Apparently all or most of the settlement funds were invested with the Amatola District Municipality. There is no record of how this investment has fared or what money has been spent. It appears that most of the settlement money is still intact. There are allegations of financial mismanagement on the part of the Land Trust but nevertheless there would appear to be a significant capital resource available to fund development in the Dwesa-Cwebe area, and perhaps the use of this fund should be investigated before consideration of extractive resource use in an MPA is approved. Again, one of the problems with accessing this money to promote development appears to be the in-fighting amongst communities and lack of transparency in any financial arrangements made by the Trust. These are community problems and communities must resolve them. It is both illogical and morally wrong to address the lack of economic opportunities in the area by damaging the conservation estate of all South Africans, when adequate other means for addressing this lack lies within the grasp of the affected communities.

6 MANAGEMENT

6.1 Biodiversity and Fisheries Management

The main purpose of this document is to allow MCM and East Cape Parks management authorities to evaluate proposals to a) institute limited catch and release recreational fishing for angling visitors to the Dwesa-Cwebe Reserve and b) allow limited extractive use by subsistence fishers from the surrounding communities. From a management perspective the two activities might have to be both sanctioned or both not sanctioned. It would be difficult to justify to either group why one was allowed to fish and the other was not. Mr G. Millar (Manager Haven Hotel) proposes that the fishing needs of the hotel must be evaluated separately from those of the subsistence fishers. It is possible to define the effort levels of each sector separately, but differential fishing access could prove to be a divisive issue for the two sectors. A third sector comprises the residents of the 29 cottages inside the MPA. It is suggested that management authorities might be severely tested trying to implement controlled fishing for hotel guests while excluding anglers from the cottages.

The area that has been proposed for fishing activities extends from the north-eastern bank of the Mbashe River to the south-western bank of the Mbayana River (4 km) on the Cwebe side of the MPA, and effectively from Humans Rocks to the Khobole River (1.8 km) on the Dwesa side of the MPA. The MCM proposal indicates that the Humans Rocks to Khobole River stretch is broken up into several areas of a few hundred metres each, some of which would be fished and some of which would not. From the point of view of a functional MPA, a two or three hundred metre length of unfished coastline between fished areas is of little value and the whole extent of the coast between Humans Rocks and the Khobole River must be considered as a fished unit if the area was opened to fishing.

The total length of the Dwesa-Cwebe MPA is 19 km so the proposal to allow fishing in the MPA would reduce the extent of the no-take protected area by 30%. Management authorities would need to review their professed commitment to both national and international conservation and fisheries management principles if such a reduction was approved, since there is a considerable shortfall in the extent of existing no-take protected areas relative to conservation planning targets. In addition, the proposed fishing area is highly sensitive in relation to two of the most threatened fish species along the South African coast (i.e. white steenbras and dusky kob).

South African conservation planning initiatives indicate quite clearly that the greatest threat to South African marine biodiversity is extractive utilization (Attwood *et al*. 2000, Lombard *et al*. 2004, Driver *et al.* 2005). This threat received a rating of 9 out of a possible 10 in terms of

severity in the National Spatial Biodiversity Assessment (Lombard *et al.* 2004). It is considered the greatest threat in the Agulhas and Natal bioregions as a whole and in the intertidal, shallow and deep subtidal zones in particular. Opening already protected sites in these bioregions to extractive resource use does not therefore constitute good management practice.

Catch and release fishing is often promoted in terms of conservation as a relatively impact free fishing activity, but there are always mortalities associated with catch and release, particularly if anglers are not skilled in the handling of live fish (Cooke *et al*. 2006). These mortalities are not always immediately apparent because the released fish often swims off into the ocean. However, loss of scales and exterior mucus protection, scratches to the eyes, fins and skin, and damage related to hooking and unhooking fish, very often causes bacterial or fungal infections that kill the fish in a week or two. Furthermore, recent work has shown that the stress of capture results in dramatically increased levels of glucose, cortisol, and lactate (known as stress bio-markers) and that it can take as long as 72 hours for a fish to recover to normal levels (van Vuren 2010). During this period of recovery fish are at a greater risk of predation and other sub-lethal impacts. Therefore, from a conservation perspective, catch and release fishing is not an easy solution that should simply be allowed in MPAs, even if fishing activities are strictly monitored. An exception would be for carefully designed and controlled research fishing activities such as that being undertaken by Venter (2009). The economic aspects of catch and release have been outlined in Section 4.7.

The question has been raised as to why shore based angling is permitted in many MPAs around the coastline but not in the Dwesa/Cwebe MPA, and why the legislation was changed at Mkambathi to allow angling in demarcated areas after the entire MPA had been declared a no-take area under the Marine Living Resources Act? These are relevant questions that can only be referred to the MRLA legislation, which states that the only extractive resource use opportunities allowed in MPAs are those permitted by the Minister for the purposes of their proper management. In terms of Dwesa-Cwebe MPA, proper management has to be considered as a balance between the perceived socio-economic benefits of allowing fishing and the benefits accruing to biodiversity conservation and fisheries management through maintaining the extent (8-10%) of no-take coastline in the Agulhas and Natal bioregions. The major features of both sets of benefits have been discussed in detail in the earlier part of this report.

6.2 Management capacity

Ten years ago, Attwood *et al*. (2000) wrote “The weakness of South African MPAs lies in their management. Provincial enforcement agencies that are charged with MPA management lack

sufficient capacity to enforce offshore resources, because of their terrestrial bias". In 2010 the situation is much the same, and it is common knowledge that poaching of marine organisms of all descriptions takes place in the Dwesa-Cwebe MPA. The argument is often advanced that poaching is merely the result of community frustration at not having access to the resources of the MPA. However, the pressure to exploit MPA resources stems from the poor state of resources in exploited areas (Attwood *et al.* 2000). It has been shown above that extractive resource use in an MPA will very rapidly reduce resource levels to those of historically exploited areas. Furthermore, any kind of resource use option in the MPA would require monitoring and enforcement from the management authorities. There is an extreme lack of enforcement capacity at Dwesa-Cwebe MPA and Nature Reserve. The Reserve is currently in the process of appointing its third Reserve manager in three years. The management plan for the Nature Reserve indicates that there are seven field rangers for Dwesa and eight for Cwebe. These field rangers, most of whom are approaching retirement age, have to undertake all the monitoring and enforcement throughout the 5700 hectares of the terrestrial reserves, undertake veld management, game counts, fence patrols, as well as the compliance and enforcement activities associated with 19 km of coastline. As a result the effort expended on enforcement in the MPA is very low (see also Appendix 2; G. Millar letter). The views expressed by Mr G. Millar (Haven Hotel Manager; Appendix 2.) are that by allowing fishing in the MPA, it will be easier to control subsistence fishers, the jobs created for fishing guides will ensure self-regulation of the recreational fishery, and the single access route allows easy monitoring of vehicle contents. These views need to be evaluated in the light of the history of the Dwesa-Cwebe communities' lack of compliance with any management regulations (both terrestrial and marine), and the disarray of the Land Trust institution as a co-management body. Compliance is not just the enforcement of a set of regulations by a management authority. Compliance is just as much about the willingness and capacity of the "user body" to regulate their own actions while working towards jointly agreed outcomes. This willingness and capacity would appear to be absent at present in the Dwesa and Cwebe communities.

In the Dwesa-Cwebe area, environmental damage has been used as a tool for expressing community opposition or dissatisfaction to national and reserve management initiatives. Effectively management is held to ransom – do as the community says or the community members will trash the resource base. This, together with the apparent unwillingness of many authorities to adopt a firm and principled approach, is very much the profile of political demonstrations nationally. At some stage management agencies have to take a stand rather than submit to this kind of blackmail process which is undemocratic, uninformed and in the end, unconstitutional, since it affects the quality of the environment for a much wider constituency than simply the Dwesa-Cwebe communities. Dye and Lasiak (1994) made the

point that Dwesa-Cwebe is part of the heritage of the entire nation and is not just for the benefit of local communities. The MPA has local, regional, national and international importance, and the value of the reserve extends to parties far beyond the reserve.

6.3 Subsistence Fishing

The Haven Hotel has consistently bought seafood (mussels, oysters, crayfish and fish) from local fishers/collectors. Local communities have benefited from the income generated from sales and the hotel has benefited because it is able to purchase seafood at a much lower price than it would have to pay on the open market. Thus everyone would appear to benefit. Strictly from a management perspective, subsistence fisher permits issued by MCM to registered subsistence fishers allow the sale of oysters and crayfish to an approved buyer authorised by MCM (note that the hotel is currently not an approved buyer). Mussels may not be sold and only certain fish species can be sold by subsistence linefishers. There are applications for 1 oyster permit, 23 linefish permits, 70 mussel permits and 7 crayfish permits by the Ntubeni community (2010 data) which would appear to be the only Dwesa-Cwebe community to have applied for any subsistence fishing permits. Commonly caught subsistence species such as blacktail, bronze bream, galjoen, white steenbras, shad and white musselcracker etc. may not be sold because of the de-commercialised status of these species. Furthermore, strict minimum size limits and daily bag limits apply to subsistence fishers for commonly caught species which may be sold such as dusky kob (60 cm TL, 1 per person per day), yellowbelly rockcod (60 cm, 1 per person per day), black musselcracker (50 cm, 1 per person per day), etc. These regulations greatly limit the hotel as a useful point of sale for local subsistence fishers of all descriptions. Contravention of these regulations has led to problems with the authorities in the past (Saturday Dispatch, 27 February 2010). Clearly, in terms of the current regulations subsistence fishers would have to take almost all their catches home for personal consumption, and the granting of subsistence linefish fishing access would do little to generate income to local fishers, since the hotel is the only regular market.

The Dwesa-Cwebe Land Settlement Agreement contains a clause which provides for sustainable access to resources of the forest and sea. Previous sections of this report indicate that extractive resource use is probably not sustainable, and there is recent research that indicates that catch and release fishing can have a very high element of extractive resource use, since fish mortalities can be very high even if the fish are released (Cooke *et al*. 2006; Van Vuuren 2010). It should also be noted that although the Settlement Agreement might provide for access to marine resources on a sustainable basis, under the Sea Shore Act (21 of 1935, and effective when the Settlement Agreement was signed), the ownership of the sea and sea shore is vested in the President of South Africa for the use and benefit of the

public. Thus the seashore below the high tide mark has never constituted part of the Settlement Agreement.

6.4 Institutional Coordination

DEAT has established the National Environmental Advisory Forum (NEAF) whose mandate as set out in Chapter 2 of the National Environmental Management Act (107 of 1998) is to advise the Minister (DEAT) on any matter concerning governance and environmental management. A NEAF sub-committee on Coastal and Fisheries Management undertook significant research related to improving the understanding of key livelihood issues and alternative livelihood options for coastal community members. The aim of the research was to bring about a reduction in the pressure on marine resources and provide guidance to sustainable alternative livelihoods for coastal fishers. When drafting the proposal to revise the management regulations of the Dwesa-Cwebe MPA to allow fishing, MCM Protected Area management structures have not engaged in consultation with NEAF and there is no indication that any of the research relating to sustainable coastal livelihoods has been examined in relation to Dwesa-Cwebe issues. There is also no indication that there has been any consultation with the Chief Directorate Integrated Coastal Management. At a meeting in 2009 it also appeared that neither the Chief Directorate Research nor the Directorate Biodiversity and Ecosystems had been consulted until a fairly late stage in the development of the proposal to open up areas of the Dwesa-Cwebe MPA to fishing. In addition, without any consultation with other relevant management stakeholders, members of the Directorate had visited the Dwesa-Cwebe region on several occasions and had apparently discussed a possible revision of the closed area management regulations with the communities. Apparently in 2005, the Chief Director of MCM also indicated in a letter that there plans to review the legislation relating to Dwesa-Cwebe MPA (See Appendix 2 G. Millar letter). The development of the proposal to allow fishing in the MPA presumably originates from the Directorate: Protected Areas, and should have proceeded in a more holistic and consultative manner that examines fishing and its relation to a range of livelihood issues. In a similar manner, the decision to make the Dwesa-Cwebe MPA a complete no-take MPA when it was promulgated under the Marine Living Resources Act was also apparently taken with no consultation of any of the stakeholders. These actions perpetuate the perception that MCM Directorates and Departments operate largely in isolation, with little coordination in the pursuit of their stated function which is to “provide appropriate scientific liaison, logistical, administrative and personnel management, in order to advise the Minister and the Department of Environmental Affairs and Tourism on the development and conservation of marine and coastal resources to ensure the sustainable utilisation of such resources, as well as to maintain marine ecosystem integrity and quality” (www.mcm-deat.gov.za).

6.5 Alternative livelihoods

No-one denies that communities along the Wild Coast should benefit from the assets that form part of their environment and heritage. The agreed vision of the Wild Coast Biodiversity Strategy and Action Plan is that **by 2020 good governance of the Wild Coast environment ensures that people of the region derive significant and sustainable benefits from the participatory conservation of its biodiversity**. The Dwesa-Cwebe area in common with most of the Wild Coast is characterised by high levels of poverty, unemployment and insufficient or no socio-economic and physical infrastructure. Since extractive resource use provides very limited short term benefits, alternative livelihoods for displaced fishers need to be urgently investigated. Implementing alternative livelihoods in fishing communities anywhere in South Africa is not going to be an easy task. Mistrust and lack of capacity are possibly the largest obstacles to successful implementation of alternative livelihood options. Implementation will require capacity building and long-term commitment from government and fishers, as well as a more imaginative and co-ordinated approach to the management of marine resources. The alternative proposed in the draft document discussed at the meeting at MCM on 30th October 2009 i.e. Opening an MPA to fishing because of community pressures - sets a dangerous precedent that could well boomerang on other MPAs in the country. In line with international perspectives, fisheries and conservation authorities need to recognise that socio-economic problems like poverty, food security and diversification of livelihoods need to be understood and addressed in an integrated manner in order for them to fulfil their mandate of sustainable resource management. In other words, management authorities need to understand the broader ecological, social and economic context of coastal communities, as well as the policy and institutional dimensions that enable or constrain sustainable livelihoods. Within MCM, an overarching vision and strategy in terms of resource management and sustainable coastal livelihoods should be developed with the participation of all Directorates and Sub-directorates. In particular there needs to be greater coordination between those directorates charged with conservation, those concerned with resource management and those concerned with socio-economic development and livelihoods.

In concluding this section on Management Considerations, Marine Protected Area management authorities should take careful not of the following quote

“Marine reserves are much like a bank account where savings gain interest and so make money for the owner. As long you spend no more than the interest, the capital will remain to produce more. However, if the capital is plundered the interest will be lost. A permanent reserve is like having permanent capital which provides dependable interest. As soon as you reopen a reserve to fishing you lose the security that the capital provided. Just as it is hard to save money in the first place,

there are costs to fishers in setting up marine reserves. However, reserves provide benefits to fishers which make the sacrifice of investment worthwhile. If reserves are permanent the hardship of closure will only come once and the benefits, when they begin, will be continuous" (Roberts and Hawkins 2000). It needs to be stressed again that in the case of Dwesa-Cwebe, these potential losses or benefits are likely to accrue to shore linefishers, most of whom come from the former Transkei (Section 4.4, Mann *et al*. 2003).

6.6 Management Recommendations

The current state of conflict and the request for fishing rights in the Dwesa_Cwebe MPA is ultimately the result of a lack of delivery and co-ordination on the part of a range of institutions in relation to managing the environment, the natural resource base and the human elements of the area. Management authorities have not addressed co-management arrangements properly. At a national level, communication channels within and between various government departments concerned with resource use, research, livelihoods, and social and economic development are poorly developed. Local and District municipalities have clearly not delivered on their development and fiduciary responsibilities. Finally, communities and their elected representatives have not co-operated together to fulfil the mandate of the Dwesa-Cwebe Land Trust. The lack of education and capacity building programmes that might improve the ability of the Dwesa-Cwebe communities to participate in management and aid them to assess the likely impacts of development proposals has compounded these problems. This fragmented and un-coordinated approach to management has resulted in a situation in which rural communities are forgotten or sidelined in economic development initiatives. As a result, resource use demands are made that will both reduce the extent of an important component of South Africa's conservation estate, and undermine the efforts to re-build collapsed fish stocks. In the process, unsophisticated rural communities are used as footballs in political and economic agendas that encourage divisions and by doing so, hinder rather than encourage development. Within this situation management recommendations must focus on the following main issues:

- Subsistence fishing
- Catch and release fishing
- Community needs and economic development

6.6.1 Subsistence fishing

The state of crisis in South African linefisheries and the collapsed state of many fish stocks has been described in detail in the preceding sections of this report. It has been convincingly demonstrated both nationally and internationally that MPAs play a critical role in helping to rebuild fish stocks. Although not immediately evident as "money in the pocket" the

sustainable value of fish exports from the Dwesa-Cwebe MPA is of the order of hundreds of thousands to millions of rand annually, much of which would accrue to local fishers. It has been shown that extractive fishing will result initially in high catch rates but these will be reduced within less than four months to catch rates of the previously exploited surrounding areas. Thus any benefit from being allowed to take fish out of the MPA will be dissipated within this time. The removal of accumulated fish will result in a once-off economic benefit that might approach R1.1 million but is more likely to be of the order of R250 000, and again this would be dissipated within the time frame of the decline in catch rates to the previously exploited surrounding areas. The sale of fish is strictly controlled by the MLRA regulations and the Hotel is the only regular point of sale. The management authority has very limited enforcement capacity and current community institutional arrangements indicate that compliance with any regulations is unlikely to be good. For these reasons, any extractive fishing activities cannot be recommended.

6.6.2 Catch and release fishing

It is not currently possible to answer definitively the question of whether catch-and-release angling is compatible with no-take MPAs. Mortality rates of released fish vary extensively (from zero to 100%) depending on a number of factors including environmental conditions, fishing gear, angler behaviour, and species-specific characteristics (Cooke *et al*. 2006). Research is beginning to show that certain handling techniques can significantly reduce post-release mortality in fish. Therefore, with appropriate regulation and angler education, catch-and-release could help enhance conservation and management goals associated with MPAs, while maintaining public support and providing alternative tourism-based activities for visitors. Based on existing data, the employment of local fishing guides to oversee tourist catch and release fishing activities would generate about R66 000 annually for local communities. However, until sufficient data are available to better understand the local impact of catch-and-release fishing, it is recommended that catch-and-release fishing by anglers should not be allowed in the Dwesa-Cwebe MPA. Difficult management issues are likely to arise if catch and release fishing by hotel guests is allowed and subsistence fishers and cottage residents are prohibited from fishing. The research currently being undertaken by Venter (2009) should be encouraged and used to assess the relevant impacts of catch-and-release fishing in the MPA. If catch and release fishing was implemented, recommendations regulating its implementation are contained in Appendix 3.

6.6.3 Community needs and economic development

Addressing community needs and economic development is by far the most difficult management recommendation to implement because it requires a level of coordination and commitment that has been lacking in all the institutional partners, from the Dwesa-Cwebe

communities all the way up to National Government. By recommending no change in the status of the fishing regulations for the Dwesa-Cwebe MPA, the charge can be laid that the needs of the community are being ignored in terms of their economic benefits. This is only true if it is accepted that there are no other economic opportunities in the area. In relation to the Haven Hotel, immediate potential investment opportunities amounting to over R10 million that do not include fishing activities have been described. The status quo in relation to operation of the hotel is another option – the hotel management has apparently increased occupancy rates from around 5% to about 23% without legal fishing. However, there appears to be very little development of non-fishing visitor activities. A significant capital injection is almost certainly required if the potential of the hotel is to be realised in a way that makes a difference to local economic conditions in the short term. Whatever options are chosen with regard to the Haven Hotel, there are a number of issues that have to be addressed immediately if the Dwesa-Cebe communities are to move forward in terms of deriving significant and sustainable benefits from the participatory conservation of the biodiversity of the area as outlined in the vision of the Wild Coast Biodiversity Strategy and Action Plan. Many of these recommendations were documented in the Strategy and Action Plan and remain to be implemented. These and other recommendations arising from this report include the following:

- Speedy resolution of the Land Trust issue and a resolution of the lease agreement stalemate. Contracting in conflict resolution specialists would be useful action.
- A coordinated attempt to access Settlement Funds from the Amatola District Municipality. This should be combined with a coordinated effort to implement the Development Plan drawn up for the use of Settlement funds.
- Re-constitute the Dwesa-Cwebe co-management structure, establish its terms of reference, and maintain it as a decision-making authority in accordance with the Settlement Agreement. All institutional levels have to commit to maintaining the functionality of the co-management body. The biggest challenge is to re-establish channels of communication and develop relationships of trust and understanding with the local communities. Note should be taken of a Memorandum on Outstanding Issues of the Dwesa-Cwebe Settlement Agreement (April 2004) drawn up by the Land Trust. This memorandum states "…..we find ourselves continuously ignored or side-lined by Government – specifically DEAET, and the representative of the Land Claims Commission. We do not have the means to run our own meetings, having not a cent to show from the lease consideration fees, compensation, or discretionary restitution funds as outlined in the Settlement Agreement. Our authority is undermined, our capacity eroded, and our means to represent our communities severely compromised**……"**

- Develop, and implement, a relevant training and skills development programme for the members of the Dwesa-Cwebe Land Trust.
- Develop and implement a programme that focuses on communicating to local communities the joint decisions of the co-management structure. The programme must also be able to feed back issues of community concern to the co-management structure.
- Implement a coordinated approach to develop meaningful alternative livelihoods.
- Educate local communities with regard to Settlement fund opportunities, investment opportunities, conservation issues, co-management processes, and alternative livelihood issues.
- Management authorities, hotel management and communities must evaluate diversification and development of alternate tourist activities within the MPA. This needs to be followed by investment and training that provides employment opportunities for the local community within the MPA.
- Increase the staffing and equipment complement for the Provincial Management Authority of the MPA to enable effective enforcement of the Marine Living Resources Act. This should include the appointment of a dedicated MPA manager.
- Training programmes that focus on education and outreach to provide local communities and visitors with the best available information on the functions and value of the MPA .
- Develop a detailed management plan for the Dwesa-Cwebe MPA which sets out the aims and objectives for the MPA and formalises the structure of the co-management agreements with regard to management of the MPA.

7 CONCLUSIONS

- The Dwesa-Cwebe MPA is situated in a transition zone between the Agulhas and the Natal bioregions and as such it is an important national biodiversity asset and a priority area for biodiversity conservation at a global, national and regional scale.
- South African linefish stocks are in a critical state and, by prohibiting extractive fishing, the Dwesa-Cwebe MPA performs a valuable fisheries management function in terms of helping to rebuild over-exploited and collapsed fish stocks.
- In addition, the Dwesa-Cwebe MPA is one of only two known spawning sites for white steenbras (*Lithognathus lithognathus*) and together with the Mbashe estuary, provides a very important nursery ground for juvenile dusky kob (*Argyrosomus japonicus*). These are two of the most threatened of all fish stocks along the South African coastline.
- Research programmes in several MPAs along the South African coast including Dwesa-Cwebe have provided clear evidence of the benefits of no-take MPAs as a tool to rebuild fish stocks.
- The terrestrial and marine reserves of Dwesa-Cwebe together provide a valuable recreational asset worth about R6 million.
- Currently no fishing is permitted in the MPA but despite the legislation there is significant recreational angling by guests staying at the Haven Hotel and by cottage owners and by subsistence fishers from surrounding communities. Communities in the Dwesa-Cwebe area including the Haven Hotel management staff, perceive angling as a source of potential income for an impoverished area and would like to have fishing permitted along a 4km stretch of coast to the north of the Mbashe River and along a 2 km stretch of coast immediately north of the southern boundary of the MPA. However, only about 50% of visitors to the area think angling is very important as an activity in the MPA. The unspoiled nature of the coast and un-crowded beaches are the biggest attractions. It is not possible to estimate the extent to which the recreational value of the area would be reduced if angling was permitted. The extent of the no-take coastline in the Dwesa-Cwebe MPA would be reduced by 30% if fishing was allowed in the proposed areas. Such a reduction cannot be recommended given that current no-take areas on the South African coast are only 50% of nationally and internationally approved target levels.
- Exports of fish and fish recruitment products from the Dwesa-Cwebe MPA to the surrounding areas are worth at least several hundred thousand rand and possibly several million rand annually. These exports benefit mainly local fishers. Opening a 4 km stretch of coast to extractive resource use would provide very short term benefits to

communities, with catch rates declining to those of the historically exploited surrounding areas within a matter of months and providing a total once-off benefit of around R225 000.

- Given the limitations on fish catches as regulated by the Marine Living Resources Act, and the limitations on sale of catches, subsistence fishers would have to take most of their catch home for personal consumption. Extractive fishing would thus provide very little legal economic benefit to the area. Extractive fishing also cannot be recommended from the biodiversity and fisheries management perspectives.
- Catch and release fishing options would generate about R66 000 annually for local community members formally employed as guides. However, there are often significant mortalities associated with the capture of fish even if they are released. These mortalities are species-specific but are generally increased when fishing on a rocky coastline (i.e. fish are more easily damaged). From a conservation perspective, catch and release fishing cannot be regarded as a non-consumptive activity, even if fishing activities are strictly monitored.
- Communities of the Dwesa-Cwebe area do not have good record of compliance with management authorities and regulations controlling the use of marine and terrestrial resources.
- At present the Dwesa-Cwebe communities have a dysfunctional decision making body (the Land Trust) and all management interactions have been suspended until the legality of two opposing Land Trusts has been determined by the courts. This dysfunctionality is a serious constraint on future investment opportunities.
- Given the poor record of compliance, the dysfunctional decision making situation and the very limited management capacity in the Dwesa-Cwebe Reserve and MPA, changes in existing MPA regulations will be difficult to implement effectively
- There are a number of potential development and associated income generating opportunities in the Dwesa-Cwebe area, but all development is greatly hampered by the lack of coordination, transparency and cooperation between all relevant institutions, from the community level all the way up to National Government. There appear to be a large number of potential eco-tourism based visitor activities associated with the area that do not necessitate the introduction of fishing activities in the MPA.
- The Land Settlement funds should form a rapidly available source of development funding but the management of, and access to, these funds is blocked by governance complexities. A participatory development plan involving the use of these funds was formulated several years ago and should be re-visited as a starting point for economic and social development.

8 REFERENCES

Aiken, J. P., and Mann, B. 2000. The Steentjie *Spondyliosoma emarginatum*. In 'South African Marine Linefish Status Reports'. (Ed. B. Q. Mann.) *Special Publications of the Oceanographic Research Institute* **7**, 191–2.

Anderson R. J.,. Bolton, J. J and Stegenga, H. 2009. Using the biogeographical distribution and diversity of seaweed species to test the efficacy of marine protected areas in the warm-temperate Agulhas Marine Province, South Africa. *Diversity and Distributions* **15**: 1017–1027.

Attwood, C. 2000. CoastCare FactSheet 3C. Galjoen.

Attwood, C.G. 2003. Dynamics of the fishery for galjoen *Dichistius capensis*, with an assessment of monitoring methods. *Afr. J. Mar. Sci*. **25**: 311-330.

Attwood C.G and M. Farquhar 1999. Collapse of linefish stocks between Cape Hangklip and Walker Bay, South Africa. South African Journal of Marine Science **21**:415-432.

Attwood, C.G., J.M. Harris and A.J. Williams 1997a. International experience of marine protected areas and their relevance to South Africa*. South African Journal of Marine Science* **18**: 311-332.

Attwood, C.G., Mann, B.Q., Beaumont, J. and Harris, J.M. 1997b. Review of the state of marine protected areas in South Africa. *South African Journal of Marine Science* **18:** 341-367.

Attwood, C.G. and Bennett, B.A. 1994. Variation in dispersal of Galjoen (*Coracinus capensis*) (Teleostei: Coracinidae) from a marine reserve. *Canadian Journal of Fisheries and Aquatic Science* **51:** 1247-1257.

Attwood, C.G. and Bennett, B.A. 1995a. Modelling the effect of marine reserves on the recreational shore-fishery of the south-western Cape, South Africa. *S. Afr. J. Mar Sci* **16**: 227-240.

Attwood, C.G. and B.A. Bennett 1995b - A procedure for setting daily bag limit on the recreational shore-fishery of the south-western Cape, South Africa.*S. Afr. J. mar. Sci*. **15**: 241-251.

Attwood C.G., Moloney, C.L., Stenton-Dozey, J., Jackson, L.F. Heydorn A.E.F and T.A. Probyn 2000. Conservation of marine biodiversity in South Africa. In In B.D. Durham & J.C. Pauw (eds). Summary Marine Biodiversity Status Report for South Africa at the end of the 20th Century, National Research Foundation, 68-82.

Attwood, C.G., Allen, J. and Claasen, P.J. 2002. Nearshore surface current patterns in the Tsitsikamma National Park, South Africa. *South African Journal of Marine Science* **24:** 151-160.

Augustyn, C. J., Lipinski, M. R., Sauer, W. H. H., Roberts, M. J., and Mitchell-Innes, B. A. 1994. Chokka squid on the Agulhas Bank: life history and ecology. *South African Journal of Science* **90:** 143–54.

Awad A.A., Griffiths C.L., Turpie J.K. 2002. Distribution of South African marine benthic invertebrates applied to the selection of priority conservation areas. *Diversity and Distributions* **8**: 129-145.

Beckley, L.E. and van Ballegooyen, R.C. 1992. Oceanographic conditions during three ichthyoplankton surveys of the Agulhas Current in 1990/91. *South African Journal of Marine Science* 12: 83-93.

Beckley, L. E. 1993. Linefish larvae and the Agulhas Current. In 'Fish, Fishers and Fisheries – Proceedings of the Second South African Marine Linefish Symposium'. (Eds L. E.

Beckley and R. P. van der Elst.) *Special Publication*, *Oceanographic Research Institute* **2**, 57–63.

Bennett, B.A. 1988. Some considerations for the management in South Africa of galjoen *Coracinus capensis* (Cuvier), an important shore-angling species off the South-Western Cape. *South African Journal of Marine Science* **6:** 133-142.

Bennett, B.A. 1993a. The fishery for white steenbras *Lithognathus lithognathus* off the Cape coast, South Africa, with some considerations for its management. *South African Journal of Marine Science* **13:** 1-14.

Bennett, B. A. 1993b - Aspects of the biology and life history of the white steenbras *Lithognathus lithognathus* in South Africa. *S. Afr. J. Mar. Sci.* **13**: 83-96.

Bennett, B. A. and C. G. Attwood 1991 - Evidence for recovery of a surf-zone fish assemblage following the establishment of a marine reserve on the southern coast of South Africa. *Mar. Ecol. Prog. Ser.* **75**(2/3): 173-181.

Bennett, B.A. and Attwood, C.G. 1993. Shore-angling catches in the De Hoop Reserve and further evidence for the protective value of marine reserves. *South African Journal of Marine Science* **13:** 213-222.

Booth A.J. 2000a. *Chrysoblephus gibbiceps.* In 'South African Marine Linefish Status Reports'. (Ed. B. Q. Mann.) *Special Publications of the Oceanographic Research Institute* **7:** 137–8.

Booth A.J. 2000b. *Cymatopceps nasutus.* In 'South African Marine Linefish Status Reports'. (Ed. B. Q. Mann.) *Special Publications of the Oceanographic Research Institute* **7:** 145–6.

Booth A.J. 2000c. *Pachymeteopon aneum.* In 'South African Marine Linefish Status Reports'. (Ed. B. Q. Mann.) *Special Publications of the Oceanographic Research Institute* **7:** 160–1.

Booth A.J. 2000d *Pachymeteopon grande.* In 'South African Marine Linefish Status Reports'. (Ed. B. Q. Mann.) *Special Publications of the Oceanographic Research Institute* **7:** 164–5.

Booth A.J. 2000e. *Pterogymnus laniarus.* In 'South African Marine Linefish Status Reports'. (Ed. B. Q. Mann.) *Special Publications of the Oceanographic Research Institute* **7:** 178–9.

Booth A.J. 2000f. *Sparodon durbanensis.* In 'South African Marine Linefish Status Reports'. (Ed. B. Q. Mann.) *Special Publications of the Oceanographic Research Institute* **7:** 189-90.

Booth, A.J. and C.D. Buxton. 1997. The management of the panga, *Pterogymnus laniarius* (Pisces: Sparidae) on the Agulhas Bank, South Africa using per-recruit models. Fish Research **32:** 1-11.

Booth, A.J. and A.E. Punt 1998. Evidence for rebuilding in the panga stock on the Agulhas Bank, South Africa. *Fish. Res.* **34**: 403-421.

Booth A.J., Brouwer, S.L. and T. Hecht 1999 - Considerations on the feasibility of a directed fishery for panga *Pterogymnus laniarius* (Pisces: Sparidae). *S. Afr. J. mar. Sci.* **21**: 77-88.

Berkeley S.A. , Chapman C and Sogard SM. 2004a. Maternal age as a determinant of larval growth and survival in a marine fish, Sebastes melaops. *Ecology* **85:** 1258-1264.

Berkeley S.A., Hixon M.A., Larson R. J., and Love M. S. 2004b. Fisheries sustainability via protection of age structure and spatial distribution of fish populations. *Fisheries* **29:** 23-32.

Bennett, B.A. and Attwood, C.G. 1993. Shore-angling catches in the De Hoop Reserve and further evidence for the protective value of marine reserves. *South African Journal of Marine Science* **13:** 213-222.

Bolton, J.J. & Anderson, R.J. 1990. Correlations between intertidal seaweed community composition and seawater temperature patterns on a geographical scale. *Botanica Marina*, **33**: 447–457.

Bolton, J.J. and Stegenga, H. 1987. The marine algae of Hluleka (Transkei) and the warm temperate/sub-tropical transition on the east coast of southern Africa. *Helgolander Meeresuntersuchungen* **41:** 165–183.

Bolton, J.J. and Stegenga, H. 2002. Seaweed biodiversity in South Africa. *South African Journal of Marine Science* **24**: 9–18.

Bolton, J.J., Leliaert, F., DeClerck, O., Anderson, R.J., Stegenga, H., Engledow, H.E. and Coppejans, E. 2004. Where is the western limit of the tropical Indian Ocean seaweed flora? An analysis of intertidal seaweed biogeography on the east coast of South Africa. *Marine Biology* **144:** 51–59.

Branch, G. M. and C. L. Griffiths (Eds.) 1994. *Two oceans - a guide to the marine life in Southern Africa*. Cape Town; David Philip Publishers.

Branch G. M. and Odendaal F. 2003. The effects of marine protected areas on the population dynamics of a South African limpet, *Cymbula oculus*, relative to the influence of wave action. *Biological Conservation* **114:** (2) 255-269.

Brouwer, S.L. 1997 - An assessment of the South African east coast linefishery from Kei Mouth to Stil Bay. M.Sc. thesis, Rhodes University, Grahamstown: 120 pp.

Brouwer, S. 2000. Movement patterns of red steenbras tagged and released in the Tsitsikamma National Park. *Tagging News*, Oceanographic Research Institute, Durban, South Africa.

Brouwer, S.L. 2002 Movement patterns of red steenbras *Petrus rupestris* tagged and released in the Tsitsikamma National Park, South Africa. *South African Journal of Marine Science* **24**: 375-378.

Brouwer, S.L., Griffiths, M.H., 2005a. Reproductive biology of carpenter seabream (*Argyrozona argyrozona*) (Pisces: Sparidae) in a marine protected area. *Fish. Bull*. 1**03**: 258-269.

Brouwer, S.L., and Griffiths, M.H. 2005b. Stock separation and life history of *Argyrozona argyrozona* (Pisces : Sparidae) on the South African east coast. *Afr. J. Mar. Sci*. 27(3): 585-595.

Brouwer, S.L., Griffiths, M.H. and M.J. Roberts 2003. Adult movement and larval dispersal of *Argyrozona arygyrozona* (Pisces: Sparidae) from a temperate marine protected area. African Journal of Marine Science 25: 395-402.

Burger, L.F. 1990. The distribution patterns and community structure of the Tsitsikamma rocky littoral ichthyofauna. Unpublished MSc thesis, Rhodes University, Grahamstown, 116pp.

Bustamante, R.H., Branch, G.M., Eekhout, S., Robertson, B., Zoutendyk, P., Schleyer, M., Dye, A., Hanekom, N., Keats, D., Jurd, M. and McQuaid, C. 1995. Gradients of intertidal primary productivity around the coast of South Africa and their relationships with consumer biomass. *Oecologia* **102**: 189-201.

Bustamante, R.H. and Branch, G.M. 1996. Large scale patterns and trophic structure of southern African rocky shores: the role of geographic variation and wave exposure. *Journal of Biogeography* **23**: 339-351.

Buxton, C. D. 1990. The reproductive biology of *Chrysoblephus laticeps* and *C. cristiceps* (Teleostei: Sparidae). *J. Zool. Lond*. 220:497−511.

Buxton, C. D 1991. The biology of the white musselcracker *Sparodon durbanensis* (Pisces: Sparidae) on the Eastern Cape coast, South Africa. *S. Afr. J. Mar. Sci*. 10:285−296.

Buxton, C. D 1992. The application of yield-per-recruit models to two South African sparid reef species, with special consideration to sex change. Fish. Res. 15:1−16.

Buxton, C.D. 1993. Life-history changes in exploited reef fishes on the east coast of South Africa. *Environmental Biology of Fishes* **36**, 47-63.

Buxton, C. D., and J. R. Clarke. 1986. Age growth and feeding of the blue hottentot *Pachymetopon aeneum* (Teleostei: Sparidae) with notes on reproductive biology. *S. Afr. J. Zool.* **21:** 33−38.

Buxton, C. D., and J. R. Clarke. 1991. The biology of the white musselcracker Sparodon durbanensis (Pisces: Sparidae) on the eastern Cape coast, South Africa. *South African Journal of Marine Science* **10:** 285-296.

Buxton, C. D., and J. R. Clarke. 1992. The biology of the bronze bream, *Pachymetopon grande* (Teleostei: Sparidae) from the south-east Cape coast, South Africa. *South African Journal of Zoology* **27**(1): 21-32.

Buxton, C.D. and M.J. Smale 1984. A preliminary investigation of the ichthyofauna of the Tsitsikamma Coastal National Park. *Koedoe* **27**:13-24.

Buxton, C.D. and Smale, M.J. 1989. Abundance and distribution patterns of three temperate marine reef fish (Teleostei: Sparidae) in exploited and unexploited areas off the southern Cape Coast. *Journal of Applied Ecology* **26:** 441-451.

Chalmers, R., Bennett, R.H., Turpie, J.K., Andrew, M., Andrew, T., Clarke, B.M., Hutchings, K. and de Wet, J. 2009. Ecology, Value and Management of the Garden Route Coast. Unpublished Report prepared for WWF – Cape Marine Program. 244 pp.

Chambers RC and Legget WC 1996 Maternal influences on variation in egg sizes in temperate marine fishes. American Zoology **36**: 180-196.

Clark, B.M. and Lombard, A.T. 2007. A marine conservation plan for the Agulhas Bioregion: Options and opportunities for enhancing the existing MPA network. Unpublished Report, Anchor Environmental Consultants and Conservation Systems. Report prepared for WWF-SA, C.A.P.E., Cape Nature and South African National Parks. 102 pages.

Colin, P.L., Sadovy, Y.J. and M.L. Domeier, 2003. Manual for the study and conservation of reef fish spawning aggregations. Society for the Conservation of Reef Fish Aggregations. Special Publication No. 1, 98pp.

Coetzee, P.S. and D. Baird 1981. Age, growth and food of *Cheimerius nufar* (Ehrenberg, 1820) (Sparidae), collected off St Croix Island, Algoa Bay. *S. Afr. J. Zool*. **16**(3): 137-143.

Conover D.O., Arnott S.A., Walsh M.R. and Munch S.B. 2005. Darwinian fishery science: lessons from the Atlantic silverside (*Menidia menidia*). *Can. J. Fish. Aquat. Sci*. **62**: 730-737.

Convention on Biological Diversity 2004. World Summit Sustainable Development Resolutions.

Cooke, S.J., Danylchuk, A.J., Danylchuk, A.E., Suski, C.D. and Goldberg, T.L. 2006. Is catch-and-release recreational angling compatible with no-take marine protected areas? Ocean & Coastal Management **49**: 342-354.

Cowley, P. D. 1990. The taxonomy and life history of the blue stingray *Dasyatis marmorata capensis* (Batoidea: Dasyatidae) from southern Africa. M.Sc. thesis, Rhodes University, Grahamstown.

Cowley, P.D. 1999. Preliminary observations on the movement patterns of white steenbras *Lithognathus lithognathus* and bronze bream *Pachymetopon grande* (Teleostei: Sparidae) in the Tsitsikamma National Park marine reserve. In: Proceedings of the Third Southern African Marine Linefish Symposium, Arniston, 28 April - 1 May 1999. South African Network for Coastal and Oceanic Research Occasional Report. 5: 106-108.

Cowley, P.D., Brouwer, S.L. and Tinley, R.L. 2002. The role of the Tsitsikamma National Park in the management of four shore-angling fish along the south-eastern cape coast of South Africa. *South African Journal of Marine Science* **24**, 27-36.

Cowley, P.D., Potts, W.M. and A.D. Wood 2004. Monitoring of Inshore Linefish Resources in the Tsitsikamma National Park. Half-year progress report on a project executed on behalf of the Department of Environmental Affairs and Tourism. 7 pp.

Crawford, R.J.M. and H.B. Crous 1982. Trends in commercial handline catches of redfishes along the Southern Cape coasts, Republic of South Africa. *Koedoe* **25**: 13-31.

Dai D.G. 1998. Molluscan conservation in South Africa: Diversity, issues and priorities. *Journal of conchology* Special Publication No. 2. 61-76.

DEAT (2005). *National Biodiversity Strategy and Action Plan*. Pretoria: Department of Environment Affairs and Tourism. 108 pages

Dicken, M.L., Booth, A.J & Smale, M.J. 2008. Estimates of juvenile and adult raggedtooth shark (*Carcharias taurus*) abundance along the east coast of South Africa. *Canadian Journal of Fisheries and Aquatic Sciences* 65: 621-632.

Driver A, Maze K, Rouget M, Lombard AT, Nel JL, Turpie JK, Cowling RM, Desmet P, Goodman P, Harris J, Jonas Z, Reyers B, Sink K, Strauss T 2005. National spatial biodiversity assessment 2004: Priorities for biodiversity conservation in South Africa. *Strelitzia* **17:** 45 pp.

Dwesa-Cwebe Nature Reserve Management Plan 2007. Integrated Reserve Management Plan for the Dwesa-Cwebe Nature Reserve. Unpublished Document commissioned by East Cape Parks. 95 pp.

Dye, A H and Lasiak T A 1994. Intertidal shellfish stocks in the Dwesa-Cwebe Nature Reserve, their status and recommendations for management. Report to the Ministry of Agriculture and Environmental Affairs, Eastern Cape Government. 18 pp.

Emanuel, B.P., R.H. Bustamante, G.M. Branch, S. Eekhout, and F.J. Odendaal. 1992. A zoogeographic and functional approach to the selection of marine reserves on the west coast of South Africa. South African Journal of Marine Science **12:** 341-354.

Fennessy, S.T. and Radebe, P.V. 2000. Yellowbelly rockcod (*Epinephelus marginatus*). Pages 117-118 in: B.Q. Mann, editor. Status Reports for Key Linefish Species. Oceanographic Research Institute Durban, South Africa. Special Publication **7,** 257 pp.

Fairhurst, L., Attwood, C.G., Durholtz, M.D. and C.L. Moloney 2007. Life history of the steentjie *Spondyliosoma emarginatum* (Curvier 1830) in Langebaan Lagoon, South Africa. *African Journal of Marine Science* **29**(1): 79-92.

Fennessy, S.T. 2000. Malabar rockcod (*Epinephelus malabaricus*). Pages 115-118 in: B.Q. Mann, editor. Status Reports for Key Linefish Species. Oceanographic Research Institute, Durban, South Africa Special Publication, **7:** 257 pp.

Fennessy, S.T., McDonald, A.M., Mann, B.Q. and Everett, B.I. 2003. An assessment of the recreational and commercial skiboat fishery in the Transkei. *African Journal of Marine Science* **25:** 61-78.

Field, J. G., Moloney, C.L., du Buission, L., Jarre, A., Stroemme, T., Lipinski, M.R. and Kainge, P. 2008. Exploring the BOFFFF hypothesis using a model of Southern African hake (*Merluccius paradoxus*). In: Tsukamoto, K., Kawamura, T., Takenchi, T., Beard, T.D. and Kaiser, M.J. (eds.). Fisheries for global welfare and environment. 5th World Fisheries Congress 2008: 17-26.

Fielding, P. J., Robertson, W. D., Dye, A. H., Tomalin, B. J., Van der ElsT, R. P., Beckley, L. E., Mann, B. Q., Birnie, S., Schleyer, M. H. and Lasiak, T. A. 1994. Transkei coastal fisheries resources. Oceanographic Research Institute Special Publication No. 3. 175 pp.

Garratt, P.A. 1985. The offshore linefishery of Natal: I: Exploited population stuctures of the sparids *Chrysoblephus puniceus* and *Cheimerius nufar*. *Invest. Rep. Oceanogr. Res. Inst*. **62**: 18pp.

Garratt, P.A. 1986. Protogynous hermaphroditism in slinger Chrysoblephus puniceus (Gilchrist and Thompson, 1971) (Teleostei: Sparidae). *J. Fish Biol.* **28**(3): 297-306.

Garratt, P.A. 1988. Notes on seasonal abundance and spawning of some important offshore linefish in Natal and Transkei waters, southern Africa. *S. Afr. J. mar. Sci*. **7**: 1-8.

Garratt, P.A., Birnie, S.L. and Chater, S. A. 1994. The fishery for englishman *Chrysoblephus anglicus* and scotsman *Polysteganus praeorbitalis* (Pisces: Sparidae) in Natal, South Africa, with notes on their biology. *Unpubl. Rep. Oceanogr. Res. Inst.* **96**: 1-25.

Gell, F.R. and Roberts, C.M. 2003. The Fishery Effects of Marine Reserves and Fishery Closures. Report for WWF-US, 1250 24th Street, NW, Washington, DC 20037, USA, 90 pp.

Gell, F.R. and Roberts, C.M. 2005. Benefits beyond boundaries. The fishery effects of marine reserves. *Trends in Ecology and Evolution* Vol. **131.**

Goosen, A.J.J. 1997. The reproduction, age and growth, and feeding habits of the spotted gullyshark, *Triakis megalopterus* off the Eastern Cape coast. M.Sc. thesis, University of Port Elizabeth: 97pp.

Goosen, A.J.J. and M.J. Smale 1997. A Preliminary study of age and growth of the smoothhound shark *Mustelus mustelus* (Triakidae). *S. Afr. J. Mar. Sci*. **18**: 85-91

Götz A. (2005) Assessment of the effect of Goukamma Marine protected area on community structure and fishery dynamics. Unpublished PhD thesis, Rhodes University, 232 pp.

Goetz, A. Kerwath, S.E., Attwood, C.G. Sauer, W.H.H. 2008. Effects of fishing on population structure and life history of roman *Chrysoblephus laticeps* (Sparidae). *Marine Ecology Progress Series* **362**: 245-259.

Griffiths, M.H. 1996. Life history of *Argyrosomus japonicus* off the east coast of South Africa. *S. Afr. J. mar. Sci*., **17**: 135-154.

Griffiths, M.H. 1997. The management of South African dusky kob *Argyrosomus japonicus* based on per recruit models. *South African Journal of Marine Science* **18:** 213-218.

Griffiths, M.H. (2000) Long-term trends in catch and effort of commercial linefish off South Africa's Cape Province: snapshots of the 20th century. *South African Journal of Marine Science* **22**: 81-110.

Griffiths, M.H., C.G. Attwood and R. Thompson 1999. New management protocol for the South African line fishery. In B.Q. Mann, editor, Proceedings of the Third South African Marine Linefish Symposium. *South African Network for Coastal and Oceanic Research, Occasional Report* **5:**145-156

Griffiths, M.H. and Wilke, C.G. 2002. Long-term movement patterns of five temperate-reef fishes (Pisces: Sparidae): implications for marine reserves. *Marine and Freshwater Research* **53**: 233-244.

Halpern, B.S. 2003. The impact of marine reserves: do reserves work and does size matter? *Ecological Applications* **13**(1), 117-137.

Halpern, B.S. and Warner, R.R. 2002. Marine reserves have rapid and lasting effects. *Ecology Letters* **5**, 361- 366.

Harrison, T.D. 2002. Preliminary assessment of the biogeography of fishes in South African estuaries. *Marine and Freshwater Research* **53:** 479-490.

Hecht, T. and C.D. Buxton 1993. Catch trends in the Transkei commercial fishery. In *Fish, Fishers and Fisheries*. Proceedings of the Second South African Marine Linefish Symposium. Beckley, L.E. and van der Elst, R.P. (Eds.). 23-24 October 1992, Durban,*Spec. Publ. Oceanogr. Res. Inst.* **2**: 127-133.

Hecht, T. and Tilney 1989. The Port Alfred fishery: a description and preliminary evaluation of a commercial linefishery on the South African East Coast. *S. Afr. J. mar. Sci. **8*** 103–117.

Heemstra, P. and E. Heemstra. 2004. *Coastal fishes of southern Africa*. National Inquiry Service Centre and the South African Institute for Aquatic Biodiversity, Grahamstown.

Hussey, N.E., McCarthy, I.D., Dudley, S.F.J. and Mann, B.Q. 2009. Nursery grounds, movement patterns and growth rates of dusky sharks, *Carcharhinus obscurus*: a long-term tag and release study in South African waters. Marine and Freshwater Research 60: 571-583.

Hutchings, K., Griffiths, M.H. and Lamberth, S.J. In press. An investigation of the effect of temporal vatiation in growth rate of *Umbrina robinsoni* on biological reference point estimates calculated using per-recruit models. *African Journal of Marine Science*.

IUCN 1998. Protected areas Programme

IUCN 2006. *2006 IUCN Red List of Threatened Species*. < http://www.iucnredlist.org/>.Downloaded 18 June 2006

Kenchington, R., Ward, T. and Hegerl, E. 2003. The Benefits of Marine Protected Areas. Technical Document prepared by the Commonwealth Department of Environment and Heritage Department, University of York, York, YO10 5DD, UK from material supplied by supplied by Richard Kenchington, Trevor Ward, and Eddie Heger. 24 pp.

Jennings, S. and Kaiser, M. J. 1998. The effects of fishing on marine ecosystems. *Advances in Marine Biology* **34:** 201-352.

Jennings, S. and J.M. Lock. 1996. Population and ecosystem effects of reef fishing. Pages 193-218 in N.V.C. Polunin and C.M. Roberts, editors. Reef Fisheries. Chapman and Hall, London.

King, C.M. 2005 - Towards a new approach for coastal governance with an assessment of the Plettenberg Bay Shore-based linefishery. Unpublished MSc thesis, Rhodes University, 169 pp.

Kerwath, S.E., Gotz, A., Attwood, C.G., Wilke, C. & Sauer, W.H.H. 2007a. Area utilization and activity patterns of roman *Chrysoblephus laticeps* in a small South Africa marine protected area. *African Journal of Marine Science* 29(2): 259-270.

Kerwath, S.E., Gotz, A., Cowley, P.D., Sauer, W.H.H. & Attwood, C.G. 2007b. Movement pattern and home range of roman *Chrysoblephus laticeps*. *African Journal of Marine Science* 29(1): 93-103.

Kerwath, S.E., Gotz, A. Attwood, C.G. & Sauer, W.H.H. 2008. The effect of marine protected areas on an exploited population of sex-changing temperate reef fish: an individual based model. *African Journal of Marine Science* 30(2): 337-350.

Lamberth S.J. and Joubert A. R. 2000. . Prioritizing species for research, conservation and management: a case study of exploited fish species. In: Mann, B.Q. (ed). Proceedings of the Third Southern African Marine Linefish Symposium. 28 April – 1 May 1999, Arniston, Western Cape. *SANCOR Occ. Rep.* 5: 159pp.

Lemm S and Attwood C. 2003. State of Marine Protected Area Management in South Africa. Unpublished Report, WWF South Africa, 123 pages.

Lombard A.T., Strauss, T., Harris, J.M., Sink, K., Attwood, C. and Hutchings, L. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 4: Marine Component. Pretoria: South African National Biodiversity Institute. 60 pp.

Mann, B.Q. 2000. Southern African marine linefish status reports. Status Reports for Key Linefish Species. Oceanographic Research Institute, Durban, South Africa, Special Publication, **7:** 257 pp.

Mann, B.Q. 2001. Establishment of a large marine protected area along the Pondoland coast – an essential prerequisite to the conservation of overexploited South African reef fish species. Sixth Indo-Pacific Fish Conference, 21-25 May 2001, Durban, South Africa. Paper.

Mann, B.Q. 2007. Facilitating the implementation of the management plans for the Pondoland MPA and developing relevant monitoring systems. Unpublished Report: Year end Report prepared for Marine and Coastal Management. 14 pp.

Mann, B.Q. 2009. Monitoring the effectiveness of the Pondoland MPA in the protection of linefish and other marine resources. Unpublished Report: Year end Report prepared for East Cape Parks Board. 17 pp.

Mann, B. Q., and C. D. Buxton. 1992 Diets of *Diplodus sargus capensis* and *Diplodus cervinus hottentotus* (Pisces: Sparidae) on the Tsitsikamma coast, South Africa. *Koedoe*. **35**(2): 27-36.

Mann, B. Q., and C. D. Buxton 1997. Age and growth of *Diplodus sargus capensis* and *D. cervinus hottentotus* (Sparidae) on the Tsitsikamma coast, South Africa. *Cybium* 21(2): 135-147.

Mann, B. Q., and C. D. Buxton. 1998. The reproductive biology of *Diplodus sargus capensis* and *D. cervinus hottentotus* (Sparidae) off the South-East Cape coast, South Africa. *Cybium* **22** (1):31−47.

Mann, B.Q. and S.T. Fennessy 1998. Evaluation of linefishery participation and management in the Transkei region of the Eastern Cape (Port Edward to Coffee Bay). Unpublished ORI Report prepared for Marine and Coastal Management: 17pp

Mann, B.Q and Celliers, L. 2005. A biodiversity survey of the Pondoland Marine Protected Area. Southern African Marine Science Symposium, 4-7 July 2005, Durban, South Africa. Paper.

Mann, B.Q., McDonald, A.M., Sauer, W.H.H. And T. Hecht, 2003. Evaluation of participation in, and management of, the Transkei shore linefishery. *Afr. J. mar. Sci.* 25: 79-97.

Mann, B.Q., Fennessy, S.T., Lang, D.R. & Ogunronbi, I. 2005. Age, growth and stock assessment of scotsman *Polysteganus praeorbitalis* and englishman *Chrysoblephus anglicus* (Pisces: Sparidae), two endemic deep-reef fishes off KwaZulu-Natal. *Oceanogr. Res. Inst. Unpubl. Rep.* 218: 13pp.

Mann, B.Q., Celliers, L., Fennessy, S.T., Bailey, S. & Wood, A.D. 2006. Towards the declaration of a large marine protected area: A subtidal ichthyofaunal survey of the Pondoland coast in the Eastern Cape. *South Africa. African Journal of Marine Science* **28:** 3&4, 535-551.

McGrath, M.D., Horner, C.C.M., Brouwer, S.L.S., Lamberth,J., Mann, B.Q., Sauer, W.H.H. and Erasmus,C.1997. An Economic valuation of the South African Linefishery. *South African Journal of Marine Science* **18**: 203-211.

Marine Protected Areas: W W F 's Role in their Future Development 1998. Editor Sue Wells Published by WWF–World Wide Fund For Nature. 57 pp.

Martin K., Samoilys M.A., Hurd A.K., Meliane I and Gustaf Lundin C.G. 2007 Experiences in the use of marine protected areas with fisheries management objectives – A review of case studies in *Report and documentation of the Expert workshop on marine protected areas and Fisheries management: review of issues and Considerations, Rome, 12–14 june 2006*. *FAO Fisheries Report* **825**, 21-109.

McGrath, M.D., Horner, C.C.M., Brouwer, S.L.S., Lamberth,J., Mann, B.Q., Sauer, W.H.H. and Erasmus,C.1997. An Economic valuation of the South African Linefishery. *South African Journal of Marine Science* **18**: 203-211.

Penney, A. J., B. J. Mann-Lang, R. P. Vand der Elst and C. Wilke 1999. Long-term trends in catch and effort in the Kwazulu-Natal nearshore linefisheries. *S. Afr. J. Mar. Sci.* **21**: 51-76.

Roberts, C.M. and J.P. Hawkins. 2000. Fully-protected marine reserves: a guide. WWF Endangered Seas Campaign, 1250 24th Street, NW, Washington, DC 20037, USA.

Roberts, C.M. and V.C. Polunin 1993. Marine Reserves: Simple solutions to managing complex fisheries? *Ambio* **22**: 363-368.

Robertson, W. D. and Fielding, P. J. 1997. Transkei coastal fisheries resources. Phase 2: Resource utilisation, development and tourism. Special Publication no. 4. Oceanographic Research Institute, Durban, South Africa. 166 pp.

Rossouw, G.J. 1983 - The biology of the sandshark *Rhinobatus annulatus* in Algoa Bay with notes on other elasmobranchs. PhD thesis, University of Port Elizabeth, South Africa: 180pp.

Rossouw, G.J. 1984 - Age and growth of the sandshark, *Rhinobatus annulatus* in Algoa Bay, South Africa, *J. Fish Biol*. **25**(2): 213-222.

Sink, K.J. 2006. A review of the role of the Marine Protected Area in the Tsitsikamma National Park in conserving marine biodiversity, supporting applied science and sustaining fisheries in South Africa. Marine Program Manager, South African National Biodiversity Institute. 24 pp.

Smale M.J 1988. Distribution and reproduction of the reef fish *Petrus rupestris* (Pisces: Sparidae) off the coast of South Africa. *South African Journal of Zoology* **23**: 272-287.

Smale M.J. 1990. Red steenbras and seventyfour: aspects of their biology and role as predators. South African Natural Science, Progress Report **167**: 46-50.

Smale M.J. and A.E. Punt. 1991. Age and growth of the red steenbras (Pisces: Sparidae) on the south-east coast of South Africa. *South African Journal of Marine Science* **10**: 131-139.

Smith, M.K.S. 2005. Towards a new approach for coastal governance with an assessment of the Plettenberg Bay linefisheries. MSc dissertation, Rhodes Universitym 221 pp.

Smith, M.M. and P.C. Heemstra P.C. 1986. Smith's Sea Fishes. Macmillan, South Africa, 1,047 pp.

Stegenga, H. and Bolton, J.J. 1992. Ceramiaceae (Rhodophyta) of the Cape Province, South Africa: Distribution in relation to concepts of marine provinces. *Botanica Marina* **35:** 99-107.

Tilney, R. 1990. Aspects of the biology, ecology and population dynamics of *Galeichthys feliceps* (Valenciennes) and *G. ater* (Castelnau) (Pisces: Ariidae) off the South-east coast of South Africa. PhD thesis, Rhodes University, Grahamstown: 278pp.

Tilney, R.L., Nelson, G., Radloff, S.E. and Buxton, C.D. (1996) Ichthyoplankton distribution and dispersal in the Tsitsikamma National Park Marine Reserve, South Africa. *South African Journal of Marine Science* **17:** 1-14.

Tshani Consulting cc.,Ilitha Consulting, FST Consulting Engineers and Community Developers, Taylor and Associates Trust, ATS Rural Development Services, Earthwise Environmental Consulting 2003. Dwesa-Cwebe Development Plan. Unpublished Report commissioned by the Dwesa-Cwebe Project Steering Committee Members and Stakeholders. 126 pp.

Trippel EA 1998. Egg Size and Viability and Seasonal Offspring Production of Young Atlantic Cod. *Transactions American Fish Society* **127**: 339-359.

Turpie J.K 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 3: Estuarine Component. Pretoria: South African National Biodiversity Institute.

Turpie, J.K. and van Niekerk, L. 2005. Conservation assessment of the Wild Coast. Priority estuaries for conservation on the Wild Coast South Africa: Appendix 3: Report commissioned by the CSIR for the Wild Coast Conservation and Sustainable Development Project. 12 pp.

Turpie, J.K. and de Wet, J. 2009. The Recreational Use and Value of the Garden Route Coast, South Africa. Unpublished Report prepared for WWF – Cape Marine Program. 47 pp.

Turpie, J.K., Beckley, L.E. and Katua, S.M. 2000. Biogeography and the selection of priority areas for the conservation of South African coastal fishes. *Biological Conservation* **92:** 59-72.

Turpie, J., Clark, B. and Hutchings, K. 2006. Economic valuations of Marine Protected Areas along the Garden Route, South Africa: Implications of changes in size and management. Unpublished Report prepared for WWF – South Africa.

Van Vuuren, L. 2010. First SA study on stress levels of caught and released fish. Aquatic species conservation in: *The Water Wheel*: 15-17.

Vallin L. and Nissling A. (2000). Maternal effects on egg size and egg buoyancy of Baltic cod Gadus morhua Implications for stock structure effects on recruitment. *Fish. Res*. **49**: 21-37.

Venter, J. 2009. Dwesa-Cwebe Protected Area: Inshore linefish monitoring project – Year-end Report. Unpublished Report East Cape Parks. 18 pp.

Wallace J.C and Aasjord D. (1984). An investigation of the consequences of egg size for the culture of Artic char (Salvelinus alpinus (L.) *J. Fish. Biol*. **24**: 427-435.

Wood, A.D., Brouwer, S.L., Cowley, P.D., Harrison, T.D. (2000) An updated check list of the ichthyofaunal species assemblage of the Tsitsikamma National Park, South Africa. *Koedoe* **43:** 83-95.

WWF 2004. Sanlam Living Waters Partnership report on proposed opening of Tsitsikamma MPA to fishing

www.mcm-deat.gov.za. Webiste for Marine and Coastal Management – Department of Environmental Affairs and Tourism. Accessed 9 April 2010.

APPENDICES

Appendix 1: **Published research by A. Dye and T. Lasiak relevant to intertidal ecology at Dwesa-Cwebe**

Appendix 2: **Letter from the Haven Hotel Manager regarding fishing in the Dwesa Cwebe MPA**

Appendix 3: **Management recommendations for possible catch and release fishing in the Dwesa-Cwebe MPA**

APPENDIX 1:

Published research by A. Dye and T. Lasiak relevant to intertidal ecology at Dwesa-Cwebe.

SELECTED PUBLISHED RESEARCH BY ARTHUD DYE AND THERESA LASIAK RELATING TO DWESA-CWEBE MARINE HABITATS

ARTHUR DYE

DYE, A H 1984. Report on the intertidal zone of Cwebe Nature Reserve. For Division of Nature Conservation, Transkei. pp10.

WOOLDRIDGE,T, A H DYE & A McLACHLAN 1981. The ecology of sandy beaches in Transkei. S. Afr. J. Zool. 16, 210-218.

DYE, A H 1988. Rocky shore surveillance on the Transkei coast, southern Africa: Temporal and spatial variability in the balanoid zone at Dwesa. S. Afr. J. Mar. Sci. 7, 87-99.

DYE, A H 1989. Studies on the ecology of *Saccostrea cucullata* (Born, 1778) (Mollusca: Bivalvia) on the east coast of southern Africa. S. Afr. J. Zool. 24(2), 110-115.

DYE, A H 1990. Episodic recruitment of the rock oyster *Saccostrea cucullata* on the Transkei coast. S. Afr. J. Zool. 25, 185-187.

DYE, A H 1992. Experimental studies of succession and stability in rocky intertidal communities subject to artisanal shellfish gathering. Neth. J. Sea Res. 30, 209-217.

DYE, A H 1992. Recruitment dynamics and growth of the barnacle *Tetraclita serrata* on the south east coast of southern Africa. Estuar. cstl. Shelf Sci. 35, 167- 177.

DYE, A H 1993. Recolonization of intertidal macroalgae in relation to gap size and molluscan herbivory on a rocky shore on the east coast of Southern Africa. Mar. Ecol. Prog. Ser. 95, 263-271.

DYE, A H 1993. Aspects of the population dynamics of *Chthamalus dentatus* (Crustacea: Cirripedia) on the Transkei coast of southern Africa. S. Afr. J. Mar. Sci. 13, 25-32.

DYE, A H and LASIAK T A 1994. Intertidal shellfish stocks in the Dwesa- Cwebe Nature Reserve, their status and recommendations for management. Report to the Ministry of Agriculture and Environmental Affairs, Eastern Cape Government. pp18.

DYE A H. BRANCH G M, CASTILLA J C and BENNETT B A 1994. Biological options for the management of the exploitation of intertidal and subtidal resources. In: Rocky Shores: Exploitation in Chile and South Africa. Ed R W Siegfried. Ecological Studies Vol 103, 131 - 154. Springer Verlag.

DYE, A H, SCHLEYER, M, LAMBERT, G, & LASIAK, T A 1994. Intertidal and subtidal filter feeders in Southern Africa In: Rocky Shores: Exploitation in Chile and South Africa. Ed R W Siegfried. Ecological Studies Vol 103, 57 - 74. Springer Verlag.

FIELDING, P.J., ROBERTSON, W D., DYE, A.H., LASIAK, T.A., TOMALIN,B.J., VAN DER ELST, R.P., BECKLEY, L.E., MANN, B.Q., BIRNIE,S. and SCHLEYER, M.H. 1994. Transkei

Coastal Fisheries Resources. Report No 98, Oceanographic Research Institute, Durban, 175 pp.

BUSTAMENTE, R.H., BRANCH, G.M., EEKHOUT, S., ROBERTSON, B., ZOUTENDYK, P., SCHLEYER, M., DYE, A.H., HANEKOM, N., KEATS, D., JURD, M. and McQUAID, C. 1995. Gradients of Intertidal Primary Productivity around the coast of South Africa, and their relationships with Consumer Biomass. Oecologia 102(2), 189-201.

DYE, A H, LASIAK, T A and GABULA, S 1997. Recovery and recruitment of the brown mussel *Perna perna* (L.) In Transkei: implications for management. S. Afr. J. Zool. 32(4),118-123.

DYE A. H. 1998. Community-level analyses of long-term changes in rocky littoral fauna from South Africa. Mar. Ecol. Prog. Ser. 164, 47-57.

DYE A. H. 1998. Dynamics of rocky intertidal communities: analysis of long time series from South African shores. Estuar. Cstl. Shelf Sci. 46(2), 287-306.

HARRIS, J M, BRANCH, G M, ELLIOT, B, CURRIE, B, DYE, A H, McQUAID, C, TOMALIN, B and VELASQUEZ, C.1998. Spatial and temporal variability in recruitment of intertidal mussels around the coast of southern Africa. S. Afr. J. Zool. 33(1), 1-11.

COCKROFT, A, SAUER, W, BRANCH, G. M, CLARK, B. DYE, A and RUSSELL, E. 2002. Assessment of resource availability and suitability for subsistence fishers in South Africa with a review of management procedures. S. Afr. J. Mar. Sci. 24, 489-501.

DYE, A H and DYANTYI, N 2002. Rehabilitation of denuded rocky shores: preliminary studies with the brown mussel *Perna perna*. S Afr J Mar Sci 24, 65- 70.

THERESA LASIAK

LASIAK, T. 1983.The impact of surf-zone habitat: implications for teleost nursery áreas South African J. Zool,

TARRAS-WALHBERG, N. and LASIAK, T. 1986 Does the intensity of recruitment of various rocky shore molluscs vary with distance with distance away from the Dwesa-Cwebe Nature Reserve. 10th Southern African Marine Science Symposium (SAMSS 2000): Land,Sea and People in the New Millennium-- Abstracts., 1, 2000

LASIAK, T. 1986. The reproductive cycles of the intertidal bivalves *Crassostrea cucullata* (Born,1778) and *Perna perna* (Linnaeus, 1758) from the Transkei coast, Southern Africa. Veliger 29 (22), 226-230.

LASIAK, T. 1986. The reproductive cycle of the intertidal gastropod Turbo coronatus Gmelin 1791, on the Transkei coast. S. Afr. J. Zool. 21 (22), 153-155.

LASIAK, T. 1987. The reproductive cycles of three trochid gastropods from the Transkei coast, Southern Africa. J. Moll. Stud. 53, 24-32

LASIAK, T and DYE, A.H. 1989. The Biology of the brown mussel, Perna Perna in Transkei, South
Africa. Implications for management of a traditional food source. Biological Conservation 47 (4): 245 – 257.

LASIAK, T. 1991. The susceptibility and/or resilience of Rocky Littoral molluscs to stock depletion by the indigenous coastal people of Transkei, Southern Africa. Biological Conservation 56 (3): 245 – 264.

LASIAK T. and WHITE, D.R.A. 1993. Micro algal food resources and competitive interactions among the intertidal limpets *Cellana capensis* (gmelin, 1791) and *Siphonaria concinna* Sowerby, 1824. S.Afr. J. mar. Sci. 13: 97-108

LASIAK,T. and FIELD, J.G, 1995. Community-level attributes of exploited and non-exploited rocky infratidal macrofaunal assemblages in Transkei. Journal of Experimental Marine Biology and Ecology 185 (1) 33 – 53.

Multivariate comparisons of rocky infratidalmacrofaunal assemblages from replicate exploitedand non-exploited localities on theTranskei coast of South Africa Marine Ecology Progress Series 167: 15 – 23.

LASIAK,T. 2006. Spatial variation in density and biomass of patellid limpets inside and outside a marine protected area Journal of Molluscan Studies 72 (2): 137-142.

APPENDIX 2:

Letter from Grant Millar, Manager Haven Hotel, to Peter Fielding re Dwesa-Cwebe MPA management issues

8 April 2020

Hi Peter
Thank you for meeting with me on Monday to discuss our view regarding current MCM regulation pertaining to the Dwesa/Cwebe nature reserve.
This letter is intended to serve as a record of our observations, opinion and recommendations regarding the current situation in the MPA.

Current Status

The Haven Hotel was established in the mid 1920's specifically to accommodate visiting anglers to the area. Since inception until 2005 angling was always permitted. More recently (1980's?) restrictions were introduced to limit angling to certain areas.
In 1999 legislation was promulgated which outlawed any form of angling in the entire Reserve. It would appear that this was done in response to an "invasion" by the local communities who descended "en mass" and removed large amounts of muscles, oysters and crayfish. The communities' action appears to have been an attempt to express their "new found freedom" as a consequence of political change and the dismantling of the then government and the homeland system. For many years, they had been denied access to the marine resources in the reserve. The community and hotel is still being punished for their action.
While legislation was promulgated in the late 90's or early 2000's it was only implemented in about 2005. This delay in implementation seems to have been largely due to MCM not consulting with ECPB when formulating the new legislation. It is surprising that, for whatever reason, the local stakeholders and those mostly affected by such legislation were never consulted. We have not been able to obtain any empiric information specific to this MPA upon which this decision was based.
Very soon after the angling ban was introduced, objections were sent to MCM explaining the severe consequences of the ban on sustainability of the hotel and its effect on employment. MCM acknowledged the problem stating -
"We are now planning to review the regulations that apply to Dwesa-Cwebe, as there have been several reports that the present situation is unworkable. It is possible to consider the re-opening of a section of the coast for catch and release fishing, which may serve the objective of maintaining hotel occupancy rates and also providing MCM with data on fish catches." M Mayekiso 12/09/2005
Since then we have attended numerous meetings and workshops requesting that legislation be amended to accommodate the needs of visitors. We have been repeatedly assured that change was imminent. At a meeting in July/Aug 2008, with a representative from MCM together with the Dwesa Reserve manager and the Cwebe Reserve manager we were informed that legislation would be changed by December 2008. Nothing happened. We were then told that the changes would be implemented by Feb 2009 and later by June 2009. Nothing happened. In December 2009 we and guests were informed by the Reserve manger that fishing would be allowed by Feb 2010. Nothing has happened.
Despite numerous attempts to meet and discuss this issue with the previous and current acting MCM Director General, no meeting has ever been granted.
There appear to be opposing or conflicting factions within MCM. Assurances given by a department within MCM seem to be undermined or sabotaged by other departments or

members within MCM. Decisions or opinions are formulated in offices in Cape Town with no understanding of the actual effect or implications of those decisions on the communities, hotel or indeed the fish.

Is anybody able to accurately determine what effect the 5 year ban on fishing in a 5km stretch of Transkei coastline has had on the recovery of depleted fish stocks? Over the past year or so, on several occasions, groups of fishermen (from ECPB) have been visiting the area to determine fish stock levels. We are concerned that these figures may be used to justify retaining the ban. On the one hand if levels are low, scientists will argue that the ban needs to be maintained to ensure recovery and on the other hand if numbers are seen to be high this will be used to justify retaining current legislation as is will be seen to be yielding results.

We would propose that the regular visits by trawlers to this MPA results in more fish being caught and killed in a single night by these (probably foreign) poachers than recreational anglers would kill in a year. The enforcement of inappropriate laws targets the wrong culprits while protecting the resources for the benefit of the real culprits. On the other hand the fishing ban has removed the single biggest attraction to the hotel which has had direct and measurable consequences.

Current legislation is in conflict with the Dwesa/Cwebe Land Settlement Agreement which specifically provides for sustainable access to resources – marine included. The agreement also states that no laws pertaining to the reserve may be changed without consulting the stakeholders and indeed owners of the reserve.

We have repeatedly asked why shore based angling is permitted in many MPA's around the coastline but not in Dwesa/Cwebe. Why are anglers permitted to fish at Robberg, Betty's Bay, Goukamma, Castle Rock, Langebaan, Sixteen Mile Beach, Malgas Island, Jutten Island, Marcus Island, Trafalgar, St.Lucia, and Maputaland. Does Pletenberg Bay rely on its existence by allowing recreational fishing on Robberg. Why was the legislation changed at Mkambati to allow angling in demarcated areas in spite of being declared a no fishing zone at the same time angling in Dwesa/Cwebe was banned?

Surely it would be more effective to ban fishing in areas where hundreds of fishermen are able to fish and kill fish while not contributing to the local economy as opposed to an area where very few people fish but contribute hugely to the local economy. The Dwesa/Cwebe reserve is a perfect example of a location where non consumptive fishing could be monitored and controlled. Guests leaving are forced to go through the gate and we do not have freezers in the rooms.

The relationship between the community, hotel and t he ECPB/MCM is extremely poor. Under current circumstances this will not improve. In the case of fishing, we have been given too many assurances which have not been fulfilled. While these punitive laws exist, there is no hope of cooperation or compliance. While the law may in theory have been promulgated to protect the fish and marine resources, in reality the community take every opportunity to fish and harvest marine resources.

In reality, many potential guests do not visit the hotel because of the fishing ban. Many of these guests go to locations where they are permitted to fish. Most of the locations are not monitored or patrolled as a result of which the same fishermen that could be catching and releasing are fishing with no control. Are the fish better off as a result?

Some guests do fish. Most of those fishing are aware of the ban. All fish caught are released. (I am aware of only one fish that was not released during the entire Xmas season) Many of those fishing will not return to the hotel as a result of the ban.

Local fishermen continue to fish. They avoid the authorities or run away when they see rangers. There is no patrolling outside the fences on the Mbashe River where numerous local fishermen are active. Some of these fishermen are forced to fish due to a lack of opportunity to earn an income from working as "gilly's" for recreational anglers.

The fishing ban also needs to be seen in context of the state of the reserve. The fences are nonexistent, poaching is rife, cattle graze undisturbed in the reserve, Rhino are legally poached/hunted, there is no maintenance of the roads and invasive plant species proliferate unchecked. Rangers walk past cattle to stop fishermen who - if they catch- release the fish. It

is apparent that the only conservation activity is the continual harassment of catch and release fishermen. What has happened to MCM's undertaking to develop and promote alternative activities?

Recommendations

MCM need to establish or re-establish channels of communication and develop relationships of trust and understanding with the local communities.

Decisions made with regard to the MPA should be made with all stakeholders and not only those representing MCM's perspective.

It is very important that MCM establish credibility with the Dwesa/Cwebe Land Trust and local stakeholders to create an environment in which dialogue can occur. This may require acknowledgement that the process of policy making has been flawed and also acknowledging the detrimental effect of policy on the socio economic environment.

MCM need to speak with one voice. Meetings and discussions are meaningless when any agreement reached is undermined other members or departments within MCM who most often have no understanding of the local situation and do not attend the meetings.

Having agreed on policy, MCM need to deliver on the agreements. By doing so they are able to expect that other stakeholders also conform to agreed policy.

Amongst the local communities, there is no knowledge of the state of marine resources and a total lack of understanding as to why restrictions are in place. Education and information dissemination is vital to co-opting the local community into any conservation initiatives.

"In the end we will only conserve what we love
We will only love what we understand and
We will only understand what we are taught"

Regulations which allow recreational, non consumptive shore based angling for guests staying at the hotel should be implemented as soon as possible.

A fee payable by anglers could be considered. This may be used to contribute towards the cost of a MCM official or student dedicated to monitoring and/or recording data.

Non consumptive angling would satisfy the needs of guests, increase employment and reduce the need for subsistence fishermen to catch fish.

Conclusion

We understand and support the need to preserve our marine resources. We are also aware of the threatened status of some fish species.

Considering that one of the primary attractions to the hotel is angling, it is in our interest to ensure that fish stocks are not depleted.

Education and information dissemination is an important part of the conservation effort.

We are willing to work with MCM in this regard.

We believe that allowing catch and release fishing at the hotel will have absolutely no impact on the fish stocks but will make an enormous impact on the sustainability of the hotel and on job creation.

We urge that MCM implement changes to the current legislation as has been assured repeatedly over the past 4 years.

APPENDIX 3:

Management recommendations for possible catch and release fishing in the Dwesa-Cwebe MPA

Areas fished - zonation

Fishing sectors

Permitting

Effort Limitations

Tackle

Bag limits and other Controls

Management, Monitoring and Compliance

Implementation

Releasing fish successfully, a guideline for shore anglers
(Article adapted from "The Angler's Friend" by B. Mann, Tight Lines Magazine – July 1994)

This is an article on releasing fish. More specifically, it tells how the conservation-minded angler can return his or her catch to the water, with minimum injury and stress to the fish. The object of this exercise is for the fish to be fit and healthy when it is released so that it will maximize its chances of survival.

Be Prepared:
If a fish is to be released, the angler should have his equipment ready. Necessary equipment would be a good pair of longnose pliers for squashing barbs and removing hooks, a stretcher or soft-mesh net for landing the fish and a clear spot on the beach with a wet towel to work on the fish. If the fish is to be tagged, then remove the tag from its card in advance, have the tape measure unrolled and the applicator ready, before the fish is even landed. If the fish is to be photographed, make sure the camera is ready for use the instant the fish is lifted from the water. If the angler is prepared in this manner, the fish spends less time out of the water and is in a far better state to be released than one which is kept out of the water for a long period.

Tackle:
What has tackle got to do with releasing a fish you may ask? For a start, the use of ultra-light tackle has no place in catch and release. A fish which has put up a tremendous fight over a long period of time will arrive at the beach exhausted or nearly dead. The stress of the fight causes a build up of lactic acid in the muscles which may ultimately cause their death. Fish which are completely exhausted by the time they are landed have a poor survival rate and are not good candidates for release. The line should be strong and the reel drag should be smooth as this plays an important role in landing a fish quickly. Erratic drags which release in jerks instead of in a steady, continuous manner, do not allow the angler to utilize his rod's pulling power properly.

There are four general areas where a fish can be hooked: a) Foul hooked in the skin somewhere. This is often an area where little damage is likely to occur. The hook can generally be easily removed in this case. b) The lips, jaw or inside the mouth. There are few sensitive structures in this area. The hook can be removed relatively easily from this area without permanent damage. The only problem may be a hook far back in the mouth behind the tongue which is more difficult to remove. c) Throat/gullet/gill area. Hooks in this area are not easy to remove without damage to sensitive structures like the gills. Barbed hooks left in this area may interfere with swallowing and/or respiration and may result in the eventual death of the fish. d) Deep gut hooked. The extent of damage will depend on where in the gut the fish is hooked. Sensitive organs in close proximity such as the liver may be damaged with almost certain fatal consequences.

The question that is always asked: "What do you do with the hook?" We strongly recommend that if you are going to release the fish you are targeting then squash the barbs on your hook beforehand. This is easily done using a pair of pliers and studies have shown that it makes a huge difference to the survival of fish. Once you have tried it you will also realize that you do not loose that many more fish. Circle hooks are also a good idea as they generally hook the fish in the side of the mouth rather than in the throat or gut. The best option is to remove the hook if this can be done easily without further injuring the fish. Using pliers or some other hook-removing apparatus can help. When removing a barbed hook that is well set, sometimes it helps to push the point through the fish's lip or jaw and to flatten the barb when it protrudes. This makes removal of the offending hook much easier. If the fish is hooked in the throat or gut we recommend that you do not try and remove it as this will result in more damage to the fish. In this situation it is best to cut the trace and leave the hook in place. If the hook is barbless it will either fall out or pass through the digestive system when the fish next feeds.

Lures armed with three sets of treble hooks can often have the middle hook removed, with no less hookups resulting. Also trebles can be replaced by one or two single hooks on some lures. First check to see if the lure's action is not badly affected by the alteration. If it is, the trebles can be left in place but you can snip some of the hook points off with a pair of side-cutters.

Playing the fish:
A fish that is to be released should be played as hard as the tackle allows. Ensure that you fish with a drag setting that forces the fish to work for any line it takes. There should be very few times during the fight when no line is being won or lost, in other words, the angler should either be retrieving line or losing line to a fish which is running, and not standing holding a fish in one spot for too long. By pumping the rod in short strokes, and recovering small amounts of line as the rod is lowered each time, the length of the fight can be considerably reduced. Another trick used by anglers is the application of side pressure on the fish. At times during the fight, particularly when the fish is winning line, you can apply maximum pressure while laying the rod to one side, instead of pulling with the rod in a vertical plane. This side pressure will often turn the fish's head in the direction of the pull, and it is easier than turning the fish whilst pulling against the direction in which the fish is swimming. Once the fish is turned, switching the side of the pull to the opposite side, e.g. from left to right, will further confuse the fish and shorten the fight.

Landing, handling and releasing:
If possible, the use of a plastic landing stretcher is recommended as this results in minimal damage to the fish. Be careful if using a landing net as this can result in damage to the fins and tail. Lures can also become entangled in a net and removing a struggling fish attached to the net by the lure is not an easy task. If you do not have a landing stretcher available, most fish can be released by hand. Make sure your hands are wet when handling fish and if at all

possible leave them in the water. Fish such as kob, garrick/leervis, white steenbras and other large species can be gently lifted by gripping them just in front of their tails and supporting their weight, halfway down their length, with your other hand. This removes the chance of any possible damage to the fish's spine. Kob, rockcod and other fish with large mouths can be landed using a bogo grip (or gloved hand) attached to the lower jaw of the fish but if you lift the fish be sure to support its weight with the other hand. Gaffing fish should be avoided. Stingrays can be landed by holding the base of the tail and the sting with a cloth in one hand and then sliding the ray up the beach with the other hand with your fingers gripping the groove in front of the upper jaw. Avoid placing your fingers in the spiracles. Large sharks such as raggies and zambies should not be removed from the water and if the trace cannot be removed cut it off as close to the hook as possible. Whenever possible, the best way to unhook a fish is to hold the fish in the water and remove the hook there. Whichever method is used, caution should be exercised by the angler as serious injury can result from an accident involving hooks or fish teeth and fins. Avoid placing fish onto hot, dry or even hard, rough surfaces, which may remove some of its protective slimy coating or its scales, thereby increasing the risk of infection.

Once the hooks are removed and the picture is taken, the fish is ready to be released. If the above steps have been carried out speedily, the fish will generally swim away almost as soon as it is put back in the water. Make sure the fish is released into deep water and not simply chucked into a shallow wave on the beach. Also do not place the fish in a rock pool as the water is generally warmer and less oxygen rich than in the sea. If the fish does not swim away, it may need to be revived. This is best done by holding the head of the fish into the current in deep water. By holding the fish by the lower lip or with your hand supporting it under the pelvic fins and moving it slowly forwards through the water the mouth is allowed to open and water is forced over the gills. An exhausted fish will sometimes take two or three minutes of this treatment before swimming off. Do not pull fish and especially sharks backwards through the water as this can result in the gills becoming clogged with sand

In summary:

- If fish are to be released, one must plan beforehand for such a release.
- The longer a fish is out of the water the less chance it has of survival.
- Fish are covered in a layer of mucus / slime which protects them from infection. Fish should thus be handled as gently and as little as possible, with wet hands and placed on a wet towel or a wet foam mattress.
- Fish bodies are supported by water. If the fish must be removed from the water, the best way to take a fish out of the water is to use a plastic stretcher or a large, fine-mesh landing net or alternatively use a bogo grip to hold the fish's lower jaw. Place a hand under the belly before lifting it out of the water. Large fish should preferably not be taken out the water. The effect of gravity while lifting fish out of water by the head can damage internal organs.
- Do not place fingers into gills or eye sockets as these organs can be damaged.
- Sunlight damages fish eyes – cover them with a wet cloth if the fish is removed from the water.
- Lactacidosis is the buildup of lactic acid in the body as a result of prolonged strenuous activity. Normal energy production is aerobic and produces energy and carbon dioxide. Once the oxygen in the blood is exhausted, energy is produced anaerobically and produces lactic acid as a byproduct. This lowers the body pH and can cause rupture of muscle fibres (including heart muscle fibres) which renders the fish stiff and vulnerable to predators and may lead to death up to 3 days later. Therefore the longer the fight the greater the extent of lactacidosis and the less the chance of survival. So, if a fish is to be released, do not use extremely low breaking strain line and fight the fish for extended periods but rather use suitable tackle, bring the fish in quickly and release it as soon as possible.

- Resuscitation. Fish rely on water passing over their gills to assimilate oxygen.
- All fish should be returned gently, head first, into water that is deep enough for them to swim away easily.