

REVIEW OF THE STATE OF MARINE PROTECTED AREAS IN SOUTH AFRICA

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The use of marine protected areas (MPAs) in South Africa should be revised in the light of growing problems related to the over-use of marine resources. No consistent policy has been applied to the establishment and management of MPAs. Existing MPAs include marine reserves, restricted areas, single-species restricted areas, National Parks, estuarine protected areas, trawling reserves and offshore islands, declared under a variety of legislation. Marine reserves and restricted areas have been declared under the Sea Fishery Act, but are managed by provincial authorities. The provincial authorities in the Northern, Western and Eastern Cape lack the necessary resources for marine management. By contrast, the KwaZulu-Natal Nature Conservation Service and the National Parks Board are adequately staffed and equipped to provide all the necessary managerial functions in their MPAs. The effectiveness of most MPAs is not assessed and they do not have clearly stated objectives or management plans. MPA boundaries are inappropriately demarcated at sea. Two marine biogeographic zones and two marine habitat types are poorly represented in MPAs. Ecologically and economically important species are well represented in MPAs, but effective protection is less satisfactory. Some MPAs are playing an important role in fisheries management. Community resource-use programmes in KwaZulu-Natal have helped to control poaching to some extent. It is recommended that South Africa establish a MPA Programme. MPA objectives should be clearly stated and communicated to the public through education programmes. Research, monitoring and enforcement in MPAs should be improved.

Marine protected areas (MPAs) are expected to play a more prominent role in the conservation of marine resources and fisheries management. Fishery scientists and international organizations, such as the World Conservation Union, are strongly advocating the use of MPAs to conserve marine resources, to rebuild fisheries and to integrate conservation with human activities in the coastal zone (Kelleher and Kenchington 1992, Gubbay 1995, Bohnsack and Ault 1996, Clark 1996, Roberts 1997). The role of MPAs is explicitly recognized in South Africa's draft policies on Marine Fisheries and Biodiversity.

Concerns about the conservation of wild marine resources in South Africa have intensified considerably since the last major inquiry into the need for marine reserves in 1977. The conservation status of many ecologically and economically important species is poor. Most coastal fisheries are not managed according to operational management procedures and many have deteriorated to the point where estimates of spawner biomass are below commonly accepted threshold values (e.g. Buxton 1992, Bennett 1993, Griffiths 1997). The commercial linefishery has targeted progressively less desirable species as the larger and more valuable species have gradually disappeared. Catches by shore-anglers have declined steadily since the 1950s and the ordinary catches of

the past are now rarities (Bennett 1991). Shellfish resources, too, show signs of severe local over-exploitation. The numbers of exploiters continues to increase, technological improvements have increased the efficiency of exploitation, and the enforcement of fishery regulations is now widely regarded as inadequate. Pollution and development have also placed enormous pressure on the coastal zone with the increase in coastal populations (Heydorn *et al.* 1992).

The deterioration of the marine environment has led to more requests for MPAs from the private sector, although it is evident that there is insufficient capacity to manage existing MPAs. There is considerable controversy surrounding the utilization of protected stocks, and extensive poaching continues in MPAs. Most MPAs were proclaimed without sufficient information and with no research or monitoring programmes to assess whether these areas are performing useful functions. The processes of establishment and management of MPAs in South Africa is in urgent need of revision.

Hockey and Buxton (1989) wrote the first comprehensive paper on the state of MPAs in South Africa. They noted that the conservation status of South Africa's coastline was potentially good, but recommended that:

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- (i) the existing diverse legislation pertaining to MPAs be consolidated;
- (ii) provincial authorities be allowed to designate MPAs (i.e. below the high-water mark, in line with a regionalization policy);
- (iii) MPAs be established to fill two conspicuous gaps in protected areas along the South African coastline, namely the West Coast and southern KwaZulu-Natal;
- (iv) MPAs be advertised and policed more effectively;
- (v) better control be exercised over the use of off-road vehicles in the coastal zone.

The Council for the Environment (1994) compiled an inventory of coastal and marine protected areas in South Africa, which presents valuable information on their administration, legislation, geography and ecology. This document confirms that much has been achieved with regard to MPAs in South Africa, but refers to hindrances, such as the plethora of state, provincial and local legislation, lack of expertise, and staff shortages. The authors list a total of 112 marine and coastal protected areas, but they cautioned that their survey was based on a literature survey and not on first-hand experience, because of a shortage of funds.

A Marine Reserves Task Group was established in 1996 by the South African Network for Coastal and Oceanic Research (SANCOR) to re-address the issue of MPA management, prompted by numerous requests for additional MPAs, unclear goals of many MPAs and disputes over access to protected resources. The present report completes one of the tasks of the group, namely to review the state of MPAs in South Africa and to identify the major problems with their administration, management, design and geographical distribution. Much of the information necessary for this task was not from published sources. Hence the report incorporates first-hand experience solicited from MPA managers, biologists and local experts via a questionnaire survey.

QUESTIONNAIRE SURVEY

A questionnaire was designed to capture important information about the management of MPAs, including legal status, management authority, functions, size, boundaries, zonation, access, facilities, management problems and species inventories.

Respondents were asked to state which species are present, using the criterion that they occur permanently or regularly in the MPA. In the case of seabirds or shorebirds, only species breeding in the MPA were regarded as being present. The status of species was

Table I: Dual classification of marine reserves, presented by the Marine Reserve Committee in 1977

(a) Areas in which particular species or groups of marine organisms are protected, for:
(i) Optimal utilization (e.g. commercial species)
(ii) Conservation of threatened species
(iii) Conservation of scarce species
(b) Areas which are <i>totally</i> protected, for:
(i) Conservation of the natural environment as a whole
(ii) Research and/or education
(iii) Recreation
(iv) Aesthetic considerations

recorded as either pristine (i.e. unexploited and undisturbed), healthy (some exploitation or disturbance) or critical (the population is depleted to one-tenth or less of its pristine size). Assigning ranks was based on very rudimentary knowledge in most cases, but respondents were asked to state that the status of a species was unknown only in extreme ignorance. Therefore, the information provided in this study on the status of a species serves only as a rough guide, because no such nationwide survey of marine life has been completed. Likewise, respondents were asked to estimate the frequency and severity of poaching for each resource, on a scale of 0 to 10, where 0 indicates never and 10 indicates every day, involving large quantities.

One questionnaire for each MPA was sent to the relevant managing authority (Western Cape Nature Conservation, Eastern Cape Nature Conservation, KwaZulu-Natal Nature Conservation Services, National Parks Board, Sea Fisheries Law Enforcement and the Cape Metropolitan Council), with the request that the most appropriate and knowledgeable person(s) complete the questionnaire. In some cases, people from outside the managing authority were co-opted into completing the questionnaire, especially where information on species was required.

The information provided was summarized and included in the sections that follow. The tables of information on species were derived entirely from this questionnaire survey. For the most part, species records were unedited, except where there were glaring contradictions. For example, some respondents recorded a whale population as pristine, whereas others stated critical, when in fact the status is similar nationwide. Species information was also checked against known distribution records (Smith and Heemstra 1986, Branch *et al.* 1994) and edited accordingly. The estimated degree of poaching was ranked into three categories: not significant, frequent and severe. Other information was used to diagnose and to illustrate successes and failures of MPAs.

Table II: Guidelines for the establishment of marine reserves, presented by the Marine Reserve Committee in 1977

<i>Reasons for choice</i>	
(i)	Protection of breeding stocks of certain commercially important species in order to ensure sustainable yields
(ii)	Threatened or scarce species may need special protection
(iii)	The rehabilitation of depleted stocks
(iv)	Sensitive and unique habitats worthy of conservation
(v)	Habitats or localities representative of different coastal ecosystems which need to be conserved with a view to education or research
(vi)	Areas of outstanding national and/or international importance
(vii)	Areas of outstanding richness and diversity of biota or other natural attributes may need special protection
(viii)	Aesthetic considerations
(ix)	Recreational considerations
<i>Additional considerations</i>	
(x)	Accessibility of areas in accordance with the type of utilization envisaged
(xi)	Controllability of areas and costs attached thereto
(xii)	Provision of buffer zones around reserves
(xiii)	Impacts of known sources of pollution in the vicinity
(xiv)	Reserves must be of viable size
(xv)	Clear demarcation and easy identification of boundaries is important
(xvi)	Reserve areas should preferably be generally acceptable to the public
<i>Problem areas</i>	
(xvii)	Development in adjacent areas
(xviii)	Vested interest within proposed reserve areas
(xix)	Socio-economic problems
(xx)	Consolidation in areas of divided jurisdiction and control

MPA POLICY IN SOUTH AFRICA

A Marine Reserve Committee was established in 1976 to complete the following task within one year: "Investigate and recommend guidelines whereby the Minister may be advised, through the Fishery Advisory Board, on the management of marine reserves in terms of Article 10(1a) of the Sea Fisheries Act, 1973, as amended". The investigation followed numerous requests for marine reserves all around the South African coastline.

The Committee recognized a dual application of MPAs (Table I). The protection of certain species or the enhancement of fisheries could be served by MPAs with a specific function. MPAs could also be used for general protection for the purpose of conservation, research or non-consumptive use. The Committee also considered a set of establishment criteria and guidelines (Table II), which included most of the important considerations now recognized in MPA designation (e.g. Kenchington and Kelleher 1995).

The criteria and guidelines were given in point form only, and some explanatory paragraphs for each would have been useful for clarification. The recommendations of this Committee remain the policy of Sea Fisheries on marine reserves, because they have not been amended or superseded.

The Committee noted that the rapid development of townships at estuaries deserved special attention and recommended declaring a number of representative estuaries as nature reserves. Jurisdiction and control of MPAs was identified as a problem area. The Committee recommended that the various authorities negotiate the management of a reserve, such that the responsibility is assigned to the most competent authority in each case. This authority had to be efficient and cost-effective, without duplicating existing services.

Following the establishment of criteria, each proposed site was visited by members of the Committee. Their investigations were widely advertised in various media and throughout relevant government services. Oral and written submissions were solicited in respect of each proposal. Many of the requests for marine reserves were a result of poorly enforced regulations. The Committee noted that improvements in enforcement would remove the motivation for some of the requests and strongly recommended that Sea Fisheries regulations should be publicized more widely. A few representative reserves of realistic size were considered to be preferable to many small reserves which would cause a "legion" of problems. The greatest need was for reserves representative of the Cape west coast, the Cape south coast and the north coast of the now-named KwaZulu-Natal.

The Committee approved the proposals for reserves in several areas and recommended that decisions on the proposals should be thoroughly publicized. Developments in subsequent years showed that the Committee was only partially successful in improving South Africa's MPA network. On one hand, their recommendations did contribute to the proclamation of several new reserves (Table III), many of which are now upheld as important marine and fishery conservation measures. Unfortunately, many of their recommendations, which were sound advice even by today's reasoning, were not implemented. The majority of marine reserves have not been well publicized, boundaries are poorly demarcated, enforcement of regulations has not improved, the situation with regard to poaching has deteriorated and estuaries are still a problem today. The Committee was unfortunately disbanded after submitting the report and, probably for this reason, its recommendations were not widely implemented.

An *ad hoc* committee was appointed in 1984 to investigate certain aspects of the conservation of False Bay. The establishment of the Strand Restricted Area

Table III: MPA proposals considered by the Marine Reserve Committee in 1977

Proposed site	Committee decision	Present status
Namaqualand coast	Approved	National Park still planned
Langebaan Lagoon	Approved	West Coast National Park
Posberg coast	Approved	De Hoop Marine Reserve
Leven Point	Approved	St Lucia Marine Reserve
Part of False Bay	Approved	Millers Point Marine Reserve
Natal south coast	Approved	Trafalgar Marine Reserve
Dassen Island	Further investigation needed	Island protected only
Tongaat	Further investigation needed	No MPA
Knysna Lagoon	Further investigation needed	Knysna National Lake Area
Woody Cape	Further investigation needed	Restricted area
Rocherpan	Further investigation needed	Rocherpan Marine Reserve
De Hoop	Further investigation needed	De Hoop Marine Reserve
Goukamma	Further investigation needed	Goukamma Marine Reserve
Kaffraria and Ciskei	Further investigation needed	Restricted area
Tongaland	Further investigation needed	Maputaland Marine Reserve

was recommended, but no reference was made to the existing policy guidelines established by the investigations in 1977. The Strand Restricted Area was proclaimed in 1985 and the following recommendations were made by the committee:

- (i) Strand Town Council erect display centres to publicize the proposed conservation measure and to educate the public about the importance and benefits of marine conservation (although approved by the Town Council in principle, no such centre has been erected);
- (ii) the need for additional enforcement was recognized (complaints against poaching in this MPA are still being lodged with the Chief Directorate: Sea Fisheries);
- (iii) the need for biological and socio-economic research and monitoring, either by a university or the Sea Fisheries Research Institute, was recognized (no such study was undertaken).

Despite the existence of 10 marine reserves and 17 restricted areas, Sea Fisheries continues to receive applications for new reserves. However, although the concept of restricted areas was actively promoted among local authorities and interest groups, because of the ease with which they could be implemented, no MPAs have been proclaimed since 1992.

The application of policy to MPAs in South Africa has not been consistent. Nor has there been a permanently established body that handles administrative and management aspects of MPAs. Investigations into MPAs have typically been short-lived, without reference to an agreed policy document. The earlier efforts at addressing problems with MPA management and marine protection had no lasting effect. The result is that the problems which led to the establishment of

the Marine Reserve Committee in 1976 were the same as those that led to the Marine Reserves Task Group in 1996, namely, poorly enforced regulations, degradation of the marine environment and public requests for additional MPAs.

New Marine Fisheries Policy

The draft Marine Fisheries Policy for South Africa (Anon. 1997) makes provision for the potential use of MPAs to manage certain types of resources, but no specific details are given in respect of objectives, design or management. Under the heading of "Management Tools and Fisheries Regulations", the policy states: "MPAs may be designated for the purpose of scientific study, experimental fishing regimes or conservation, including special areas for the protection of particular species. Control will be applied to all users at all levels. MPAs may be considered as an appropriate means of control. MPAs will be carefully zoned to limit the effect on the activities of subsistence users. User zones will be considered as a means of separating different user groups."

MPA LEGISLATION

A MPA can be defined as "any area of intertidal or subtidal terrain, together with its overlying waters and associated fauna, flora, historical and cultural features, which has been reserved by legislation to protect part or all of the enclosed environment" (Kelleher and Kenchington 1992). A variety of marine (including estuarine) areas in South Africa come under special legal protection, proclaimed in terms of

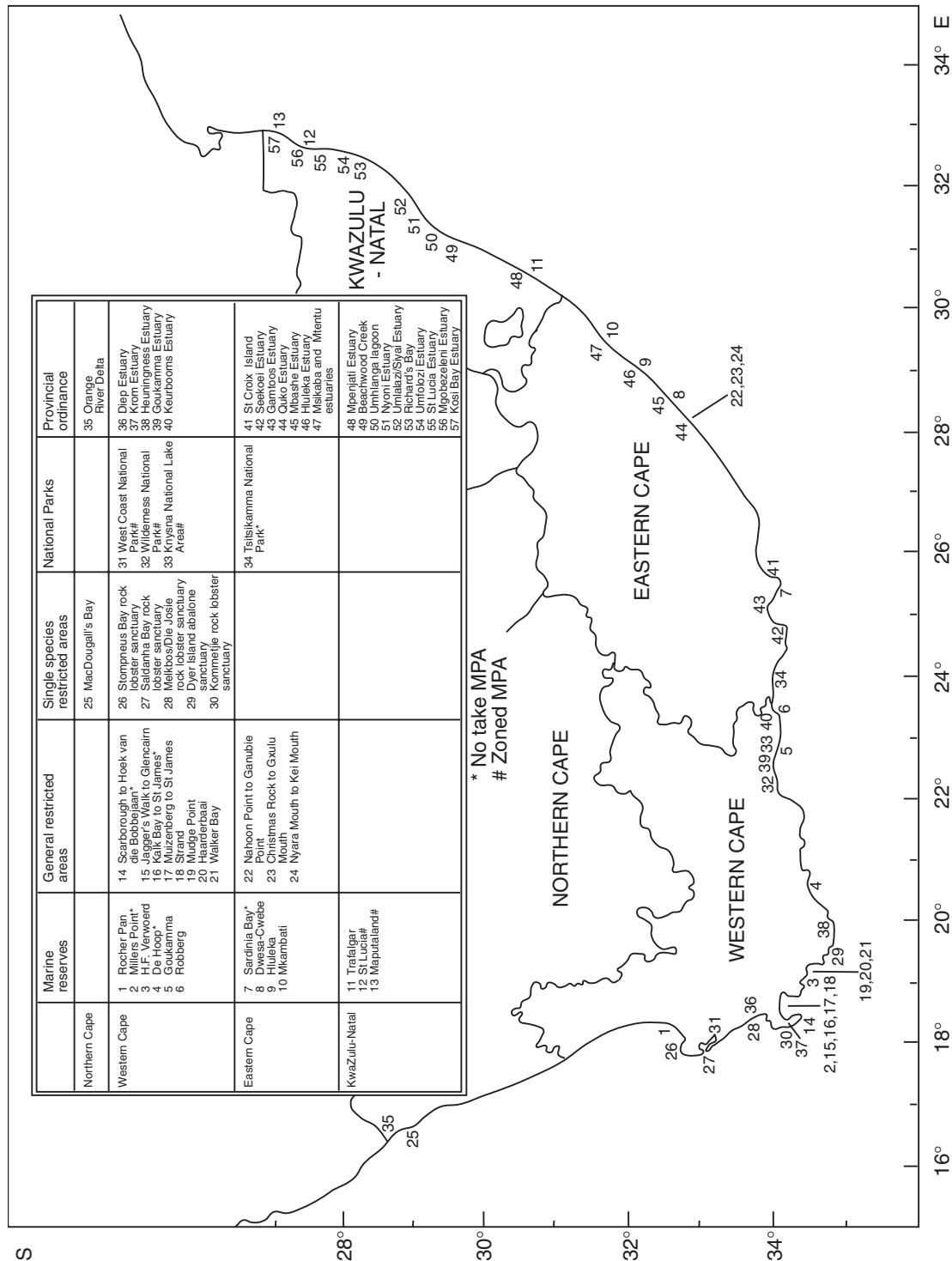


Fig. 1: The position and legal classification of MPAs in South Africa

the Sea-Shore Act (1935), the Sea Fishery Act (1988, with subsequent amendments), the Seabirds and Seals Protection Act (1973), the National Parks Act (1976), the Lake Areas Development Act (1975) and provincial nature conservation ordinances (Cape: Ordinance 19 of 1974; KwaZulu-Natal: Ordinance 15 of 1974). These MPAs are fairly evenly distributed around the South African coastline, except along the coast of the Northern Cape, where they are poorly represented (Fig. 1).

The Sea-Shore Act (1935)

The Sea-Shore Act affords ownership of the sea in territorial waters to the State President and provides for the granting of rights in respect of the seashore and the sea. Legislative competence is assigned to a national level to be implemented (currently) by the Minister of Environmental Affairs and Tourism (referred to here as the Minister). Section 10 of the act allows the Minister to assign certain powers to regional authorities. In general, provincial and local authorities have been granted control over the seashore. However, with one exception, MPAs (not including estuaries) have been declared at a national level, in contrast to terrestrial nature reserves which have been proclaimed at national, provincial or local levels.

Access to areas of the sea or seashore by the public has been denied in terms of the Act to protect mineral and military interests. These areas are not discussed further, because their management has compromised conservation, although some resources may have been protected from exploitation. For example, there has been severe disturbance of the sea bed in diamond-mining concessions off the Northern Cape, and the storage of hazardous substances along the False Bay shoreline may have impacted marine resources in the immediate vicinity.

The Sea Fishery Act

Marine reserves can be declared by the Minister for the protection of fish or aquatic plants. The Director-General may allow activities in a marine reserve which are not incompatible with the objectives of the reserve. Furthermore, species may be caught in the marine reserve, but the conditions by which they may be caught must be stipulated according to a management plan approved by the Minister. A marine reserve can be withdrawn only with the approval, by resolution, of Parliament. In all, 10 marine reserves have been proclaimed. On gaining independence

Table IV: Gear-restricted fishing areas in South Africa

Area	Restricted Gear	Species
Cape Point to Orange River, within 5 miles of high-water mark	Trawl net	All
Elands Bay to Orange River, within 3 miles of high-water mark	Set net	All
Stompneus Bay	Set net	All
Saldanha Bay	Net and longline	All
Cape Point to Saldanha, within 3 miles of high-water mark	Set or drift net	All
False Bay	All nets	All
Walker Bay	Purse seine	All
Cape Hangklip to Cape St Blaize, within 6 miles of high-water mark	Set or drift net	All
Cape Hangklip to Cape St Blaize, within 12 miles of high-water mark	All nets	Sharks
North of a line between Cape Infanta and Cape Barracouta	Trawl net	All
North of a line between Cape Vacca and Cape St Blaize	Trawl net	All
North of a line between Cape St Blaize and Gericke Point	Trawl net	All
North of a line between Cape Seal and Bloukrans River mouth	Trawl net	All
North of a line between Cape St Francis and Cape Recife	Trawl net	All

from South Africa in 1980, the then Republic of Transkei retained the Sea Fisheries Act (1973) and proclaimed three marine reserves. With the re-incorporation of the Transkei into South Africa in 1994, these MPAs fall under the Sea Fishery Act (1988), bringing the total to 13. Three of these prohibit all exploitation, two have been zoned to separate totally protected areas from limited fishing areas and the remainder allow some form of fishing (Fig. 1).

The Minister may also set area limitations on the catching of fish, or removal of aquatic plants, as a general restriction on fishing. Although these are not marine reserves, they are in effect no different, as all or some of the species can be protected within an area. These are referred to as *restricted areas*, or specifically as rock lobster *Jasus lalandii* or abalone *Haliotis midae* sanctuaries in the case of single-species protection. Restricted areas are not officially named, and a management plan is not required by law. Another important legal difference between restricted areas and marine reserves is that the former may be withdrawn with the approval of the Minister, instead of Parliament. Restricted area legislation is therefore regarded as more flexible and has been used to declare most of South Africa's MPAs either as general or single-species restricted areas (Fig. 1).

In addition, the restricted area legislation has been

used to create a network of gear-refugia, where the use of certain types of fishing gear is prohibited. All gear-refugia prohibit some type of net and may provide significant protection of benthic communities. Nevertheless, these restrictions are so limited in their objectives that it is debatable whether they constitute MPAs. These specialized restricted areas are listed in Table IV.

MPAs created under the Sea Fishery Act regulate or prohibit fishing, but no provision is made for the control of activities other than the exploitation of marine species (e.g. structural development or pollution) which may be detrimental to the MPA or run counter to its objectives. This is an important distinction between MPAs created under the Sea Fishery Act and those created under the National Parks Act or provincial ordinances. Protection of the physical marine environment and the control of acts not related to fishing is authorized by a variety of other legislation which does not apply specifically to MPAs: namely, the Sea-Shore Act (1935), the Dumping at Sea Control Act (1950), the Environmental Conservation Act (1982), and the Prevention and Combating of Pollution of the Sea by Oil Act (1981). The problem is that, whereas the MPA is designated at national level in terms of the Sea Fishery Act, the Minister has to request provincial authorities to apply the Sea-Shore Act to prevent undesirable activities or access in MPAs. Because of this cumbersome legal process, control over resource use in MPAs is not balanced by adequate protection for the habitat.

This failing in the Sea Fishery Act is exemplified by building developments in the coastal zone of the Strand Restricted Area. This MPA protected all invertebrate resources from exploitation, but a harbour and marina development was allowed to proceed below the high-water mark. The development displaced natural biological communities and altered the shoreline irreversibly. Local residents and fishermen were perplexed by the ruling which denied them access to resources that were eventually destroyed by development.

The Sea Fishery Act is the most common legal instrument for declaring MPAs, but it offers the poorest environmental protection.

The Seabirds and Seals Protection Act

The Act provides for the control over islands and rocks, principally for the protection of seabirds and seals, and their breeding grounds. In all, 35 offshore islands within South African territorial waters are protected, in terms of access, exploitation and

development. No person may set foot on an island without the authority of the Minister. Islands are administered by provincial authorities.

The National Parks Act

Section 4 of this Act states: "*The object of the constitution of a national park is the establishment, preservation and study therein of wild animals, marine and plant life and objects of geological, archaeological, historical, ethnological, oceanographic, educational and other scientific interests and objectives relating to the said life or first mentioned objects or to events in or the history of the park, in such a manner that the area which constitutes the park shall, as far as may be and for the benefit and enjoyment of visitors, be retained in its natural state.*" The National Parks Act establishes the strongest claim to permanent protection of natural environments in South Africa (Council for the Environment 1991). Provision is made for declaring National Parks in the sea.

There are four National Parks which include marine or estuarine environments. The Tsitsikamma National Park is a large "no take" MPA, the first to be proclaimed in South Africa. The remaining National Parks are Ramsar sites. The West Coast National Park was proclaimed because of its importance for the conservation of migratory shorebirds. The Knysna National Lake Area and the Wilderness National Park have been declared partly under the Lake Areas Development Act.

Provincial ordinances

The KwaZulu-Natal ordinance provides for the establishment of nature reserves, and authorized the establishment of the Natal Parks Board, now the KwaZulu-Natal Nature Conservation Services (KNNCS) with effect from 1 April 1998. The mission of the KNNCS is: "*To conserve the indigenous biodiversity of KwaZulu-Natal, which includes the landscapes, ecosystems and processes upon which it depends, and to assist all people in ensuring the sustainable use of the biosphere*". KwaZulu-Natal differs from the other coastal provinces in that the Natal Nature Conservation Ordinance (15 of 1974) partially replaces the Sea Fishery Act in tidal estuaries, lagoons and along the seashore. The marine environment in that province therefore falls under joint national and provincial legislative control. The contiguous St Lucia and Maputaland Marine Reserves, which were proclaimed under the Sea Fishery Act,

have been zoned in terms of provincial legislation. These two MPAs and four estuarine protected areas (EPAs) form part of the Greater St Lucia Wetland Park (GSWP), and are under the legislative control of the KNNCS. South of the GSWP, another six EPAs have been declared and are managed by the KNNCS. (Fig. 1, Mann *et al.* 1996).

A number of estuaries come under special provincial legislation in the Eastern Cape, but this is aimed largely at preventing development or protecting birds (Fig. 1). A 500-m zone around St Croix Island is declared a no-access zone in terms of the Eastern Cape Provincial Ordinance. This MPA is significant in that it is the only case for which a provincial ordinance has been used to deny access to an area of sea below the high-water mark. Western Cape Nature Conservation is currently proposing to use this same legal mechanism to restrict access around Dyer Island and other sensitive marine areas (H. W. Heard, Cape Nature Conservation, pers. comm.) in addition to a few existing estuarine protected areas. Six estuaries come under special protection in the Western Cape. The most protected of these is De Mond, the estuary of the Heuningnes River (Fig. 1), for which legislation prohibits development, protects invertebrates, and controls the entry of visitors. Fishing is still permitted there.

The delta of the Orange River is a Ramsar site and falls under the control of the Northern Cape Nature Conservation and Namibian authorities. Access to this delta is controlled and limited, largely as a consequence of diamond-mining operations in this region. Saltwater intrusion into the delta is minimal, and it is not regarded as having a substantial marine component.

The Environmental Conservation Act

This Act contains general environmental legislation, which makes provision for the promulgation of regulations for coastal areas, and provides for the control of human disturbances in the coastal zone (e.g. mining, dredging, building). Permits are required for any form of development in a limited area extending 1 km inland of the high-water mark, although numerous areas of coast are exempt from this condition. The policy on off-road vehicles in the coastal zone, for example, was implemented under Section 2 of this Act.

Admiralty zones

The early colonial governments left a legacy of

common land between private land and the high-water mark. These strips, known as Beach Reserves, Admiralty Reserves, Forest Reserves, Coastal Forest Reserves, and Government Reserves, are narrow (between 50 and 60 m) and have provided for excellent coastal zone management, but they do not extend all around the South African coastline (Heydorn *et al.* 1992).

MPA MANAGEMENT IN SOUTH AFRICA

Institutional framework

South Africa has never had a unified and integrated approach to coastal and marine management (Heydorn *et al.* 1992). The constitution of South Africa provides for a three-level government structure (central, provincial and local), and the environment is administered at all three. At central government level, coastal and marine management falls under two of the Chief Directorates of the Department of Environment Affairs and Tourism, namely Sea Fisheries and Environmental Management. Within the latter, the SubDirectorate: Coastal Management provides advice on the management of the coastal zone, but not specifically on MPAs. Sea Fisheries is the main authority on the use of marine resources below the high-water mark, except in KwaZulu-Natal where the provincial ordinance (15 of 1974) has superseded part of the Sea Fishery Act. Sea Fisheries has no permanent body which advises or manages MPAs. The Sea Fisheries Research Institute currently conducts research projects in two MPAs. The Monitoring, Control and Surveillance arm of Sea Fisheries provides a general enforcement service, but enforcement officers are not dedicated to MPAs.

Prior to 1994, South Africa was split into four provinces, two of which had a marine border. Parts of the Eastern Cape became the independent (coastal) territories of Ciskei and Transkei, each of which adopted their own legislation. The 1994 interim constitution abolished those provinces and independent states and created nine provinces, four of which have a marine border. A new policy of regionalization has vested more power with the provinces than before.

The 1977 report of the Marine Reserve Committee states that the relevant authorities should negotiate the management of a MPA, to ensure that one authority is charged with this responsibility. In practice, provincial authorities have taken on these responsibilities, except in National Parks where the National Parks Board manages them exclusively. The delegation of management of MPAs to these independent conserva-

tion agencies has meant that Sea Fisheries is generally not consulted on the management of individual reserves, despite the fact that the Sea Fishery Act gives many of these a fisheries function. Western Cape and Eastern Cape provincial conservation agencies have a strong terrestrial bias and are not well positioned to manage MPAs, or to draft management plans in isolation. Few of the MPAs managed by provincial authorities in the Western or Eastern Cape have dedicated vessels for management or enforcement. In most coastal reserves in these provinces, management of the MPA is given a low priority relative to the terrestrial component. Staff and budgetary shortages effectively mean that MPAs are poorly managed, especially those that have no adjoining terrestrial reserve (e.g. Millers Point, H. F. Verwoerd, and all restricted areas).

In comparison to the authorities in the Western and Eastern Cape, the KNNCS provides an excellent service in all MPAs in Kwa-Zulu-Natal, even those promulgated under the Sea Fishery Act. Their management includes regular shore patrols, monitoring programmes and the publication of brochures which inform the public of regulations and results of monitoring and research projects. The greater management capacity of the KNNCS in MPAs can be attributed to a large extent to the legislative authority granted to that province in respect of seashore and fisheries. National Parks are also well staffed and enforced, and, although they provide very little monitoring of marine resources themselves, they do support research projects conducted by other organizations within their parks, particularly by the Oceanographic Research Institute, located in Durban.

Participation in the establishment of MPAs

Participation in the establishment of MPAs has been limited to the relevant authorities, with very little input from user groups or affected parties. The establishment of the reserves recommended by the Marine Reserve Committee in 1977 was accompanied by public hearings and written inputs from interested parties, but participation could not be described as extensive. In some cases, rights to an area were removed. For example, at the De Hoop Marine Reserve, coastal land was expropriated, and in the Tsitsikamma National Park, fishing rights were removed. The establishment of protected areas is gradually becoming a more participatory process in South Africa.

Current negotiations about the development of the new Namaqualand National Park, in which a MPA is proposed, demonstrates the recent willingness of authorities to encourage participation in a formal process. The coastal strip under discussion extends

from just beyond the Spoeg River in the north to Island Point in the south, a distance of approximately 50 km. The offshore boundary of the park has not been finalized. Most of the land in question belongs to De Beers Namaqualand Mines (DBNM), which is in the process of concluding its land-based mining operations in the area. Over the past two years, a project, funded through the South African Network for Coastal and Oceanic Research, has coordinated a process aimed at facilitating interest-group involvement in the establishment of the park. A Planning Forum has been set up, which includes representation from the National Parks Board, DBNM, relevant provincial and local government departments, farmers' organizations, resource users and representatives of the 18 rural communities in the surrounding area.

That Forum will generate options and make recommendations to the National Parks Board and other decision-makers on issues such as the use of natural resources, the design of visitor facilities and the formation of a representative Park Management Committee. The deliberations of the Forum are being guided by a set of widely debated and agreed-upon principles, such as participatory decision-making, equitable access, conservation, opportunities for education and research, integration of traditional knowledge, and affirmative action.

Management plans

Management plans are necessary to guide the management of MPAs, to ensure that they attain their objectives efficiently and economically. They also serve the purpose of informing interested parties on the functions and strategies of MPA management. The Sea Fishery Act requires that each marine reserve be specified in terms of a management plan. MPAs in the Greater St Lucia Wetland Park and the National Parks have management plans. Management plans are currently being drafted for the De Hoop Marine Reserve and the adjacent De Mond Estuary. For most MPAs, however, management is not guided by plans.

MPA functions

South African MPAs lack some important administrative and managerial components. The first of these becomes evident when an attempt is made to establish the functions of the many MPAs that have been established. MPAs can perform a number of functions, and the basis for much of the advocacy for MPAs is that they can be used to solve a variety of resource management problems (Bohnsack and Ault 1996). In South Africa, there is the implicit assumption that

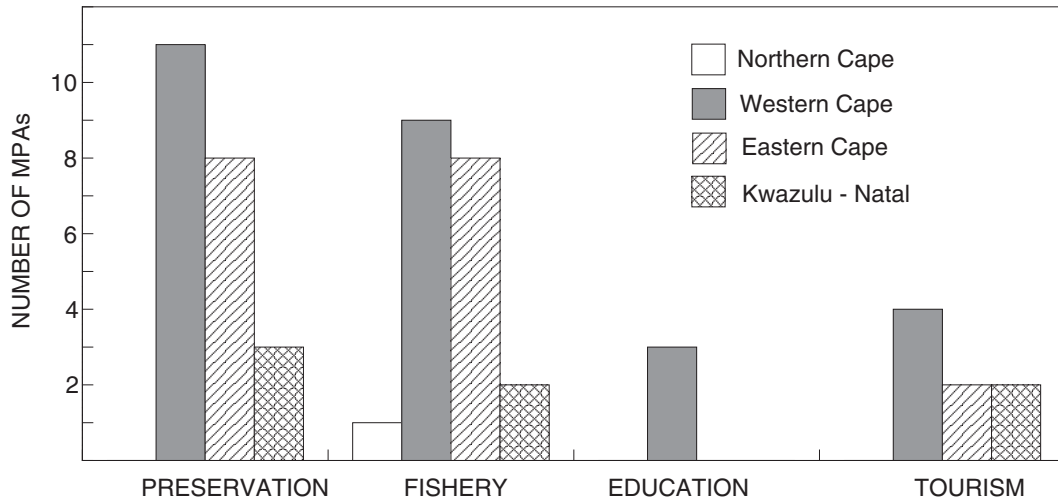


Fig. 2: The number of MPAs (excluding estuarine protected areas) in each province which serve preservation, fishery, education, and tourism functions

reserves exist for “conservation”, but this term can embrace a number of functions, e.g. preservation, sustainable utilization, rebuilding of stocks, research and education. These functions can be compatible or conflicting in practice. For example, preservation, research and education can be served by a single MPA. In contrast, some people are dismayed at seeing exploitation in MPAs, whereas others cannot accept that a MPA is established for the benefit of the nation if it excludes human use totally. Reserve managers need a clear statement on the functions of their MPA to guide decisions on resource harvesting and other forms of use.

The results of the questionnaire survey indicated that many of the functions of MPAs are unclear or vague, particularly those declared under the Sea Fishery Act. For only six of the marine reserves, and for only two of the restricted areas, could managers quote functions from management plans or documents. Quite specific functions exist for the MPAs of the National Parks Board and the KNNCS. In other cases, the functions have been inferred from the legislated mission of the administering authority, or stated in hindsight about the role of the MPA. Fishery management is a typical example here. The De Hoop Marine Reserve plays a critical role in the maintenance of fishery yield in adjacent areas (Attwood and Bennett 1994), yet this area was proclaimed a reserve after expropriation of private land for a strategic military purpose. Should this purpose fall away, its protected area status might be difficult to maintain in the face

of public pressure to utilize the fish resources consumptively. A clear redefining of the purpose of this MPA to include protection of all its biota and fishery management is vital. On the other hand, some MPAs serve no important function (e.g. Hawston and Rocherpan) and were not conceived *a priori* as part of a marine resource management plan.

In some cases there is considerable indecision over the regulation of usage within the MPAs, and the public is confused about their purposes. A recent example demonstrates the dilemma. Managers of the Dwesa-Cwebe Marine Reserve (one of those established in Transkei) allowed subsistence users to exploit intertidal resources (in contravention of the authorizing legislation and contrary to scientific advice), when adjacent unprotected intertidal communities had been severely degraded by intense, uncontrolled exploitation. Originally, all biota were protected in Dwesa-Cwebe, but immense pressure from local subsistence users resulted in a situation in which intertidal exploitation was permitted “under supervision”. This situation received bad publicity and, following an investigation by a multidisciplinary task group, total protection was reinstated. Implicit here was a shift from a function of preservation to sustainable use. This is an extreme, but not rare, conflict between socio-economic and environmental agendas. The reserve is currently serving neither, because the functions of the MPA were not clearly stated nor rigidly adhered to.

According to MPA managers, in terms of the cur-

rently defined functions of particular MPAs, preservation of ecosystems and enhancement of fisheries are the two most common functions (Fig. 2). Although considerable potential exists for education and tourism, few MPAs serve those functions, to some extent as a result of the lack of visitor facilities and funding.

Law enforcement

In the MPAs of the Northern, Western and Eastern Cape, enforcement is carried out by the (national) marine fisheries control officers and provincial authorities. Fisheries control officers concentrate on the regulation of the economically important resources around the entire coastline, and MPAs are not afforded a high priority. Provincial authorities are effective at controlling shore-based activities in those MPAs which have an adjoining terrestrial reserve, but they do not have sea-going capacity. As a result, enforcement in many MPAs in those provinces is poor and poaching is a serious threat to conservation and fisheries management.

The Sea Fisheries control officers do not cover KwaZulu-Natal. MPAs in this province are left entirely to the provincial authorities. In general, those MPAs are well enforced and they have dedicated marine rangers with sea-going capacity, backed up by shore-based enforcement. Despite this, however, poaching is considered to be a problem in KwaZulu-Natal.

Policing at sea is definitely the weakest link in MPA enforcement. The problem is largely the shortage of enforcement vessels and poorly demarcated boundaries. Fishing vessels cannot be excluded from MPAs, as their rights of passage are protected by maritime law. Unfortunately, the experience has been that fishing vessels cannot be trusted to respect MPAs. Illegal linefishing, squid jigging, trawling and even longlining are frequently practiced in the De Hoop Marine Reserve, the Tsitsikamma National Park and others. The abundance of large, sought-after fish in these areas makes such activity very profitable. Without a permanent presence of patrol vessels in protected waters, fishing vessels poach with relative impunity, and compromise the function of MPAs.

Research and monitoring

It is necessary to establish whether a MPA attains its objective(s). This can be achieved by monitoring relevant biological indicators and human utilization. The few MPAs which have monitoring programmes include De Hoop Marine Reserve (inshore fish, inter-

tidal communities, visitor numbers), Tsitsikamma National Park (offshore reef fish, visitor numbers), St Lucia/Maputaland Reserve (coral communities, fish catches, visitor numbers) and the estuarine protected areas (visitor numbers and fish catches). Unfortunately, this is not a standard function performed in all MPAs in South Africa, even where objectives are clearly stated. For example, an important objective of the Goukamma Marine Reserve is the protection of intertidal invertebrate resources and offshore reef fish. Neither of these biological communities are monitored to assess their density, either over time or in comparison with adjacent areas. No comment can therefore be made on the effectiveness of that reserve for the conservation of these resources.

One major reason for the lack of monitoring programmes is the lack of marine-trained staff among the authorities which manage MPAs. Within the government service, most expertise in marine surveying and resource assessment is housed at Sea Fisheries and within the ranks of the South African navy, neither of which play an active role in MPA management. Provincial conservation authorities have a strong terrestrial bias. In KwaZulu-Natal, this problem has been alleviated through the advisory function and assistance provided by the Oceanographic Research Institute and the recently formed marine section of the Scientific Services of the KNNCS. Many universities undertake research projects in MPAs, but these rarely fulfil a monitoring role, as their terms of funding are short and the focus of their work tends to be experimental rather than the establishment of long time-series.

MPA size and demarcation

The required size of MPAs is currently a debated issue among marine scientists and managers in South Africa. The Committee in 1977 recommended large reserves for practical reasons. Today the provincial authorities share this viewpoint, because many complain that the small reserves are difficult to police and that a buffer zone is needed for adequate protection.

Fishery research suggests that the size of an MPA depends on movements of the species it contains (Attwood and Bennett 1995). Small MPAs may be sufficient for resident species such as abalone and stenotypic reef fish, but wider-ranging species will require larger protected areas. South Africa has a range of MPA sizes, from <1 km (shoreline length) in Haarder Bay to 145 km in the contiguous St Lucia and Maputaland Marine Reserves. The average length is 16 km. It has been argued that the 50 km De Hoop Marine Reserve is appropriately sized for the protection of the dominant shore-angling fish species (Attwood

and Bennett 1994). Some restricted areas are very small, and it is likely that they will function effectively as sites for education, but are probably too small to make a notable contribution towards conservation or fishery enhancement. The single-species rock lobster *J. lalandii* and abalone *Haliotis midae* reserves may be adequate for their purpose, but no research has been undertaken to establish relative densities or dispersal. Similarly, no comment can be offered on the trawling reserves. The large St Lucia and Maputaland Marine Reserves have been zoned for various activities. This appears to be a successful measure which could be applied elsewhere, especially where the needs of conservation and subsistence usage are in conflict.

All MPAs are bounded on at least one side by the mainland coast. Seaward boundaries are defined as either a straight line between two land beacons, a given radius from a land beacon, or a line running parallel to the shore at a given distance measured perpendicularly from the high-water line. In the case of the latter, the offshore distance ranges from 10 m to 12 nautical miles and the remaining boundaries are defined by a bearing from a land beacon.

Although the boundaries are clearly specified in legislation, they are not demarcated at sea by marker buoys. With the exception of boundaries that join two visible beacons, navigators must rely on radar or range finders to locate reserve boundaries. Most small fishing craft are not fitted with such equipment. Instead the satellite-based, global positioning system (GPS) is the navigation equipment of choice. It is relatively cheap, easy to operate and gives position in grid-coordinates with an accuracy of about 50 m. Unfortunately, MPA boundary grid-coordinates have not been surveyed. Therefore, the specification of MPA boundaries is not compatible with the more popular navigation equipment. Skippers are generally unaware of the exact location of boundaries, and proving the location of a vessel is frequently cited as a major legal impediment to prosecuting skippers who contravene regulations in MPAs.

ARE MARINE BIOTA ADEQUATELY PROTECTED IN SOUTH AFRICA?

The conservation of biological diversity requires that representative areas of each biogeographic zone are included in MPAs. The maintenance of undisturbed ecosystems requires that each habitat type (or ecotype) be represented in MPAs. The conservation of threatened species and the maintenance of fishery yield require that relevant species are included in suf-

ficient MPAs to provide protection throughout their range. It is also necessary to examine the regulations which afford protection and the adequacy of enforcement. Not all MPAs provide legal protection from harvesting, and poaching can reduce protection even further.

Biogeographic zones

South Africa has three major marine biogeographic zones: the cool temperate West Coast, the warm temperate South Coast and the subtropical East Coast. There are boundaries in the regions of Cape Point and the East London/Port St Johns area. The subtropical East Coast can be split into two sub-provinces in the vicinity of Durban, and the cool temperate West Coast into two at about St Helena Bay (Emanuel *et al.* 1992). Two of these zones are poorly protected. Besides a 12 km stretch in the extreme south, a small portion of Langebaan Lagoon and a few rock lobster sanctuaries, the cool temperate West Coast has no MPA in which representative habitats are protected. The need for a MPA on the West Coast was noted in the 1977 report. A 50 km stretch of coast centred at the Groen River estuary was proposed as a National Park, and negotiations to this end are now at an advanced stage. The southern part of the East Coast has no MPA in which representative habitats are protected. The Trafalgar Marine Reserve was established to cover the southern KwaZulu-Natal coast, but this MPA is small (<5 km shoreline length) and shore-angling is permitted there. (KwaZulu-Natal authorities are currently actively investigating enhancing its size and conservation capability.) The warm temperate South Coast and the northern subtropical East Coast, however, seem to be adequately represented in MPAs.

South Africa has recently ratified the Convention on Biological Diversity, which requires the *in situ* conservation of all biogeographic zones in a network of protected areas. In terms of this obligation, the present distribution of MPAs does not afford full protection to South Africa's marine biodiversity.

Ecotypes

South Africa has five major marine ecotypes which need consideration for protection: rocky shores, sandy shores, offshore reefs (including coral reefs of Zululand), offshore soft sediment and estuaries. Breeding sites of seabirds, seals and turtles must also be considered as important habitat for conservation.

Coastal dunes are also often best protected by inclusion in protected land adjacent to MPAs.

INTERTIDAL HABITATS

Hockey and Buxton (1989) listed the percentage of each MPA's coastline constituted by rocky and sandy shores. These habitats have an equal share of MPA coastline. On average, MPAs include 8.1 km of rocky shore and 8.0 km of sandy shore. Considering only the "no take" MPAs, the split is in favour of rocky shores, with 82% coverage. Mixed rock and sand shorelines are adequately protected in the De Hoop, Goukamma, Sardinia Bay, Mkambati, Hluleka, Trafalgar and St Lucia marine reserves, whereas exposed rocky-shore communities find refuge in the Cape of Good Hope, H. F. Verwoerd, De Hoop, Tsitsikamma, Robberg and St Lucia marine reserves. The major sandy beach ecosystems of the Eastern Cape are not protected.

OFFSHORE REEFS

Millers Point, De Hoop, Goukamma, Tsitsikamma and all MPAs farther east include prominent offshore reefs, which are the habitat for commercially important, and endemic, fish species. Tsitsikamma is a prominent and effective refuge for deep-reef communities. The three Transkei MPAs extend 6 miles seawards and include important offshore habitat in a transitional biogeographic zone. Although fishing on these reefs is prohibited, the areas are not adequately policed and poaching is rife. The southern KwaZulu-Natal coastline is the only area where additional offshore reef protection is required. The hard corals that are found only on the northern coast of KwaZulu-Natal are protected in the large St Lucia and Maputaland Reserves.

SOFT-SEDIMENT BENTHOS

Soft-sediment areas are one of the less specious habitats of the ocean, but they are important feeding and breeding grounds for exploited demersal species (e.g. panga *Pterogymmus lanarius*, kingklip *Genypterus capensis* and East Coast sole *Austroglossus pectoralis*). The threat to these environments is primarily the effect of trawling gear on the structure of the sediment. Dragging nets over the sea bed destroys the three-dimensional structure of the benthic environment, reducing it to a homogenous habitat which hosts an impoverished and disturbed marine community. The trawling reserves listed in Table IV include soft-sediment benthic communities. These areas are generally

small and close inshore, or include reefs which make trawling hazardous. Whether or not these trawling reserves provide adequate protection to representative benthic communities is unknown.

ESTUARIES

South Africa has about 250 "functional estuaries", of which about 30 are protected to varying degrees (Fig. 1). Nonetheless, protection of estuaries is regarded as inadequate because most of the protected estuaries are small, insignificant systems (e.g. those within the Tsitsikamma National Park) or protection is incomplete, covering only part of the estuary (e.g. Keurbooms, Gamtoos and Mgeni), or for the protection of birds only (e.g. Orange and Seekoei). Most large estuaries have been severely disturbed and degraded. A large part of the problem is that estuaries have not been included in the selection criteria for marine reserves. Whitfield (1997) noted that, from an estuarine perspective, it would be difficult to choose two worse 80-km stretches of coast for reserves than the Tsitsikamma National Park and St Lucia Marine Reserve. Indeed, the De Hoop Marine Reserve also includes no significant estuary. With the exception of the tiny Tsitsikamma estuaries, fish are not protected from exploitation in any South African estuary.

The major cause of estuarine degradation is the anthropogenic manipulation of riverine flow and through land-use changes, but residential, industrial and agricultural pollution is rapidly becoming a major problem (Whitfield 1997). Fish that have been depleted as a result of alterations to riverine flow include estuarine pipefish *Syngnathus watermeyer*, freshwater mullet *Myxus capensis* and catadromous anguillid eels (Whitfield 1997). In addition, some important linefish species have declined as a result of the reduction in good quality estuarine habitat, e.g. white steenbras *Lithognathis lithognathus* (Bennett 1993). Overfishing is also contributing to the decline in abundance of some fish species. It is evident that proper management and rehabilitation of estuaries can only be achieved through the management of water resources in entire catchments, but there is value in maintaining estuarine protected areas, particularly to guard against building developments in wetlands and overfishing. Considering that many important coastal fish species utilize estuaries in their pre-recruitment and adult phases (Whitfield 1997), it is surprising that estuarine fish have not been afforded better protection.

The jurisdiction of Sea Fisheries has never included tidal or semi-closed estuaries (with the exception of the Knysna Lagoon, which is now managed by the National Parks Board). Estuaries fall within the man-

	McDougall's Bay	Rocher Pan Marine Reserve	Stompneus Bay	Saldanha Bay	West Coast National Park	Scarborough to Hoek van die Bobbejaan	Millers Point Marine Reserve	Jagger's Walk to Glencairn	Kalk Bay to St. James	Muizenberg to St. James	Strand	H.F.Verward Marine Reserve	Mudge Point Marine Protected Area	Haarder Bay	Hermanus	De Hoop Marine Reserve	Goukamma Marine Reserve	Robberg Marine Reserve	Tsitsikamma National Park	Sardinia Bay Marine Reserve	Christmas Rock to Gxulu Mouth	Nahoon Point to Gonubie Point	Nyara Mouth to Kei Mouth	Dwesa-Cwebe Marine Reserve	Mkambati Marine Reserve	Hluweka Marine Reserve	Trafalgar Marine Reserve	St Lucia Marine Reserve	Maputaland Marine Reserve		
Southern right whale			H				H	H	H	H		H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		
Humpback whale																H	H	H	H	H	H	H	H	H	H	H	H	H	H		
Humpback dolphin																H	H	H	H	H	H	H	H	H	H	H	H	H	H		
Heavisides dolphin			P	P																											
Common dolphin							P					P			P	P	P		P		P	P	P	U	U	U	P	P	P		
Dusky dolphin			P	P																				U	U	U	U	P	P		
Bottlenose dolphin			P	P			P	P				P			P	P	P		P	P	P	P	P	P	P	P	P	P	P		
Cape clawless otter						U	U					U	H			P	P		H	U	H	C	H	H	H	H	U				
Cape fur seal	P	P	P	P			P					P	P		P	P			P	P											
African penguin												C																			
Damara tern																H															
Caspian tern	H				H											H													H		
Swift tern					H																										
Cape gannet					H																										
White pelican																													H		
Bank cormorant	H			H	H		H																								
Crowned cormorant	H			H	H							H																			
Whitebreasted cormorant	H	H		H	H	H	H					H				H	H	H	H												
African black oystercatcher	H		H	H	H	H	H	C	H	C	H	C	H	H	H	P	H	H	H	H	C	H	H	H	H						
Green turtle																													H	H	
Leatherback turtle																													H	H	
Loggerhead turtle																													H	H	
Belman											C	C																	U	U	
Bronze bream																P	C		P	C	C	C	C	C	H	H	H	H	U	U	
Elf/shad			H	H	H				H	H	H	H			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
Galjoen	H		C	H		P	H	C	H	C	C	C	C	C	C	P	H	H	P	P	C	C	C	C	H	H	H	H	U		
Grunters																							C	C	C	H	H	H	H	H	
Kob				C	C				C	C	C	C			C	H	H	H	H	C	C	C	C	H	H	H	C	H	H		
Musselcracker							C	C	C	C	C	C	C	C	C	P	H	H	P	P	H	H	H	H	H	H	H	H	U	U	
Poenskop							C									H	C	C	P	P	C	C	C	C	C	C	C	U			
Red steenbras							C	C				C	C		C	H	C	C	P	U	C	C	C	C	C	C	C	C	U		
Seventyfour							C									U	C	C		C	C	C	C	C	C	C	C	C	U		
Stumpnoses			H	H	H		H		H	H	H				H	U	U	P	P	H	H	H	H	H	H	H	H	H	H	H	
White steenbras							C	C	C	C	C	C	C	C	C	H	C	U	H	H	C	C	C	C	C	H	H	U	U		
Lutjanidae																								H	H	H	H	U	P	P	
Serranidae							C									H	H	U	P	P	C	C	C	H	H	H	H	H	P	P	
Carangidae					U		H	C	H	H	H	H				H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
Shallow reef sparids					U		H	C	H	C	C	C	C	H	H	P	H	H	P	P	H	C	C	H	H	H	H	H	P	P	
Deep reef sparids	H		H	H			P	C				C	C	C	C	C	H	H	U	P	P	C	C	C	C	H	H	U	P	P	
Bronze whaler							H	H			H	U	H		H	P	H	H	P	P	U	U	U	U	H	H	H	U	U		
Great white shark					U		H	H	H	H	H	U	H		H	H	H	H	H	P	U	U	U	U	H	H	H	U	U	U	
Hammerhead shark																H	H	H	H	P	U	U	U	H	H	H	H	U	H	H	
Mako shark							U									H	H	U	H	H	U	U	U	H	H	H	H	U	U	U	
Ragged tooth shark							H	H	H	H	H	U	H		H	P	H	H	P	P	H	H	H	H	H	H	H	U	H	H	
Sand/guitar sharks		P	P	P	H				H	H	H	H			H	P	H	H	P	P	H	H	H	H	H	H	H	H	H	H	
Skates			H	H	H		H	H	H	H	H	H			H	P	U	H	P	P	U	U	U	H	H	H	H	U	H	H	
Smooth hounds	U	H	H	H	H		H	H	H	H	H	H			H	P	U	H	P	P	H	H	H	H	U	U					
Soupin shark			H	H			H	H	H	H	H	H			H	P	U	H	P												
Spotted gulley shark			H	H			H	H	H	H	H	H	H	H	H	P	H	H	P	P	H	H	H	H	H	H	H				

Fig. 3: The status of species or species group in South African MPAs. The letters indicate that the MPA is pristine (P), healthy (H), critical (C) or unknown (U). A blank indicates absence and shading is used to show that the area is beyond the distribution of the species

	McDougall's Bay	Rocher Pan Marine Reserve	Stompneus Bay	Saldanha Bay	West Coast National Park	Scarborough to Hoek van die Bobbejaan	Millers Point Marine Reserve	Jagger's Walk to Glencairn	Kalk Bay to St James	Muizenberg to St James	Strand	H.F.Verword Marine Reserve	Mudge Point Marine Protected Area	Haarder Bay	Hermanus	De Hoop Marine Reserve	Goukamma Marine Reserve	Robberg Marine Reserve	Tsitsikamma National Park	Sardinia Bay Marine Reserve	Christmas Rock to Gxulu Mouth	Nahoon Point to Gonubie Point	Nyara Mouth to Kei Mouth	Dwesa-Cwebe Marine Reserve	Mkambati Marine Reserve	Hlualeka Marine Reserve	Trafalgar Marine Reserve	St Lucia Marine Reserve	Maputaland Marine Reserve	
Abalone						H H	C H	C H	H H	C H	C H																			
Black/brown mussels	H		H H	H H	H H	H H	H H	H H	H H	H H	H H																			
Chitons	H		P P			H P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P	P P
Clams					H																									
Cowrie																														
Cuttlefish			P P	H		P																								
Giant clam																														
Giant periwinkles/alikreukel						H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P	H P
Limpets	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Octopus	H	H	H	U	P	P	P	P	H	H	P	H	H	H	P	H	P	P	P	P	C	C	C	C	H	H	H	P	P	H
Pencil bait																														
Periwinkles	H		H H	H	P	P	P	P	H	H	P	H	P	P	P	P	P	P	P	C	C	C	C	H	H	H	P	P	P	
Plough shells		P	P																											
Rock oysters																														
Scallop							P	P	U	U																				
Siffie							P	P	P	H	H	H	H	H	H	P	H	P	H	P	H	C	H	H	H	H	P	U	U	
Squid						H	H																							
White mussel		H																												
West Coast rock lobster	C		H	H	H	H	P	H																						
East Coast rock lobster																														
South Coast rock lobster																														
Ghost crabs																														
Sand prawns																														
Mud prawns																														
Mole crab																														
Swimming crabs																														
Fiddler crab																														
Rock crabs	P	P	P	P	P	P	P	P	P	H	P	P	P	P	P	P	P	P	P	P	H	U	U	H	H	H	H	P	H	
Shoveller crayfish																														
Knysna crab																														
Swimming prawns																														
Musselworm							H	U	P	H	P	H	H	H	H	P	C	P	P	P	C	C	C	H	H	H	H	H	U	U
Bloodworm							H																							
Wonderworm	U																													
Cape reef worm	H	H	H	U	P	P																								
Pansy shells																														
Sea urchin	P	P	P	H	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	H	H	H	H	H	H	H	P	P	H
Sea cucumbers	P	P	P	H	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	H	U	U	H	H	H	P	P	H	
Colonial hard coral																														
Red bait	H	P	H	H	P	P	P	P	H	P	P	H	P	P	H	P	P	P	P	H	C	H	H	H	H	H	P	H	H	
Dune vegetation	C	C	H	H	P	C			C	C	C	H	C	C																
Salt marsh vegetation																														
Kelp	P	P	P	H	P	P	P	P																						
Gracilaria spp.																														
Gelidium spp.																														
Porphyra capensis																														
Gigartina spp.																														
Hypnea spicifera																														

Fig. 3 (continued)

agement responsibilities of provincial or local agencies. In the past, separate provincial regulations on the capture of marine species in estuaries were enforced, but these have been replaced by Sea Fisheries legislation in the interests of uniformity. Provincial legislation is perhaps more appropriate for the establishment of estuarine protected areas than the Sea Fisheries Act, given the inadequacy of the latter for environmental protection. Considering that estuaries fall on the boundary of land, sea and rivers, provincial management is also more likely to ensure collaboration between the many agencies which control estuaries in one way or another. Possible reasons for the paucity of estuarine protected areas include:

- (i) estuaries have been managed from an individual rather than a national perspective;
- (ii) towns have usually developed at the larger estuaries which suffer heavy human use and lack the pristine qualities which favour the establishment of a reserve;
- (iii) the three largest coastal reserves do not include any significant estuaries;
- (iv) estuaries are influenced by events far into the catchment area, making it difficult to protect them, particularly in the case of large estuaries.

BREEDING SITES

Where the breeding sites of seabirds and seals occur on offshore islands, these habitats are effectively protected by the Sea Birds and Seals Protection Act. Some species of seabirds breed on the mainland and these are areas of concern for provincial conservation agencies. The endangered Damara tern *Sterna balae-narum* and the African black oystercatcher *Haematopus moquini* are protected in reserves that have a marine and terrestrial component (e.g. De Mond and Cape Point Marine Reserve). African penguins *Spheniscus demersus* breed in two mainland colonies near the high-water mark, one of which falls within the H. F. Verwoerd Marine Reserve, and the other is now under the protection of the National Parks Board. Protection of turtle breeding sites is an important function of the St Lucia/Maputaland Reserve.

Species representation in MPAs

The data extracted from the questionnaires that were completed by MPA managers, or those with suitable familiarity with MPAs, were used to assess the degree of protection of individual species or groups of similar species. Most economically and ecologically important marine species are well repre-

sented in MPAs (Fig. 3). The higher vertebrate taxa are protected throughout South African waters, in terms of the Sea Fishery Act and the Seabirds and Seals Protection Act. The presence of these animals in MPAs might not improve their conservation status, but it could contribute to marine conservation in general by promoting tourism activities in MPAs. Protection of breeding sites (e.g. for turtles, seals, birds) may, however, be of paramount importance in several MPAs to fulfil their function. Many MPAs include cetacean species, such as the De Hoop Marine Reserve, which has capitalized on their presence. Seabirds may forage in many MPAs, but they breed in few MPAs adjoining the mainland (Fig. 3 refers to the presence of breeding birds). Seabirds are protected on all offshore islands. Fish are extensively represented, but the status of their populations are regarded as critical in many cases, suggesting that protection is not very effective. Exceptions to the good invertebrate coverage include shoveller crayfish *Scyllarides elizabethae* and white mussel *Donax serra* (sandy beaches are poorly protected, as stated earlier). Clams include a large variety of species, some of which are harvested, but very little can be established currently about their presence or status in MPAs. On a regional basis, invertebrates are not well represented in MPAs on the West Coast and the critical status of intertidal, rocky-shore organisms of the Eastern Cape is cause for concern. Abalone stocks are also listed as critical in many MPAs. Estuarine protected areas are not included on Figure 3, and estuarine invertebrates (e.g. mud prawns *Upogebia* spp., bloodworm *Arenicola loveni*, pencil bait *Solen capensis*) are represented in many of these. Of the primary producers, the only critical group is dune vegetation, but all taxa are well represented, except on the West Coast.

Legal protection of fish is offered by only approximately half of the MPAs (Fig. 4). Along the Southern Cape coast, the MPAs between and including the De Hoop Marine Reserve and Tsitsikamma National Park provide substantial protection for recreationally and commercially important species. Protection of fish in the Eastern Cape and southern KwaZulu-Natal is inadequate by comparison. The West Coast is not diverse in coastal fish species, but protection there is nonetheless totally inadequate. With very few exceptions, invertebrates are protected in all MPAs (Fig. 4).

All MPAs are poached to varying degrees (Fig. 5). Poaching is less severe in MPAs in KwaZulu-Natal, mainly because of more efficient policing and management there, and is mainly limited to uncontrolled subsistence exploitation in the Maputaland Marine Reserve. Abalone, rock lobster, intertidal shellfish and reef fish are the prime targets of poachers.

An important result to have emerged from the survey is the poor level of knowledge of biota in MPAs. In some cases, experts were consulted outside of the relevant management agencies (e.g. academics or local divers), but even then there was considerable uncertainty about the state of the resources, particularly those which are not commercially important (e.g. sharks, most invertebrates and algae). A more detailed GIS-type survey will be necessary to examine the total protection of selected species, because the sizes of MPAs and the full distribution of the species are not reflected in the present database.

Fishery protection

The role of MPAs in fisheries management has reached international attention very recently, prompted by the recognition of various authors (e.g. Boehlert 1996, Bohnsack and Ault 1996, Buxton 1996, Roberts 1997) of:

- (i) the failure of conventional single-species management to control bycatch and habitat destruction;
- (ii) the failure of conventional fishery control methods for fish with certain types of life-history characteristics;
- (iii) the importance of conserving ecosystem structure as the context for stable fishery production;
- (iv) the value of undisturbed ecosystems for comparative study.

It seems that fish populations cannot sustain high fishing pressure indefinitely. While many nations are now attempting to institute "no take" reserves in response to this global fisheries awakening, South Africa has been fortunate in having at least two large MPAs that are sustaining a number of fisheries.

Tsitsikamma National Park (TNP) protects endemic seabreams that are vulnerable to overfishing, because they are long-lived, undergo sex-change and suffer from barotrauma (Buxton 1996). The density of these populations in the TNP is considerably higher than in adjacent exploited areas. Fish in the exploited populations change sex earlier in life, which leads to a lower reproductive capacity (Buxton and Smale 1989, Buxton 1993, 1996). Although there is little doubt about the protection offered by the reserve, the important question of fishery enhancement is the subject of an ongoing multidisciplinary research project. Seabreams in the TNP may contribute substantially to recruitment in adjacent areas through the passive drift of eggs and larvae. Current measurements indicate that dispersal is likely to be widespread (Tilney et

al. 1996). Chokka squid *Loligo vulgaris reynaudii* also spawn in the reserve, where they are protected from high fishing pressure and damage caused to squid eggs by boat anchors (Sauer 1995). Similar to the seabreams, it is hypothesized that squid larvae spawned in the TNP recruit in exploited areas.

Surf-zone fish populations in the De Hoop Marine Reserve have recovered since the designation of the reserve in 1985 (Bennett and Attwood 1991). An intensive fish-tagging programme has shown that reserve populations contribute to adjacent stocks through the emigration of adult fish, in the case of galjoen *Dichistius capensis* (Attwood and Bennett 1994) and, through the protection of immature fish that later undertake spawning migrations, in the case of white steenbras *Lithognathus lithognathus* (Attwood and Bennett 1995) and red steenbras *Petrus rupestris* (A. J. Penney, formerly Sea Fisheries Research Institute [SFRI], unpublished data).

A number of other MPAs have contributed to fishery management in South Africa. Abalone sanctuaries have provided undisturbed populations for research into growth, movement and recruitment (Tarr 1995). Results of these projects have led to improved management advice. The rock lobster sanctuaries have been used for research into growth, and it is hypothesized that local recruitment is enhanced, but this has not been tested (A. C. Cockroft, SFRI, pers. comm.). Research into the functioning of intertidal, rocky-shore communities of the Eastern Cape in the Dwesa-Cwebe Marine Reserve has contributed to an invaluable understanding of the dynamics of this important subsistence resource (Lasiak and Dye 1989, Dye in press).

Fishermen are not always aware of the benefits of MPAs and it is important that they be informed of them if any measure of public support is required. To this end, the findings mentioned above have been published in the popular press (e.g. Attwood and Bennett 1993, Buxton 1995, Cowley and Hecht 1997, Ward 1997), and fishery scientists have made appearances in television and radio shows. There is some indication, especially among recreational anglers, that the concept of protecting fish stocks in MPAs is gaining acceptance.

Restrictions

MPAs collectively cover 17% of the South African coastline. Only six MPAs protect all biota (Figs 1, 4) and the total coverage of these is 4.9% of the coastline. The three National Parks in the Cape Province and the St Lucia/Maputaland Reserve are zoned to include core preservation areas, where all exploitation is forbidden, and to prevent mutually exclusive human

	McDougall's Bay	Rocher Pan Marine Reserve	Stompneus Bay	Saldanha Bay	West Coast National Park	Scarborough to Hoek van die Bobbejaan	Millers Point Marine Reserve	Jagger's Walk to Glencairn	Kalk Bay to St. James	Muizenberg to St. James	Strand	H.F.Verword Marine Reserve	Mudge Point Marine Protected Area	Haarder Bay	Hermanus	De Hoop Marine Reserve	Goukamma Marine Reserve	Robberg Marine Reserve	Tsitsikamma National Park	Sardinia Bay Marine Reserve	Christmas Rock to Gxulu Mouth	Nahoon Point to Gonubie Point	Nyara Mouth to Kei Mouth	Dwesa-Cwebe Marine Reserve	Mkambati Marine Reserve	Hiuleka Marine Reserve	Trafalgar Marine Reserve	St Lucia Marine Reserve	Maputaland Marine Reserve				
Belman																P	P																
Bronze bream																	P	P												P	P		
Elf/shad								P									P													P	P		
Galjoen						P	P	P									P																
Grunters																															P	P	
Kob									P											P	P										P	P	
Musselcracker							P	P									P				P	P											
Poenskop							P										P	P	P	P	P												
Red steenbras												P				P	P	P	P	P			P	P	P								
Seventyfour							P										P	P					P	P	P								
Stumpnoses							P		P								P	P	P	P			P	P	P						P	P	
White steenbras						P	P	P									P																
Lutjanidae																																	
Serranidae							P										P	P	P	P	P									P	P	P	
Carangidae							P	P									P	P												P	P	P	
Shallow reef sparids						P	P	P									P													P	P	P	
Deep reef sparids							P					P				P	P	P	P	P			P	P	P				P	P	P		
Bronze whaler							P										P	P	P	P										P			
Great white shark							P	P	P	P		P				P	P	P	P	P	P		P	P	P	P			P	P	P		
Hammerhead shark																	P	P	P	P										P	P		
Mako shark							P										P	P	P	P			P	P	P					P			
Ragged tooth shark								P									P	P												P	P	P	
Sand/guitar sharks																	P													P	P	P	
Skates							P	P				P					P	P					P	P	P					P	P		
Smooth hounds							P	P									P	P															
Soupin shark							P	P									P	P															
Spotted gulley shark							P	P									P																
Abalone							P	P	P	P	P	P		P	P	P																	
Black mussels							P	P	P	P	P					P	P	P	P	P	P									P	P		
Chitons							P	P	P	P	P	P	P	P	P	P	P	P	P	P	P									P	P		
Clam							P																										
Cowrie																	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P		
Cuttlefish							P										P	P	P	P	P												
Giant clam																																	
Giant periwinkles/alikreukel							P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P		
Limpets							P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P		
Octopus							P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P		
Pencil bait																																	
Periwinkles							P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P		
Plough shells																	P	P															
Rock oysters																	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P		
Scallop							P	P	P	P							P	P	P	P													
Siffie							P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P		
Squid							P	P									P	P															
White mussel																	P	P															

Fig. 4: Species or species groups which are afforded total legal protection from exploitation in each MPA, as indicated by the letter P

	McDougall's Bay	Rocher Pan Marine Reserve	Stompneus Bay	Saldanha Bay	West Coast National Park	Scarborough to Hoek van die Bobbejaan	Millers Point Marine Reserve	Jagger's Walk to Glencairn	Kalk Bay to St James	Muizenberg to St James	Strand	H.F.Verwoerd Marine Reserve	Mudge Point Marine Protected Area	Haarder Bay	Hermanus	De Hoop Marine Reserve	Goukamma Marine Reserve	Robberg Marine Reserve	Tsitsikamma National Park	Sardinia Bay Marine Reserve	Christmas Rock to Gxulu Mouth	Nahoon Point to Gonubie Point	Nyara Mouth to Kei Mouth	Dwesa-Cwebe Marine Reserve	Mkambati Marine Reserve	Hluleka Marine Reserve	Trafalgar Marine Reserve	St Lucia Marine Reserve	Maputaland Marine Reserve	
West Coast rock lobster		P	P	P	P	P	P	P				P	P	P																
East Coast rock lobster																									P	P	P	P	P	P
South Coast rock lobster																			P											
Ghost crabs																						P	P	P	P	P	P	P	P	
Sand prawns					P	P				P	P											P	P	P	P					
Mud prawns				P																		P	P	P	P					
Mole crab																												P	P	
Swimming crabs	P						P	P	P	P	P					P	P			P	P	P	P	P	P	P	P	P	P	
Fiddler crab																									P	P	P			
Rock crabs						P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	
Shoveller crayfish																					P									
Knysna crab																						P	P	P	P	P				
Swimming prawns																									P	P		P	P	
Musselworm						P	P	P	P	P	P					P	P	P	P	P	P	P	P	P	P	P	P	P	P	
Bloodworm										P															P	P	P			
Wonderworm						P				P		P											P		P	P	P			
Cape reef worm						P	P		P	P	P					P	P	P	P	P	P	P	P	P	P	P	P	P	P	
Pansy shells																												P	P	
Sea urchin						P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	
Sea cucumbers						P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	
Hard coral																													P	P
Red bait							P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	
Dune vegetation						P	P	P		P	P						P	P			P	P	P	P	P	P	P	P	P	
Salt marsh vegetation					P																	P	P	P	P					
Kelp						P	P	P				P				P	P				P	P	P	P						
Gracilaria spp.						P	P														P	P							P	P
Gelidium spp.								P	P	P						P	P	P	P	P	P	P	P	P	P	P	P	P	P	
Porphyra capensis						P		P	P	P	P										P	P								
Gigartina spp.						P		P	P	P																				
Hypnea spicifera						P		P	P	P	P					P	P				P	P							P	P

Fig. 4 (continued)

activities from impinging upon one another. All the remaining MPAs allow angling from the shore, some allow exploitation of invertebrates as well, whereas the single-species restricted areas protect either abalone or rock lobster and nothing else.

Typically, pressure from exploiters has allowed for exemptions from protection in what were originally intended to be total "no take" MPAs. The most extreme example is the Mudge Point MPA, which allows shore-angling, abalone and rock-lobster exploitation and the harvesting of seaweeds (in terms of a permit) and washed-up red bait. In effect, nothing of significance is protected there. Of the 13 marine reserves, nine permit shore-angling. The presence of fishermen on the shore makes it difficult to police the ban on inter-

tidal exploitation of shellfish for bait (e.g. red bait, venus ears, rock crabs) or food (oysters). In some cases, such as at H. F. Verwoerd Marine Reserve, angling effort can be extremely intense, making a mockery of the concept of a protected area. In KwaZulu-Natal, off-road vehicle access to sandy beaches in some MPAs has effectively reduced protection. A single exemption can compromise the protective value of the MPA.

The primary concern here is that MPA management is not strong enough to withstand public pressure. The cause of this may include a lack of policy and management plans (with stated MPA functions) to defend MPA regulations. Public pressure to gain access to MPAs can be attributed to poor awareness of the

	McDougall's Bay	Rocher Pan Marine Reserve	Stompneus Bay	Saldanha Bay	West Coast National Park	Scarborough to Hoek van die Bobbejaan	Millers Point Marine Reserve	Jagger's Walk to Glencairn	Kalk Bay to St James	Muizenberg to St James	Strand	H.F.Venward Marine Reserve	Mudge Point Marine Protected Area	Haarder Bay	Hermanus	De Hoop Marine Reserve	Goukamma Marine Reserve	Robberg Marine Reserve	Tsitsikamma National Park	Sardinia Bay Marine Reserve	Christmas Rock to Gxulu Mouth	Nahoon Point to Gonubie Point	Nyara Mouth to Kei Mouth	Dwesa-Cwebe Marine Reserve	Mkambati Marine Reserve	Hluleka Marine Reserve	Trafalgar Marine Reserve	St Lucia Marine Reserve	Maputaland Marine Reserve			
Belman										2	1					2	1			2	1	1	1	1	2	2		1	1			
Bronze bream																2	1			2	2	2	2	2	1	2	2	1	2	2		
Elf/shad			2	2	1			1	2	2	2	1	2	2	2	2	1	2		2	2	2	2	2	1	2	2	1	2	2		
Galjoen	2		3	2		2	1	1	2	2	2	2	1	2	2	2	3	2	2	2	2	2	2	2	1	2	2	1				
Grunters																	1				2	2	2	1	1	2	2	1	1	1		
Kob				1	1				2	2	1	2				2	2	2		2	2	2	2	2	1	2	2	1	1	1		
Musselcracker							1	1	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	1		1		
Poenskop							2									2	2	2	2	2	2	2	2	2	2	2	2	1				
Red steenbras							2	1				2	2			2	2	3	2	2	2	2	1	2	2	2	2					
Seventyfour							1									2	2	1			2	1	2	3	2	2						
Stumpnoses			1	1	2			1	1	2	2					2	1	1	2	2	2	2	2	1	2	2	1	1	1	1		
White steenbras							1	1	2	2	2	1	1	2	2	2	1	1	2	2	2	2	2	2	2	2	2	2				
Lutjanidae																									1	1	2	2	1	1	1	
Serranidae							1									2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	2	
Carangidae					1		1	1	2	1	2					2	2	2	2	2	2	2	2	2	1	1	2	2	1	1	1	
Shallow reef sparids					1		1	2	2	1	2	1	2	2	2	2	3	2	2	2	2	2	2	2	1	2	2	1	2	2		
Deep reef sparids	1		1	1			2	2		2	2	2	2	2	2	3	2	2	2	2	2	2	2	3	3	2	2	1	2	2		
Bronze whaler							1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Great white shark					1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Hammerhead shark																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Mako shark							1									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Ragged tooth shark							1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Sand/guitar sharks			1	1	1	1		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Skates			1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Smooth hounds	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Soupin shark			1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Spotted gulley shark			1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Abalone						3	2	2	2	2	2	3	3	2	2	1					1	2	3	2	3	2	1	1				
Black mussels	2		2	1	1	1	1	2	2	2	2					1	1	3	2	1	1	3	3	3	3	2	2	1	1	1		
Chitons	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	2	2	1	1	1		
Clam					1																											
Cowrie																1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	
Cuttlefish			1	1	1		1					1				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Giant clam																																
Giant periwinkles/alikreukel						2	1	2	2	2	2	2	3	2	2	1	3	1	2	2	3	3	3	3	3	3	2					
Limpets	2		1	1		1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	2	3	3	3	3	2	2	1	1	2		
Octopus	2		1	1	1	1	1	2	1	2	1	1	2	1	1	1	3	2	2	1	3	3	3	3	2	2	2	1	2	2		
Pencil bait																								3								
Periwinkles	2		1	1		2	1	2	1	2	2	1	1	2	1	1	3	1	1	1	2	3	2	3	2	2	1	1	2			
Plough shells			1	1												1	1			1	1	1	1	2	1	1	1	1	1	1	1	1
Rock oysters										1						1	3	2	1	1	2	2	2	2	2	2	2	1	1	2		
Scallop							1	1	1	1						1	1	1	1	1												
Siffie							1	2	1	2	1	1	1	2	2	1	3	1	1	1	1	2	2	2	3	2	2	1	1	2		
Squid						1	2									1	1															
White mussel	1															1	2															

Fig. 5: An assessment of the severity of poaching in South African MPAs. The numerals indicate that poaching of that species in that MPA is a minor problem (1), is cause for concern (2) or is rampant and totally unchecked (3)

	McDougall's Bay	Rocher Pan Marine Reserve	Stompneus Bay	Saldanha Bay	West Coast National Park	Scarborough to Hoek van die Bobbejaan	Millers Point Marine Reserve	Jagger's Walk to Glencairn	Kaik Bay to St. James	Muizenberg to St. James	Strand	H.F.Verword Marine Reserve	Mudge Point Marine Protected Area	Haarder Bay	Hermanus	De Hoop Marine Reserve	Goukamma Marine Reserve	Robberg Marine Reserve	Tsitsikamma National Park	Sardinia Bay Marine Reserve	Chrismas Rock to Gxulu Mouth	Nahoon Point to Gonubie Point	Nyara Mouth to Kei Mouth	Dwesa-Cwebe Marine Reserve	Mkambati Marine Reserve	Hluleka Marine Reserve	Trafalgar Marine Reserve	St Lucia Marine Reserve	Maputaland Marine Reserve		
West Coast rock lobster	2		2	3	2	3	2	2	2			3	3	2	2																
East Coast rock lobster																									2	2	2	2	1	1	
South Coast rock lobster																		1													
Ghost crabs																						1	1	1	1	1	1	1	1	2	
Sand prawns					2	1				1	2																				
Mud prawns				1	2																	2	2	2	2	2					
Mole crab																												1	1	2	
Swimming crabs	1						1	1	1	1	1	1				1	1				1	1	1	2	1	1	1	1	1	1	
Fiddler crab																									1	1	1				
Rock crabs	1	1	1			1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	
Shoveller crayfish																															
Knysna crab																						2	2	2	2	2			1	1	
Swimming prawns																									1	2		1	1	1	
Musselworm					1	2	1	1	1	2	2	1			2	1	3	1	2	1	2	2	2	3	2	2	2				
Bloodworm				2						1														2	1	1					
Wonderworm	2				2								2										2	2	1	1					
Cape reef worm	1		1	1	1	1	1	1	2	2	2			2	1	2	1	1	1	1	1	1	1	2	2	2	2	1	1	1	
Pansy shells																												1	1	1	
Sea urchin	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	
Sea cucumbers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	
Hard coral																															
Red bait	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	2	1	1	1	1	2	2	2	2	2	2	1	1	2		
Dune vegetation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	2	2	2	1	1	1	1	1	
Salt marsh vegetation				1	1																	1	1	2							
Kelp	1	1	1	1	1	1	1	1	1	1		1	1	1	1						1	1	1	1							
Gracilaria spp.			1	1	1														1	1									1	1	
Gelidium spp.							1	1	1	1			1	1	1	1				1	1	1	1	1	1	1	1	1	1	1	
Porphyra capensis					1	1	1	1	1	1	1	1	1	1	1				1	1	1	1									
Gigartina spp.				1	1	1	1	1	1	1	1	1	1	1	1																
Hypnea spicifera					1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	

Fig. 5 (continued)

reasons for maintaining MPAs. Resource users also demand access, because resources are severely degraded or depleted outside of MPAs.

SUBSISTENCE RESOURCE-USE PROGRAMMES IN MPAS

Demands for access to protected marine resources is one of the threats facing marine conservation in South Africa. In response to this threat, there has been some experimenting with the development of controlled subsistence and traditional fisheries.

Results from these pioneering efforts suggest that organized resource-use programmes can bring such fisheries under control, while ensuring that coastal communities derive optimal long-term benefit from the resource. Three subsistence harvesting programmes have been developed in KwaZulu-Natal, two of which are in estuarine protected areas. These are described below, with some general principals that have emerged in each case.

Subsistence mussel exploitation project

In KwaZulu-Natal, the utilization of natural

resources from inside and around protected areas has been a major source of conflict between authorities and local communities. The communities perceive the protected areas as curtailing access to resources required for traditional and subsistence purposes, and the response is often poaching. In the case of intertidal marine resources, poaching is extremely difficult to contain, and is often done on a large scale using destructive methods in order to gather resources as quickly as possible to avoid arrest. The consequence of an inflexible approach to management of resources in protected areas is a costly law-enforcement problem, which in itself may exacerbate the unsustainable use of resources.

An initiative in northern KwaZulu-Natal to address the illegal unsustainable subsistence use of intertidal mussels on the coast alongside the Mapelane Nature Reserve is currently under way. A Joint Mussel Management Committee (JMMC) has been established, with representation of the community, the KNNCS reserve staff and scientists. Workshops and interviews facilitated the development of a mutual understanding of the needs, grievances and concerns. A 2-km stretch of coast has been established for the exclusive use of mussels by the Sokhulu community, and is currently being managed by the JMMC under special permit. As the methods used and quantities of mussels required by subsistence users are illegal under the current licensing system, and sustainable rates and methods of subsistence utilization have not previously been determined, it was agreed that the community would participate in experiments to obtain the information required to manage subsistence use. A joint experiment to assess the efficiency and bycatch of different harvesting tools resulted in the choice of a screwdriver over the previously preferred bush-knife, because the experiment clearly demonstrated a significant reduction in the disturbance of small mussels with the use of a screwdriver. To determine a sustainable harvest rate, the 2-km stretch has been sub-zoned for different quantities of harvest. This collection system is being controlled and monitored by community monitors, who report to the JMMC. Mussel harvesters are registered with the committee and issued with a permit.

This large-scale participatory experiment should provide a visual demonstration of the effects of different harvesting rates and, coupled with stock surveys by the researchers, should facilitate acceptance of sustainable harvests. To date there has been good progress and cooperation in setting up this co-management system, but two major issues requiring attention have surfaced, i.e. conflict between different users who are opposed to allowing local communities access to resources in protected areas, and the need

for training to enable all players to participate fully in the process. The first issue demonstrates that the conflict is not always only between the authority and the local community, but is complicated by the perceived or entrenched rights of other users who have different needs and aspirations for the protected area. Attention to the second issue, that of training, is crucial for the success of community resource-use programmes; meaningful participation by communities in management and decision-making requires that they have the information, skills and confidence to voice their needs, to challenge proposals and to address problems. In the current project, this training is taking the form of workshops on committee structure and function, literacy and basic environmental education.

The following general principals have emerged from this programme:

- (i) Real responsibility must be given to and shared by the community, e.g. resource allocation (zonation), participation in decisions about the use of resources, involvement in monitoring and regulation of use of resources.
- (ii) There must be commitment from the community and the authority. This requires that there is a real reason for each party to participate in the process. Both parties must be willing to commit themselves to accepting joint decisions.
- (iii) Communication at all stages is vital. Partners must openly share knowledge, because there is a need for the partners to understand the problems and perspectives of the other.
- (iv) Co-management must be based on joint problem-solving. This requires joint participation in research and management so that everyone has the same facts at hand, and there is a scientific basis for the management strategy. Literacy training is needed so that everyone is equipped to participate in decision-making, to remove unequal power structures.
- (v) All users should be involved in decisions about allocation (zonation) of the resource, and facilitating communication to prevent conflict.

Fish netting in Kosi Bay

The Thonga people in Kosi Bay have a fishing tradition dating back hundreds of years (Tinley 1964). Today, methods of resource harvesting by local communities include fish trapping, linefishing, traditional spearfishing, gillnetting and collection of various marine and estuarine invertebrates (Kyle 1995, Kyle *et al.* 1997a, b). Sedges and reeds are also collected around the estuary (Kyle 1995). Rural KwaZulu-

Natal has a high population growth rate which, combined with high local unemployment and a rapid change from a subsistence to a cash economy, has led to progressively increasing demand for resources in the estuary (Kyle 1995).

Comprehensive methods of resource use management and monitoring of yield have been established in cooperation with local communities since 1980 (Kyle 1995). Monitoring is undertaken by locally recruited and trained people who record harvests taken by the various user groups on a daily basis. Analysis of results has shown that resource utilization is generally sustainable (Kyle 1995, Kyle *et al.* 1997a, b).

Fish netting in St Lucia

Lake St Lucia is a large estuarine system (35 000 ha) which forms part of the Lake St Lucia Game Reserve proclaimed in 1995 and currently administered by the KNNCS. Prior to 1995, only linefishing was allowed in the estuary, and all other means of fishing (e.g. nets, traps, spearing) were regarded as difficult to control and were prohibited. However, illegal gill-and seine-netting by rural communities living adjacent to the lake has taken place in St Lucia since the 1960s (Mann 1995). Although active law enforcement by the KNNCS prevented large-scale commercialization of this activity, illegal netting has continued to take place on a smaller scale and the policy to prohibit netting in the lake resulted in conflict between the adjacent communities and conservation authorities.

A project to quantify illegal fish harvesting in Lake St Lucia and to assess its impact on the lake's fish resources was initiated in 1992 (Mann 1996). The outcome of this project was a recommendation to legalize a controlled gill-net fishery in St Lucia in an attempt to integrate rural development with conservation and to ensure sustainable use of the fish resources (Mann 1995). A preliminary calculation of potential sustainable yield suggested that approximately 194 tons of fish could be harvested from the system annually, but between 91 and 135 tons were being caught illegally (Mann 1995). A conservative approach was taken initially and a small, subsistence gill-net fishery was implemented during 1995. Methods of implementation and conditions of the fishery were decided following negotiations between all stakeholders (scientists, reserve managers, tribal authorities, elected fishing committees, netters). The aim of these negotiations was to develop a co-management system where responsibility was shared between conservation authorities and the netters. Monitoring of all fish landed was undertaken on a daily basis by local people who were trained and paid by the conserva-

tion authorities.

Implementation of the net fishery at St Lucia greatly improved neighbour relations between the adjacent rural communities and the conservation authorities. However, implementation and control of the fishery proved to be extremely difficult and involved a considerable investment of personnel time by the management authorities – more so than in policing the former ban on netting. In areas such as Nibela, which lacked organized structure in the community, the legal fishery was used as a loophole to scale up illegal netting activities. Netters were generally not satisfied with the attempt to restrain the fishery at subsistence levels and continually requested greater access, more permits, longer nets and bigger netting areas. Although the amount of illegal netting in two areas (Nkundusi and Mduku) decreased following implementation of the legal fishery, there was little evidence of netters developing ownership rights and protecting their rights to fish (self policing). Current laws preventing the sale of certain fish species also resulted in problems for management.

The following general principals have emerged from the programme:

- (i) There must be clearly defined harvesting boundaries to allow a sense of resource ownership to develop among local communities.
- (ii) Resource users must live close to the resource areas. It is generally the neighbours to protected areas that are disadvantaged by restricted access and it is these people who should receive some benefit from resource utilization within the protected area.
- (iii) Resource users must have a good knowledge and understanding of the concept of sustainable yields. In many cases the purpose behind management measures is not understood, leading to violation of harvesting rights.
- (iv) User group size should be small and there should be strong leadership. Strong control and leadership within communities is essential for any community-based natural resource-use programme to succeed.
- (v) Violation of harvesting should carry appropriate penalties. Financial rewards encourage illegal harvesting, which can only be stopped through effective law enforcement.
- (vi) There must be state/government tolerance of local resource user groups. Subsistence resource utilization within a protected area must have the full agreement and cooperation from the conservation authorities. Control of subsistence usage within a protected area involves enormous personnel effort (it is certainly easier and cheaper

to prohibit access from a protected area). A co-operative management system should include education, monitoring of yield and regular meetings to ensure continued cooperation, in addition to conventional law enforcement.

PROBLEMS AND RECOMMENDATIONS

Lack of central coordination

The fragmentary and *ad hoc* approach to MPA establishment and management, between and within provinces, needs to be restructured to promote coordinated management. It is evident that the establishment of *ad hoc* committees to investigate MPAs has not been successful. In general, the work done by these committees is lost and not passed on to subsequent investigations. A more positive, goal-directed approach to MPA management is needed.

At present, legislative competence in the marine environment is assigned to a national level, but the management of MPAs is assigned to the provinces. This approach has been unsuccessful on two counts. First, there is little or no communication between the national authority (Sea Fisheries) and the provincial nature conservancies on the goals and management of MPAs. Sea Fisheries receives little feedback from the provincial managers of MPAs. Therefore, evaluation of the MPAs in marine conservation and fisheries management has not been possible at national level. Many MPAs are not performing any discernible function, or have been compromised by a relaxing of regulations in the face of local public pressure, with no management plan to guide decisions. Despite the Sea Fishery Act requiring management plans for MPAs, none have been drafted by the national authority, because priorities have focused limited manpower and funds on the economically important fisheries. Second, not all the provinces have the capacity to manage MPAs. Management and enforcement of MPAs is inadequate in the Northern, Western and Eastern Cape. In contrast, the KNNCS has managed MPAs remarkably well. Provincial management can work, but the authorities must have the necessary resources and trained staff. The legislation which has assigned partial legislative responsibility to KwaZulu-Natal for marine management has forced that province to develop the capacity for marine management.

A coordinating body should be established at central government level to develop the necessary communication channels between the various authorities in the interests of effective MPA management. Several

other nations have developed MPA programmes, specifically to guide the establishment and management of MPAs. South Africa should consider the establishment of a MPA programme within the Chief Directorate: Sea Fisheries or the Subdirector: Coastal Zone Management. The programme should develop working partnerships with provincial authorities to ensure that all components of MPA management are successfully accomplished. The programme should also be in a position to assist with management where the provincial capacity is inadequate. Such a programme could become quite large and expensive, and various innovative forms of funding should be considered.

In addition, a working group of scientists and managers from within the Department of Environment Affairs and Tourism, National Parks Board, the relevant provincial authorities and marine science institutes could be created to provide advice on MPA management. Such a group would differ from existing working groups established for specific fisheries, by having a broader composition, and broader goals.

Legislation

Shipping and coastal industries pose a threat to certain components of the marine ecosystem. Typical environmental problems in MPAs include beach litter, oil spills, industrial runoff, uncontrolled development in the coastal zone (mainly estuaries), and destruction of dune and saltmarsh vegetation. At present, MPAs declared in terms of the Sea Fishery Act do not alleviate these threats. The inadequacy with this legislation is the failure to empower the Minister to stop non-fishing-related activities in MPAs which are not compatible with the goals of the area. An amendment of the Sea Fishery Act would be the most practical means to rectify this omission, bearing in mind that most MPAs are declared in terms of this Act. Alternatively, the three Cape Provinces could be given greater authority below the high-water mark, as is the case in KwaZulu-Natal, although this is likely to complicate, rather than streamline, MPA legislation.

Management

No effective management is possible without a management plan, yet very few MPAs have one. The drafting of management plans should be a legal requirement and a priority for the central MPA coordinating body. A standard management plan format is needed for this purpose. MPAs should be staffed

with marine rangers to implement the management plans and report on the functioning of the MPAs.

Objectives

The objectives of many MPAs are not documented or publicized. This has led to the situation where the managers of MPAs are uncertain of which regulations to apply, or how to respond to various pressure groups. Public support for MPAs also depends on advertisement of the objectives. Some MPAs, e. g. Goukamma Marine Reserve, have advertised the objectives and the reasoning behind them at the entrance to the reserve. This type of signposting should be standard for all MPAs.

Enforcement

Many MPAs are experiencing severe poaching problems which are compromising their function. The need for dedicated enforcement staff in most MPAs is perhaps the greatest reason for the continuation of poaching. Experience from the U.S.A. is that the mere presence of officers in the MPA is sufficient to deter most wrong-doers (Causey 1995). The concept of "interpretative" and "preventative" enforcement should be applied to MPAs in South Africa.

Two other problems which have been identified are the shortage of policing vessels and poorly defined boundaries. An improvement of enforcement will require additional personnel and considerable capital investment, but it is clear that, without adequate enforcement, MPAs will not provide adequate protection.

More extensive use of MPAs with controlled resource-use programmes should be considered where poaching by traditional and subsistence users is a problem, building on the experiences from KwaZulu-Natal. These should preferably be established adjacent to no-take MPAs, which can act as core-areas of protection and recruitment, and for base-line monitoring. A major factor contributing to non-compliance of MPA regulations is the historical lack of public participation in their establishment and management.

Education programmes

MPAs are a showpiece of marine conservation and should be exposed to the public. The media could be utilized to promote the concept of MPAs, and an

annual newsletter could report on developments in MPAs. Education programmes for schools could be organized to give scholars exposure to marine conservation. MPAs could be more actively promoted in the popular media.

Monitoring programmes

Monitoring should be included as an essential part of the management plans of MPAs. Reliable information is essential for the assessment of MPA functioning. Where provincial or national staff shortages prevent adequate monitoring, some alternative options can be considered to provide the information on a regular basis, e.g. contracting independent biologists, making use of marine science students as part of their training programme, and volunteer groups.

MPA distribution

The existing distribution and coverage of MPAs does need some attention. Hockey and Buxton's (1989) suggestion for the establishment of MPAs to fill two important gaps in the MPA distribution, namely the West Coast and the KwaZulu-Natal south coast, needs to be reiterated, particularly in the light of South Africa's commitment to the Convention on Biological Diversity. These conspicuous omissions can be filled. Planning of the Namaqualand National Park is already at an advanced stage. The current MPA distribution needs to be examined in greater detail to assess its adequacy for the various coastal fisheries which are showing signs of severe over-exploitation. The development of a GIS database should be a priority to serve as a basis for evaluating the adequacy of MPA coverage.

Estuaries

The recommendation in 1977 for the creation of estuarine reserves did not have much effect, and estuaries are still poorly protected. To overcome the problem of jurisdiction, a central government body should be appointed, perhaps within the Subdirector: Coastal Zone Management, specifically to cater for the management of estuaries by ensuring collaboration between the various authorities with jurisdiction in the catchment. Such a body or programme should function within a national policy on estuarine management (Whitfield 1997). The foundations for better estuarine management are being laid with the

present redrafting of the Water Act, to allow for the maintenance of aquatic ecosystems. The creation of additional estuarine protected areas should be pursued as a priority.

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