# SPATIAL DISTRIBUTION, RELATIVE ABUNDANCE AND SIZE DISTRIBUTION OF SUPRABENTHIC LINEFISH SPECIES PRESENT OVER SUBTIDAL REEF ALONG THE CAPE PENINSULA NATIONAL PARK COASTLINE - ZA5046

## Final Report

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**For**

**THE TABLE MOUNTAIN FUND, WWF-SA AND CAPE PENINSULA NATIONAL PARK**

**Centre for Marine Studies**

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## CONTENTS PAGE

# SECTION I

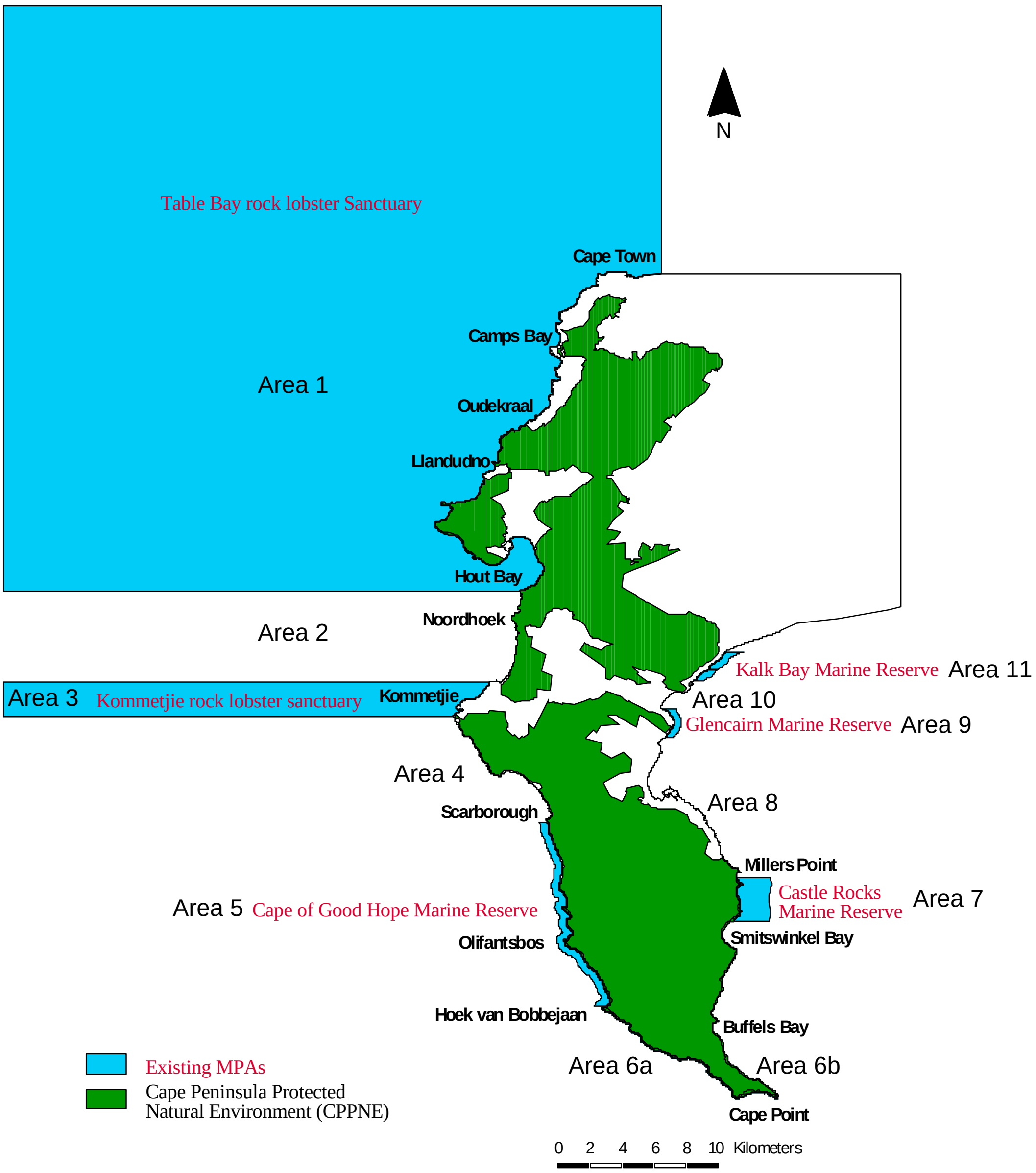
## 1. PROJECT OBJECTIVES

Marine Protected Areas (MPAs), in spite of being the most powerful means of protecting marine resources and biodiversity worldwide, do not always achieve the goals for which they have been established. This is due to one or a combination of factors, including: ineffective management, poor enforcement, being too small (and thus not encompassing sufficient habitat), and having been established at inappropriate sites (Bohnsack 1994, Attwood, Harris & Williams 1997a, Lechanteur 2000).

Seven MPAs are located along the Cape Peninsula coastline, off the South-western tip of the African continent (Figure 1). However, although community support (essential for good management – Attwood, Mann, Beaumont & Harris 1997b) may have been obtained for the establishment of some, where they are located today, it has to be recognised that many were poorly sited. This is partly due to a lack of information on the spatial distribution, habitat requirement and stock status of exploited species, and lack of knowledge on where optimal habitat was to be found. As a result of this, the existing MPA network on the Cape Peninsula is considered to be largely ineffective as a conservation tool (Mayfield & Branch 2000, Lechanteur 2000). Most of these MPAs thus do not help the region's suprabenthic reef-dependent linefish species, many of which are suffering from overexploitation.

The Cape Peninsula National Park (CPNP) is currently attempting to develop a marine component for the Park by establishing a large MPA off the Cape Peninsula complete with a series of no-take sanctuary zones. The efficacy of the existing network of MPAs must, therefore, be assessed, and where necessary, alternative (optimal) MPA sites must be proposed to replace the present MPA sites that are found to be ineffective. This report aims to assist with this process by mapping the distribution of principal subtidal habitat types, and provide baseline information concerning the composition of suprabenthic reef-dependent linefish species located at different sites along the Cape Peninsula coastline. Such data would form the basis for evaluating the existing (and proposed) MPA network, before these are incorporated into the Park. In addition, this report also aims to provide guidelines and material to help develop a programme that will enable recreational divers to assist with the long-term monitoring of exploited invertebrates and reef fish stocks on the Cape Peninsula.

Figure 1: Existing Marine Protected Areas of the Cape Peninsula.



## 2. BACKGROUND AND MOTIVATION

The Cape Peninsula coast is extremely rich in marine and coastal biodiversity, with about 43% of all the South African marine species occurring in this region. It supports several important fisheries and contributes to the livelihood of many people (Attwood *et al.* 1997a). Linefishing effort, including both commercial and recreational linefishers, is considerable along the Cape Peninsula coastline. This is helped by the fact that the majority of the Peninsula's Coastline is easily accessible, with roads lining most of its coast, and boat launching sites being present at regular intervals. Furthermore, two commercial fishing harbours are also located along its coast, one (Kalk Bay) within False Bay, and one (Hout Bay) along the West Coast of the Peninsula.

Of the recreational linefishers, shore anglers are the most numerous, followed by spearfishers and recreational boat based anglers (Lechanteur 2000). Shore angling catches comprises mainly *Dichistius capensis* (*Dichistius capensis*), elf (*Pomatomous saltatrix*) and Kob (*Argyrosomus inodorus*) (Lechanteur 2000). Although the catch taken by individual shore anglers is mostly small, their impact on targeted linefish species is high due to the very high cumulative total fishing effort expended by shore angler along the South African coast (Bennett 1988, 1991, 1992, Brouwer, Mann, Lamberth, Sauer & Erasmus 1997). The impact of spearfishers on the Cape Peninsula's linefish stocks is largely unknown. Lechanteur (2000) reported that the catch of spearfishers active within False Bay comprises mostly reef-dependent species. Although a number of these are not taken by other linefishery sectors regularly, many of the most commonly speared species are shared by one or a number of fishery sectors. The same applies along the West Coast of the Cape Peninsula, although there, far fewer species are landed by spearfishers compared to within False Bay (Lechanteur unp. data). Although the total number of spearfishers active along the Cape Peninsula coastline is low (less than 350 spearfishers having been encountered during a 5 year survey), and their total spearfishing effort is low compared to that of shore anglers, their impact on linefish species could still be important, since their Catch-Per-Unit-Effort (CPUE) is considerably greater than that of shore-anglers off both coasts. Recreational boat-based fishing effort is difficult to estimate, but is likely to be increasing, especially since no commercial fishing licences are being issued at the present time.

Commercial fishing effort is also very high along the Peninsula coastline, and involves boat-based anglers and beach-seiners. Commercial boat-based catches comprise a large number of pelagic and demersal species. Of importance, however, is the large number of reef-dependent species taken when pelagic fish are not present. Commercial beach seiners, because they are not capable of fishing over reef, have no impact on reef-dependent species along the Cape Peninsula, although their total catch of pelagic species is large.

To try and manage the impact of linefishers on targeted stocks, two forms of conventional linefishery management measures are employed in South Africa: I. Effort control, and II. Limiting total catch. Effort control involves limiting the total number of fishers permitted to fish a resource, which indirectly limits the total catch of this sector. Limiting the total catch of individual fishers at each outing is a more direct way of limiting the total catch taken by a sector. Along the Cape Peninsula coastline, effort control is enforced onto commercial boat-based anglers and commercial beach-seiners, whereas catch limiting measures, such as daily-bag-limits, minimum sizes and gear restrictions are enforced onto both commercial and recreational fishers. It is evident that past and presently enforced fishery management measures have failed to conserve exploited linefish stocks sustainably. Along the Cape Peninsula coastline, linefish species that were landed regularly during the 1930 – 1950s are presently extremely rare in catches. Indeed, species that were then not targeted by linefishers became targeted in the 1960s, after which they too became so rare that yet other (and smaller) species became targeted by the 1980s. This sequential overexploitation is a common problem both locally and internationally. The conservation status of many of the reef-dependent linefish species present along the Cape Peninsula is thus poor. In many cases, this is due to a number of factors, including:

1. Many species are landed by a number of linefishery sectors, which makes their management difficult
2. The general biology of a number of these is complicated (e.g. slow growth, late maturity, sex change), which again makes them difficult to manage.
3. Most South African coastal fisheries are poorly managed.

4. There is a lack of knowledge on the general biology of a number of exploited species
5. Fishery regulation enforcement is poor

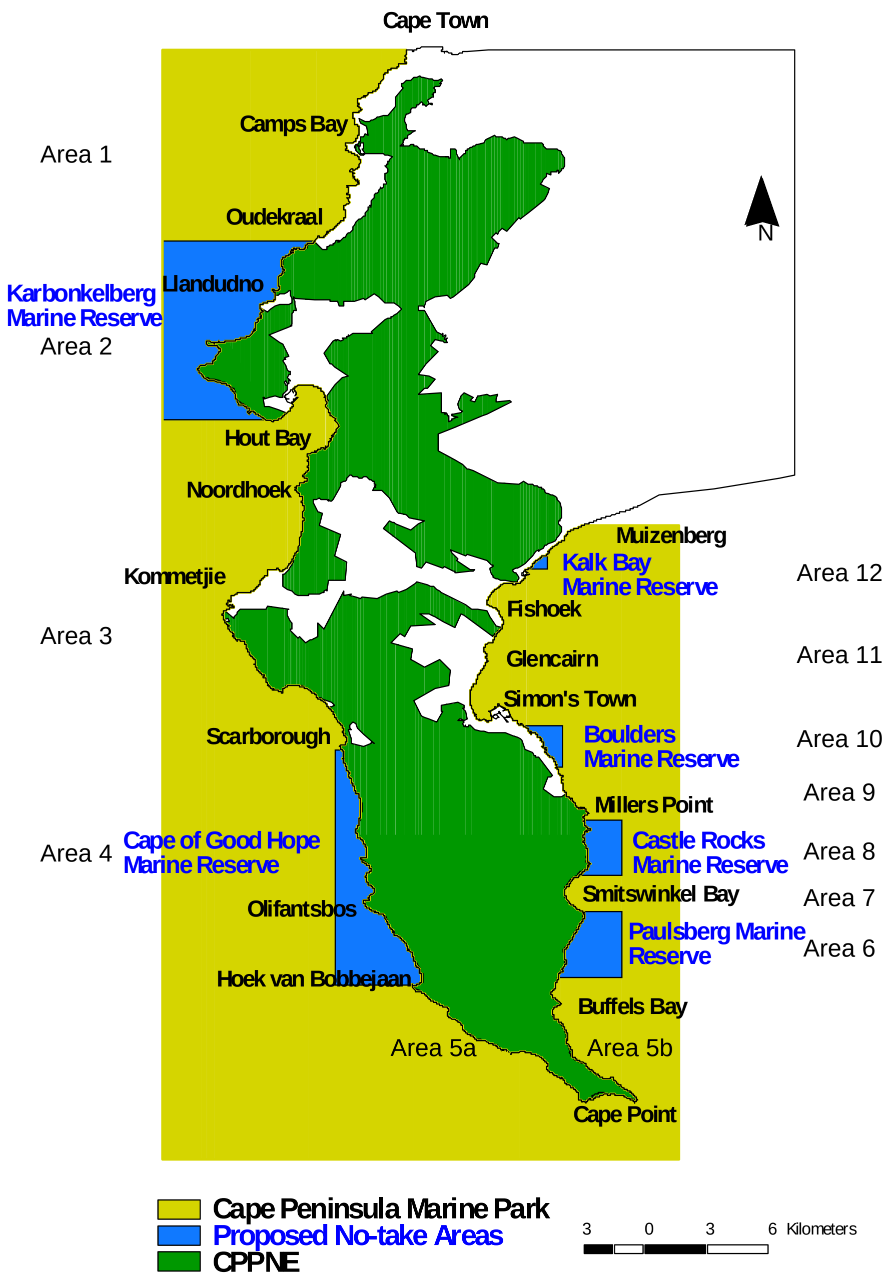
Given that the future of linefishing in South Africa is likely to include more fishers demanding greater access to dwindling resources, careful planning is required to ensure sustainable management of linefish resources for future generations. Because of the failure of traditional fishery management measures worldwide, MPAs have been viewed as an important tool for marine conservation. Indeed, if properly managed and supported by the general public, MPAs can provide substantial benefits for both fish and fishers. They have been shown to, amongst other benefits, conserve natural ecosystems, act as effective biodiversity reservoirs, rebuild depleted stocks, improve fishery yields and provide protection against stock collapse (Polunin & Roberts 1993, Man, Law & Polunin 1995, Attwood et al. 1997a b,). MPAs also provide a good foundation for education and marine research.

Seven MPAs are presently found along the Cape Peninsula coastline, the first of which was proclaimed in 1964 (Attwood *et al.* 1997a). A number of these are ineffective, however, mainly due to their poor placement. At the time of proclamation, vital information on biogeography, exploited species distribution patterns, their habitat requirements and the whereabouts of such habitat was not available or taken into account. The existing MPA network is also plagued with legislative, socio-economic and administrative problems (Hockey & Buxton 1989), which has antagonised local fishers and encouraged poaching. The revision and rationalisation of the existing MPA network on the Peninsula is an urgent priority. The newly proclaimed CPNP is willing to take over the management of marine areas along its boundaries, and has diverted a portion of the funds provided by the Global Environment Fund (GEF) for a feasibility study to evaluate this. Unfortunately this process has been constrained to a desktop study only, due to limited funds. Gaps thus still remain in our knowledge of the distribution patterns of exploited linefish species on the Peninsula, and this is severely hampering efforts in this regard.

The aim of this project is to map the distribution of habitat types and suprabenthic reef-dependent linefish species present along the Peninsula coastline. This data will be used to guide the review process, and assist with the identification of possible new sanctuary zones and the formulation of appropriate boundaries, zonation and management plans for the

Marine Component of the Park as a whole. The data will also be extremely valuable as baseline information, against which future improvements can be evaluated and the benefits of the new MPA network demonstrated.

Figure 2: Proposed Marine Protected Areas of the Cape Peninsula.



## 3. TERMS OF REFERENCE

The objectives of the assessment of reef fish communities were threefold.

1. To provide micro-scale baseline data on the distribution and composition of suprabenthic reef-dependent linefish assemblages, thereby providing:
   - A general overview of the status of exploited reef fish species on the Peninsula.
   - Information needed to evaluate the effectiveness of the existing and proposed MPA network on the Peninsula in terms of biodiversity conservation as well as the conservation and management of exploited linefish species.
   - Provide essential baseline information against which future changes (improvements and/or declines) can be evaluated, and benefits of the MPA network (or lack thereof) demonstrated.

2. The additional collection of habitat characterisation data along the coast of the Park will supplement the information assembled during the Invertebrate Stock Assessment (Mayfield, Clark & Balarin 2001). Such information can be used to:
   - Assess the effectiveness of the existing MPA network with respect to biodiversity conservation;
   - Ensure that sufficient important basic habitat types are incorporated within the revised MPA network
   - Offer a means of extrapolating information on the distribution of other species along the coast of the Park.

3. The provision of guidelines and material for the proposed involvement of the diving public to:
   - Offer a cost effective means to provide information for future long-term monitoring of exploitable invertebrates, fish stocks and other reef species
   - Through the process of public participation of this diving community, create public awareness of the MPA process and the role played by the WWF and associated institutions.

## SECTION II

## 1. METHODS

Several non-destructive visual survey techniques have been employed worldwide (*e.g.* Berry *et al.*1982; Zoutendyk 1982; Buxton & Smale 1989; Thresher & Gunn, 1986; Beckley & Buxton 1989; Van Herwerden 1989; Burger 1991; Chatter *et al.* 1993, 1995; Fennessy *et al.* 1998; Lechanteur 2000). The accuracy of these techniques is however, often related to the behaviour of the fish species being censused (Thresher & Gunn 1986; Buxton & Smale 1989; Burger 1991), and have rarely been validated (Samoilys & Carlos 1992). The behaviour of fish in the presence of SCUBA divers thus needs to be taken into consideration when deciding on a census method (Buxton & Smale 1989; Samoilys & Carlos 1992). Within False Bay, certain reef fish species, and particular size classes of others, move away from approaching SCUBA divers. These 'shy' species thus appear rare to such divers, whereas they appear more abundant to stationary and more unobtrusive divers (Y. Lechanteur pers. obs.). With this in mind, the instantaneous stationary point count census method was used in this study. Not only is it time efficient (Lechanteur 2000), but it is also reported to be the most accurate method by Samoilys & Carlos (1992), who investigated different fish survey techniques on coral reefs. Being instantaneous, this technique also enables divers to estimate the relative abundance of both 'shy' and 'inquisitive' reef fish species simultaneously, as no matter whether species are 'attracted to' or 'scared' by divers, their presence within an area is noted almost immediately (Samoilys & Carlos 1992). This therefore minimises the problem of incoming and outgoing fish affecting results (Samoilys & Carlos 1992). A further advantage of this technique is that it allows for a better reef coverage, increasing the chance of encountering the full range of reef architecture present a site.

Fish counts were undertaken at 40 sites along the east coast of the Cape Peninsula coastline, and 46 sites along its western coast, thereby covering a wide range of coastline and available reef habitat on the Peninsula. To maximise the probability of encountering the various reef fish species at each site, each site was censused within three depth strata: 0-8 m, >8-15 m and >15-25 m. Counts were only undertaken within False Bay when the water temperatures on the bottom was >13°C. This was to minimise density variations attributable to the change in behaviour and/or spatial distribution of numerous False Bay reef fish species as water temperature declines to 13°C or less (Lechanteur 2000). Similarly, along the West Coast, counts were only undertaken when the bottom water temperature was >12°C, since 12°C appears to be the temperature at which the spatial distribution of the dominant reef fish species changes markedly along that section of coast (Lechanteur unp. data).

Each count was undertaken in the following way: a lone diver descended unobtrusively onto the reef, and immediately identified and counted the fish present on an area of reef while remaining stationary. Fish leaving this area, as well as 'inquisitive species' (that moved into the area) were counted as soon as they were recognisable while the diver descended onto the reef. 'Inquisitive species' were then ignored while the diver searched for 'shy' species under rock cover. Fish size was estimated within 5 cm total length (TL) size classes with fish smaller than 15 cm TL being ignored completely (fish below this size are difficult to identify). Having counted the fish, the diver noted the following parameters from within each count's census area:

- Relative surface area of reef censused during that count. This was estimated visually
- Maximum vertical reef elevation (m)
- Characterisation of cave structure (rock shelter within which a fish could hide) present. This was characterised as either:
  i. Small cave - none to only small (shallow with only one entrance) caves present
  ii. Large cave - at least one large (deep with more than one entrance) cave present.
- Depth of the site (m)

All information was recorded on pre-marked Perspex slates. On completion of a count, the diver swam back to mid-water (or surface) and finned sufficiently away (roughly three times the visibility on the day) before descending for the next count. This ensured that fish encountered at the next site were unlikely to have been affected by the divers' presence at the previous site. At least 8 counts were completed within each depth stratum at each site where reef was present. Counts were randomly distributed, rather than along a transect line with fixed points, to minimise fish disturbance. The location of each site was fixed accurately using GPS to enable repeated sampling in the future. Weather and sea conditions were also noted during each survey trip.

The underwater survey team comprised commercially qualified divers experienced in fish identification. Each were trained in the Underwater Visual Count (UVC) method employed, and given instruction concerning size estimation prior to the commencement of the study (Samoilys & Carlos 1992). These divers completed dives from the shore as well as from a boat. When diving from the boat, they were taken to and from the dive area by a commercially qualified boat skipper. Care was taken to ensure that safety limits were not exceeded.

The physical reef data recorded was first analysed to obtain an idea of the types of reef present at the different sites sampled along the Cape Peninsula coastline. Following that, the fish count information collected by the divers was converted into relative abundance (density) estimates and size distributions. These data were grouped per site, groups of sites, or particular reef categories to reduce relative abundance variance (Samoilys & Carlos 1992), and used to compare the following:

- The relative abundance of individual species and groups of species on reefs with different physical reef characteristics, to investigate whether depth, vertical reef elevation and availability of large caves affects their spatial distribution
- The composition of reef fish assemblages among the different sites, to establish whether different sites (or groups of sites) are inhabited by different assemblages
- The relative abundance of different species and/or size classes of species at different sites (or groups thereof), to establish their reef fish conservation potential

The results of the comparisons outlined above, were then used to investigate composition of fish assemblages along different portions of the Peninsula's coastline, as well as the potentials of the different proposed and existing MPAs as line fishery management tools. Where deemed necessary, a revision of the proposed MPA boundaries are recommended, based on the results obtained from this study. Information from similar studies to this study (but only undertaken within False Bay) are also used in this discussion. It must, however, be remembered that the data obtained during this study can only be employed to highlight which of the dived sites has more reef fish conservation potential than others, and does not allow for optimal MPA size estimation.

The second component of this project entails the initiation of a programme for the long-term monitoring of exploited invertebrates and reef fish assemblages by recreational divers on the Cape Peninsula. It is important to note that this is not expected to cover all the long-term monitoring requirements for these species on the Peninsula, but will rather serve to supplement future scientific surveys and provide information that could point to the need for specific scientific research. Many such initiatives have been implemented elsewhere (e.g. Bohnsack *et al*. 1987, Schmidt & Sullivan 1996) and have proved to be highly effective in collecting much needed data on relative fish abundance and size, and in enhancing public awareness of the need for marine conservation. This section of the report will develop the required questionnaire material, suited to the capabilities of recreational divers on the Peninsula, including identification and data recording sheets. To increase public support for this part of the project and acquire participating divers, public participation information sessions will be offered at three of the major diving institutions, where divers from the region will be introduced to basic survey techniques and the use of the equipment provided.

**Note:** These information sessions are not intended to be construed as formal diver training in scientific survey techniques, as this would contravene Department of Manpower regulations. These sessions would only be to familiarise recreational divers with simple survey techniques and the correct use of the data collection materials. The CMS and the University of Cape Town will not accept any liability arising from recreational divers participating in this aspect of the project.

## 2. FISH ASSEMBLAGES PRESENT OFF THE EAST COAST OF THE CAPE PENINSULA

A total of 2 383 fish counts, covering 88 305 $m^2$, were obtained from 86 sites along the Cape Peninsula coastline. The Cape of Good Hope was delineated as the boundary separating the eastern and western coasts of the Cape Peninsula. Forty sites (1 044 counts - 44 442 $m^2$) were sampled off the Peninsula's east coast, and 46 (1239 counts - 43 863 $m^2$) off its west coast. Of the reef surface area counted off its east coast, 8 986 $m^2$ was located within MPAs, compared to 6 191 $m^2$ off its west coast.

The composition and relative abundance of fish assemblages encountered along the different exploited and protected (proposed and / actual) stretches of coast off the east coast of the Peninsula are noted in Table 1. The most abundant assemblage was encountered within the Kalk Bay Sanctuary Zone (111.0 fish.100m$^{-2}$), whereas the most diverse assemblage was encountered within the Castle Rocks Sanctuary Zone (20 species). The poorest (2 species, mean overall abundance of 1.1 fish.100m$^{-2}$) was found between Muizenberg Corner and the Kalk Bay Sanctuary Zone (Table 1).

## 3. FISH ASSEMBLAGES PRESENT OFF THE WEST COAST OF THE CAPE PENINSULA

The composition and relative abundance of fish assemblages encountered along the different exploited and protected (proposed and / actual) stretches of coast off the west coast of the Peninsula are noted in Table 2. The most abundant assemblage was found between the Cape of Good Hope and the Cape of Good Hope Sanctuary Zone, whilst it was most diverse off both that portion of coast as well as that between the Cape of Good Hope Sanctuary Zone and the Karbonkelberg Sanctuary Zone. Both of these stretches of coast are exploited. The poorest assemblage with respect to diversity and fish abundances was noted within the Cape of Good Hope Sanctuary Zone, where only one species was counted, at an overall abundance of only 2.8 individuals.100m$^{-2}$ (Table 2).

## 4. MAPPING OF HABITAT TYPES

Little micro-scale information is available concerning the types of reefs located off the Cape Peninsula. Apart from obtaining information concerning the composition of fish assemblages present at different sites along the Peninsula's coastline, this study also obtained information concerning the architecture of reefs encountered at each site. Reef architecture information noted included the depth at which reef was encountered, the range of vertical reef elevation encountered there (m), as well as the availability of large caves. This information is important, as apart from pointing out the presence/absence of reef at different depths, it provides micro-scale information concerning the reef architecture present there which in turn can influence the composition and abundance of the fish assemblages present (Lechanteur 2000). Indeed, this factor may explain much of the differences recorded in Tables 1 & 2.

Table 1. Composition (densities/100 $m^2$) of the fish assemblage counted off different stretches of coast along the east coast of the Cape Peninsula. Note: only species counted at more than one site are listed, and densities calculated irrespective of depth are the means obtained for all sites, even if no reef was found within one or more of the depth strata at that site

| Number of sites | Depth stratum (m) | No of sites where reef present | Reef surface area ($m^2$) | Total fish | Total reef teleosts | Total cartilaginous species | All pelagic & other species | *Chrysoblephus laticeps* | *Pachymetopon blochii* | *Boopsoidea inornata* | *Spondyliosoma emarginatum* | *Pachymetopon aeneum* | *Chirodactylus brachydactylus* | *Gymnocrotaphus curvidens* | *Petrus rupestris* | *Dichistius capensis* | *Diplodus sargus capensis* | *Dilpodus cervinus hottentotus* | *Parascorpis typus* | *Oplegnathus conwayi* | *Sparodon durbanensis* | *Sarpa salpa* | *Cheilodactylus fasciatus* | *Seriola lalandi* | *Poroderma africanum* | *Poroderma pantherinum* | *Haploblepharus pictus* | *Haploblepharus edwardsii* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Muizenberg corner to Kalk Bay Sanctuary Zone (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0-8 | All | 365 | 1.1 | 1.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | >8-15 | None | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1 | >15-25 | None | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **1** | **All** | **All** | **365** | **1.1** | **1.1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0.5** | **0** | **0** | **0.5** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Kalk Bay Sanctuary Zone (PROTECTED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0-8 | All | 394 | 119.3 | 119.3 | 0 | 0 | 7.4 | 9.1 | 0.5 | 0 | 0 | 7.4 | 0.3 | 0 | 0.8 | 6.1 | 0 | 0.8 | 0 | 0 | 83.8 | 3.3 | 0 | 0 | 0 | 0 | 0 |
| 1 | >8-15 | All | 32 | 9.4 | 9.4 | 0 | 0 | 9.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | >15-25 | None | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **1** | **All** | **All** | **426** | **111.0** | **111.0** | **0** | **0** | **7.5** | **8.5** | **0.5** | **0** | **0** | **6.8** | **0.2** | **0** | **0.7** | **5.6** | **0** | **0.7** | **0** | **0** | **77.5** | **3.1** | **0** | **0** | **0** | **0** | **0** |
| Kalk Bay Sanctuary Zone to Glencairn Sanctuary Zone (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0-8 | All | 584 | 53.9 | 53.6 | 0.3 | 0 | 0.5 | 5.3 | 0.2 | 0 | 0 | 1.7 | 0 | 0 | 0 | 2.4 | 0 | 0 | 0 | 0 | 42.8 | 0.7 | 0 | 0 | 0 | 0.2 | 0.2 |
| 1 | >8-15 | All | 400 | 64.5 | 64.5 | 0 | 0 | 3.3 | 6.3 | 0 | 0 | 0 | 3.0 | 0 | 0 | 0 | 0 | 0 | 1.5 | 0 | 0 | 50.0 | 0.5 | 0 | 0 | 0 | 0 | 0 |
| 1 | >15-25 | None | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **1** | **All** | **All** | **984** | **58.2** | **58.0** | **0.2** | **0** | **1.6** | **5.7** | **0.1** | **0** | **0** | **2.2** | **0** | **0** | **0** | **1.4** | **0** | **0.6** | **0** | **0** | **45.7** | **0.6** | **0** | **0** | **0** | **0.1** | **0.1** |
| Glencairn Sanctuary Zone (PROTECTED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0-8 | All | 1078 | 33.8 | 14.4 | 0.1 | 19.3 | 0.1 | 9.8 | 0 | 0.5 | 0 | 2.0 | 0.1 | 0 | 0.4 | 0 | 0.7 | 0.1 | 0 | 0.1 | 0 | 0.8 | 0 | 0 | 0 | 0.1 | 0 |
| 2 | >8-15 | All | 872 | 14.2 | 13.5 | 0.7 | 0 | 0.9 | 6.1 | 0 | 0 | 0 | 1.4 | 0 | 0 | 0 | 0 | 0 | 0.6 | 0 | 0 | 4.5 | 0 | 0 | 0 | 0 | 0 | 0.7 |
| 2 | >15-25 | None | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **2** | **All** | **All** | **1950** | **27.3** | **14.8** | **0.3** | **12.2** | **0.5** | **8.4** | **0** | **0.3** | **0** | **1.8** | **0** | **0** | **0.2** | **0** | **0.4** | **0.4** | **0** | **0** | **2.3** | **0.4** | **0** | **0** | **0** | **<0.05** | **0.2** |
| Glencairn Sanctuary Zone to Boulders Sanctuary Zone (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0-8 | All | 512 | 2.1 | 1.8 | 0.4 | 0 | 0 | 1.6 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 |
| 1 | >8-15 | All | 556 | 1.3 | 1.1 | 0 | 0.2 | 0.4 | 0.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | >15-25 | None | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **1** | **All** | **All** | **1068** | **1.7** | **1.4** | **0.2** | **0.1** | **0.2** | **1.1** | **0** | **0** | **0** | **0.1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0.2** |

Table 1 (Continued). Composition (densities/100 $m^2$) of the fish assemblage counted off different stretches of coast along the east coast of the Cape Peninsula. Note: Only species encountered at more than one site are listed, and densities calculated irrespective of depth are the means obtained for all sites, even if no reef was found within one or more of the depth strata at that site

| Number of sites | Depth stratum (m) | No of sites where reef present | Reef surface area ($m^2$) | Total fish | Total reef teleosts | Total cartilaginous species | All pelagic & other species | *Chrysoblephus laticeps* | *Pachymetopon blochii* | *Boopsoidea inornata* | *Spondyliosoma emarginatum* | *Pachymetopon aeneum* | *Chirodactylus brachydactylus* | *Gymnocrotaphus curvidens* | *Petrus rupestris* | *Dichistius capensis* | *Diplodus sargus capensis* | *Dilpodus cervinus hottentotus* | *Parascorpis typus* | *Oplegnathus conwayi* | *Sparodon durbanensis* | *Sarpa salpa* | *Cheilodactylus fasciatus* | *Seriola lalandi* | *Poroderma africanum* | *Poroderma pantherinum* | *Haploblepharus pictus* | *Haploblepharus edwardsii* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boulders Sanctuary Zone (PROPOSED PROTECTED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 0-8 | All | 3418 | 22.9 | 22.3 | 0.4 | 0.2 | 0.4 | 13.9 | 1.3 | 0 | 0 | 2.4 | 0.1 | 0 | 0.1 | 0.3 | 0.2 | 0.3 | 0 | 0 | 2.8 | 0.6 | 0 | 0 | 0 | 0.1 | 0.2 |
| 4 | >8-15 | 3 / 4 | 1399 | 25.7 | 25.6 | 0.1 | 0 | 1.1 | 16.3 | 3.4 | 1.4 | 0 | 1.3 | 0.2 | 0 | 0.2 | 0.6 | 0.1 | 0.1 | 0 | 0 | 0.1 | 0.6 | 0 | 0.1 | 0 | 0.1 | 0.1 |
| 4 | >15-25 | None | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **4** | **All** | **All** | **4817** | **26.1** | **25.7** | **0.3** | **0.1** | **0.8** | **16.0** | **2.6** | **0.7** | **0** | **2.2** | **0.1** | **0** | **0.2** | **0.5** | **0.1** | **0.2** | **0** | **0** | **1.8** | **0.6** | **0** | **<0.05** | **0** | **0.1** | **0.2** |
| Boulders Sanctuary Zone to Castle Rocks Sanctuary Zone (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 0-8 | All | 1496 | 33.5 | 33.5 | 0 | 0 | 0.3 | 23.2 | 3.4 | 0.1 | 0 | 2.2 | 0 | 0 | 1.4 | 0.1 | 0.6 | 0.2 | 0 | 0.1 | 1.3 | 0.6 | 0 | 0 | 0 | 0 | 0 |
| 3 | >8-15 | All | 1571 | 59.6 | 59.5 | 0.1 | 0 | 1.8 | 35.1 | 3.2 | 4.4 | 0 | 4.4 | 0.6 | 0.1 | 2.3 | 0 | 1.2 | 0.2 | 0 | 0 | 4.3 | 1.7 | 0 | 0 | 0 | 0 | 0.1 |
| 3 | >15-25 | 2 / 3 | 1375 | 19.2 | 18.5 | 0.4 | 0.4 | 1.8 | 11.7 | 0.3 | 2.7 | 0 | 0.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.3 | 0 | 0 | 0.3 | 0 | 0.1 |
| **3** | **All** | **All** | **4372** | **37.2** | **36.9** | **0.2** | **0.1** | **1.3** | **23.9** | **2.2** | **2.3** | **0** | **2.3** | **0.2** | **0.1** | **1.1** | **0.1** | **0.6** | **0.2** | **0** | **<0.05** | **1.4** | **1.2** | **0** | **0** | **0.1** | **0** | **0.1** |
| Castle Rocks Sanctuary Zone (PROTECTED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 0-8 | All | 2669 | 51.8 | 51.5 | 0.3 | 0 | 2.6 | 28.8 | 0.3 | <0.05 | 0.2 | 6.0 | 1.5 | 0.1 | 2.1 | 0.4 | 0.5 | 1.3 | 0.2 | 0.3 | 6.6 | 0.6 | 0 | <0.05 | <0.05 | <0.05 | 0.2 |
| 5 | >8-15 | All | 3081 | 62.5 | 61.9 | 0.6 | <0.05 | 9.0 | 26.5 | 5.6 | 0.7 | 3.6 | 6.7 | 1.5 | 0.1 | 2.6 | 0.3 | 0.4 | 1.0 | 0.3 | 0 | 2.1 | 1.4 | 0 | 0.1 | <0.05 | <0.05 | 0.4 |
| 5 | >15-25 | All | 860 | 17.9 | 17.1 | 0 | 0.9 | 5.6 | 5.5 | 0.2 | 0.9 | 0 | 1.2 | 0.9 | 0 | 0.7 | 0.1 | 0 | 0.3 | 0 | 0 | 0.8 | 0.6 | 0 | 0 | 0 | 0 | 0 |
| **5** | **All** | **All** | **6610** | **52.0** | **51.4** | **0.4** | **0.2** | **6.0** | **25.0** | **2.9** | **0.5** | 1.7 | 5.5 | 1.4 | 0.1 | 2.2 | 0.3 | 0.4 | 1.0 | 0.2 | 0.2 | 3.2 | 0.9 | 0 | 0.1 | <0.05 | <0.05 | 0.3 |
| Castle Rocks Sanctuary Zone to Paulsberg Sanctuary Zone (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 0-8 | Al | 870 | 18.7 | 18.3 | 0.5 | 0 | 0.5 | 10.7 | 2.5 | 0 | 0.1 | 1.4 | 0.1 | 0.5 | 0.1 | 0 | 0 | 0.6 | 0 | 0 | 1.3 | 0.5 | 0 | 0.3 | 0 | 0 | 0.2 |
| 2 | >8-15 | All | 1021 | 36.5 | 35.9 | 0.7 | 0 | 1.3 | 16.2 | 6.8 | 0 | 0.2 | 3.5 | 0 | 0 | 0.6 | 0 | 0 | 0.6 | 0 | 0 | 6.6 | 0.1 | 0 | 0 | 0 | 0 | 0.5 |
| 2 | >15-25 | 1 / 2 | 160 | 93.1 | 93.1 | 0 | 0 | 1.3 | 78.1 | 0 | 0 | 0 | 2.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.9 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2** | **All** | **All** | **2051** | **39.1** | **38.6** | **0.5** | **0** | **1.0** | **23.0** | **4.8** | **0** | 0.1 | 2.6 | 0.1 | 0.2 | 0.4 | 0 | 0 | 0.6 | 0 | 0 | 5.6 | 0.2 | 0 | 0.1 | 0 | 0 | 0.3 |
| Paulsberg Sanctuary Zone (PROPOSED PROTECTED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | 0-8 | All | 2850 | 14.0 | 13.8 | 0.3 | 0 | 0.2 | 10.3 | 0 | 0.2 | 0 | 1.2 | 0.1 | 0 | 0.4 | 0 | 0.4 | 0.1 | 0 | 0 | 0.6 | 0.3 | 0 | 0 | 0 | 0 | 0.3 |
| 8 | >8-15 | All | 3154 | 9.2 | 7.8 | 0 | 1.4 | 0.6 | 3.4 | 0 | 0.4 | 0 | 0.9 | 0.1 | 0 | 0.4 | 0 | 0.2 | 0.2 | 0 | 0 | 1.5 | 0.1 | 0 | 0 | 0 | 0 | 0 |
| 8 | >15-25 | 7 / 8 | 2134 | 11.8 | 10.4 | 0.1 | 1.3 | 0.2 | 7.6 | 0 | 0.6 | 0 | 0.4 | 0.2 | 0 | 0.4 | 0 | 0.1 | 0.3 | 0 | 0 | 0.4 | 0.1 | 1.3 | 0 | 0 | 0 | 0 |
| **8** | **All** | **All** | **8138** | **11.7** | **10.7** | **0.1** | **0.9** | **0.4** | **6.7** | **0** | **0.4** | 0 | 0.8 | 0.1 | 0 | 0.4 | 0 | 0.3 | 0.3 | 0 | 0 | 1.0 | 0.2 | 0.3 | 0 | 0 | 0 | 0.1 |
| Paulsberg Sanctuary Zone to Cape of Good Hope (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | 0-8 | 11/12 | 4611 | 46.8 | 45.5 | 0.2 | 1.1 | 0 | 31.4 | 0.4 | 0 | 0 | 5.3 | 0 | 0 | 1.8 | 0.1 | 0 | 0.2 | 0 | 0 | 6.0 | 0.2 | 0 | 0 | 0 | 0 | 0.2 |
| 12 | >8-15 | All | 5268 | 26.6 | 26.0 | 0.1 | 0.5 | 0.2 | 19.3 | 2.1 | 0.3 | 0 | 1.3 | 0 | 0 | 0.3 | 0 | 0.2 | 0.2 | 0 | 0 | 1.8 | 0.2 | 0 | 0 | 0 | 0 | 0 |
| 12 | >15-25 | 10/12 | 4232 | 16.4 | 13.5 | 0 | 2.9 | 0.3 | 10.9 | 0.2 | 0.6 | 0 | 0.2 | 0 | 0 | 0.1 | 0 | 0 | 0.4 | 0 | 0 | 0.6 | 0.1 | 0.8 | 0 | 0 | 0 | 0 |
| **12** | **All** | **All** | **13711** | **29.7** | **28.1** | **0.2** | **1.5** | **0.2** | **20.9** | **0.8** | **0.3** | **0** | **2.1** | **0** | **0** | **0.7** | **0.1** | **0.1** | **0.3** | **0** | **0** | **2.5** | **0.1** | **0.2** | **0** | **0** | **0** | **0.1** |

Table 2. Composition (densities/100 m$^2$) of the fish assemblage counted off different stretches of coast along the west coast of the Cape Peninsula. Note: Densities calculated irrespective of depth are the means obtained for all sites, even if no reef was found within one or more of the depth strata at that site

| Number of sites | Depth stratum (m) | No sites where Reef present | Reef surface area (m$^2$) | Total fish | Total reef teleosts | Total cartilaginous fish | Total pelagic and & dwelling species | *Pachymetopon blochii* | *Chirodactylus brachydactylus* | *Dichistius capensis* | *Boopsoidea inornata* | *Parascorpis typus* | *Diplodus sargus capensis* | *Spondyliosoma emarginatum* | *Sarpa salpa* | *Seriola lalandi* | *Trachurus* sp. | *Liza richardsonii* | *Haploblepharus pictus* | *Triakis megalopterus* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cape of Good Hope to Cape of Good Hope Sanctuary Zone (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | |
| 8 | 0-8 | All | 2945 | 18.1 | 18.1 | 0 | 0 | 13.8 | 0.1 | 1.6 | 0 | 0 | 0 | 0 | 2.6 | 0 | 0 | 0 | 0 | 0 |
| 8 | >8-15 | All | 2793 | 14.0 | 13.5 | 0 | 0.5 | 13.4 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 |
| 8 | >15-25 | 7 | 1710 | 37.3 | 17.0 | 0 | 20.3 | 17.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20.3 | 0 | 0 | 0 | 0 |
| **8** | **All** | **All** | **7448** | **14.9** | **13.0** | **0** | **1.9** | **12.1** | **0.1** | **0.8** | **0** | **0** | **0** | **0** | **1.1** | **1.7** | **0** | **0** | **0** | **0** |
| Cape of Good Hope Sanctuary Zone (PROTECTED ZONE) | | | | | | | | | | | | | | | | | | | | |
| 8 | 0-8 | All | 1640 | 4.6 | 4.6 | 0 | 0 | 4.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | >8-15 | All | 2112 | 1.2 | 1.2 | 0 | 0 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | >15-25 | All | 2510 | 4.0 | 4.0 | 0 | 0 | 4.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **8** | **All** | **All** | **6262** | **2.8** | **2.8** | **0** | **0** | **2.8** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Cape of Good Hope Sanctuary Zone to Karbonkelberg Sanctuary Zone (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | |
| 9 | 0-8 | 8 / 9 | 3395 | 6.1 | 4.7 | 0.03 | 1.5 | 3.4 | 0 | 1.3 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 1.5 | 0 | 0.03 |
| 9 | >8-15 | All | 3577 | 1.9 | 1.9 | 0 | 0 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0.03 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | >15-25 | 8 / 9 | 3330 | 2.6 | 2.6 | 0 | 0 | 2.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **9** | **All** | **All** | **10302** | **4.0** | **3.6** | **0.01** | **0.4** | **3.1** | **0** | **0.4** | **0** | **0** | **0.02** | **0.01** | **0** | **0** | **0** | **0.4** | **0** | **0.01** |

Table 2 (continued). Composition (densities/100 $m^2$) of the fish assemblage counted off different stretches of coast along the west coast of the Cape Peninsula. Note: Densities calculated irrespective of depth are the means obtained for all sites, even if no reef was found within one or more of the depth strata at that site

| No. of sites | Depth stratum (m) | No sites where Reef present | Reef surface area ($m^2$) | Total fish | Total reef teleosts | Total cartilaginous fish | Total pelagic & sand dwelling species | *Pachymetopon blochii* | *Chirodactylus brachydactylus* | *Dichistius capensis* | *Boopsoidea inornata* | *Parascorpis typus* | *Diplodus sargus capensis* | *Spondyliosoma emarginatum* | *Sarpa salpa* | *Seriola lalandi* | *Trachurus sp.* | *Liza richrdsonii* | *Haploblepharus pictus* | *Triakis megalopterus* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Karbonkelberg Sanctuary Zone (PROPOSED PROTECTED ZONE) | | | | | | | | | | | | | | | | | | | | |
| 10 | 0-8 | All | 3840 | 15.4 | 15.4 | 0 | 0 | 15.4 | 0.02 | 0 | 0 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | >8-15 | All | 3830 | 10.3 | 10.3 | 0 | 0 | 10.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | >15-25 | All | 3485 | 2.6 | 2.6 | 0 | 0 | 2.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **10** | **All** | **All** | **11155** | **10.4** | **10.4** | **0** | **0** | **10.4** | **0.01** | **0** | **0** | **0.01** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Karbonkelberg Sanctuary Zone to Cape Town harbour (EXPLOITED ZONE) | | | | | | | | | | | | | | | | | | | | |
| 11 | 0-8 | All | 2860 | 16.8 | 16.8 | 0 | 0 | 16.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | >8-15 | All | 3571 | 11.1 | 11.1 | 0.02 | 0 | 10.8 | 0 | 0 | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0 |
| 11 | >15-25 | 10/11 | 2364 | 8.5 | 8.5 | 0 | 0 | 8.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **11** | **All** | **All** | **8795** | **12.6** | **12.6** | **0.01** | **0** | **12.5** | **0** | **0** | **0.1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0.01** | **0** |

Table 3. Break-down of the number of counts completed on different category reef (with and without caves) within the different Sanctuary Zones along the east coast of the Cape Peninsula coastline (Figure 1)

Kalk Bay Sanctuary Zone

| | Reef elevation (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 – 1 | | >1 - 3 | | >3 - 5 | | >5 - 8 | |
| Depth (m) | None | Large | None | Large | None | Large | None | Large |
| 0 - 8 | 8 | 2 | 2 | 2 | - | 1 | - | - |
| >8 – 15 | 2 | - | - | - | - | - | - | - |
| >15 - 25 | - | - | - | - | - | - | - | - |

Glencairn Sanctuary Zone

| | Reef elevation (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 – 1 | | >1 - 3 | | >3 - 5 | | >5 - 8 | |
| Depth (m) | None | Large | None | Large | None | Large | None | Large |
| 0 - 8 | 18 | - | 10 | 5 | - | - | - | - |
| >8 – 15 | 15 | - | 1 | 5 | - | 1 | - | - |
| >15 - 25 | - | - | - | - | - | - | - | - |

Boulders Sanctuary Zone

| | Reef elevation (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 – 1 | | >1 - 3 | | >3 – 5 | | >5 - 8 | |
| Depth (m) | None | Large | None | Large | None | Large | None | Large |
| 0 - 8 | 21 | - | 21 | 10 | 3 | 5 | 1 | 5 |
| >8 – 15 | 7 | - | 13 | - | 2 | 6 | 1 | 6 |
| >15 - 25 | - | - | - | - | - | - | - | - |

Castle Rocks Sanctuary Zone

| | Reef elevation (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 – 1 | | >1 - 3 | | >3 - 5 | | >5 – 8 | |
| Depth (m) | None | Large | None | Large | None | Large | None | Large |
| 0 - 8 | 7 | - | 18 | 18 | 3 | 16 | - | 6 |
| >8 – 15 | 2 | - | 12 | 17 | 2 | 22 | 3 | 7 |
| >15 - 25 | 3 | - | 20 | 3 | 6 | 5 | 2 | 1 |

Paulsberg Sanctuary Zone

| | Reef elevation (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 – 1 | | >1 - 3 | | >3 - 5 | | >5 – 8 | |
| Depth (m) | None | Large | None | Large | None | Large | None | Large |
| 0 - 8 | 34 | 3 | 22 | 9 | - | - | - | - |
| >8 – 15 | 24 | 3 | 26 | 12 | 1 | 2 | - | - |
| >15 - 25 | 31 | 2 | 12 | 2 | 1 | 1 | - | - |

This is because the reefs located off the Cape Peninsula coastline differ among sites. This is the case with respect to the depth range at which reefs are present, the range of vertical elevation present on reefs, and the availability of large caves. No reef was located deeper than 15 m within the Kalk Bay Sanctuary Zone, Glencairn Sanctuary Zone and Boulders Sanctuary Zone (Table 3). Along the East Coast of the Peninsula, a greater range of vertical elevation was noted within the Castle Rocks and Boulders Sanctuary Zone (Table 3), whereas the proposed Karbonkelberg Sanctuary Zone had the greatest vertical elevation range along the Peninsula's west coast (Table 4). Along the east coast of the Peninsula, large caves were noted most regularly within the Castle Rocks, Simonstown and Paulsberg Sanctuary Zone (Table 3). Large caves were not regularly noted along the west coast of the Peninsula, but were most abundant within the proposed Karbonkelberg Sanctuary Zone (Table 4).

Table 4. Break-down of the number of counts completed on different category reef (with and without caves) within the different Sanctuary Zones along the west coast of the Cape Peninsula coastline (Figure 1)

Cape of Good Hope Sanctuary Zone

| | Reef elevation (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 – 1 | | >1 - 3 | | >3 - 5 | | >5 – 8 | |
| Depth (m) | None | Large | None | Large | None | Large | None | Large |
| 0 - 8 | 58 | - | 9 | 1 | - | - | - | - |
| >8 – 15 | 52 | 1 | 4 | 2 | - | - | - | - |
| >15 - 25 | 50 | 2 | 13 | - | - | - | - | - |

Karbonkelberg Sanctuary Zone

| | Reef elevation (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 – 1 | | >1 - 3 | | >3 - 5 | | >5 – 8 | |
| Depth (m) | None | Large | None | Large | None | Large | None | Large |
| 0 - 8 | 36 | 11 | 12 | 7 | 4 | - | - | - |
| >8 – 15 | 22 | 6 | 22 | 14 | 4 | 3 | 1 | - |
| >15 - 25 | 33 | 7 | 16 | 12 | 4 | 1 | - | - |

## 3. IMPORTANCE OF HABITAT TYPE INFORMATION

The information collected concerning the type of reef architecture present within the different sanctuary zones can be used to rate these areas with respect to the type of environment they provide to marine species. More importantly, however, if we understand which reef parameters affect the spatial distribution of the species that we hope will derive benefit from the MPA in question, one can be more exact in rating MPAs with respect to its benefits they provide to the species in question. To be able to do this, though, one needs to understand which reef parameters affect the spatial distribution of the species in question. Little is known about which physical parameters affect the spatial distribution of False Bay reef fish species, although Lechanteur (2000) suggests that depth, reef elevation and proximity of caves are important factors. This is supported by South African spearfishing (van Rooyen 1988) and angling (Schoeman & Schoeman 1990; Crous 1994) guides, along with published studies undertaken on the East coast of South Africa (Buxton & Smale 1989; Mann & Buxton 1993). The importance of each factor is discussed below.

### 3.1 Depth

Depth influences the spatial distribution of reef fish species (van Rooyen 1988; Buxton & Smale 1989; Shpigel & Fishelson 1989; Schoeman & Schoeman 1990; Crous 1994). This may be related to a number of factors, including turbulence due to wave action, favoured prey distribution, water temperature, the presence of competitors, and light intensity (Bell 1983; Buxton & Smale 1989; Mann & Buxton 1993). The importance of depth in affecting the conservation potential of a site is highlighted by Lechanteur (2000), who concludes that for a False Bay site to have maximal reef fish species diversity and abundance, it must encompass reefs at all depths.

### 3.2 Vertical reef elevation

The significance of vertical relief to reef fishes has been demonstrated by several authors (*e.g.* Buxton & Smale 1989; Crous 1994; Gascon & Miller 1982; Thresher 1983; van Rooyen 1988; Shpigel & Fishelson 1989; West, Buckley & Doty 1994). Pinnacles and blinders become important aggregating sites for reef fishes when water temperature decreases sharply at a site (van Rooyen 1988; Buxton & Smale 1989). Vertical reef elevation is also an important factor determining reef quality within False Bay, as it affects the spatial distribution of numerous species. This is especially apparent in the case of *Pachymetopon blochii* and *Boopsoidea inornata*, two species common on both flat and high relief reefs in warm water, but that aggregate around high pinnacles/blinders when water temperature drops to ≤13 °C.

### 3.3 The availability of large caves

Cover, in the form of caves and crevices is an important resource for fishes (Jones 1984; Lewis & Wainwright 1985; Shulman 1985; Caley & St John 1996). Indeed, the presence and sizes of holes are important factors affecting the composition of reef fish assemblages (Gascon & Miller 1982, Buxton & Smale 1989, and Mann & Buxton 1993). Within False Bay, Lechanteur (2000) reports that species densities and reef teleosts densities are maximal on reefs with large caves present. Caley & St John (1996) report similar findings on coral reefs. It is likely that greater species and densities of reef teleosts are present on reefs containing large caves as such reefs provide the reef requirements of both species that do and do not require large caves.

Each of these physical factors alone may affect the spatial distribution of individual fish species, but as is reported by Gascon & Miller (1982), Lewis & Wainwright (1985), and Roberts (1996), the density and/or composition of reef fish assemblages may also be affected by a combination of physical factors. This is the case for a number of South African linefish species, these being characteristic of reefs with different combinations of reef elevation, depth and/or cover (van Rooyen 1988, Schoeman & Schoeman 1990). Such factors thus need to be taken into account when deciding where to establish future marine reserves (Rowley 1994). This is supported by the findings of Lechanteur (2000), who compared the protected reef fish assemblages inhabiting two separate protected areas that encompass different reef architecture along the west coast of False Bay. Based on overall species numbers, species richness, fish densities (reef teleosts or individual species) and fish size structure, a fish assemblage inhabiting structurally more complex reef is superior in quality (*i.e.* larger individuals and greater diversity) to that inhabiting flatter reef. He concludes that physical reef characteristics such as vertical elevation and/or presence of large caves are important factors that need to be considered when investigating where to establish marine reserves in the hope of conserving reef-dependent fishes. Only by establishing a marine reserve within an area capable of providing all the reef requirements of the species it is aimed to conserve will it be beneficial to them (Hockey & Branch 1994; Rowley 1994).

# 4. SPATIAL DISTRIBUTION OF REEF FISH SPECIES WITH RESPECT TO PHYSICAL REEF PARAMETERS

A total of 4 678 fish from 13 species were counted along the west coast of the Cape Peninsula compared to 14 132 fish from 34 species counted along the Peninsula's east coast. *Pachymetopon blochii* dominates fish numbers along the west coast of the Peninsula, making up over 84.3 % of the fish encountered along that section of coast. It also dominates fish numbers along the Peninsula's east coast (56.9%), albeit to a lesser extent as species like *Sarpa salpa* (12.1%), *Chrysoblephus laticeps* (4.5%), *Boopsoidea inornata* (4.3%), *Chirodactylus brachydactylus* (7.6%) and *Dichistius capensis* (2.5%) are also abundant there (Table 5).

The fish count data obtained was used to analyse whether the abundance of individual species or groups of species are related to depth, vertical reef elevation or the presence of large caves, off both sides of the Peninsula. The data were first categorized into west coast and east coast sections, being sorted according to whether they were obtained from within Marine Protected Areas or from exploited areas. To investigate the effect of depth on the assemblages, these groups of counts were sorted within three depth ranges (0 – 8m, >8 – 15 m, >15 – 25m) irrespective of vertical reef elevation or available cave sizes. When investigating the effect of reef elevation, counts were still first categorized by depth before being grouped (irrespective of available cave sizes) within reef elevation categories (0 – 1m, >1 – 3m, >3 – 5m, >5 – 8m). When investigating the effect of the availability of different sized caves, the same sorting process was employed as for reef elevation, except that the final sorting was according to available cave size, irrespective of reef elevation. The two cave size categories used are:

None – No or only small (shallow with only one entrance/exit) cave(s) available
Large - At least one large (deep with more than one entrance/exit) present

Table 5. Numerical composition of the fish assemblages encountered off the west and east coast of the Cape Peninsula. Note: only reef dependent species of which more than 20 individuals were counted are listed

| Species | Common name | West Coast | East Coast |
|---|---|---|---|
| **Demersal teleost species** | | | |
| **Sparidae** | | | |
| *Boopsoidea inornata* | Fransmadam | P | 605 |
| *Chrysoblephus laticeps* | Red Roman | - | 643 |
| *Diplodus cervinus hottentotus* | Wildeperd / Zebra | - | 102 |
| *Diplodus sargus capensus* | Blacktail / Dassie | p | 90 |
| *Gymnocrotaphus curvidens* | John Brown | - | 116 |
| *Pachymetopon aeneum* | Blue Hottentot | - | 114 |
| *Pachymetopon blochii* | Cape Hottentot | 3 942 | 8 038 |
| *Sarpa salpa* | Strepie | 200 | 1 704 |
| *Spondyliosoma emarginatum* | Steentjie | p | 261 |
| **Cheilodactylidae** | | | |
| *Cheilodactylus fasciatus* | Redfinger/ Steenklip | - | 210 |
| *Chirodactylus brachydactylus* | Butterfish | p | 1 067 |
| **Corocinidae** | | | |
| *Dichistius capensis* | Galjoen | 185 | 355 |
| **Parascorpidae** | | | |
| *Parascorpis typus* | Milkfish | p | 178 |
| **Demersal cartilaginous species** | | | |
| **Scyliorhinidae** | Puffadder Shyshark | - | 68 |
| *Haploblepharus edwardsii* | | | |
| **Overall totals** | | 8 | 22 |
| Reef teleost species | | 2 | 6 |
| Cartilaginous species | | 13 | 34 |
| Total number of species | | | |

P – Species counted, but fewer than 21 individuals seen

To reduce the variation in abundance that would have resulted due to the small surface areas covered by individual counts, fish counts within each depth/vertical reef elevation/cave size categories were grouped so that the total reef surface area covered by a group totalled 200–300 $m^2$. The information from each group was converted into numbers/100$m^2$. Because counts were obtained randomly throughout the different sites, equal numbers of replicate groups were not obtained for all the depth, vertical elevation, and cave size categories. The Mann-Whitney U test was thus employed to compare densities between reefs with different sized caves, whereas the Kruskall-Wallis test was employed to compare densities obtained from reefs found at different depths or providing different vertical elevations, as a comparison of more than two sets of density estimates was sometimes necessary (Zar 1984).

## 4.1 Depth

<u>West Coast</u>

The abundances of all fish and all reef teleosts combined, as well as those of *Pachymetopon blochii* and *Dichistius capensis* considered separately, were greatest within the 0 – 8m stratum and minimal within the 15 – 25m stratum (Table 6), none of these trends were significant ($p > 0.05$). Although this points to depth not being an overwhelming factor affecting fish assemblages along the Peninsula's west coast, it must be remembered that the counts analysed were only obtained in water warmer than 12 °C, at which time fish are visible on west coast reefs at all depths (pers. obs.). When the water is 12 °C or colder, west coast reefs appear devoid of fish life. It is not known where the fish go, but it is likely that at such times, west coast reef fish retreat to deeper waters. This needs further investigation.

Table 6. Variations in abundances (and standard deviation) of all reef teleosts combined, *Pachymetopon blochii* and *Dichistius capensis* within different depth strata along the west coast of the Cape Peninsula. Note: none of the differences are significant

| | | Depth strata | | |
|---|---|---|---|---|
| Location | Species | 0 – 8 m | >8 – 15 m | >15 – 25 m |
| Outside current Sanctuary Zones | All reef teleosts combined | 17.34 (16.66) | 10.86 (98.66) | 5.19 (45.13) |
| Within current Sanctuary Zones | *Pachymetopon blochii* | 14.06 (14.15) | 10.76 (98.66) | 5.19 (45.13) |
| | *Dichistius capensis* | 1.46 (6.48) | 0 | 0 |

False Bay

The abundance of numerous reef fish species, some of which are exploited by the False Bay linefishery, is significantly related to depth. Some of these species (*e.g. Dichistius capensis*, *Diplodus sargus* and *Chirodactylus brachydactylus*) are more abundant within the 0-8m and / or >8-15m stratum, whereas others such as *Chrysoblephus laticeps* are most abundant within the deepest stratum. Others (*e.g. Pachymetopon* blochii, *Boopsoidea inornata*) are most abundant within the intermediate depth (>8 – 15m) stratum (Table 7). This highlights the fact that for a False Bay site to house maximal number of reef fish species and individuals, it must encompass reef at all depths.

Table 7. Variations in abundances (and standard deviation) of species groups and individual species within different depth strata along the east coast of the Cape Peninsula. Note: only results for species groups or individual species that showed significant differences in abundances are presented

| | | Depth strata | | |
|---|---|---|---|---|
| Location | Species | 0 – 8m | >8 – 15m | >15 – 25m |
| Within current Sanctuary Zones | All cartilaginous species comb. | 0.21 (0.29) | 0.53 (0.50) | 0 |
| | *Boopsoidea inornata* | 0.32 (0.70) | 4.31 (5.13) | 0.12 (0.23) |
| | *Chrysoblephus laticeps* | 2.50 (1.83) | 7.06 (4.20) | 5.45 (3.49) |
| | *Pachymetopon blochii* | 22.16 (14.00) | 22.16 (19.01) | 4.87 (2.37) |
| | *Chirodactylus brachydactylus* | 4.9 (2.60) | 5.53 (2.90) | 1.04 (0.68) |
| | *Haploblepharusedwardsii* | 0.12 (0.24) | 0.43 (0.49) | 0 |
| Outside current Sanctuary Zones | All reef teleosts combined | 29.12 (22.42) | 28.42 (31.34) | 19.79 (27.97) |
| | All cartilaginous species comb. | 0.3 (0.44) | 0.12 (0.22) | 0.15 (0.32) |
| | *Boopsoidea inornata* | 0.91 (2.5) | 2.09 (4.16) | 0.16 (0.44) |
| | *Chrysoblephus laticeps* | 0.20 (0.40) | 0.85 (1.00) | 0.82 (1.16) |
| | *Spondyliosoma emarginatum* | 0.04 (0.19) | 1.03 (2.63) | 1.11 (2.13) |
| | *Chirodactylus brachydactylus* | 2.51 (2.66) | 1.78 (1.83) | 0.46 (2.79) |
| | *Dichistius capensis* | 0.86 (1.90) | 0.49 (1.34) | 0.17 (0.67) |
| | *Diplodus sargus capensis* | 0.21 (0.60) | 0.11 (0.62) | 0.01 (0.07) |
| | *Haploblepharus edwardsii* | 0.25 (0.44) | 0.07 (0.19) | 0.01 (0.07) |

## 4.2 Vertical reef elevation

West Coast

No significant correlation between the abundances of individual species or groups of species and vertical reef elevation were found. However, the abundances of all fishes combined, all reef teleosts combined, and *Pachymetopon blochii* are all positively related to vertical reef elevation, highlighting the importance of this reef characteristic along the west coast of the Cape Peninsula (Table 8).

Table 8. Variation in the abundances (and standard deviation) of all reef teleosts combined and *Pachymetopon blochii* on west coast reefs with different vertical reef elevation. Note: none of the differences are significant. Insufficient counts were obtained from reef with vertical elevation in excess of 1 m within the >15 – 25 m stratum

| | | Vertical reef elevation | | |
|---|---|---|---|---|
| Depth stratum | Species | 0 – 1 m | >1 – 3 m | >3 – 5 m |
| 0 – 8 m | All reef teleosts comb. | 13.13 (20.97) | 24.21 (21.43) | 32.25 (17.67) |
| | *Pachymetopon blochii* | 9.32 (11.63) | 17.50 (18.86) | 32.25 (17.67) |
| >8 – 15 m | All reef teleosts comb. | 6.14 (8.38) | 11.20 (22.00) | 23.30 (16.35) |
| | *Pachymetopon blochii* | 6.14 (8.38) | 10.99 (21.80) | 23.30 (16.35) |

False Bay

The abundances of a number of species, including some that are important to the False Bay linefishery (*e.g. Chrysoblephus laticeps*, *Pachymetopon blochii*, *Gymnocrotaphus curvidens*, *Chirodactylus brachydactylus*, *Dichistius capensis*, *Diplodus sargus capensis*), are significantly positively related to vertical reef elevation within False Bay (Table 9). This results in the abundances of all fishes combined and all reef teleosts combined also being significantly positively related to vertical reef elevation within certain depth strata. These abundances increase sharply on reefs with elevation in excess of 3 m (Table 9). This highlights the fact, along the Peninsula's eastern shore, the presence of high rising pinnacles / blinders at a site increases the number of fish species and individuals present there.

Table 9. Variation in the abundances (and standard deviation) of a number of individual species on east coast reefs with different vertical reef elevation. Note: only species whose abundances differed significantly among reef with different elevation are presented

| Depth stratum | Species | 0 – 1 | >1 - 3 | >3 - 5 | >5 - 8 | >8 - 12 |
|---|---|---|---|---|---|---|
| 0–8 m Outside | *Boopsoidea inornata* | 0.43 (1.6) | 0.63 (1.8) | 3.91 (6.4) | 6.92 (7.6) | - |
| | *Cheilodactylus fasciatus* | 0.09 (0.2) | 0.3 (0.5) | 0.65 (0.4) | 2.27 (1.8) | - |
| | *Gymnocrotaphus curvidens* | 0.04 (0.2) | 0 | 0 | 0.25 (0.4) | - |
| 0–8 m within | *Chrysoblephus laticeps* | 0.97 (1.0) | 2.3 (1.5) | 5.11 (1.6) | - | - |
| | *Pachymetopon blochii* | 5.70 (3.6) | 22 (11.6) | 47.01(13.7) | - | - |
| | *Chirodactylus brachydactylus* | 1.85 (1.8) | 5.78 (3.0) | 5.75 (1.7) | - | - |
| | *Gymnocrotaphus curvidens* | 0 | 0.82 (1.0) | 2.36 (1.0) | - | - |
| | *Dichistius capensis* | 0.09 (0.2) | 1.67 (2.2) | 4.53 (1.8) | - | - |
| >8–15 Outside | *Pachymetopon blochii* | 13.02(17.9) | 17.1(19.4) | 40.10(26.1) | 28.39(15.8) | 20.18(0.8) |
| | *Boopsoidea inornata* | 1.76 (5.4) | 1.36 (2.7) | 6.32 (8.7) | 4.44 (1.5) | 5.42 (0.5) |
| | *Cheilodactylus fasciatus* | 0.12 (0.3) | 0.38 (0.7) | 1.39 (1.7) | 1.66 (1.7) | 1.38 (1.3) |
| | *Chirodactylus brachydactylus* | 0.86 (1.1) | 1.98 (1.6) | 3.93 (2.4) | 4.84 (0.5) | 3.73 (0.7) |
| | *Dichistius capensis* | 0.12 (0.35) | 0.31 (1.1) | 3.16 (4.5) | 1.61 (2.4) | 1.46 (0.1) |
| | *Diplodus sargus capensis* | 0 | 0.02 (0.1) | 1.96 (3.4) | 0 | 0.46 (0.7) |
| | *Diplodus cervinus hottentotus* | 0 | 0.55 (1.3) | 0.77 (0.7) | 1.50 (0.3) | 0.58 (0.8) |
| >8-15 within | *Pachymetopon blochii* | 3.72 (3.8) | 15.78(6.2) | 28.80(11.2) | 48.93(17.0) | - |
| | *Chirodactylus brachydactylus* | 0.71 (1.0) | 5.22 (1.6) | 5.91 (2.5) | 10.02 (1.1) | - |
| | *Gymnocrotaphus curvidens* | 0 | 0.49 (0.6) | 1.84 (1.9) | 2.67 (0.7) | - |
| | *Dichistius capensis* | 0 | 0.56 (0.7) | 3.46 (4.42) | 4.27 (1.3) | - |
| >15-25 Outside | *Chrysoblephus laticeps* | 0.50 (0.7) | 0.76 (0.9) | 1.86 (0.9) | - | - |
| | *Cheilodactylus fasciatus* | 0.23 (0.3) | 0.09 (0.4) | 1.9 (1.4) | - | - |

Outside – Outside current Sanctuary Zones
Within – Within current Sanctuary Zones

## 4.3 Availability of large caves

West Coast

The abundance of *Pachymetopon blochii* was positively related to the availability of large caves on west coast reefs, but this was not statistically significant. Similarly, although following the same trend as that of *P. blochii*, the abundance of neither all fish combined nor all reef teleosts combined was significantly related to the availability of large caves along the west coast.

False Bay

The abundance of a number of reef fish species, some of which are important to the False Bay linefishery (*e.g. Chrysoblephus laticeps*, *Pachymetopon blochii*, *Chirodactylus brachydactylus*fish, *Gymnocrotaphus curvidens*, *Dichistius capensis* and *Diplodus sargus capensis*), was significantly greater ($p < 0.05$) on reefs with large caves compared to on reefs with no caves (Table 10). The abundance of all fishes combined and all reef teleosts combined followed the same trend, although it was not significant within all depth strata or areas. No species' was significantly more abundant on reef with no caves than on reef with large cave. These results highlight the fact that along the east coast of the Cape Peninsula, the presence of large caves on reefs is an important physical reef characteristic affecting the fish assemblage inhabiting it.

Table 10. Variations in the abundances (and standard deviation) of a number of individual species on east coast reefs with and without large caves. Note: only species whose abundances differed significantly among reef with and without large caves are presented

| | | Depth strata (m) | | | | | |
|---|---|---|---|---|---|---|---|
| Site location | Species | 0 - 8 | | >8 - 15 | | >15 - 25 | |
| | | Large | No cave | Large | No cave | Large | No cave |
| Outside current Sanctuary Zones | *C. laticeps* | 0.6 (0.8) | 0.1 (0.2) | 1.9 (1.4) | 0.5 (0.7) | 2.2 (1.0) | 0.8 (0.9) |
| | *B. inornata* | 2.9 (4.3) | 0.4 (1.8) | 3.7 (4.1) | 1.5 (4.2) | - | - |
| | *C. fasciatus* | 1.0 (1.0) | 0.1 (0.3) | 1.2 (1.4) | 0.2 (0.3) | 1.2 (1.5) | 0.4 (0.7) |
| | *C. brachydactylus* | 3.2 (1.9) | 2.3 (3.1) | 4.0 (2.6) | 1.1 (1.0) | 1.0 (0.6) | 0.5 (0.7) |
| | *G. curvidens* | - | - | 0.4 (0.7) | 0.01(0.1) | - | - |
| | *D. capensis* | - | - | 1.4 (2.7) | 0.2 (0.4) | - | - |
| | *D. cervinus (hott)* | - | - | 0.7 (1.2) | 0.1 (0.7) | - | - |
| Within current Sanctuary Zones | *C. laticeps* | 4.0 (2.0) | 1.2 (1.0) | 8.6 (3.7) | 4.8 (3.5) | | |
| | *P. blochii* | 34.1(18.2) | 12.6 (9.7) | - | - | | |
| | *B. inornata* | - | - | 6.7 (5.5) | 0.7 (1.3) | | |
| | *C. fasciatus* | 1.4 (1.1) | 0.5 (0.6) | - | - | | |
| | *C. brachydactylus* | 6.9 (2.8) | 3.2 (2.4) | - | - | | |
| | *G. curvidens* | 2.2 (1.6) | 0.04 (0.1) | 1.7 (1.6) | 0.1 (0.2) | | |
| | *D. capensis* | 3.3 (2.5) | 0.3 (0.5) | 2.9 (3.2) | - | | |
| | *D. sargus (capen)* | 1.6 (2.3) | 0.2 (0.5) | - | - | | |
| | *P. typus* | 1.7 (0.9) | 0.3 (0.6) | - | - | | |

It must be borne in mind when interpreting these results, that fish counts were only undertaken when the water temperature on the bottom was warm (>13°C within False Bay,

>12°C along the West Coast). Observations by the divers involved in the study suggest that the trends discussed above are enhanced under cooler conditions on both sides of the Peninsula.

The above analyses of the fish counts provided insight into the relative importance of the different physical reef characteristics affecting the composition of fish assemblages at different sites along the Peninsula. Important results include:

1. The fish assemblage present along the west coast of the Cape Peninsula is considerably less diverse than that present along the Peninsula's east coast.
2. Along the Peninsula's west coast, the abundance of individual species or groups of species is not significantly related to depth, vertical reef elevation or availability of large caves, although abundances do vary among these physical reef characteristics.
3. The abundance of most of the reef fish species important to the False Bay linefishery are significantly positively related to at least one of the following physical reef characteristics: depth, vertical reef elevation and availability of large caves.

These results point to the fact that the spatial distribution of fish species is not random along the Cape Peninsula. Indeed, the results highlight that based on the type of reef present at a site, one can predict the type of fish assemblage that should be present there. More importantly, the results point to the fact that, based on the findings discussed above, one should be able to rate a particular site's linefish conservation potential simply by investigating the physical characteristics (depth range, vertical reef elevation profile, availability of large caves) of the reef present there. Gathering such information from the same sites counted during this study, and / or additional sites would certainly be cheaper than obtaining both that and fish count data from these. Furthermore, the additional physical reef characteristics data obtained from each site would provide a more representative coverage of the reef structure present at each site than was obtained during this study, increasing the accuracy of its reef fish conservation potential rating. However, should additional fish counts also be undertaken at the same and / or new sites in the future, as part of a comparative study, those counts can be added to the present ones to provide a greater coverage of reefs.

## SECTION III

## 1. IMPORTANCE OF MARINE RESERVES

The rapidly increasing density of humanity in coastal areas (Davis 1981) and the resultant increase in the intensity of human pressures on marine systems has increased the need for marine conservation (Allison *et al*. 1998). In recent years, the importance of marine reserves to the success of conservation efforts has become widely recognised and promoted (Roberts and Polunin 1993; Polunin and Roberts 1993; Agardy 1994; Halpern in press). In particular, they are important for the management of exploited species because human harvesting often pushes targeted species below the level at which a natural predator would shift its focus to other prey (Davis 1981), and because other management methods have frequently failed (Bohnsack 1998). Reserve areas can play pivotal roles in the recovery of over-exploited stocks and sustain fishery yields (Polunin *et al*. 1983). They may also provide a source of recruitment to fished-out areas through long-shore migration of adults (Alcala and Russ 1990; Man *et al*. 1995). Furthermore, since reserves tend to contain individuals at both a higher density and of a larger mean size than adjacent exploited areas, recruitment elsewhere can be enhanced by the export of eggs or larvae (Bohnsack 1994; Man *et al*. 1995). An additional advantage of Marine Protected Areas (MPAs) is that they can be used to measure population parameters that cannot be obtained from exploited areas (Hockey and Branch 1994).

## 2. STATUS OF THE RESOURCES

Linefishing effort is high along the Cape Peninsula coastline, and includes both recreational fishers (shore-based and recreational boat-based anglers, and spearfishers) and commercial boat-based anglers. A number of reef fish species are targeted by these linefishers, and in many cases more than one sector targets the same species, which complicates the management of these resources considerably (Lechanteur 2000). The size composition and tonnage taken of each of the exploited species landed by the linefishery along the Cape Peninsula is unknown and difficult to estimate. However, the total take of some of the species regularly targeted by more than one linefishery sector (*e.g. Pachymetopon blochii*, *Chrysoblephus laticeps*) is likely considerable (Lechanteur 2000). Indeed, the stock status of the majority of the reef fish species exploited along the Cape Peninsula coastline is not positive, many species showing a sharp decrease in catch-per-unit-effort (CPUE) and / or mean catches (Attwood 2000, Griffiths 1999). This has resulted in smaller less attractive species (*e.g. Diplodus sargus capensis*, *Spondyliosoma emarginatum*, *Boopsoidea inornata*) becoming increasingly targeted in the region. This all points to the stocks of reef fish resources found off the Southern and Western Cape coast being in need of adequate management.

## 3. DISTRIBUTION OF RESOURCES ON THE CAPE PENINSULA

The use of MPAs has increased in popularity among fishery managers worldwide, including South Africa. However, as found locally (Lechanteur 2000), establishing an MPA without taking into cognisance the habitat requirements of the species that are hoped to benefit from it results in the MPA failing to achieve its goal. One thus needs to know the whereabouts of the species in question, and understand their habitat requirement, before one can investigate where to establish the MPA. This section reports on the composition of fish assemblages noted at the different sites along the Cape Peninsula coastline. Based on the comparison of the fish assemblages encountered within the different proposed and/or existing MPAs, and the remaining exploited areas, the reef fish conservation potential of each MPA is also discussed.

Results obtained from the Peninsula's east and west coasts are presented separately below.

### 3.1 West Coast

Two MPAs are proposed along the west coast of the Cape Peninsula, namely the Cape of Good Hope Sanctuary Zone (already existing) and the proposed Karbonkelberg Sanctuary Zone (Figure 2). To investigate and compare the conservation potential of the two different MPA categories (existing versus proposed), the fish abundance data obtained from each sites were pooled into one, and each site then categorized into the following groups:

1. Existing MPA – All sites located within any of the presently existing MPAs
2. Proposed MPA – All sites located within any proposed MPAs (including sites within an existing MPA that is proposed to remain as an MPA
3. Existing exploited areas - All sites not located within existing MPAs (including those located within proposed MPAs)
4. Proposed exploited sites - All sites not located within proposed MPAs (including sites within existing MPAs that are not proposed to remain as such)

No significant difference in all fishes combined, all reef teleosts combined, *Pachymetopon blochii* or *Dichistius capensis* abundances were found between existing, proposed or exploited sites along the Peninsula's west coast, although all were maximal outside the existing and/or proposed MPAs (Table 11). Similarly, of the 1 258 *Pachymetopon blochii* individuals >30 cm total length (TL) counted along the west coast of the Cape Peninsula (66 of these >40 cm TL), only 124 (including only 1 >40 cm TL) were counted within the two MPAs proposed for that stretch of coast (Table 12). These comparisons of fish abundance and size distributions among present and/or proposed MPAs, and exploitable areas, suggest that the network of MPAs proposed for the western coast of the Cape Peninsula may not be optimally located with respect to reef fish conservation. To investigate and compare the reef fish conservation potential of each individual MPA, abundances and size distributions obtained within each MPA were compared among MPAs and the remaining exploitable sites.

Table 11. Abundances (and standard deviation) of all reef teleosts combined, and *Pachymetopon blochii* and *Dichistius capensis* within different stretches of coasts off the Peninsula's west coast. Note: none of the differences are significant

| Species | Within existing Sanctuary Zones | Within proposed Sanctuary Zones | Outside existing Sanctuary Zones | Outside proposed Sanctuary Zones |
|---|---|---|---|---|
| All reef teleosts comb. | 2.8 (3.09) | 6.97 (10.18) | 9.92 (11.08) | 9.81 (10.50) |
| *Pachymetopon blochii* | 2.8 (3.09) | 6.97 (10.18) | 9.59 (10.81) | 9.38 (10.10) |
| *Dichistius capensis* | 0 | 0 | 0.26 (1.07) | 0.36 (1.23) |

Table 12. Size distribution (cm total length) of the two most abundant reef fish species counted within and outside existing and proposed sanctuary zones along the west coast of the Cape Peninsula

| Sanctuary Zone / Stretch of coast | *Pachymetopon blochii* Number | 15 | 25 | 35 | 45 | *Dichistius capensis* Number | 25 | 35 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| **Sanctuary Zones** | | | | | | | | | |
| Cape of Good Hope | 149 | 33.6% | 53.0% | 8.1% | - | 0 | - | - | - |
| Karbonkelberg | 647 | 27.7% | 49.3% | 17.2% | 0.2% | 0 | - | - | - |
| **Within** | | | | | | | | | |
| Existing Sanct. Zone | 149 | 33.6% | 53.0% | 8.1% | - | 0 | - | - | - |
| All proposed S. Zones | 796 | 28.8% | 50.0% | 15.5% | 0.1% | 0 | - | - | - |
| **Outside** | | | | | | | | | |
| Outside existing S. Z. | 3 801 | 17.2% | 53.0% | 28.1% | 1.7% | 185 | 1.6% | 61.1% | 37.3% |
| Outside proposed S.Z. | 3 154 | 14.7% | 52.9% | 30.2% | 2.0% | 185 | 1.6% | 61.1% | 37.3% |

Cape of Good Hope Marine Reserve (existing and proposed)

Fish abundances (2.8 fish/100m$^2$) are low within the existing Cape of Good Hope Marine Reserve, compared to the other exploited west coast sites (10.59 fish/100m$^2$). Furthermore, only one species (*Pachymetopon blochii*) was encountered there, compared to 13 (most at extremely low densities though) at exploitable sites. Similarly, only 8% of the individuals counted there were >30 cm TL, compared to outside this MPA, where 29.8% of *Pachymetopon blochii* individuals counted were >30 cm TL (Table 12). The fact that *Pachymetopon blochii* and *Dichistius capensis* are more abundant and larger at exploited sites than within the existing Cape of Good Hope Marine Reserve (where linefishing is not permitted) points to this MPA having poor conservation potential with respect to these species. This may be linked to the fact that although reef is present there within all depth strata, it provides little vertical elevation (almost 85% of counts completed there recorded elevation less than 1 m, none recorded elevation in excess of 3 m), or large caves (only 3.1% of counts) (Table 4).

The apparent absence of *Dichistius capensis* within the Cape of Good Hope Marine Reserve may, however, also be explained by its elusiveness when in proximity of divers. The species is difficult to approach underwater (van Rooyen 1988), and thus difficult to observe in the poor visibility that is typical of the shallow water stratum within the Cape of Good Hope Marine Reserve. To verify the absence/presence of *Dichistius capensis* within the Cape of Good Hope Marine Reserve, one should compare the catch composition and CPUE of research shore-based anglers active within that MPA to that of fishers outside of its borders (but still along the west coast of the Peninsula). Such information should be obtainable at relatively short notice from researchers at Marine and Coastal Management. Based on the data collected during the present study, however, it appears as if this MPA is not be located optimally with respect to reef fish conservation.

Karbonkelberg Marine Reserve (proposed)

Although this is at present still an exploited stretch of coast, the abundances of *Pachymetopon blochii* within the Karbonkelberg Marine Reserve (5.91 fish/100 $m^2$) were more than double those within the existing Cape of Good Hope Marine Reserve. Also, 17.3% of the *Pachymetopon blochii* individuals counted within this proposed MPA were >30 cm TL (1 individual >40 cm TL) (Table 12). This may be linked to the more diverse reef architecture present there, since only 53.5% of the counts completed there recorded reef with less than 1 m elevation (7.9% recorded elevation >3-8 m), and 28.4% of counts recorded the presence of large caves (Table 4). These results point to this site having some conservation potential with respect to *Pachymetopon blochii*, although it offers no apparent conservation benefit for *Dichistius capensis*. The fact that the abundance of *Pachymetopon blochii* within this stretch of coast are lower than those obtained from all exploitable areas combined is explained by some of the sampled sites within the Karbonkelberg Marine Reserve having very low fish abundances compared to others. It is felt that the overall stretch of coast encompassed within the Karbonkelberg Marine Reserve should benefit reef fish conservation along the West Coast and should be retained as a Sanctuary Zone.

## 3.2 East Coast

Three presently existing (Kalk Bay Sanctuary Zone, Glencairn Sanctuary Zone and Castle Rocks Sanctuary Zone) and two additional proposed MPAs (Boulders Sanctuary Zone, Paulsberg Sanctuary Zone) are located along the Cape Peninsula's east coast (Figures 1 & 2). To investigate and compare the reef fish conservation potential of the two different MPA categories (existing versus proposed), the fish abundance data obtained from each sites were treated as were those from the Peninsula's west coast, resulting in the same four groups of sites (Existing MPA, Proposed MPA, Existing exploited areas, and Proposed exploited sites) being compared. The size distributions of a number of species encountered within each were also compared.

A number of groups of species, as well as individual reef fish species (including some of linefishery importance – *e.g. Chrysoblephus laticeps*, *Chirodactylus brachydactylus*fish, *Gymnocrotaphus curvidens* and *Diplodus sargus capensis*) were significantly more abundant within the existing MPAs than within proposed MPAs or on exploited reefs (Table 13).

Table 13. Abundances (and standard deviation) of group of species and individual species within different stretches of coasts off the Peninsula's east coast. Note: only species in bold differed significantly in abundance among sites

| Species group / species | Within existing Sanct. Zones | Within proposed sanctuary Zones | Outside existing Sanct. Zones | Out proposed Sanct. Zones |
|---|---|---|---|---|
| All reef teleosts combined | 39.22 (19.25) | 25.28 (20.27) | 21.72 (17.67) | 25.18 (18.59) |
| All cartilaginous fish comb. | 0.28 (0.22) | 0.22 (0.26) | 0.17 (0.23) | 0.17 (0.21) |
| *Pachymetopon blochii* | 18.05 (10.16) | 12.98 (10.03) | 14.18 (14.52) | 16.56 (16.21) |
| *Dichistius capensis* | 1.48 (1.24) | 0.86 (1.17) | 0.50 (0.75) | 0.56 (0.7) |
| ***Chrysoblephus laticeps*** | **4.72 (3.45)** | **2.40 (3.15)** | **0.45 (0.72)** | **0.4 (0.63)** |
| ***Pachymetopon aeneum*** | **1.05 (2.69)** | **0.47 (1.81)** | **0.01 (0.03)** | **0.01 (0.04)** |
| ***Chirodactylus brachydactylus*** | **4.63 (2.31)** | **2.63 (2.54)** | **1.58 (2.00)** | **1.83 (2.23)** |
| ***Gymnocrotaphus curvidens*** | **0.90 (0.84)** | **0.47 (0.68)** | **0.06 (0.14)** | **0.03 (0.09)** |
| ***Diplodus sargus capensis*** | **0.89 (1.94)** | **0.48 (1.31)** | **0.10 (0.21)** | **0.07 (0.20)** |
| ***Diplodus cervinus hottentotus*** | **0.31 (0.34)** | **0.24 (0.33)** | **0.15 (0.3)** | **0.14 (0.29)** |
| ***Cheilodactylus fasciatus*** | **1.03 (0.96)** | **0.62 (0.84)** | **0.30 (0.49)** | **0.3 (0.45)** |

Similarly, the size distribution of most of these species of linefishery importance comprised more larger individuals within the presently existing and proposed MPAs, than at exploited sites (Table 14). This is a positive result, as it points to the existing MPAs achieving some conservation success. However, in his comparison of the fish assemblages inhabiting two of the existing MPAs (Glencairn Marine Reserve and Castle Rocks Marine Reserve), Lechanteur (2000) found significant differences in the composition and abundance of species within the two MPAs. He concluded that the Castle Rocks Marine Reserve was more beneficial to reef fish and fishers than the Glencairn Marine Reserve, as it is inhabited by a more diverse and more abundant fish assemblage (including significantly more individuals of linefishery importance). With this in mind, the fish assemblages noted from the sites within each MPA were grouped and compared among MPAs and exploited areas, in an attempt to elucidate which of the proposed/existing MPAs had more reef fish conservation potential.

Table 14. The size distribution (cm total length) of reef teleosts (important to the False Bay linefishery) counted within and outside sanctuary zones along the east coast of the Cape Peninsula

| Stretch of coast | *Pachymetopon blochii* | | | | | *Chrysoblephus laticeps* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | 15 | 25 | 35 | 45 | No. | 15 | 25 | 35 | 45 | 55 |
| Castle Rocks S. Z. | 1651 | 30.2 | 49.4 | 15.3 | 5.0 | 398 | 6.0 | 41.5 | 35.2 | 17.1 | 0.3 |
| Kalk Bay S. Z. | 36 | 52.8 | 44.4 | - | 2.8 | 32 | 3.1 | 25 | 40.6 | 28.1 | 3.1 |
| Glencairn S. Z. | 175 | 53.1 | 45.7 | 0.6 | 0.6 | 9 | 33.3 | 33.3 | 33.3 | - | - |
| All existing S. Z. | 1862 | 32.8 | 49 | 13.6 | 4.6 | 439 | 6.4 | 40.1 | 35.5 | 17.5 | 0.5 |
| Boulders S. Z. | 730 | 37.9 | 47.9 | 14.0 | 0.1 | 31 | 9.7 | 67.7 | 22.6 | - | - |
| Paulsberg S. Z. | 545 | 243 | 296 | 6.0 | 0 | 33 | 15.0 | 13.0 | 4.0 | 1.0 | - |
| All proposed S. Z | 2962 | 1038 | 1478 | 361 | 85 | 494 | 43.0 | 207 | 164 | 78.0 | 2.0 |
| Outside existing S.Z. | 6446 | 37.5 | 54 | 8.3 | 0.2 | 204 | 19.6 | 51 | 27.5 | 2.0 | - |
| Outside proposed S.Z. | 5076 | 33.8 | 57.4 | 8.4 | 0.3 | 149 | 16.8 | 49 | 32.2 | 2.0 | - |

| Stretch of coast | *Chirodactylus brachydactylus* | | | | | *Gymnocrotaphus curvidens* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | 15 | 25 | 35 | 45 | No. | 15 | 25 | 35 | 45 | 55 |
| Castle Rocks S. Z. | 368 | 7.9 | 62.5 | 28.8 | 0.8 | 92 | 4.3 | 15.2 | 62.5 | 15.2 | - |
| Kalk Bay S. Z. | 29 | 20.7 | 75.9 | 3.4 | - | 1 | - | 100 | - | - | - |
| Glencairn S. Z. | 36 | 25.0 | 66.7 | 8.3 | - | 1 | - | - | - | 100. | - |
| All existing S. Z. | 433 | 10.2 | 63.7 | 25.4 | 0.7 | 94 | 4.3 | 16.0 | 63.8 | 16.0 | - |
| Boulders S. Z. | 101 | 16.8 | 70.3 | 12.9 | - | 5 | - | 40.0 | 60.0 | - | - |
| Paulsberg S. Z. | 72 | 20.8 | 56.9 | 20.8 | 1.4 | 7 | 57.1 | 28.6 | 14.3 | - | - |
| All proposed S. Z | 570 | 11.8 | 63.9 | 23.7 | 0.7 | 105 | 7.6 | 18.1 | 61.0 | 13.3 | - |
| Outside existing S.Z. | 634 | 11.7 | 68.8 | 19.4 | 0.2 | 22 | 22.7 | 27.3 | 27.3 | 22.7 | - |
| Outside proposed S.Z. | 497 | 10.3 | 70.0 | 19.7 | - | 11 | 9.1 | 18.2 | 18.2 | 54.5 | - |

| Stretch of coast | *Dichistius capensis* | | | | | *Diplodus sargus capensis* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | 15 | 25 | 35 | 45 | No. | 15 | 25 | 35 | 45 | 55 |
| Castle Rocks S. Z. | 145 | 3.4 | 8.3 | 58.6 | 29.7 | 20 | 5.0 | 55.0 | 40.0 | - | - |
| Kalk Bay S. Z. | 3 | - | - | 66.7 | 33.3 | 24 | - | 25.0 | 70.8 | 4.2 | - |
| Glencairn S. Z. | 4 | - | - | 50.0 | 50.0 | 0 | - | - | - | - | - |
| All existing S. Z. | 152 | 3.3 | 7.9 | 58.6 | 30.3 | 44 | 2.3 | 38.6 | 56.8 | 2.3 | - |
| Boulders S. Z. | 7 | - | - | 100 | - | 21 | 23.8 | 19.0 | 57.1 | - | - |
| Paulsberg S. Z. | 26 | - | - | 100 | - | 1 | 100 | - | - | - | - |
| All proposed S. Z | 181 | 2.8 | 6.6 | 66.3 | 24.3 | 66 | 10.6 | 31.8 | 56.1 | 1.5 | - |
| Outside existing S.Z. | 203 | - | 2.5 | 82.3 | 15.3 | 46 | 13.0 | 26.1 | 58.7 | 2.2 | - |
| Outside proposed S.Z. | 174 | - | 2.9 | 78.2 | 19.0 | 24 | - | 33.3 | 62.5 | 4.2 | - |

The Kalk Bay Sanctuary Zone (existing and proposed)

This is a small MPA within which little reef is present at depth exceeding 8 m (Table 3). The inshore reef, however, is inhabited by an abundant and relatively diverse fish assemblage (Table 15). In addition to this, the size distributions of *Chrysoblephus laticeps*, *Dichistius capensis* and *Diplodus sargus capensis* comprise a fair proportion of individuals >30 cm TL (Table 14). The fish diversity noted within this MPA, along with the relatively high fish abundances and preponderance of large individuals of linefishery importance, is linked to the diverse reef architecture encountered there, including vertical elevation exceeding 3 m, and large caves being recorded from 29.4 % of the counts undertaken (Table 3). The limited amount of reef present within this MPA (only 1 site could be dived there), especially in deeper depth strata, however, points to the Kalk Bay Sanctuary Zone having limited reef fish conservation potential. Similar to the findings of this study, the results of the study investigating the conservation potential of the Peninsula's MPA with respect to exploited invertebrates (Mayfield, Clark & Balarin 2001) suggested that the Kalk Bay Marine Reserve could be de-proclaimed, especially if there is a maximum limit to the number or size of the proposed Marine Protected Areas. It is thus felt that because it offers little conservation benefits to commercially exploited species, this MPA can be de-proclaimed.

Table 15. Abundances (and standard deviation) of groups of species and individual species that varied significantly within different stretches of coastline off the Peninsula's east coast

| Species group / species | Glencairn Sanctuary Zone | Boulders Sanctuary Zone. | Castle Rocks Sanct. Z. | Paulsberg Sanctuary Zone | Kalk Bay Sanctuar. Zone | Outside All Sanct. Zones. |
|---|---|---|---|---|---|---|
| All reef teleosts combined | 9.9 (4.7) | 19.6 (18.5) | 51.4 (5.2) | 10.3 (7.4) | 37.0 | 26.7(18.8) |
| *Pachymetopon blochii* | 5.5 (3.3) | 11.9 (10.7) | 25.0 (4.0) | 6.6 (5.7) | 8.5 | 17.7(16.6) |
| *Chrysoblephus laticeps* | 0.2 (0.1) | 0.7 (1.4) | 6.0 (2.6) | 0.4 (0.5) | 7.5 | 0.4 (0.7) |
| *Chirodactylus brachydact.* | 1.3 (0.2) | 1.6 (1.5) | 5.5 (1.2) | 0.8 (0.9) | 6.8 | 1.9 (2.3) |
| *Gymnocrotaphus curvidens* | 0.1 (0.1) | 0.1 (0.3) | 1.4 (0.7) | 0.1 (0.2) | 0.2 | 0.03(0.1) |
| *Dichistius capensis* | 0.2 (0.1) | 0.1 (0.1) | 2.2 (1.0) | 0.4 (1.0) | 0.7 | 0.6 (0.7) |
| *Cheilodactylus fasciatus* | 0.3 (0.2) | 0.6 (0.8) | 0.9 (0.5) | 0.2 (0.3) | 3.1 | 0.3 (0.5) |
| *Diplodus sargus capensis* | 0 | 0.3 (0.3) | 0.3 (0.3) | 0.01(0.03) | 5.6 | 0.1 (0.2) |
| *Diplodus cervinus hottent.* | 0.3 (0.2) | 0.1 (0.1) | 0.4 (0.4) | 0.3 (0.4) | 0 | 0.1 (0.3) |
| *Boopsoidea inornata* | 0 | 2.3 (3.1) | 2.9 (0.6) | 0 | 0.5 | 1.1 (2.3) |
| *Pachymetopon aeneum* | 0 | 0 | 1.7 (3.4) | 0 | 0 | 0.01(0.04) |

Glencairn Sanctuary Zone (existing but to be de-proclaimed)

The fish assemblage encountered within the Glencairn Sanctuary Zone reached an overall abundance of 18 fish/100 m$^2$. This is considerably less than the average density of fish at exploited sites along the Peninsula's east coast (27.79 fish/100m$^2$). Although the size distributions of the species encountered within this MPA comprised some large individuals, the overall low abundances obtained for all species concerned highlight the overall poor quality of the fish assemblage present within this area. This is linked to the limited reef architecture present there (Lechanteur 2000), with no reefs being present within the >15-25 m stratum, reefs being predominantly flat (60% of counts recorded elevation less than 1 m, 38.2% 3 m or less), and providing no large caves (80% of counts) (Table 3). These findings are similar to those of Lechanteur (2000), and highlight the poor reef fish conservation potential of the Glencairn Marine Reserve. These findings are similar to those of the study that investigated the conservation potential of the Peninsula's MPA with respect to exploited invertebrates (Mayfield, Clark & Balarin 2001), and support the proposed de-proclaiming of the Glencairn Marine Reserve.

Castle Rocks Sanctuary Zone (existing and proposed)

Significant differences in the abundance of all fishes combined, all reef teleosts combined, *Pachymetopon blochii*, *Chrysoblephus laticeps*, *Chirodactylus brachydactylus*, *Gymnocrotaphus curvidens*, *Dichistius capensis*, *Diplodus cervinus hottentotus*, *Diplodus sargus capensis* and *Cheilodactylus fasciatus* were found among the MPAs and exploited areas. In all these cases (except for *Diplodus sargus capensis*), abundances were maximal within the Castle Rocks Sanctuary Zone (Table 15). Furthermore, the size distributions of the majority of these species comprised a high proportion of individuals >30 cm TL within this MPA. This is especially the case for *Chrysoblephus laticeps*, *Pachymetopon blochii*, *Gymnocrotaphus curvidens*, *Chirodactylus brachydactylus*fish and *Dichistius capensis*, where the number of individuals >30 cm TL counted within this 3.25 km long MPA comprised between 37.8 and 86% of the total number of such individuals counted along the whole of the Peninsula's east coast (Table 14). This is very important, as the majority of these species are important to the False Bay linefishery, and thus need to be managed carefully. The high abundances, diversity and proportions of individuals >30 cm TL obtained within this MPA are linked to the diverse reef architecture present, including reef present within all depth strata (93.1% of counts undertaken), much vertical elevation exceeding 1 m (42,2 % exceeding 3 m), and the availability of many large caves (54.9 % of counts recorded large caves present) (Table 3). These findings highlight the good reef fish conservation potential of that site, and support the continued use of it as an MPA.

Paulsberg Sanctuary Zone (proposed)

The fish assemblage noted along this stretch of coast reached a mean abundance of 11.16 (S.D. 7.39). This is more than three times less than what was encountered off exploitable sites along the Peninsula's east coast, and is mostly explained by the fact that limited reef was encountered within the >15-25 m depth stratum south of Batsata Rock. This is of concern. However, much reef was encountered within all depth strata off Batsata Rock, where a number of *Chrysoblephus laticeps*, *Chirodactylus brachydactylus*fish and *Dichistius capensis* individuals >30 cm TL (Table 14) were counted, highlighting the reef fish conservation potential of this site. It is felt, however, that the data obtained from this stretch of coast underestimates the reef fish conservation potential of this site, as although Batsata rock and its surrounding reefs provide much vertical elevation in excess of 5 m (pers. obs.), the fish counts obtained from that site do not show this. It is proposed that should additional fish counts be undertaken within the Paulsberg Sanctuary Zone, especially around Batsata Rock, the proposed establishment of an MPA at this site will be vindicated (with respect to reef fish conservation).

Boulders Sanctuary Zone (proposed)

The overall abundance of all reef teleosts combined obtained within this proposed MPA was 19.98 (S.D. 18.68) fish/100m$^2$. Although this is higher than that obtained within some of the other proposed/existing MPAs, this is still lower than was obtained at the remaining exploited sites, suggesting that this site has limited reef fish conservation potential. The low abundances obtained within this MPA are mostly due to the lack of reef present within the >8-15 m and >15-25 m depth strata (Table 3). Indeed, although the stretch of coast within this proposed MPA encompasses a diversity of subtidal habitats, including two sets of small offshore islands (Noah's Ark and Oatlands Point), little reef is present within the deeper depth strata within this proposed MPA. This is not obvious when analysing the fish abundance data obtained from within this MPA, however, as three of the four sites dived within this MPA were located where it was known that reef was present further offshore. The fish abundances presented here are thus not representative of the MPA coastline, but rather of its known good spots. However, the size distributions of a number of important linefishery species encountered within this MPA (*e.g. Chrysoblephus laticeps*, *Pachymetopon blochii*, *Chirodactylus brachydactylus*, *Gymnocrotaphus curvidens*, *Dichistius capensis*, *Diplodus sargus capensis*) comprised a fair proportion of individuals >30 cm TL, highlighting the reef fish conservation potential of these individual locations within this

MPA. The limited amount of such quality reef within the proposed MPA, however, points to the limited benefit this MPA would provide to reef fishes. The fish data obtained from within this MPA, in conjunction with the above discussion concerning the lack of offshore reef at this site, points to this proposed MPA having limited reef fish conservation potential. However, because the area covers a wide diversity of substrata (and a penguin colony on land), it could still be a useful marine biodiversity reserve. It is largely because of this that the proposed establishment of this MPA is supported.

## 4. ALTERNATIVE PROPOSALS

<u>Peninsula's west coast</u>

It is worrying that based on the data collected during this study, all reef teleosts combined, *Pachymetopon blochii* and *Dichistius capensis* were found most abundant in exploitable areas (Table 11) along the west coast of the Peninsula, highlighting that the proposed MPAs may not be located optimally there. Along that portion of the coast, optimal *Pachymetopon blochii* conservation sites need to encompass reef at all depths, while also providing much vertical elevation (>5 m) and large caves. The author believes that the proposed Karbonkelberg Sanctuary Zone is well located for this purpose. To increase the conservation benefits provided to *Pachymetopon blochii* from the proposed MPAs, it is advised that the Karbonkelberg Sanctuary Zone be extended northwards to include the reefs just North of South Paw (offshore of Clifton). This is so, because not only would this increase the total amount of reef protected, but it would also increase the number of offshore islands protected (which offer optimal reef habitat).

<u>Peninsula's east coast</u>

The majority of sites with good potential for reef fish conservation are already encompassed within the proposed MPAs. The only suggestion is to lengthen the Paulsberg Sanctuary Zone southward by a few 100 m so that it encompass the reefs offshore of Bordjiesrif. This is because reef is present there at depth exceeding 20 m, a commodity which is otherwise lacking within this MPA.

# SECTION IV

## 1. DIVING FRATERNITY BASED DATA COLLECTING PROJECT

This portion of the report deals with how to use the recreational diving fraternity could potentially assist in to collecting information that can be used to benefit the management of the Cape Peninsula National Park's marine resources. Although using the general diving fraternity to collect information concerning the reef fish and invertebrate assemblages present at different sites along the Cape Peninsula's coastline is innovative, this is not a simple task. This section thus provides recommendations concerning where and how to obtain diver support for the project, what information to ask divers to collect, and what that information can be used for by park management. It also provides a short list of the benefits that can be obtained from such a diving fraternity-based undertaking. The questionnaire to be filled by the divers is explained, and actions needed to be undertaken by park authorities to keep diver interest up for this project are also proposed.

A number of important issues have to be resolved for this project to be successful. These range from:

A. Human resources collecting the information

1. Which divers are likely to want to help in this undertaking?
2. How many divers are likely to take part?
3. How knowledgeable will they be about reef fish / shellfish identification, and size and abundance estimation?

SCUBA divers are likely to be keen to participate in this project, as the majority of them are conservation conscious (pers. obs.), and would thus like to help in this project. A number of freedivers would also be prepared to help in this regard. There are a number of dive clubs for SCUBA divers and freedivers in Cape Town and surrounding areas, and it is likely that should each of these be contacted and members informed about this project, one would find many eager participants.

It would be necessary to organize a formal visit to each of these clubs to explain the background of this project, explain how to fill in the report sheet, give general information on how to identify the specific species they will be asked to provide information on, and explain what the information will be used for.

B. What information do the divers collect?

A number of different diver categories are encountered along the Cape Peninsula, including:

- Freedivers that do not exploit marine resources
- Freediving spearfishers
- Freediving collectors of perlemoen and / or west coast rock lobsters
- SCUBA divers that do not exploit marine resources
- Poachers (both freedivers and SCUBA divers)

Overall, the experience and ability of divers within each category vary greatly, as do their interests while in the sea. The type (and quality) of information that can be collected by these different diver categories could thus vary greatly. The information requested from any of these divers must, therefore, be of a simple enough nature that any of them will be able to record it with some degree of accuracy.

Based on these requirements, it is proposed that participating divers fill in a report sheet on completing each dive. On that report sheet (Appendix 1), he/she will state whether he/she was freediving or SCUBA diving, the date, dive site, maximum depth dived and dive time, before ticking off yes/no blocks about the diving conditions and fish and shellfish resources seen during the dive. Resource information asked for will include:

- The maximum size of individuals of certain reef fish species encountered (within certain size categories)
- The relative abundance of certain reef fish species (categorized on total numbers seen during the dive)
- The relative abundance of rock lobsters, perlemoen abalone and allikreukel (categorized on total numbers seen during the dive)

One cannot request information on all reef fish species, as there are too many of these, and not all are important or easy to identify. Furthermore, the report sheet must not be too lengthy to fill in, which would cause diver interest in the project to wane. The reef fish species on which information will be requested were chosen for the following reasons

- Ease of identification (a silhouette of them will be given on the report sheet)
- They are presently exploited by the False Bay and / or West Coast linefisheries
- They are (or at least though to be) resident, and thus likely to benefit from the establishment of the proposed marine reserves

The information requested from the divers is simple enough to record, and will be useful in pointing out general trends at the different sites, as well as pointing out where more in-depth studies may need to be undertaken by qualified scientific personnel.

C. <u>Who is to collate and analyze the information obtained by the divers?</u>

The Cape Peninsula National Park will assume responsibility for the capture of all data collected by recreational divers, and will manage the database. This will require some dedication, as it is likely that although interest and participation in the project will be great at first, numerous divers will, after a while, lose interest in the project and stop filling in report sheets, if not kept up to date on progress. To keep diver interest up, results will need to be provided to the diving fraternity, either in the form of newsletters, posters or other forms.

D. <u>What benefits can this diving fraternity-based project provide to the Cape Peninsula National Park and its marine resources?</u>

The most immediate benefits will be obtained by the fact that the diving fraternity will know about the different Marine Reserves envisaged for the Cape Peninsula coastline, and will know that they will be able to participate in their monitoring. Just that benefit alone is already a great achievement.

If sufficient divers take part in this project, it should be possible to use the information collected by them should be able to point out to identify general trends in the size structure and abundance of the reef fish and shellfish stocks at the different sites, and detect changes in these over time.

The information could thus be used to ‘monitor’ the exploited assemblages present at the different sites. Should changes in these be noted from certain/all sites, this could point for a need for more in-depth studies to be undertaken by qualified scientific personnel.

**Appendix 1.** The report sheet to be completed by each participating diver on completion of a dive off the Cape Peninsula coastline.

| FREEDIVING | | SCUBA DIVING | | |
|---|---|---|---|---|
| DIVE SITE (name of dive site) | | | | |
| DEPTH (maximum & minimum reached) | | | | |
| CONDITIONS | COLD/WARM WATER | THERMOCLINE | VISIBILITY | SWELL |
| | | PRESENT / ABSENT | | SMALL / LARGE |

| CRAYFISH / ROCK LOBSTER | | NONE SEEN | <10 SEEN | >10 SEEN |
|---|---|---|---|---|
| | UNDERSIZE | | | |
| | LEGAL | | | |

| PERLEMOEN / ABALONE | | NONE SEEN | <10 SEEN | >10 SEEN |
|---|---|---|---|---|
| | UNDERSIZE | | | |
| | LEGAL | | | |

| ALIKREUKEL / COCKLE | | NONE SEEN | <10 SEEN | >10 SEEN |
|---|---|---|---|---|
| | ALL SIZES | | | |

| RED ROMAN | NONE SEEN | <10 SEEN | >10 SEEN | MAX. SEEN |
|---|---|---|---|---|
| | | | | <1KG - <36 cm |
| | | | | >1 KG - >36 cm |
| | | | | >2 KG - >45 cm |

| JOHN BROWN | NONE SEEN | <10 SEEN | >10 SEEN | MAX. SEEN |
|---|---|---|---|---|
| | | | | <1KG - <36 cm |
| | | | | >1 KG - >36 cm |
| | | | | >2 KG - >43 cm |

| HOTTENTOT | NONE SEEN | <10 SEEN | >10 SEEN | MAX. SEEN |
|---|---|---|---|---|
| | | | | <1KG - <38 cm |
| | | | | >1 KG - >38 cm |
| | | | | >2 KG - >46 cm |

| GALJOEN | NONE SEEN | <10 SEEN | >10 SEEN | MAX. SEEN |
|---|---|---|---|---|
| | | | | <1KG - <40 cm |
| | | | | >1 KG - >40 cm |
| | | | | >2 KG - >46 cm |

| BUTTERFISH | NONE SEEN | <10 SEEN | >10 SEEN | MAX. SEEN |
|---|---|---|---|---|
| | | | | <0.5KG - <35 cm |
| | | | | >0.5 KG- >35 cm |
| | | | | >1 KG - >42 cm |

| COMMENTS |
|---|
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## SECTION V

## 1. REFERENCES

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