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4 **Using recreational divers to inform more efficient conservation management** 5 **within an MPA - A case study from the Cape Peninsula, South Africa**

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7 *Antaya March^a, Louisa E Wood^a and Jonathan Potts^a

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9 ^aCentre for Blue Governance, University of Portsmouth, United Kingdom

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11 *Corresponding author: antaya.march@port.ac.uk

12

13 Abstract

14 In South Africa, recreational scuba diving is one of the most popular coastal activities, which is largely carried
15 out within Marine Protected Areas (MPAs). MPAs act as the basis for marine conservation in the country,
16 operating as the primary tool for the management of the country's marine resources. Effective management
17 of MPAs depends on the uptake of voluntary guidelines, including Codes of Conduct by recreational users,
18 such as the scuba diving community. With a focus on the MPA of Table Mountain National Park (TMNP),
19 this paper aims to determine the value that Cape divers attach to the marine environment in which they dive,
20 their understanding of the role of the TMNP MPA, and their knowledge and attitudes regarding its
21 management. A semi-structured questionnaire with responses from around 30% of the local diving community
22 showed that while users attached a high value to the MPA in which they dive, they presented a lack of knowledge
23 around the regulations and conditions involved with diving within the MPA. This is associated with poor
24 dissemination of user information and general awareness. In-depth interviews with dive operators and
25 management personnel of the MPA indicated a disconnect between the different levels of management,
26 operators and users. Based on this research, we propose alternative and additional management strategies for
27 recreational scuba diving that would contribute to the success of the TMNP MPA including inter alia increased
28 collaboration with the dive community for citizen science activities, improved stakeholder engagement and
29 better access to information on management regulations and expectations.

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31 Key words

32 Marine Protected Areas; SCUBA; recreational diving; environmental impacts; management; water users

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34 1. Introduction

35

36 The declaration of marine protected areas (MPAs) to ensure ecological integrity, biodiversity conservation,
37 fisheries management and social opportunity has become a particularly important tool for conservation and
38 marine science (Jentoft et al., 2007; Agardy et al., 2011; Maestro et al., 2019). The effectiveness of MPAs has
39 been a long-standing matter of debate (Kolding, 2006; Pendleton et al., 2018). There is concern that MPAs are
40 not entirely able to protect from all of the primary threats to marine environments such as pollution and climate
41 change (Bates et al., 2019; Luna-Jorquera et al. 2019) and that they often neglect social dimensions (Sowman
42 et al., 2018). However, the use of MPAs to protect areas from extensive anthropogenic damage remains a vital
43 approach to maintaining the environmental integrity of the marine environment. Managing protected areas
44 often involves balancing potentially conflicting objectives of protecting natural resources while still ensuring
45 social dimensions of dependence on the resources and that of income generation through tourism and resource
46 use (Rouphael & Hanafy, 2009). Such a balance between resource use and recreational, subsistence and
47 commercial uses are the primary aims of a number of protected areas around the world, including the Great
48 Barrier Reef Marine Park, the Galapagos Marine reserve and the Red Sea (GBRMPA, 1994; DPNG, 1999; El
49 Din; 2003). A primary mechanism of balancing these seemingly opposing objectives is through sound
50 management frameworks that facilitate a structured response to user impacts (Pomeroy et al., 2005; Rouphael

1 & Hanafy, 2009). A robust management framework should establish the ideal condition of the environment
2 that allows the ecosystem to continue to provide its services, enable identification of human impacts, and
3 establish steps to maintain the accepted ideal condition (Farrell & Marion, 2002). For management frameworks
4 to be effective, public participation is essential (Day, 2017). However, studies have indicated that there is low
5 awareness among recreational users of the regulations for MPAs and the relevant Codes of Conduct that are
6 in place (e.g. Mozambique; Rocha et al. 2020, Italy; Lucrezi et al. 2017; Indonesia and the Philippines, Christie,
7 2005). This indicates the need for improved management of MPAs and the implementation of education
8 systems to ensure that MPAs are effective.

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10 The recreational scuba diving community is a key user group of MPAs (Harriott et al., 1997; Green &
11 Donnelly, 2003) and the basis of a global and rapidly growing tourist industry (PADI, 2019). Characteristics
12 of marine systems in good condition, such as attractive or healthy marine flora and fauna, interesting geologic
13 formation and good water quality are also characteristics that attract scuba divers. However, the steep rise in
14 scuba diving and dive-related tourism since the 1980s (Rouphael & Inglis, 1997) has engendered extensive
15 research into the impacts on the marine environment in which these activities take place (Tratalos & Austin,
16 2001; Musa, 2002; Roche et al., 2016; Giglio et al., 2020; Lucrezi et al., 2021). Impacts in MPAs attributed to
17 recreational use through scuba diving may include anchor or line damage, the presence of moorings, diver
18 behaviour, operating procedures, the relative cover of marine flora and fauna, and the topography of the sites
19 (MacLeod & Cooper, 2005; Hunt et al., 2013; Lucrezi et al., 2021). Whilst divers are known to be generally
20 good ambassadors for the marine environment, there is uncertainty regarding the level of awareness among
21 divers about the impacts of the industry on the marine environment (Lucrezi et al., 2013). Indeed, previous
22 research assessing divers' perceptions of their impacts on coral reef systems found that only divers who had
23 seen notable damage by boats anchoring, pollution, disturbance of marine life, and significant sediment
24 disruption when underwater were aware that the dive industry had any harmful impacts (Dearden et al., 2007).
25 Best practice guidelines and protocols to promote sustainable tourism should be incorporated into MPA
26 management plans to ensure diving activities are within sustainable levels (Davis and Tisdell, 1995; Giglio et
27 al., 2022). However, while much work has been done on best practice for the dive industry, particularly by
28 organisations like Reef-World's GreenFins (Hunt et al., 2013; Roche et al., 2016), who set protocols to
29 promote environmentally sustainable dive tourism in South-East Asia, this is largely restricted to tropical reef
30 areas. Research into the effects of recreational diving in non-tropical MPAs is an emerging topic (e.g.
31 Hammerton and Bucher, 2015; Giglio et al., 2018; Lucrezi et al., 2021) given that the pressure on tropical reef
32 systems is likely to be driving touristic diving activities to sub-tropical and temperate underwater regions
33 (Lucrezi et al., 2021), and there is often high local interest in diving in non-tropical regions (Hermoso et al.
34 2021).

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36 In South Africa, MPAs are used as the basis for marine conservation, operating as the primary tool for the
37 management of the country's marine resources (Chadwick et al., 2014). There are 41 MPAs of South Africa's
38 mainland ocean territory, making up 5% of the country's exclusive economic zone (EEZ). MPAs are declared
39 under the Marine Living Resources Act 1998 (MLRA), which is a legal mandate for establishing MPAs,
40 designed to control the exploitation and conservation of living resources in the marine environment. Most
41 MPAs in the country are managed as multiple use areas, with some exclusion of activities through zonation
42 and "no take" zones. These zones, by protecting the ecosystem, ensure the provision of the goods and services
43 that attract users of special interest. Scuba diving is one of the most popular coastal activities in South Africa
44 (Geldenhuys et al., 2014). Divers are able to recreate in all areas of the protected site, including in "no take"
45 zones. The scuba industry contributes to the management costs of MPAs through fees, requiring an annual
46 permit to participate in diving activities within the MPAs (Western Cape Government, 2019). One example of
47 a South African MPA, which is also a popular dive location, is the MPA covering the cold-water, kelp forest
48 dominated coastal and marine environments around the Cape Peninsula, which is part of the Table Mountain
49 National Park (TMNP). The park itself has been in existence since 1977 (TMNP, 2015), however the TMNP
50 MPA was only declared in 2004. While the TMNP has a management plan and existing structures in place that
51 include systems around limits of acceptable change and carrying capacity, there is currently no strategic

1 management plan specific to the MPA, and current systems apply predominantly to the terrestrial aspect of the
2 park. In WWF’s assessment of the management of South Africa’s MPAs, it was stated that this was “a limiting
3 factor to effective management of the MPA” (WWF, 2014, p30) and that this was a high priority that needed
4 to be addressed. Lack of management plans in MPAs is a globally common situation (Petit et al. 2018). In the
5 case of the Cape Peninsula, the lack of integration of biological, physical and social dimensions into a single
6 coherent management framework has been an intractable task given the insufficient capacity and infrastructure
7 (Pfaff et al, 2019), further impeded by bureaucratic government processes (Colenbrander and Bavnick, 2017).
8 The existing management paradigm has been criticised for its lack of integration and the inclusion of social
9 dimensions, particularly the inclusion of resource users in planning and decisions-making (Sowman et al.,
10 2011; Sowman and Sunde, 2018).

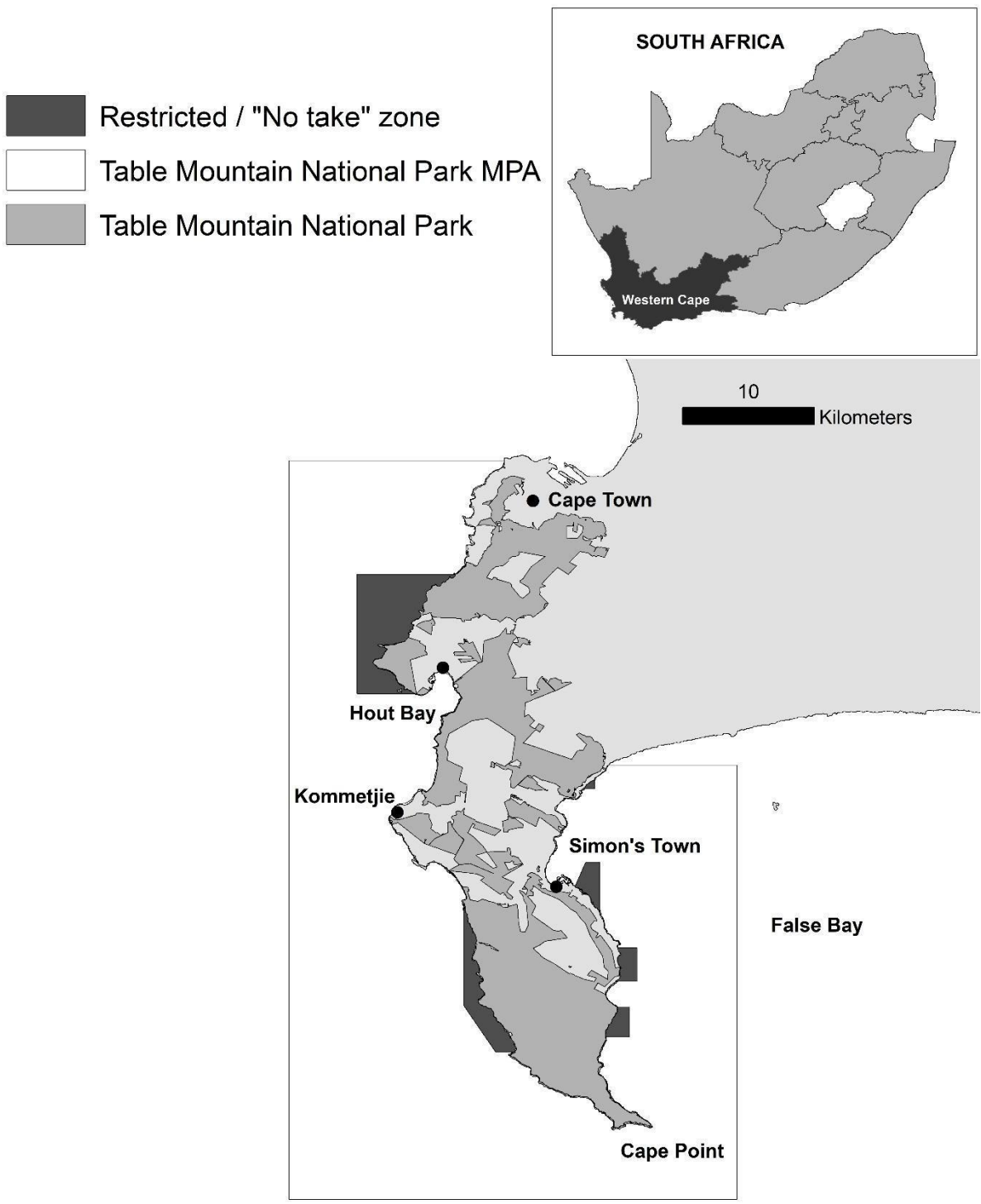
11
12 This study aims to determine the value that Cape divers attach to the marine environment in which they dive,
13 their understanding of the role of the TMNP MPA, and their knowledge and attitudes regarding its
14 management. In addition, divers’ understanding and perceptions of “no take” zones in the MPA are assessed,
15 in order to determine whether divers see value in this as a management strategy. The results of this study can
16 be used to tailor recommendations for the revision of the management regime in the TMNP, as well as
17 providing new scientific data to support the devising of the guidelines for the management of recreational
18 diving at national and international level.

19 20 2. Research methods

21 2.1 Study site

22 This study was conducted within the Table Mountain National Park (TMNP) MPA in Cape Town, South
23 Africa. The TMNP covers 953.25km² and encompasses the waters surrounding the Cape Peninsula region
24 (Figure 1). It is situated in a transition zone between the Agulhas and Cape ecoregions, thus supporting rich
25 marine species diversity. Water temperatures vary greatly between the Atlantic and False Bay shores of the
26 MPA, reaching maximum temperatures of 16°C on the Atlantic side (western shores of the peninsula) and
27 20°C on the False Bay side (eastern shores of the peninsula). It is a culturally important area with traditional
28 fishing communities, historical sites and an abundance of shipwrecks. TMNP is also important for commercial
29 fisheries, such as the traditional line fishery and the West Coast rock lobster industries, for which certain
30 constituents for recreational and subsistence fishers are based within the MPA. Due to the fact that the MPA
31 covers the shores of Cape Town, it promotes high tourism levels, a range of recreational activities and
32 extensive research and education. Tourist attractions within the MPA include Simon’s Town and Cape Point,
33 which are internationally recognized. There is also a significant eco-tourism industry based around
34 *Carcharodon carcharias* (great white shark), *Arctocephalus pusillus* (cape fur seal) and *Spheniscus demersus*
35 (African penguin). Protected species include *C. carcharias*, *Haliotis sp.* (abalone), *S. demersus* and a number
36 of over-exploited line fish species including *Dichistius capensis* (galjoen), silver kop and *Petrus rupestris* (red
37 steenbras).

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Figure 1. Map identifying the TMNP MPA, its boundaries and restricted “no take” zones.

When the TMNP MPA was established in 2004, co-management by the South African National Parks (SANParks) board and the Department of Environmental Affairs (DEA) was implemented, which still exists as the managing agreement in 2021. However, the DEA was renamed in 2019 as the Department of Environment, Forestry and Fisheries (DEFF), incorporating the forestry and fisheries functions. Under this agreement, DEFF controls law enforcement and the issuing of permits and quotas, while SANParks is responsible for inshore and administrative law enforcement and educational activities (TMNP, 2015).

Patrols and checks for permits are carried out by SANParks, but they do not have control over the number of permits issued (SANParks personnel, 2020, personal communication). Furthermore, no funds generated by

1 the MPA are used for the management of the MPA (WWF, 2015). All income from permits is directed to the
 2 Marine Living Resources Fund as administered by DEFF (SANParks personnel, 2020, personal
 3 communication). This raises questions around the legitimacy of the permit system and the value that permit
 4 holders may be receiving for their money (anonymous dive operator, 2020, personal communication), which
 5 is a relevant issue for recreational divers (Biggs et al., 2016).

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 7 The permit itself has general conditions on the document, much of it pertaining to fishing practices. In signing
 8 the permit, the permit holder confirms they have acquainted themselves with the conditions of the permit and
 9 that they have read the Marine Living Resources Act (Act No. 18 of 1998) (MLRA) . There are no indications
 10 of any regulations or conditions related to the practice of scuba diving. However, the DAFF Marine
 11 Recreational Activities Information Brochure (2017) documents mandatory practices for fishing and
 12 recreational scuba diving, which is meant to accompany all permits when issued (SANParks personnel, 2020,
 13 personal communication). There is no mention of this brochure on the permit, creating a disconnect between
 14 the permit and the conditions thereof. The conditions for scuba diving, according to the brochure, are presented
 15 in Table 1. Notable is condition (7) which states that divers must abide by the Diver Code of Conduct (DCoC).
 16 The website provided alongside this condition returns no results of the DCoC, nor does any internet search.
 17 One of the authors is aware of this DCoC and the basis of what it entails through many years' experience as a
 18 dive professional in the area of study, however, no written version of this can be located. Other conditions
 19 include not diving at night; no dumping, chumming or discharging; and no disturbance of marine life.
 20

21 Table 1. Conditions of recreational SCUBA diving permit holders.

RECREATIONAL SCUBA DIVING PERMIT CONDITIONS	
The holder of a recreational SCUBA diving permit shall:	
(1)	adhere to the National Environmental Management: Biodiversity Act, 2004 (Act No 10 of 2004): Threatened or Protected Marine Species Regulations
(Government Gazette 40875 of 30 May 2017) with regards to interacting with protected marine species:	
(2)	not remove, unduly disturb or harass any marine organism or habitat, including shells or substrate, marine mammals, seabirds and fish.
(3)	not feed fish, practice chumming, or dump any material, or discharge any biological attractants in the MPA.
(4)	dive in the Table Mountain, Pondoland, Amathole, Aliwal Shoal, Dwesa-Cwebe and Stilbaai MPA during daylight hours only (from half an hour before local sunrise to the time of local sunset), unless as part of a group being taken out by an DEA-authorized business operator. A representative of a registered Diving Club or individuals must notify the managing authority of the MPA to their satisfaction if they intend night diving. (Table Mountain (SANParks) – 021-783 0234, Pondoland (Eastern Cape Parks and Tourism Agency) – 043-705 4400/063-698 1558, Amathole (Eastern Cape Parks and Tourism Agency) – 043-742 4450, Aliwal Shoal (Ezemvelo KZN Wildlife – 031-274 1150), Dwesa-Cwebe (Eastern Cape Parks and Tourism Agency -047-499 7900) and Stilbaai (Cape Nature – 028-754 2234).
(5)	not scuba dive in the Bird Island MPA at all.
(6)	not dive in any MPA where a scuba diving permit is required between 23:00 and 04:00 at all.
(7)	abide by the Diver Code of Conduct (www.environment.gov.za).
(8)	note that these conditions will be applicable to any new MPAs that may be declared, re-gazetted or required to have a permit in the future.

(9)	adhere to the condition that boats taking persons diving in an MPA where a permit is required shall only launch from an authorized launching site, and shall not launch earlier than an hour before local sunrise or return later than an hour after local sunset unless night diving in compliance with condition 4.
NB: Permit conditions and allowable scuba diving areas may be subject to change.	

1 Source: Taken from the DAFF Marine Recreational Activities Information Brochure (2017)

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3 2.2 Data collection and analysis

4 A semi-structured online questionnaire was used to collect data from recreational divers using online
5 distribution mailing lists for eight different dive centres and clubs between May and July 2020. The
6 questionnaire targeted only local members of the dive community as opposed to tourist divers, given the
7 restrictions to recreation and tourism incurred by the COVID-19 pandemic. In addition, in-depth interviews
8 were conducted with owners of dive operators and SANParks personnel. Online questionnaires and in-depth
9 interviews were conducted in English. Prior to starting the survey, participants were made fully aware of how
10 the data would be used and that participation was through informed consent and remain confidential. To engage
11 with SANParks personnel and gather data, a research agreement was obtained between SANParks and the first
12 author.

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14 Each online questionnaire took participants approximately 10-15 minutes to complete and consisted of four
15 main subject areas: (1) diver values associated with the marine environment and diving within it; (2) perceived
16 impact of diving on the marine environment; (3) awareness of the role of the MPA, and (4) opinions and
17 understanding relating to MPA management. In addition, divers were asked about their diving background and
18 habits, including qualification level, frequency of diving and income dependent on diving in order to assess
19 trends in diver perceptions of MPA management. A 5-point Likert scale was used to assess the importance
20 respondents place on the diving experience in the Cape Peninsula, perceived compatibility of other permitted
21 activities in the MPA, and the success of “no take” zones. Likert scales were also used to determine
22 respondents’ views on management of the TMNP MPA regarding potential management strategies,
23 community involvement, enforcement and education. Open-ended questions were used to gain further insight
24 into opinions and suggestions toward the management of the MPA and the users thereof. The full questionnaire
25 can be found in the supplementary materials.

26
27 In addition to the online questionnaires, structured interviews with SANParks were conducted remotely (due
28 to COVID-19 restrictions) and took place with personnel in different areas of the management of the MPA,
29 including the scientific research and marine conservation management sectors. The interviews were designed
30 to take no longer than 15 minutes and focused on key areas of the online survey that raised questions about
31 knowledge gaps in the divers’ awareness of the role and management of the MPA. In-depth interviews with
32 dive operators and club leaders were also conducted remotely via video calls and were designed to provide
33 further insight into the relationship between the dive operators, the general diving community and the
34 management of the MPA.

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36 With the intention to make results easier to interpret, the following variables were categorised into two groups:
37 diving frequency (monthly/less than monthly) and diver experience (professional e.g. divemaster and above/
38 leisure e.g. rescue diver and below). To estimate the reliability of the Likert questions in the questionnaire,
39 Cronbach’s alpha coefficient was calculated using the psych package (Revelle, 2018). All data analysis was
40 conducted in R v.6.3.1 (R Core Team, 2020). Descriptive analysis was employed to describe basic features of
41 the whole data set. Chi-square tests (Pearson’s Corrections) were used to determine whether diver experience
42 affected behaviours (permit ownership) and perceptions of management (attitudes towards “no take” zones).
43 For Likert scale questions, data was visualised using the ‘likert’ package (Bryer and Speerschneider, 2016).

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3. Results

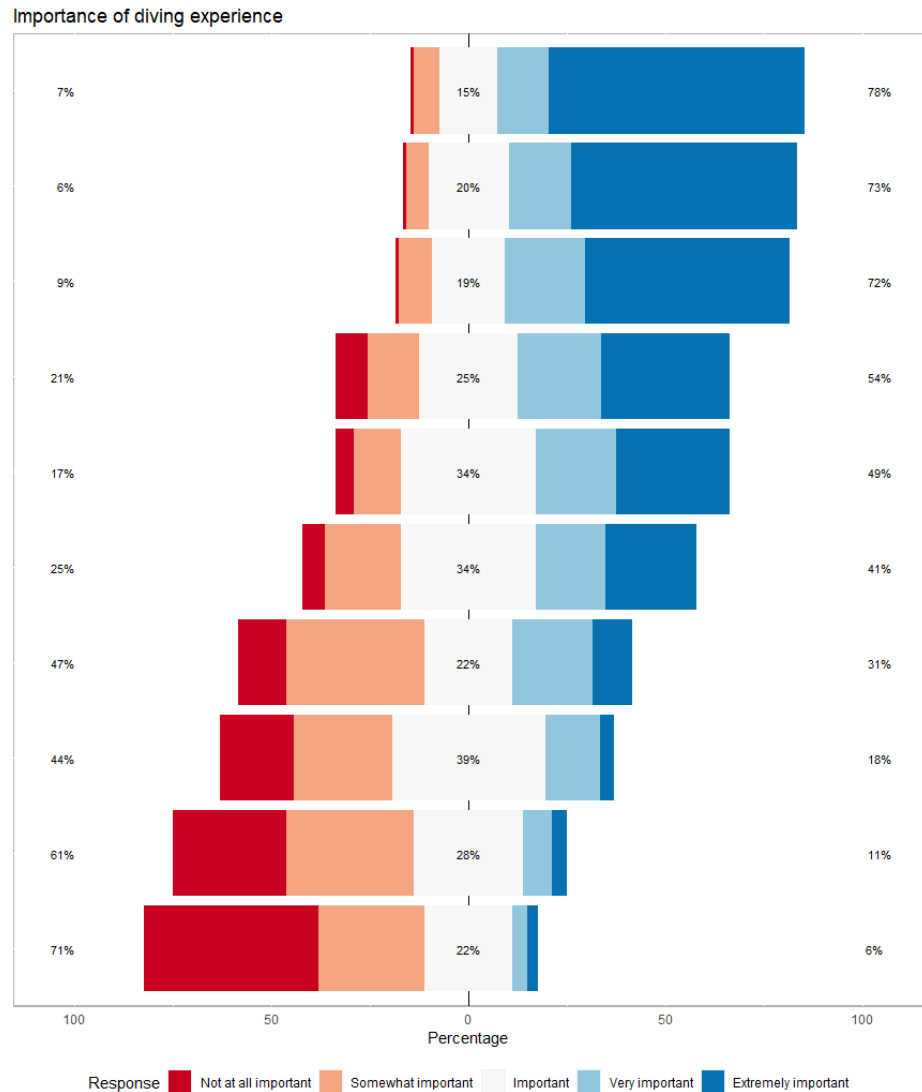
Respondent details, recreational use and diver experiences

A total of 110 responses to the online-questionnaire were received, of which 108 were complete, making up ~30% of the estimated local dive community (anon. SANParks personnel, 2020, as interviewed). Cronbach's alpha coefficient was greater than 0.6 for all questions, and hence were accepted. Of the respondents, 35% were dive professionals (divemasters, instructors or above), the other 65% dived solely for leisure, and all were local to the Cape Peninsula. Most respondents dived every month or more (62%) and most dived independently with dive buddies¹ (44%). 37% of respondents dived with a dive centre and 19% of them dived with a club.

Most divers entered from the shore; 56% predominantly shore dived, predominantly due to costs associated with boat diving, and 21% dived equally from the shore and from a boat. Several key informants raised the issue that access to shore sites was often physically restricted due to local geography e.g. the presence of uneven terrain, and lack of access from the road. This prompted further queries regarding whether paying a fee for a dive permit is justified, when 'well-known dive sites do not have access points that are safe and prevent damage to the environment around the entry point' (anonymous dive operator, personal communication, 2020).

Regarding the importance of the diving experience in the Cape Peninsula, most of the respondents indicated that viewing the natural scenery, viewing the marine wildlife and diving in clean water were extremely important, comprising 57%, 65% and 52%, respectively (Figure 2). Conversely, almost half (44%) of all respondents indicated that being around other divers underwater was not at all important to them. Similarly, when questioned on their reasons for diving, only 4% of divers indicated that they dived for the social aspects. This is in contrast to the 58% that dive primarily to connect with nature. When questioned on their involvement in conservation action or marine activism, 78% of respondents stated that they were involved to some degree. Common activities mentioned included beach clean ups, underwater clean-ups, volunteering with NGOs and education through awareness campaigns.

¹ The term used by diving associations to describe pairs that dive together to ensure safety.



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Figure 2. Importance of different aspects to the diving experience. Motivations are organized (top down) in descending order from those with the highest percentage of positive responses (Extremely important) to those with the highest percentage of more negative responses (Not at all important). From left to right, numbers represent: the summed percentages of responses.

Most respondents had a sound understanding of the level of impact of dive-associated activities; less than 20% indicated that any of the activities (disturbance of marine life, feeding the marine life, noise from boats, anchors/diving shot lines on the substrate, etc.) had ‘no impact’ on the marine environment.

In assessing the respondents’ perceptions on the compatibility of other permitted activities within the MPA, it is apparent that extractive activities (including mining and all forms of fishing) are perceived to be incompatible with the preservation of the MPA (Figure 3). Sailing and non-motorized water sports (kayaking, stand up paddle boarding and surfing) are seen as within the compatible range, e.g. either highly compatible or compatible (80% and 90% respectively) while motorized water sports activities are generally seen as incompatible. Respondents’ perceptions on the compatibility of boat tour operators were not consistent, likely due to conflicting views around whether boat tour operators carry out sustainable procedures and contribute to eco-tourism. For the case of events and filming, one respondent suggested that improving the knowledge of the impact or carrying capacity associated with large group events could contribute to deeper understanding of the factors contributing to ecological decline (SANParks personnel, 2020, as interviewed).

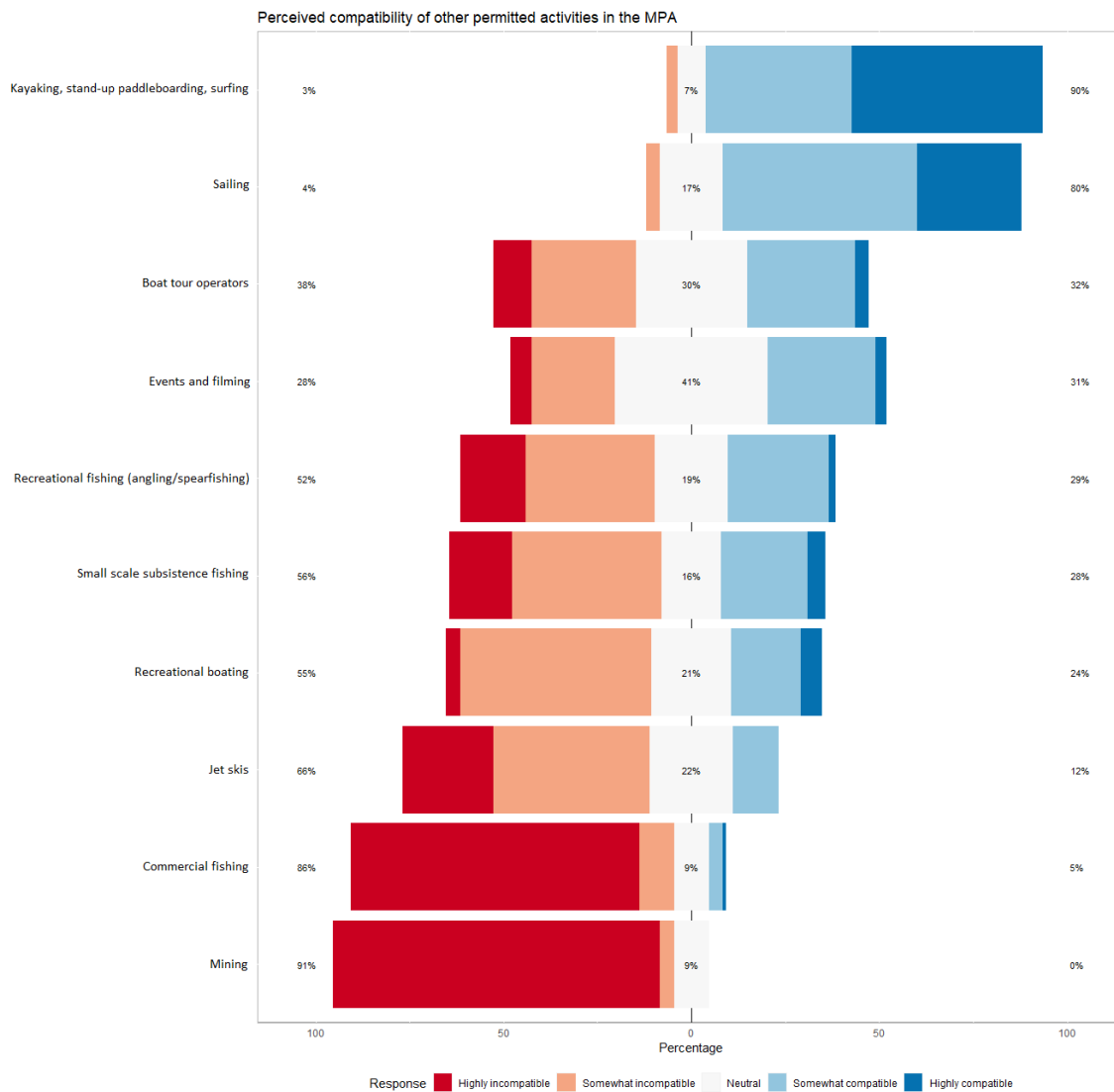
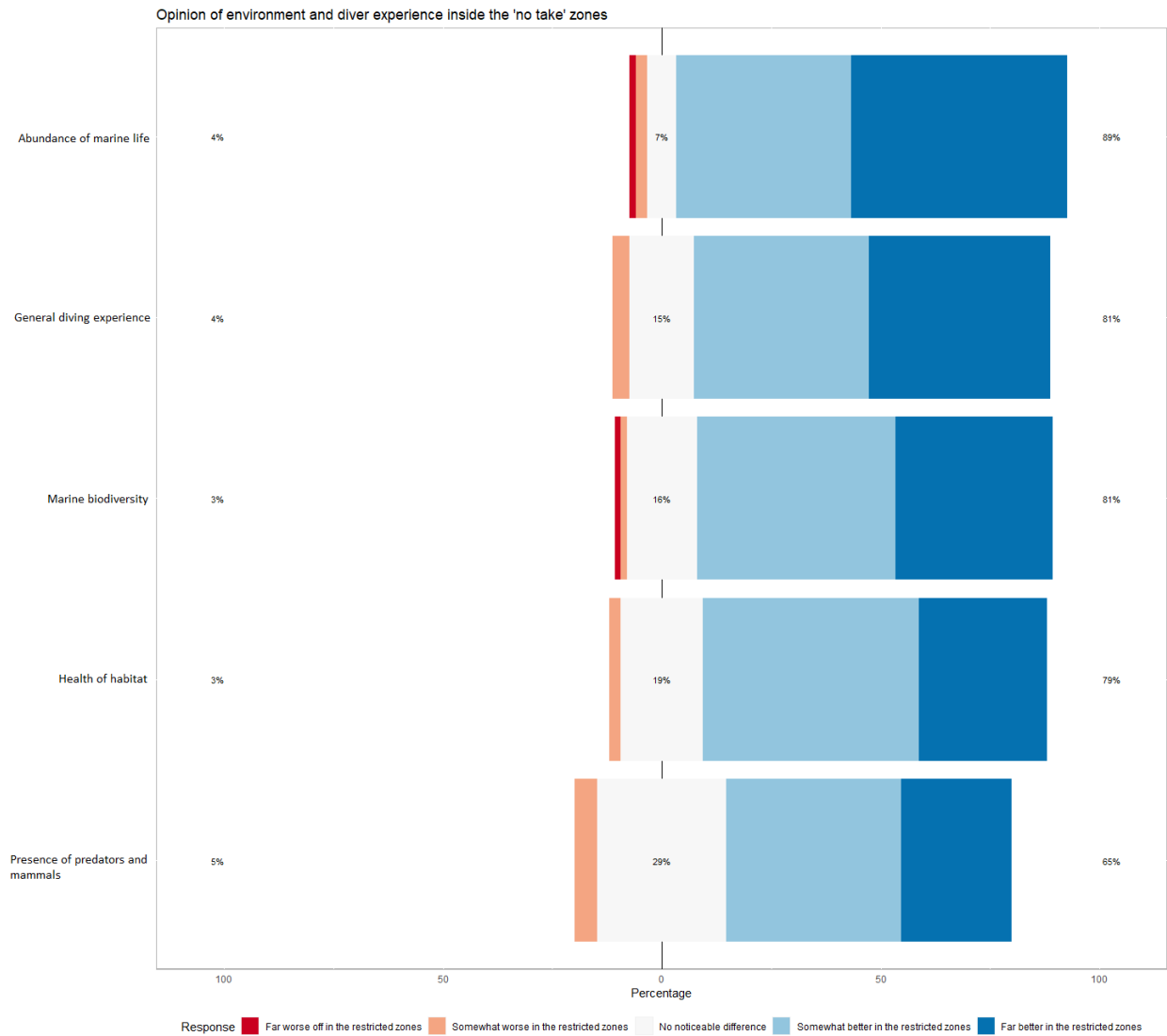


Figure 3 . Perceived compatibility of other permitted activities in the MPA. Activities are organized (top down) in descending order from those with the highest percentage of positive responses (Highly compatible) to those with the highest percentage of more negative responses (Highly incompatible). From left to right, numbers represent: the summed percentages of responses.

3.2 Attitudes and perceptions toward management of the MPA

Over two thirds of respondents were aware of the “no take” zones in the MPA, with 44% of respondents being able to name known “no take” areas. Divers with professional qualifications (divemaster or above) were significantly more likely to be aware of “no take” areas ($X^2 = 4.9986$, $df = 1$, $p\text{-value} < 0.05$) compared to respondents that dived for leisure. Similarly, respondents that dived more frequently were significantly more likely to be aware of “no take” areas ($X^2 = 9.007$, $df = 1$, $p\text{-value} < 0.05$), with 81% of respondents that dived monthly being aware of “no take” areas compared to 51% of respondents that dived less than monthly. Of those that were aware of “no take” zones in the MPA, most perceived that the abundance of marine life (89%), general diving experience (81%), marine biodiversity (81%), health of the habitat (79%) and the presence of predators and mammals (65%), were better inside the “no take” areas.

Over two thirds (81%) of the dive community strongly supported “no take” zones as a management strategy. It is also noteworthy that those who indicated support for the “no take” zones –it was frequently mentioned that they only support them when properly enforced.



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Figure 4. Opinion of environment and diver experience inside the 'not take' zones. Elements of the diver experience are organized (top down) in descending order from those with the highest percentage of positive responses (Far better in the restricted zones) to those with the highest percentage of more negative responses (Far worse off in the restricted zones). From left to right, numbers represent: the summed percentages of responses.

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Despite ownership of a permit being a mandatory requirement, 34% of respondents indicated that they did not have valid permits. Divers with professional qualifications (divemaster or above) were significantly more likely to have a valid, in-date recreational dive permit (82%) than respondents that dive solely for leisure (56%) ($X^2 = 7.66$, $df = 1$, p -value < 0.05). Further, there was a significant association between permit ownership and diving frequency ($X^2 = 15.601$, $df = 1$, p -value < 0.001). Only 41% of respondents that dived less than monthly owned a permit compared to 81% of respondents that dived at least monthly.

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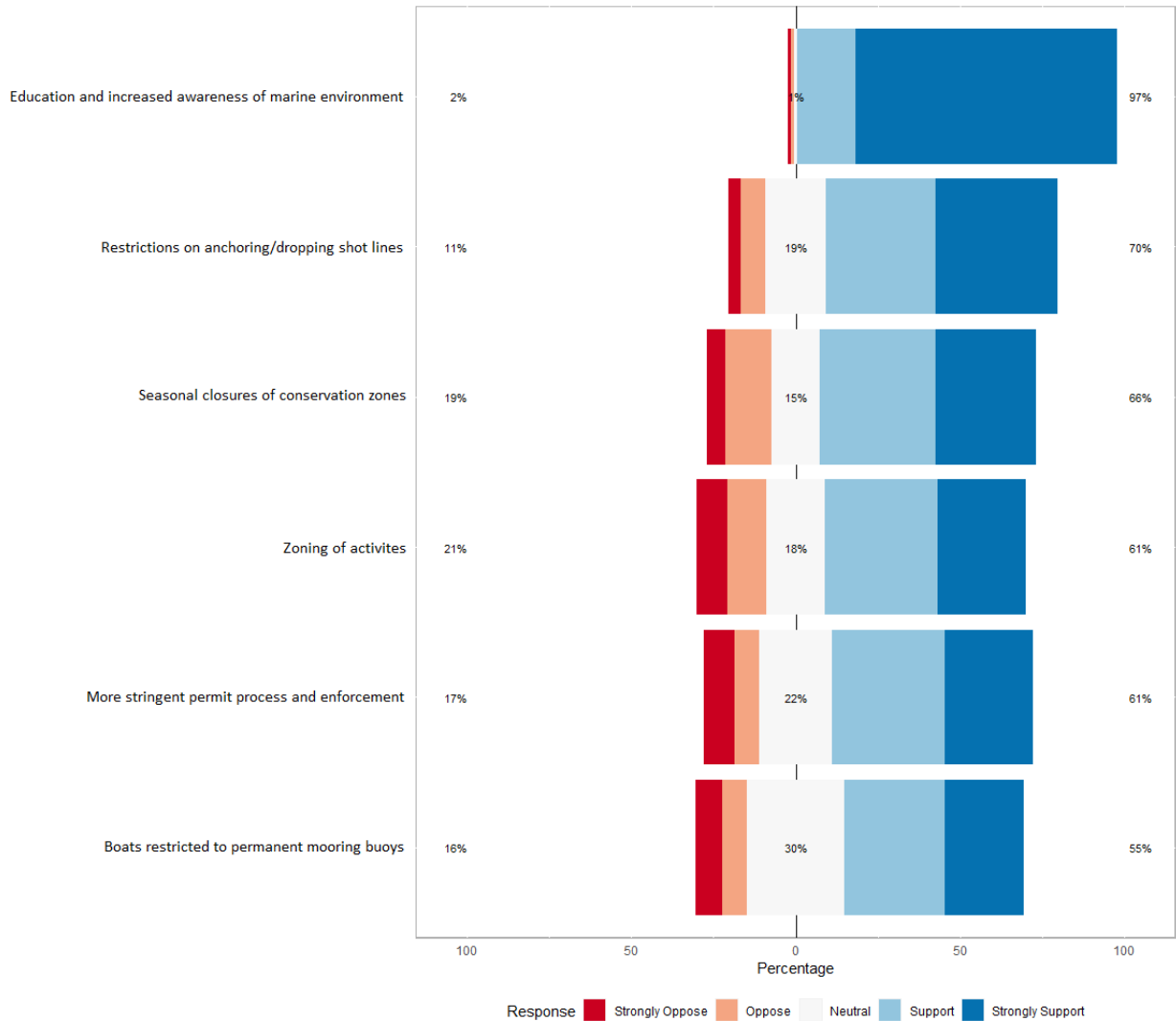
While SANParks carries out 'regular patrols in diving hotspots' (SANParks personnel, 2020, as interviewed), frequent comments were made by respondents with regards to permit ownership. This included reference to the lack of regular permit checks and lack of enforcement. Furthermore, of respondents that do have valid permits, 32% were unaware of the conditions of the permit. The lack of visibility of the Diver Code of Conduct was also mentioned by several of the respondents. Of respondents with permits, 62% had never heard of the

1 Diver Code of Conduct. It is further stipulated on the permit that in compliance with its administration, it is
 2 mandatory to read the MLRA. 76% of divers have never read this.

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 4 In total, 47% of divers do not feel there are enough measures in place to minimise the impact of recreational
 5 diving on the MPA. Support of further management strategies towards recreational diving and other activities
 6 in the MPA varied (Figure 5). More than 60% noted that they support (34%) or strongly supported (27%) a
 7 more stringent permit process and enforcement. All of the suggested management strategies, including
 8 seasonal closure of conservation zones, zoning of activities, restrictions on anchor or diving shot lines, and
 9 restricting boats to permanent mooring buoys were also supported or strongly supported by the majority of
 10 respondents (Figure 5). The most popular management strategy indicated by respondents was a focus on
 11 'education and awareness' (supported or strongly supported by 97% of respondents). SANParks are well
 12 known for their engagement with various non-profit organisations to raise awareness around general ocean
 13 conservation issues in general regarding the MPA, such as the I Am Water Trust, the Beach Co-operative, Sea
 14 Change, Shark Spotters, and many more through their People and Conservation Department (Kock A, 2020,
 15 pers comms), but no education and training is carried out for dive centres / dive operators to ensure that they
 16 are aware of environmental issues as well as all codes, practices and regulations (anon SANParks personnel,
 17 2020, as interviewed).

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Degree to which divers support different management strategies



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1 **Figure 5:** Degree to which divers support these potential further management strategies. Management strategies are
2 organized (top down) in descending order from those with the highest percentage of positive responses (Strongly
3 Support) to those with the highest percentage of more negative responses (Strongly Oppose). From left to right,
4 numbers represent: the summed percentages of responses.
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7 When questioned on consultation by TMNP MPA management with recreational water users, 79% of the diver
8 community had never heard of any such consultation. Of the 21% who had heard of consultations, only 10%
9 had ever been involved.
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11 4. Discussion

12 This study provided key insights into diver perceptions of the marine environment in the MPA in which they
13 dive and their attitude and knowledge of protected area management. These findings are discussed here to
14 guide the revision of the management plan in the TMNP, as well as in the contexts of supporting broad
15 guidelines for the management of recreational diving within MPAs at national and international level.
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- 17 • Valuation of marine environment

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19 It is evident from this study that the natural beauty and health of the marine environment is of high value to
20 divers, with respondents indicating that natural scenery, marine wildlife and clear water are extremely
21 important to the diving experience. Similar results on diver values associated with the marine environment
22 have been observed in previous studies (Schuhmann et al., 2008; Schoeman et al., 2016). Similar to these
23 findings, Marconi et al (2020) found that no-take MPAs attracted a higher number of divers, motivated by the
24 conservation status, than a sustainable or multiple use MPA. In their study of diver perceptions of value and
25 experience of diving in areas dedicated to territorial user rights based fisheries (TURFs), Biggs et al (2016)
26 posited that divers prefer to dive where there are higher levels of diversity and higher abundance of fish and
27 invertebrates, which they associated with TURFS. This high value attached to marine environments lends to
28 the idea that this instils a sense of personal responsibility and care for the condition of coastal and marine
29 ecosystems (Cottrell & Meisel, 2004). In this same vein, the findings of this study evidence that divers are
30 aware of the impacts that the recreational scuba industry has on the marine environment, which is in line with
31 studies which focus on the impacts of diving on highly sensitive coral reef systems (Toyoshima and Nadaoka,
32 2015; Roche et al., 2016; Giglio et al., 2020). While the severity of such impacts on cold-water ecosystems
33 and kelp forests is an emerging area of research, there is a clear direct relationship between acknowledging the
34 potential harm by diving activities on local marine environments and responsible diving behaviour (Ong &
35 Musa, 2012; Lucrezi et al., 2019). Moreover, Roupheal & Inglis (2001) identify that divers familiar with
36 particular dive sites are characterised by some degree of attachment to them, engendering a willingness to pay
37 and learn more about the biological components of the area. The same can be seen from the results of this
38 study, where all of the participants are local divers, holding a high regard for the ecosystems in which they
39 dive, and contributing, in varying degrees (but rarely none), to conservation efforts. Engagement with marine
40 environmental issues is highlighted by the large number of respondents that stated they were involved in
41 conservation action or marine activism. Common activities mentioned included beach clean-ups, underwater
42 clean-ups, volunteering with NGOs and education through awareness campaigns. These characteristics
43 suggest that the scuba diving community around the Cape Peninsula, and beyond, have enormous potential to
44 contribute to conservation measures, monitoring activities and working towards achieving the aims of the

1 MPA. Similar results in cold-water ecosystems have been noted by Hermoso et al (2021) in Chile, as well as
2 Lucrezi et al (2018) and Cerrano et al (2017) in Italy.

3
4
5 ● Research programmes and marine citizen science

6
7 A research programme, particularly for monitoring, is fundamental to managing MPAs, where gathering
8 information and ensuring evidence is robust is crucial for an effective management process (Batista & Cabral,
9 2016; JNCC, 2020). SANParks TMNP has in place a research unit that focuses on evaluating and monitoring
10 the performance and sustainability of parks in achieving their biodiversity, cultural-heritage and socio-
11 economic mandates, including research within the MPA. However, considering engaging the dive community
12 in citizen science or monitoring activities, SANParks personnel are “not aware of any, but [I] do think the
13 SCUBA community and SANParks could work together more for the benefit of the MPA” (anon SANParks
14 personnel, 2020, as interviewed). Given the profile of scuba divers and their potential to contribute to marine
15 research and monitoring through citizen science activities, as outlined above, as well as the lack of financial
16 and human resources capacity of SANParks (anon SANParks personnel, 2020, as interviewed), harnessing this
17 consistent community would widely benefit the management goals of the TMNP MPA. There are a range of
18 varying factors that make scuba divers highly suitable participants of citizen science activities within the MPA
19 including technical underwater skills, the use of dive computers to log depth, temperature and bottom time, as
20 well as underwater photography and videography skills. From divers, management could receive data on the
21 status of ecosystems and specific species that can inform management decisions. Furthermore, the consistent
22 local Cape dive community, with high value attached to the marine environment, tends to display an
23 understanding of local phenomena, with the ability to identify changes in the environment and thus call for
24 management action (Lucrezi, 2021). As such, the participants’ ability to pinpoint local events and issues may
25 represent a key opportunity to take advantage of divers’ local ecological knowledge. Such cooperation between
26 users and MPA management has seen positive effects in various cases including Ventanilla, Mexico, where
27 the inclusion of the local community in conservation and management practices saw increased indicators for
28 more sustainable use of the MPA (Foucat, 2002). Similar results were seen by Elliott et al. (2001) in the case
29 of the Wakatobi National Park, Indonesia. The DEFF and SANParks would thus highly benefit from close
30 collaboration with these recreational divers by having them actively involved in monitoring and planning. That
31 is the kind of approach that would instil a sense of pride and place (Hermoso et al., 2021).

32
33 ● Lack of awareness of management measures, and stakeholder engagement

34
35 While there are systems in place to ensure divers abide by sustainable practice, there appears to be a disconnect
36 between what is expected of divers and the information they receive. Furthermore, the access to information
37 is limited, with no user-friendly websites or information pages that explain what it means to dive within the
38 MPA. The permit form is highly generic and does not inform the permit holder of any specific conditions, and
39 similarly does not mention that there are, in fact, any other conditions. There was a consensus among
40 respondents that education on the ‘do’s and don’ts’ of diving within the MPA is insufficient, and that clear
41 guidelines would be useful. Previously, the permits for dive operators and individuals were administered by
42 DEFF, with little control given to SANParks on this process, which may explain the little engagement between
43 SANParks and the dive community. More recently, however, SANParks has taken over the role for dive
44 operators, which could pave the way for higher levels of engagement.

45 Currently, no mechanisms are in place to educate dive operators to ensure that they are aware of environmental
46 issues as well as all codes, practices and regulations associated with MPA management. Nor are measures in
47 place to educate key personnel on proper operating procedures (anon SANParks personnel, 2020, as
48 interviewed). This sort of training could waterfall down to the dive community as operators and club leaders
49 can ensure best practice.

1 Given that more than 40% dive on their own with their ‘buddies’, separately from dive centres or clubs, the
2 importance of ensuring divers are regulated and have access to information is high, since a large proportion
3 dive independently without a regulated body. Simple tools such as social media or interactive applications can
4 be highly effective in reaching the public, and it is through these platforms that updates about consultation can
5 be made or even where online fora can be established to engender a feeling of involvement.

6
7 The inclusion of communities for more sustainable MPA management cannot occur without extensive
8 stakeholder consultation on said management. Much research has shown that often MPAs fail to achieve
9 ecological objectives due to stakeholder conflict, lack of stakeholder engagement and a number of other social
10 factors (Agardy et al., 2011; Christie et al., 2009; Twichell et al., 2018). Stakeholder engagement is highlighted
11 in the TMNP 2015 Management Plan where consultation makes up a primary component of the plan. Important
12 to this process would be consulting with dive operators and clubs in the area, of which there are more than 20.

14 • Limitations

15 It is important to consider limitations in the approach to this study that may affect conclusions drawn on diver
16 knowledge and perceptions towards MPA management. Given travel limitations due to COVID-19 restrictions
17 during the survey period, all respondents were from the local diving community, which affected the
18 composition of recreational scuba divers sampled and the sample size. Important differences between local
19 and international divers have been reported (Hermoso et al. 2019), which may have implications on the
20 effectiveness of suggested management strategies. For example, when considering the design of marine citizen
21 science (MCS) projects based around diving communities, Hermoso et al. (2019) highlighted the need for site-
22 specific MCS strategies based on diver community composition. Simple protocols were suggested in more
23 popular diving areas, whilst medium or long-term programmes were suggested in areas where most divers are
24 local with high return rates.

27 5. Recommendations

28 Based on the results of this research, a series of recommendations has been devised (see Figure 6), that can be
29 applied to the management of the TMNP, but also more broadly to other MPAs of similar contexts.

30
31 At the operator level (including registered clubs), it should be made mandatory that all divers, including
32 qualifying students, have valid MPA dive permits before commencing dive activities (Arin & Kramer, 2002).
33 Working with SANParks, following a best practice of operating procedures to ensure the sustainability of
34 diving within the MPA, particularly in the “no take” zones is recommended. As these areas are sanctuaries for
35 marine life, it is imperative that they are not further degraded to ensure maintenance of their function as
36 breeding and nursery areas to support ecological functioning and fishery restocking purposes. Furthermore, a
37 sustained, mutual, relationship between dive operators and SANParks will be beneficial and could be used to
38 involve divers in conservation-based and citizen science activities to engender a greater awareness,
39 appreciation and understanding of the role of the MPA (Martin et al., 2016), as well as contributing to citizen
40 science and monitoring activities. This relationship can further be used by SANParks to communicate best
41 practices with dive operators and the wider community.

42
43 A priority for SANParks could be the development of an MPA specific management plan. The current TMNP
44 management plan has no specific measures in place for the management of the MPA and no framework on
45 which responses to change are implemented, which is regarded as a highly limiting factor for the management
46 of the MPA (WWF, 2015). Currently the management measures are purely reactive as opposed to proactive,
47 and a lack of prediction or proactive measures makes it “impossible to quantify if an MPA has met
48 expectations” (Nickols et al., 2019, p. 2377).

1 Further work by SANParks, as part of their responsibilities around education, could involve the erection of
2 signboards at popular shore-entry dive sites to ensure divers are aware of the DCoC as well as the implications
3 and conditions of diving within the MPA. As many shore divers dive independently, this is crucial to ensuring
4 that the DCoC and education are delivered to the wider dive community. Access to information could also be
5 improved through the development of a mobile application specific to recreational water users which gives all
6 the necessary updates to regulations, zonation and environmental status. Technology is particularly useful in
7 broadening the distribution of information to the younger generation who will serve as ambassadors for the
8 environment into the future (Rocha et al., 2020). Furthermore, this could provide an anonymous platform for
9 the reporting of abalone or West Coast rock lobster poaching, which is a major conflict that many recreational
10 divers and the management of the MPA face (Brill & Raemaekers, 2013).

11
12 Increased patrols by rangers to ensure all users are valid permit holders can also act as a platform for regular
13 checks to patrol for any activity that may cause damage to protected areas (both coastal and marine). Where
14 most divers indicated that their permits had never been checked, this suggests that much of the activity within
15 the MPA goes unregulated. In terms of funding, the income generated from the permit system, and that paid
16 as levies from dive businesses, could be redirected to the management of recreational water use within the
17 MPA to aid in the ongoing lack of funding. Currently, the use of said income is directed to the Marine Living
18 Resources Fund, from which the distribution of funding is unclear.

19
20 Formal training should take place for all permit issuing staff to ensure that they are conveying the correct
21 information and conditions associated with regulations when applicants receive permits. The DCoC, DEFF
22 Marine Recreational Activities Brochure and MLRA should accompany the permits upon receipt. This could
23 also be improved by consolidating all relevant regulations, information and codes to adhere to in one
24 comprehensive document that is attached to the permit and is available online with easy access. This would
25 prevent the clear disconnect that exists between information and regulation administered and what the divers
26 receive.

27
28 DEFF could take on further responsibility to carry out comprehensive marine spatial planning (MSP) within
29 the MPA to demarcate areas of different water use. This more systematic planning for the use of the MPA will
30 provide divers with a sense of pride and ownership to the areas that are marked out solely for recreational use
31 and ensure the wellbeing of the marine systems in the area. MSP can bridge the gap between the different
32 authorities responsible for varying activities or the management of the MPA as a whole (Douvere, 2008).
33 Comprehensive MSP comprises an integrated process that involves all stakeholders that can help the MPA
34 obtain its objectives.

35
36 Regular workshops and communication should be held to close the gap that exists between users, operators
37 and TMNP Management. This would allow all relevant stakeholders to discuss regulation, conflicts and policy
38 updates that pertain to them and the sustainability of their respective practices. Such stakeholder engagement
39 is imperative to the cooperation of all users and creates synergies between users and management (Day, 2017).
40 Moreover, it can increase aspects of community conservation and citizen science (Twichell et al., 2018), which
41 further contributes to the longevity of the MPA.

42
43 The success of these strategies depends on a collaborative process that involves managers and diving
44 stakeholders in developing adaptive public use planning. Monitoring and evaluation (which can also be
45 supported by citizen science as mentioned above) should be well integrated to evaluate the effectiveness of the
46 proposed actions aimed at the adaptive management of recreational diving alongside other activities in the
47 area.

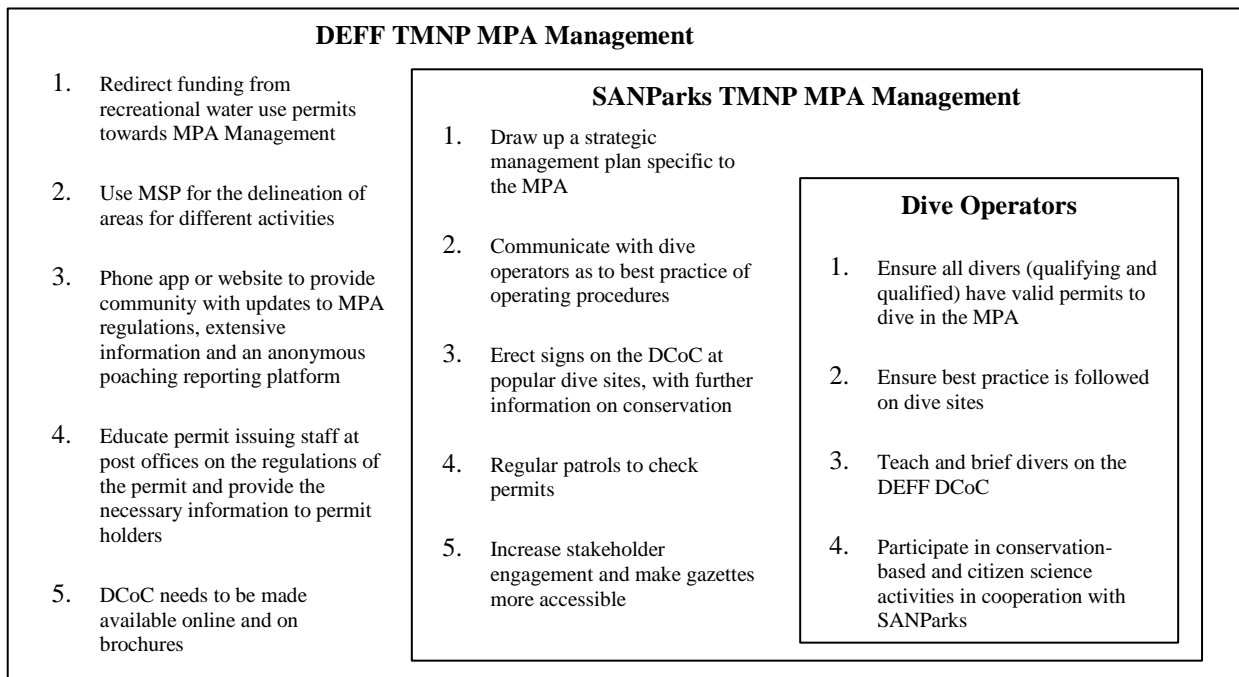


Figure 6: Suggested actions to be adopted by the relevant acting bodies within the TMNP MPA

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6. Conclusions

This research examined the attitudes and perceptions of the recreational dive community of the Cape Peninsula towards the TMNP MPA in which they dive and the management thereof. The results indicate gaps in diver understanding of the MPA, areas which may be improved and a series of recommendations for improved management.

The findings also indicate that divers attach high value to the marine environment and the conservation thereof, but lack understanding as to the role of the MPA in which they dive and question its validity due to lack of accessible information, poor enforcement, poor community engagement and larger scale problems such as poaching. There is also a gap in understanding as to the regulations associated with diving within the MPA, which correlates to poor dissemination of such information by the corresponding administrative agencies.

The results show that divers are generally in favour of well-regulated conservation measures and highly encourage further education of both personnel involved and the dive community itself. Deepening the knowledge of the dive community and operators on the regulations may enhance their compliance and willingness to cooperate on a broader scale of conservation measures. More inclusive engagement with the dive community may help break the stigma associated with the MPA of a failing permit system and poor management. It would be a powerful tool to utilize the passion and knowledge of the divers to the betterment of the environment and enhance compliance with the MPA, particularly through engaging the evidently willing dive community in research as well as monitoring. Combining participatory methods such as citizen science, community education, training and enforcement, and management process engagement can not only build the active community of those contributing to the goals of the MPA but can also enhance the perceptions of the MPAs success (Twichell et al., 2018).

Findings imply positive feedbacks within the system that may strengthen the role of the MPA if funding is redirected to MPA management uses, public participation and the use of citizen science programmes are increased, and education is strengthened. An MPA specific management plan is essential to the future success of the TMNP MPA and would be well supplemented by MSP and further research into the impacts of recreational activities on the Cape Peninsula’s marine environment.

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