



The unique marine ecosystem surrounding Macquarie Island

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Summary Report



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Foreword



King Penguin. Photo: Tui De Roy.

The internationally significant geoh heritage of Macquarie Island and the multitude of undersea features of the Macquarie Ridge are teeming with life in Australia's Sub-Antarctic. While most humans would perceive this environment as hostile and dangerous, here we find a multitude of animals and plants prospering in one of the world's recovering wild places.

This report brings forward the unique properties of the waters of Macquarie Island, in an area of around 478,000 km², contained within Australia's Exclusive Economic Zone which is roughly a circle of 200km radius around the island. The exclusive economic zone is an area beyond and adjacent to Australia's territorial sea and our sovereign rights over this area allow us to explore and use resources, but also bestow on us the responsibility to understand, conserve and manage the environment for all humanity.

The marine environment surrounding Macquarie Island is like no other in the world, and as a marine scientist I have been fortunate to visit. I will never forget the exuberance of marine life; silky kelp surging in the waves, seal pups teasing king penguins, and dozens of giant elephant seals lined up in a sleepy row. Ecosystems representing complex webs of interconnection and supporting astounding biodiversity. This report provides a useful summary of the key features and what we know about their influence on the ecology of this precious marine place. Most importantly it examines how well protected are these features within marine reserves, and finds we need to do better if we are to uphold our duty and protect this unique place in the face of a rapidly changing climate.

This report provides a valuable contribution for all Australians to learn a little more of a place that many will never visit but will want to know is kept as the wild and windswept place in the middle of the vast ocean between Tasmania and Antarctica. I commend the five eminent scientists who are the joint authors of this report for bringing together information on this area that is crucial for its conservation and management, and I look forward to the discussions to reinforce the protection of Australia's most remote island and its waters.

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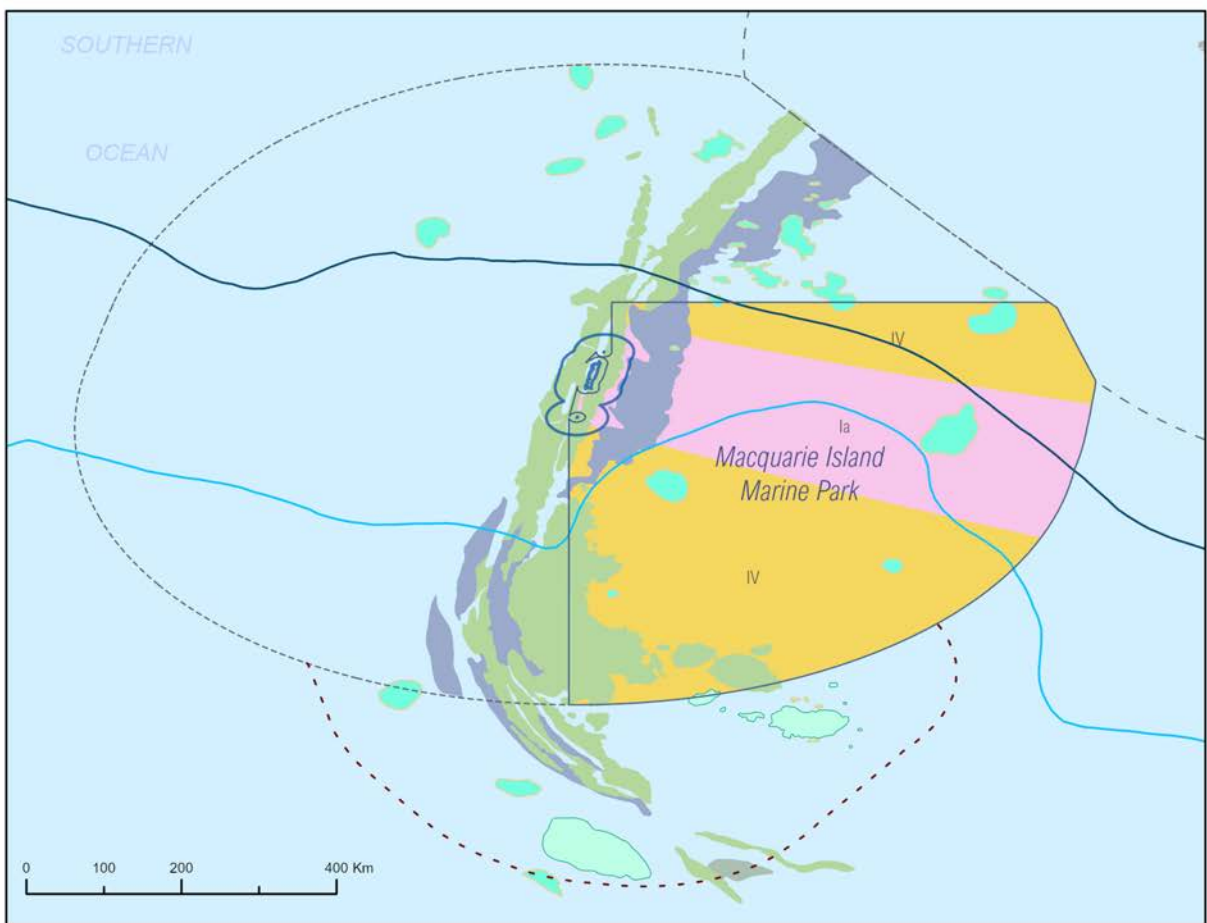
Executive Summary

Macquarie Island lies about 1500 km to the southeast of Tasmania and the Exclusive Economic Zone surrounding it (hereafter referred to as the M-EEZ) constitutes a unique part of Australia's ocean domain. The entire M-EEZ is significant for its geology, oceanography, and ecology. Macquarie Island is the exposed crest of the undersea Macquarie Ridge. Overall, its landscape of steep escarpments, lakes, and Sub-Antarctic vegetation provides an outstanding spectacle of wild, natural beauty complemented by vast congregations of wildlife, including penguins and seals.

Geologically, the area is dominated by the Macquarie Ridge, uplifted at the junction of two oceanic plates, the Indo-Australian Plate and the Pacific Plate. The Macquarie Ridge runs for over 1600 km roughly north to south bisecting the M-EEZ. Macquarie Island is the only place on earth where rocks from the earth's mantle are being actively exposed above sea level. It was on this basis that Macquarie Island and waters around it to 12 nm were designated a World Heritage Area in 1997.

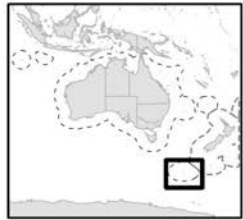
The M-EEZ is also significant oceanographically. The Macquarie Ridge is one of only three such ridges impeding the eastward flow of the Antarctic Circumpolar Circulation (ACC) across the Southern Ocean. This creates significant differences in physical and biological oceanography to the west and east of the ridge. Furthermore, the M-EEZ is divided north to south by two major fronts, the Sub-Antarctic Front and the Polar Front, creating three distinct bodies of water. The M-EEZ is also the point where these two fronts come closest to each other in the entire Southern Ocean.

Ecologically, the M-EEZ is very significant both for its benthic and pelagic ecosystems. The benthic ecology has been best studied along the Macquarie Ridge, including a number of seamounts in the region. There is evidence for changes in community composition north to south, and it is likely that the ridge provides "stepping stones" linking Sub-Antarctic and polar faunas. This bioregion is distinct from others in south-east Australia.



- World Heritage Area
- Macquarie Island Commonwealth Marine Park**
- IUCN Zone type**
- IV - Habitat Protection Zone
- Ia - Sanctuary Zone
- Antarctic circumpolar current fronts**
- Polar Front
- Subantarctic Front

- Geomorphic features**
- knoll/abyssal-hills/hills/mountains/peak
- ridge
- trench/trough
- plateau
- seamount/guyot
- Australian EEZ
- Seas and Submerged Lands (Limits of Continental Shelf) Proclamation 2012
- New Zealand EEZ



Map Info
 Date: February 2023
 Datum: GCS WGS 1984

Data Sources
 Coastal waters and EEZ: © Commonwealth of Australia (Geoscience Australia)
 WHA: © CAPAD 2020

Note: Data sources for all map data can be found in report appendices

Macquarie Island Marine Park

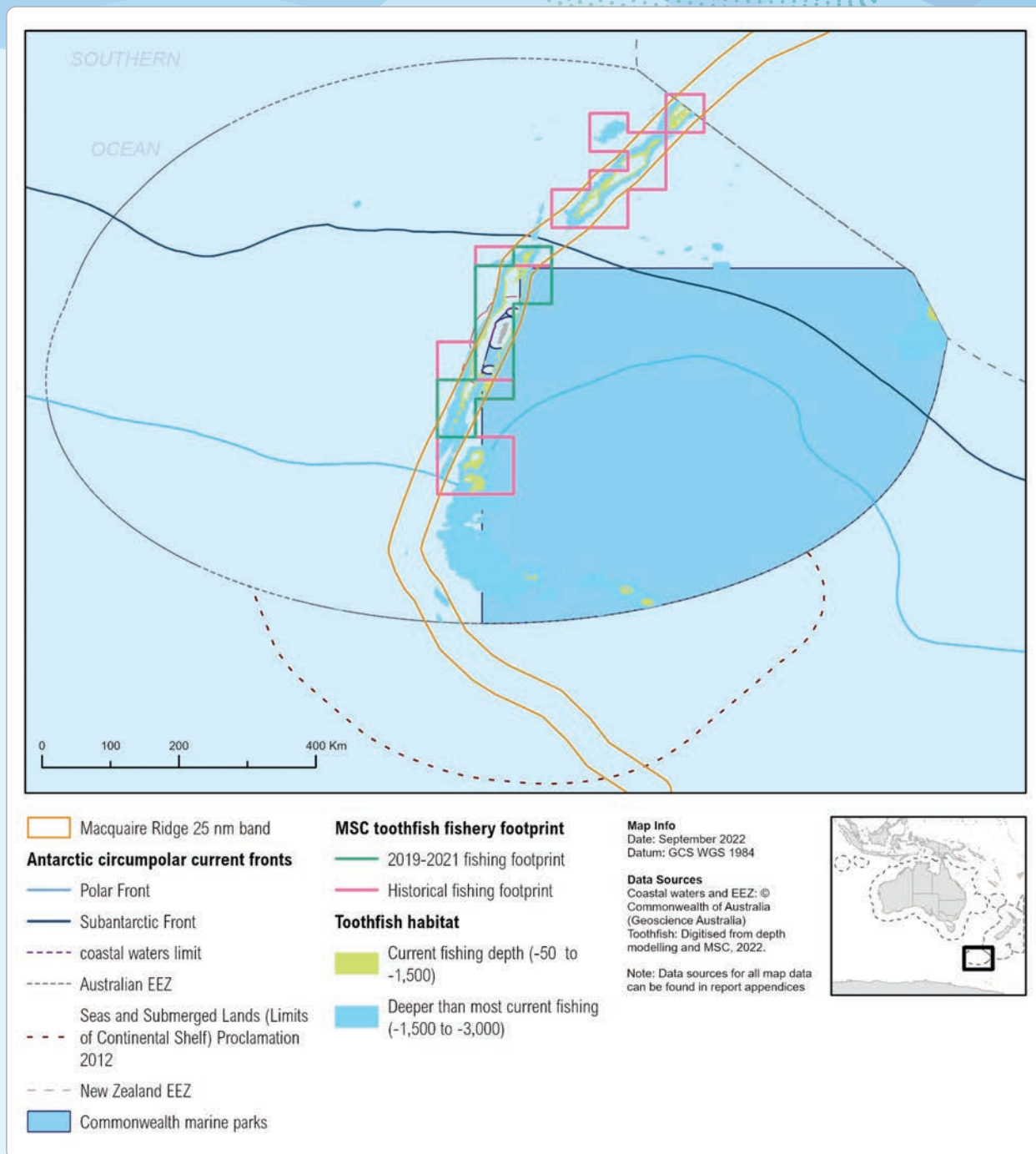


Southern Elephant Seal, Macquarie Island. Photo: J. Cleeland

The pelagic ecosystem is also very significant, comprising a high diversity of seabirds and marine mammals. Fifty-seven species of seabirds have been recorded in the M-EEZ of which 25 breed on Macquarie Island, including four species of penguins and four species of albatross. Two species are endemic to Macquarie Island, the royal penguin and the Macquarie Island imperial shag. Of the seabirds recorded in the region, the wandering albatross is listed as vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the island is listed as Critical Habitat for this species. This albatross is also listed as Endangered in Tasmania under the *Threatened Species Protection Act 1995*. Eight other species of seabirds are listed as endangered and thirteen are threatened or vulnerable. The M-EEZ is also host to three species of fur seals, southern elephant seals, and thirteen species of cetaceans. Seabirds and marine mammals have been recorded foraging widely across the M-EEZ.



Wandering Albatross, Macquarie Island. Photo: J. Cleeland



Fishing Footprint (reproduced from MSC 2022).

Direct human impacts in the M-EEZ are mostly limited to fishing and marine debris, but in the future could potentially include other extractive industries such as seabed mining. The current Patagonian toothfish fishery targets a deep-water species using bottom longlines mostly in the central zone of the Macquarie Ridge. Its impact is currently relatively low on non-target species assuming that its existing footprint does not increase, and it has minimal impacts on the overall environmental values of the M-EEZ. However, some damage is likely to benthic erect sessile fauna by bottom-set longlines. If new fisheries were allowed to develop targeting pelagic or midwater resources these could directly impact the seabirds and marine mammals that forage in the M-EEZ. Encouragingly, following the cessation of 19th Century exploitation of penguins and seals for oil and fur that resulted in their near extirpation, most of the populations have either recovered or are recovering.

The M-EEZ contains several marine parks and reserves (State and Commonwealth). Waters immediately adjacent to Macquarie Island are Tasmanian state waters to three nautical miles and are fully protected. In addition, a Commonwealth Marine Park covers most of the southeast quadrant of the M-EEZ, including a sanctuary zone and two benthic habitat/ species management zones.

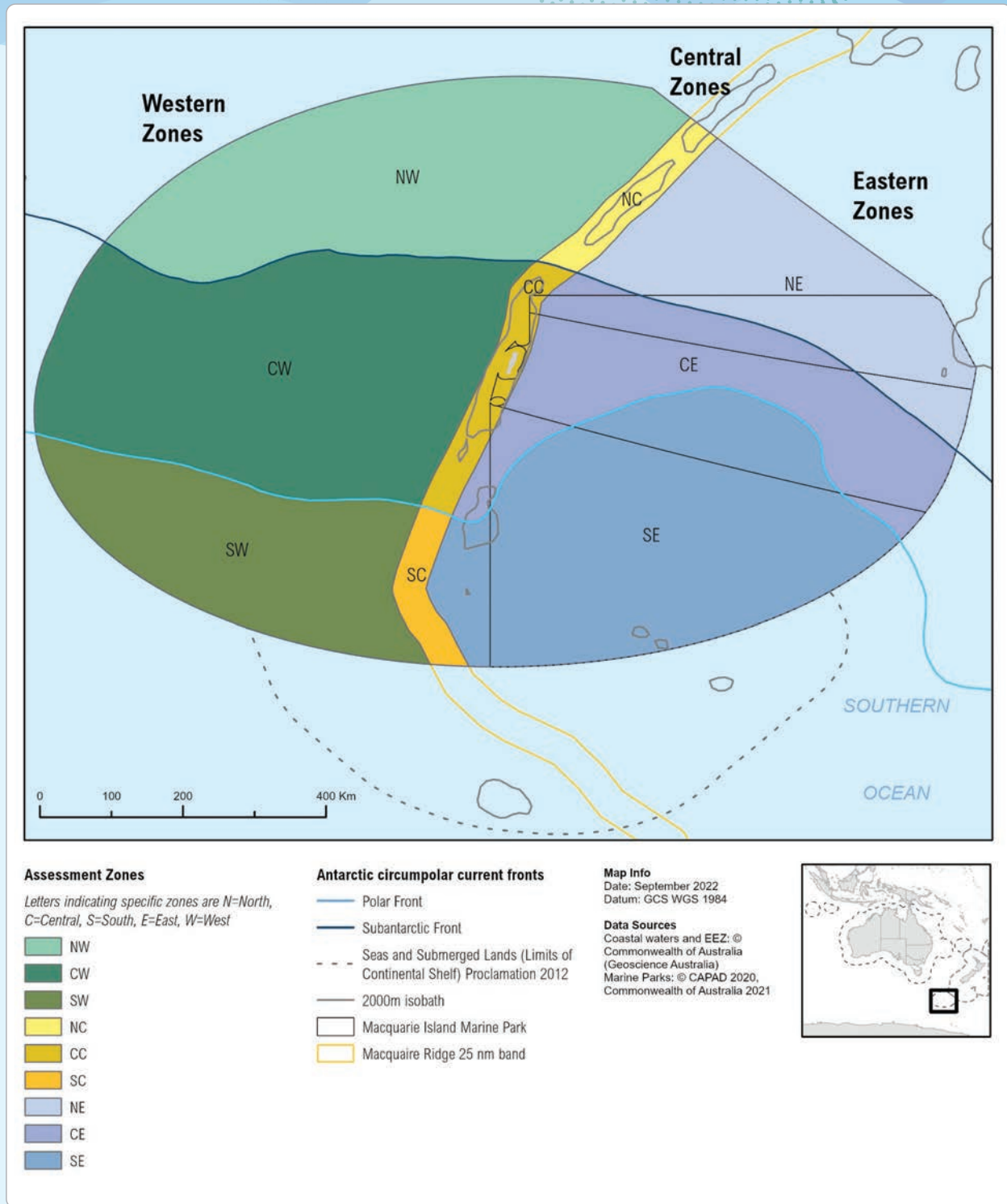
Since the designation of the Commonwealth Marine Park in 1999, our understanding of both the values and the pressures faced in the M-EEZ has advanced. The scheduled review of the Commonwealth Macquarie Island Marine Park in 2023 presents the opportunity to both future-proof for future climate changes, and improve the effectiveness of the marine park through:

- expanding and upgrading its extent and zoning,
- continuing to accommodate the existing, well managed commercial fishery in the waters along the Macquarie Ridge to the north, west and south of the islands.

The Commonwealth Marine Park was incorporated into the regional network of marine protected areas for South-east Australia in 2013, which was established under “CAR” criteria – to be Comprehensive, Adequate and Representative. This report has undertaken further analysis of the Commonwealth Marine Park for the M-EEZ using the CAR criteria, and identified nine Assessment Zones, divided east and west by the Macquarie Ridge and north and south by the ocean fronts. The analysis of the current data available of both the pelagic environment surrounding Macquarie Island as well as the benthic environment, including the known species distributions within these environments, shows the area is not comprehensively or adequately represented by the current marine park. In particular, the entire area west of the Macquarie Ridge is unrepresented, as are most of the northern and southern parts of the Ridge.



Black browed Albatross. Photo: J. Cleeland



Assessment zones used to assess comprehensiveness, adequacy and representativeness of the existing reserve system within the M-EEZ.

Letters indicating specific zones are N=North, C=Central, S=South, E=East, W=West.

The report also considers future threats to the environmental values of the M-EEZ. Ocean warming is expected to result in changes in the South-east Marine Region although the M-EEZ is expected to retain its dynamic oceanography into the future.

The report considers two options to meet the criteria of a CAR reserve system and concludes that the most parsimonious approach would be to declare the whole M-EEZ as a marine park, with increased sanctuary zones as well as a habitat-protection zone over the current fishery area to allow continuation of the sustainable Patagonian toothfish fishery. This provides the simplest, most expeditious reserve design that is relatively easy to implement with no significant impact on the existing fishery, as well as the best protection of the unique geological, oceanographic, and ecological values and importance of the entire Macquarie Island region, and the most resilience to ongoing climate change in the M-EEZ and the South-east Marine Region¹.

Finally, the report notes the potential for future management actions to protect areas of the seafloor and subsoil on Australia's extended continental shelf to the south of the M-EEZ, where Macquarie Ridge extends and features at least one prominent seamount. A seamount sampled in 2008 was observed to contain a ferro-manganese crust and to support gorgonian deep-sea corals. No prominent seamounts were observed and sampled on the Macquarie Ridge immediately to the north in the M-EEZ. This area of extended continental shelf is eligible for inclusion in the South-east Marine Park Network as part of Australia's obligation under the Convention on Biological Diversity (CBD) and possibly through general obligations under the UN Convention on the Law of the Sea (UNCLOS).



Grey-headed Albatross. Photo: J. Cleeland

¹ Six Commonwealth Marine Regions were designated within Australian waters for the purpose of regional marine planning and marine bioregional planning under section 176 of the Commonwealth EPBC Act

Options for expanding the Commonwealth marine park

Based on the analysis presented in the report, two options emerge for extending the coverage of marine parks in the M-EEZ to meet the CAR principles.

- **Option 1:** Extend protection of the entire M-EEZ through designation as a sanctuary zone, with the exception of the existing fishing footprint area, which would be managed as a habitat/ species management zone that allowed sustainable fishing under strict management.
- **Option 2:** Extend the current Commonwealth Marine Park (CMP) to include multiple new sanctuary zones to extend coverage along the Macquarie Ridge and on the western side of the M-EEZ.

Both options seek to minimize impacts on the current, sustainable, Patagonian toothfish fishery. Overall option 1 is considered the most parsimonious way forward, as outlined below in the advantages and disadvantages of the two options.

Furthermore, beyond the current area under consideration, we identify in section 9.1 of the report the potential opportunity in the future to extend habitat protection to the benthic environment in Commonwealth waters south of the M-EEZ on Australia's extended continental shelf.

Option 1

Option 1 would extend the marine park coverage to the whole M-EEZ, with zoning as a sanctuary zone or IUCN Ia, apart from the area of the present toothfish fishery (mainly within the Central/Central AZ) which would be designated as an IUCN IV habitat/species management area allowing the specified multiple use activity of the current fishery.

An IUCN Category Ia is defined as a strict nature reserve, that is a protected area managed mainly for science and is an area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring (Environment Australia 2002).

An IUCN Category IV is defined as a habitat/species management area and is a protected area managed mainly for conservation but that allows for multiple uses with active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species. The zone would be managed primarily to ensure the maintenance of habitats and would seek to ensure that exploitation inconsistent with agreed principles does not occur (Environment Australia 2002).

Option 2

Option 2 would seek to provide comprehensive, adequate and representative coverage of protected zones for all nine Assessment Zones (AZ) identified in our analysis, including to all depth zones within each AZ. Adequate in this option would require at least 30% coverage for all AZ/depth zones, including multiple examples of distinct geomorphic or ecological features where possible. The new areas of marine park would be chosen to minimize impacts on the recent footprint of the toothfish fishery.

Advantages and disadvantages of the options

The advantages and disadvantages of each option are discussed in relation to 1) meeting the CAR criteria for marine park design, and 2) protecting the conservation values of the M-EEZ against future developments in fishing and seabed mining.

Option 1 provides the simplest, most expeditious reserve design that is relatively easy to implement and has no significant impact on the existing fishery. Option 1 provides the best protection of the unique geological, oceanographic, and ecological values and importance of the entire Macquarie Island region.

The advantage of option 1 is that it affords comprehensive protection to the entire M-EEZ while allowing continuation of the current fishery. This option is not expected to impact catches of the current fishery because the catch limits are set for the stock residing in the whole of the M-EEZ. Restrictions on future pelagic fisheries would depend on the details of zoning (IUCN level) across the area (sanctuary zones would preclude any fishing, but habitat/ species management zones may not necessarily preclude pelagic fishing). Mining would be precluded under either category of protection.

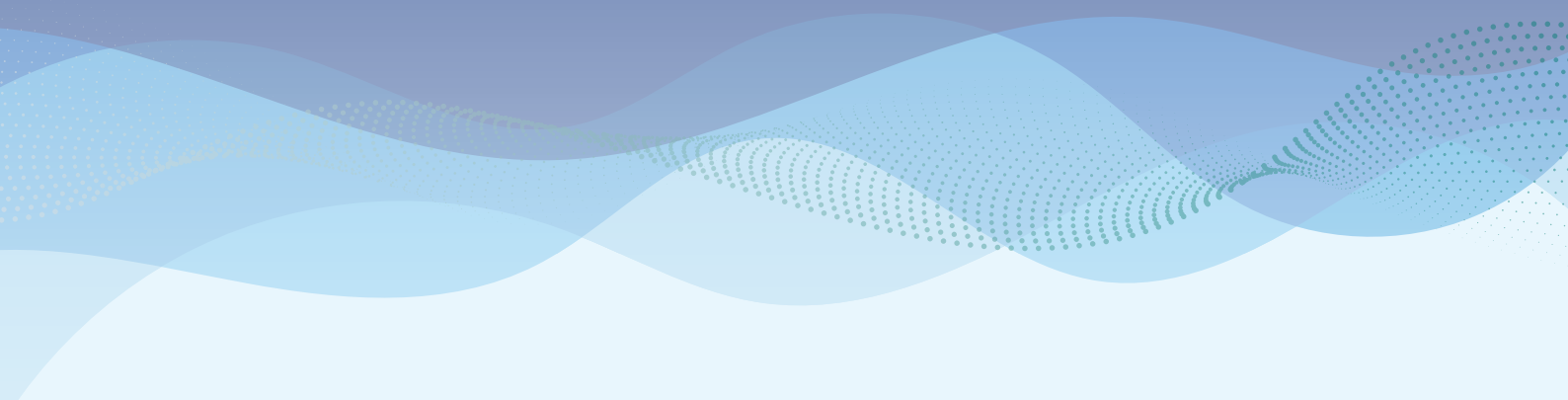
The disadvantage of option 1 is the potential restriction it would place on future economic development within the region, particularly for fishing and mining, possibly also impacting bioprospecting. It would signal a clear priority for protection over development. Should priorities change over time, it would not necessarily preclude future development entirely, but would provide a strong requirement for orderly and careful future development, including prior consideration of environmental impacts, if such developments were later contemplated. Any consideration of changes to the current fishery management arrangements should ensure that the management changes maintain or enhance conditions for a long-term sustainable fishery.

Option 1 also provides the most protection for an uncertain future driven by ocean warming and acidification, noting the added importance of the Macquarie Island province in increasing the resilience of the South-East marine region and the lack of benthic protected areas along the Macquarie Ridge in the adjacent New Zealand EEZ.

Option 2 can be designed to address the current CAR deficiencies of the existing marine park (identified in section 6 of this report) and would go some way towards protecting against future developments in mining and fishing, particularly the possible expansion of fishing to target pelagic or mid-water resources.

Option 2 more explicitly provides some opportunity for future economic activities. However, option 1 also accommodates the current fishery area (noting the need to specifically manage benthic impacts), and like all marine parks is reviewed every 10 years.

However, a challenge for option 2 would be to select adequate protection zones that were not too spatially complex, while meeting the requirement of CAR principles across AZ, depth range, and multiple feature level. For example, it is not good reserve design to protect many small areas that are not contiguous and are scattered across the M-EEZ. Furthermore, it may be difficult to include sufficient area for protection within the Central/Central AZ given the current spatial footprint of the current fishery.



There will also be a remaining challenge for option 2 to adequately protect key predator foraging ranges for seabirds and marine mammals, given their wide patterns of use of the M-EEZ should future fishery developments include pelagic or midwater fisheries. A feature of the M-EEZ is the west-east flow of the Antarctic Circumpolar Current, which under option 2 would require consideration of multiple areas of importance “downstream” of the ACC in the M-EEZ to have sufficient buffering from upstream effects. The potential threat to predators and food chains from future fisheries could potentially be ameliorated by sound fisheries management, including monitoring for any unacceptable ecological impacts, and working in concert with protection offered by the marine parks. The prospects for future seabed mining are unknown at this stage, as are what would be the specific potential areas of interest, adding to the uncertainty of selection of protection zones under option 2.

Consideration of these options highlights the simplistic nature of the IUCN protected area categorization system, and the need to consider marine park management and fisheries management together. The unique nature of the M-EEZ, its conservation values and the current and possible future economy, suggests that the simple categorisation of sanctuary zones and habitat protection zones may not adequately capture all the conservation needs and how these need to be managed in light of the potential for future economic activities, uncertainty around current ecosystem dynamics and the potential for the region to be under pressure from climate change in the future.

Our assessment of historical information/data demonstrates that the M-EEZ has high conservation significance at a global, national and regional scale. Other than the footprint of the current fishery, it is difficult to designate a sanctuary zone as a portion of the M-EEZ to sustainably manage these significant values based on current knowledge. This lack of ability to easily identify areas with lower values indicates the whole M-EEZ warrants protection (option 1).

Conclusions

The analysis of the current data available of both the pelagic environment surrounding Macquarie Island as well as the benthic environment show the area is a complex system that is not comprehensively or adequately represented by the current MPA system. In particular, the entire area west of the Macquarie Ridge is unrepresented, as are most of the northern and southern parts of the ridge.

In the pelagic environment large-scale oceanographic features influence where species occur. Additionally, these are inherently dynamic, with moving boundaries whose positions change over time. In the M-EEZ frontal systems can be used to mark an overall boundary or transition from one area of the ocean to another. Our analysis has identified key features that have a strong influence on the variety of habitats and species that are found in the area. Similarly in the benthic environment, species distributions are determined by topography, latitude, depth and substrate characteristics and are zoned according to specific depth contours associated with differing species compositions. Bringing both these pelagic and benthic features together we have identified nine zones within the EEZ waters surrounding Macquarie Island that are expected to contain differences in biological assemblages. Currently biological data for most of this area is extremely limited. Information obtained from fishing in the area, particularly bycatch information, was not made available in time for this report, but all known other published sources of biological information were examined.

This study has shown the importance of updating the current knowledge of any region prior to any formal review process. For instance, updates to the regional profiles and the conservation values atlas prior to Australian marine park networks planned reviews could be formalised to include the most up to date data of key ecological features, protected species, important species areas, and geomorphic features. The extended continental shelf should be considered in future reviews of Australia's Marine Park networks.

On the currently available science, it is possible to achieve comprehensive, adequate, and representative protection through an extension of marine parks under two options provided here.

- **Preferred option: OPTION 1** – to represent the entirety of the significant biological diversity across the extent of the whole M-EEZ, with little additional research effort required.
- **Alternate option: OPTION 2** – this is considered the secondary option, because it will require significant further research (possibly including additional surveys) to assemble the required data to prioritise the areas in order to meet the CAR principles

