

# **Ocean Beaches and Headlands Assessment Report**

Assessment of recreational fishing access on ocean  
beaches and headlands in NSW marine park sanctuary  
zones

December 2013

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## Introduction

### Background

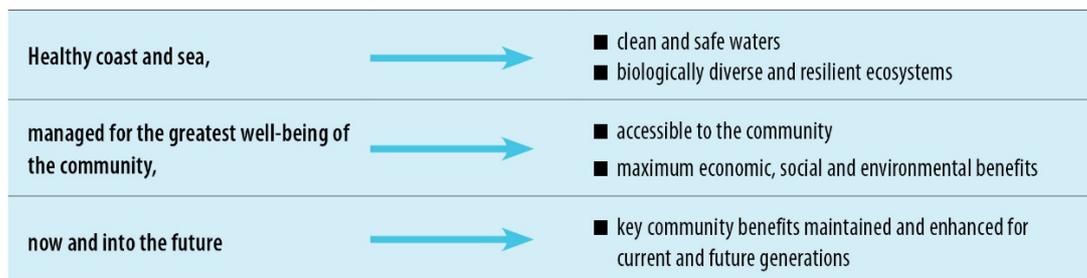
In 2011, the NSW Government commissioned an Independent Scientific Audit of Marine Parks in NSW to advise the government on future management directions for marine parks and on better management of the NSW marine environment generally. The 2012 report of the Audit included recommendations for delivering more effective and evidence based management of the entire marine estate of NSW, including the existing marine parks.

The Audit concluded that information was lacking with respect to some sanctuary (no-take) zones, specifically for ocean beaches. After consideration of the Audit findings, and public consultation during and after the Audit, the NSW Government announced in March 2013 that there would be an amnesty from prosecution for recreational shore-based line fishing in certain marine park sanctuary zones on mainland open ocean beaches and headlands, except in identified areas excluded for the protection of threatened species. The amnesty was to be in place until the threats and risks associated with this activity were assessed. This assessment also considered the risks associated with allowing spearfishing from headlands, noting that existing rules preventing spearfishing from ocean beaches would remain.

### Vision for the NSW marine estate

The Marine Estate Management Authority’s document *Managing the NSW Marine Estate: Purpose, Underpinning Principles and Priority Setting* sets out that the vision for the marine estate is to **have a healthy coast and seas, managed for the greatest well-being of the community now and into the future.**

This vision encapsulates the three key elements of managing the NSW marine estate to maintain and enhance the estate’s natural assets while allowing access and use in a way that maximises the long-term economic, social and environmental benefits to the people of NSW.



**Figure 1: The Marine Estate Management Authority’s vision for the NSW marine estate**

#### Principles

As described in *Managing the NSW Marine Estate: Purpose, Underpinning Principles and Priority Setting*, the Marine Estate Expert Knowledge Panel and Marine Estate Management Authority have agreed to operate in accordance with the following principles:

1. Effective community engagement, to identify and inform key benefits and threats
2. Identification of management priorities will be based on threat and risk assessment
3. To evaluate trade-offs, values will be placed on alternative uses of the marine estate

4. Best available evidence will be used in trade-off decisions, but judgment will still be required
5. The well-being of future generations will be considered
6. Existing access rights will be respected<sup>1</sup>
7. The precautionary principle will be applied
8. Efficient and cost-effective management to achieve community outcomes
9. Management decisions will be transparent and adjust in response to new information
10. Management performance will be measured, monitored and reported and information pursued to fill critical knowledge gaps

Putting these principles into practice will be achieved by following these steps:

- identifying the benefits for current and future generations
- identifying how and where these benefits are under threat
- assessing these risks so management effort focuses on the most important issues
- assessing the adequacy of current management settings
- using the least cost management regime that delivers maximum community benefit
- adapting management over time as new information arises
- measuring the delivery of benefits and report on progress.

### Objectives

The ocean beaches and headlands assessment is being made against the Marine Estate Management Authority's vision for the marine estate. The relationship of the vision and goals to the current assessment is as follows:

#### *Clean and safe waters*

Beach and headland recreational fishing access can result in litter and discarded fishing gear, which can affect the values of some users of these areas. Spearfishing has been banned from ocean beaches (other than the last 20 metres at each end of the beach) for many decades on the grounds of promoting bather safety.

#### *Biologically diverse and resilient ecosystems*

Biological diversity is the variability among living organisms at all levels of organisation, including genetic, species, habitat and ecosystem diversity. The ecological risk assessment has primarily used information on species diversity because there is limited information on the interactions of shore-based recreational fishing on genetic and ecosystem diversity. More intact and natural areas are considered likely to be more resilient to pressures.

#### *Accessible to the community*

Recreational fishing is a highly popular pastime enjoyed by more than one million people in NSW. Providing access to quality recreational fishing areas is a long-standing management priority because it is thought to bring significant social and economic benefits to regional areas.

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<sup>1</sup> The principles define that future management of the estate will **recognise and respect existing rights and arrangements**, but retain the option to modify them over time to maximise community benefits.

### *Maximum economic, social and environmental benefits*

Benefits will be maximised by providing for the widest range of uses (commercial, recreational, Aboriginal, education and scientific study) and, where uses are conflicting, making defensible and transparent trade-offs to determine optimum use or uses.

### *Key community benefits maintained and enhanced for current and future generations*

One of the core principles of ecologically sustainable development is that 'decision making processes should effectively integrate both long- and short-term economic, environmental, social and equity considerations'. This will require the use of an appropriate timeframe for making decisions; adapting management arrangements in response to new information; and monitoring and reporting to ensure progress against the goals of maintaining and improving access, amenity, and ecological condition over the long term.

The principles define that future management of the NSW marine estate will recognise and respect existing rights and arrangements, but retain the option to modify them over time to maximise community benefits.

### **Assessment rules**

#### *What is to be decided*

The decision is whether to allow or not allow shore-based recreational line fishing and spearfishing from ocean beaches and headlands in mainland sanctuary zones. It is a binary decision for each sanctuary zone, although there is the option of allowing fishing or spearfishing in part of a zone.

#### *Dealing with limitations of knowledge*

Limited knowledge can introduce uncertainty into decision making on the basis of ecological risk. These include the likely impacts of shore-based fishing and spearfishing on biological diversity and fish assemblages on ocean beaches and headlands. Marine park sanctuary zones can provide important areas to monitor and understand ecological change and provide fundamental information to guide management over the medium to long term.

Given these limitations, a precautionary approach would include retaining a series of sanctuary zones (or areas within zones) at sites representing the different bioregional, habitat and ecosystem types to deal with potentially unknown impacts and to use as scientific reference sites.

#### *Areas with conflicting uses*

Some areas will have one or more uses (e.g. private and charter scuba diving, snorkelling, education and scientific study) that are in conflict with recreational fishing and spearfishing. Not allowing fishing in one or more of these areas in each park would create sites that can be accessed across most regional areas to cater to the needs of those who wish to experience fish communities in a less disturbed state.

Limited information has been available on areas of special value to Aboriginal communities. Some of these cultural values and uses could be affected by the results of this assessment. Further information will be sought during the community consultation phase.

#### *Cost-effective management*

Compliance costs (including both education and law enforcement) make up a considerable component of expenditure on marine protected areas.

Zones that are easily identifiable by users with a minimum number of boundaries are best for enforcement and compliance. Clear and easily understood enforceable zone regulations have been positively correlated with marine protected area performance.

### *Unique assets and meeting multiple objectives*

Priority should be given to making decisions to allow or not allow fishing to protect unique economic, social or ecological attributes (e.g. site of unique social value such as a high value fishing site, diving site or unique ecosystem type).

Where a number of sites within a marine park (or bioregion) are under consideration, priority should be directed at recommending a decision to allow or not allow fishing based on meeting the greatest number of compatible objectives.

## NSW marine parks

NSW marine parks aim to conserve marine biodiversity, maintain ecological processes and provide for sustainable uses of the marine environment. The six marine parks in NSW cover 345,000 hectares, or around 34 per cent of NSW coastal waters in three of the five marine bioregions. They are currently managed under the *Marine Parks Act 1997*. The principal management arrangements are currently zoning plans that outline what activities are permitted in different areas of the marine park. The criteria for identifying and selecting marine protected areas and associated zones include a range of key biophysical, social, and economic factors. The four types of zones are sanctuary zones, habitat protection zones, general use zones, and special purpose zones.

The guidelines used to develop the current zoning arrangements in NSW marine parks are detailed in the document *Developing a representative system of Marine Protected Areas in NSW – an overview* (NSW Government 2001). The zoning guidelines were used to develop the specific assessment criteria that were applied during the development and reviews of marine parks zoning arrangements. The zoning guidelines are grouped into three categories:

- conservation of natural and cultural resources
- sustainable resource use
- manageability of zones.

Sanctuary zones have the objective of providing the highest level of protection for biological diversity, habitat, ecological processes, natural features and cultural features (both Aboriginal and non-Aboriginal). Other activities that provide for recreational, educational and other uses are permitted if they do not involve harming any animal or plant or causing any damage to or interference with natural or cultural features or any habitat. The sanctuary zones also provide important areas for scientific research.

## Sanctuary zones being assessed

The March 2013 amnesty was applied in marine park sanctuary zones on NSW mainland open ocean beaches and headlands, except in identified areas excluded for the protection of threatened species. This one exception is in a section of the Burrewarra Point sanctuary zone in Batemans Marine Park because of the frequent presence of grey nurse sharks (a threatened species) at this site.

The amnesty does not apply to:

- sanctuary zones in estuaries or in embayments, such as inside Jervis Bay
- marine park sanctuary zones around islands that cannot be reached by land

- Lord Howe Island Marine Park
- the 12 aquatic reserves.

The extent and distribution of sanctuary zones are described as they are currently defined in the Marine Parks (Zoning) Regulation 2009 (this predates the declaration of the amnesty on shore-based recreational line fishing in open ocean beach and rocky headland sanctuary zones). Excluding estuaries, the sanctuary zones range from about 9 to 31 kilometres in total length per marine park; and occupy approximately 5 per cent of the length of the NSW mainland coastline.

There are five mainland marine parks along the NSW coast: Cape Byron (in the north), Solitary Islands, Port Stephens-Great Lakes, Jervis Bay and Batemans marine parks (in the south). Excluding estuaries, ocean sanctuary zones occupy 15–23 per cent of the ocean coastlines within these five marine parks. There are 25 sanctuary zones included in the amnesty: four are in Cape Byron, five are in Solitary Islands, six are in Port Stephens-Great Lakes, four in Jervis Bay and six are in Bateman marine parks. Several sanctuary zones have multiple shoreline locations, and these were assessed separately. This report focuses exclusively on these sanctuary zones which are part of the amnesty.

## Recreational shore-based fishing assessment

The Marine Estate Expert Knowledge Panel assessed shore-based recreational fishing for the sanctuary zones included in the amnesty. This included a risk assessment of ecological values from shore-based recreational fishing activities on ocean beaches and headlands in sanctuary zones, a survey of social values of these areas, and an assessment of economic costs. Components of the assessment included the following:

- The value to shore-based recreational fishers of amnesty-affected ocean beaches and headlands was assessed. This assessment included the likely economic effects on recreational fishers of any future closure of these sites. This component assessed the marginal cost of restricting shore-based recreational line fishing at beach and headland sites that are included in the amnesty.
- Social values were evaluated using both targeted stakeholder interviews and an online survey to gather additional information on social values associated with beaches and headlands, particularly relating to beaches and headlands in marine parks and the current recreational shore-based fishing amnesty.
- An ecological risk assessment was also conducted on the effects of shore-based recreational fishing, including spearfishing, on open ocean beaches and rocky headlands in NSW sanctuary zones. The ecological assets (or values) assessed relate to those associated with nearshore areas on and adjacent to the ocean beaches and headlands. These were intertidal and subtidal ocean soft-sediments (beaches) and rocky reefs (headlands), fish assemblages, and threatened fish and shorebird species associated with these habitats.

The ecological risks were assessed against specific objectives using a qualitative risk assessment approach based on the International Standard (ISO 31000, 2009) that calculates a risk level from the most appropriate levels of consequence and likelihood. This approach is consistent with that used in many places in Australia and internationally for assessing risk, and it has been identified in *Managing the NSW Marine Estate: purpose, underpinning principles and priority setting* as a key component of the overall threat and risk framework currently being developed that will be applied in broader assessments of NSW marine estate management.

Separate technical reports are available on the economic, social and ecological components conducted as part of this overall assessment.

## Ecological characteristics of beaches and headlands

### Ocean beaches

There are more than 700 beaches along the NSW coast. They differ in their beach type, length, habitat configuration, exposure and sediment composition. Due to their exposure to wind and swell, they are dynamic environments. The exposure and resulting sediment movement is reduced in some beaches by intertidal reefs and subtidal rocky reefs immediately offshore. Different beach types and environments within beach systems support characteristic faunal assemblages, which are determined to a large extent by the size of particles making up the sediment. Detached algal material commonly found drifting in the surf zone after heavy seas also supports characteristic assemblages of organisms.

A diverse range of invertebrate species can occur below the sand surface, the most obvious being the larger animals such as pipis and beach worms. There is also a diverse range of smaller species that live within the sediment, including algae and crustaceans that are an important part of the food chain in this habitat. The shallow subtidal areas of sandy beaches are important spawning, nursery or feeding areas for a variety of fish species such as Australian salmon, sea mullet, sand whiting, yellowfin bream, tailor and several flathead and stingray species. The composition of fishes on beaches changes along the NSW coast, with an increasing number of tropical and subtropical species occurring along the north coast. Two threatened shark species (the grey nurse shark and white shark) occasionally move through the shallow waters along ocean beaches. Sandy beaches are also key foraging and roosting sites for shorebirds and seabirds, including threatened species such as the little tern, pied oystercatcher and beach stone-curlew.

### Rocky reefs (headlands)

The broad distribution of intertidal and subtidal rocky reefs on the ocean coast of NSW reflects the patterns of the regional and local geology. Along most of the coast, there are prominent rocky reef outcrops adjacent to most headlands, and there are also some significant reef systems immediately offshore of ocean beaches in all regions. The structure of rocky reefs can vary greatly, depending on the dominant rock type, exposure and slope, and there is evidence that an increase in the complexity of the rocky reefs increases the number of 'microhabitats' that could increase the diversity of species in an area. There are often distinct patterns of marine invertebrates, rockpool fishes and algae within intertidal rocky reef habitats, although there are local variations that are thought to be determined by levels of exposure, wave action, complex biological interactions (such as competition, predation), patchiness in recruitment, and the history of disturbances. Rocky shores are also an important habitat for threatened birds (particularly the sooty oyster catcher): some species are resident, and others are migratory and appear annually.

Shallow nearshore rocky reefs have been mapped along the entire NSW coast, although there is only limited information about the distribution of the animals and plants that dominate the rocky reef habitat at the local level. Shallow nearshore rocky reefs contain habitats known as fringe, turf, kelp, urchin barrens, ascidian and sponge, but there is considerable local variations in their extent. Shallow rocky reefs also contain a diverse assemblage of fish and invertebrate species, which range from small cryptic residents through to transient species that move between reef systems. Abundant fish species include snapper, red morwong, yellowfin bream, luderick, rock blackfish (drummer), wobbegongs, bullseyes, eastern blue groper, and many species of wrasse and leatherjackets. Many pelagic migratory species also regularly occur on shallow reefs, including yellowtail kingfish, silver trevally and yellowtail scad. These fishes vary considerably in their ecology and life history characteristics (for example, their distribution, habitat use, movement, and age and growth).

The composition of fishes on shallow reefs changes along the NSW coast, with an increasing number of tropical and subtropical species occurring along the north coast. In addition, several threatened fish species

are encountered on, or in waters adjacent to, rocky reefs along the NSW coast, including grey nurse shark, white shark and black rockcod.

## Summary of the economic, social and ecological assessments

### Economic assessment

An economic study assessed the marginal cost of restricting shore-based recreational line fishing at beach and headland sites that are the subject of the current amnesty in NSW Marine Parks. Recreational fishers in three NSW Marine Parks were interviewed to gain a better understanding of their site preferences and their most likely behavioural response to restricting access to these amnesty sites. Fishers were asked about site attributes and their site selection processes. These were used to rate the quality of all beach and rocky headland sites within the selected marine park for shore-based fishing – including sites under consideration and alternative fishing sites. The following findings have been considered by the Panel:

- Restricting fishing at the majority of amnesty sites examined is unlikely to impose any additional cost to fishers as there are sites of comparable quality to these amnesty sites within fishers' normal walking distance from the access point.
- There are a small number of sites examined where fishers could walk to a site that is of comparable quality to the amnesty site, but this would entail walking further than they would normally (1.3 kilometres), and the additional distance travelled was considered in the assessment.
- There were a number of sites where fishers cannot walk to a site of comparable quality to the amnesty site – that is, no site of comparable quality exists within their walking limit (1.3 kilometres) – the cost of travelling by car to an alternative site was also considered in the assessment.

The costs to shore-based recreational line fishers of restricting access to amnesty sites, as reported above, are notably low. This arises from the fact that NSW has implemented a multiple-use marine park system and readily accessible alternative sites are available in most locations.

Although this assessment estimates only the cost of restricting shore-based recreational fishing at amnesty sites, any change in the distribution of fishers along the coastline could represent a cost or benefit to other recreational users. This is especially likely for groups who could come into conflict with fishers over use of the resource, such as swimmers, snorkelers, divers and kayakers.

### Social assessments

#### Interviews

A number of in-depth, semi-structured interviews were conducted with coastal users in two marine parks to provide detailed information about the threats to the social values associated with beaches and headlands. These were conducted across a spectrum of the community, including surfers, recreational fishers, commercial fishers, spearfishers, passive users, divers, snorkelers, kayakers and coastal community groups. This social research suggests that these coastal users fit into two groups that can be categorised as an 'ecological' cultural model and a 'community' cultural model.

Those who fit into the ecological cultural model give primacy to ecological function and connectivity, prioritising these objectives over other social and economic objectives. This model gives priority to 'no take' or national park style protection as the highest and most ideal form of protection of the marine environment. Those who fit in the community model prioritise the coast as a place of social interaction and community use and emphasise the importance of traditional and cultural uses of marine resources to local communities. Both groups supported a threat-based approach to assessing whether the amnesty on shore-based recreational fishing in coastal sanctuary zones should continue.

There was a general agreement in both groups that shore-based recreational fishing poses minimal ecological risk to the beach environment. The interviews indicated that headlands are seen as a more complex social and ecological environment, and that the primary threats to social values associated with allowing shore-based recreational fishing from headlands were identified as issues associated with equity values and ecosystem conservation values. Equity values centred on perceptions of preferential treatment of some user groups (shore-based line fishers) over others (spearfishers, boat-based fishers, commercial fishers), while ecosystem conservation values are associated with the more complex biodiversity values of headlands, and the perception that weakening sanctuary zone restrictions could result in disillusionment and disappointment amongst people who value no-take areas.

The study concluded that the threats to social values from allowing or not allowing shore-based fishing from headlands will vary from site to site according to their accessibility, physical or geomorphological features, and their social importance.

### Online Surveys

Online surveys, consisting of two components, were conducted to better understand how the broader community values ocean beaches and headlands in NSW marine parks and to gather views on the future management of these areas. The first survey comprised an invitational (known respondent) targeted email to almost 80,000 contacts drawn from NSW DPI's electronic newsletter. This group of respondents primarily included purchasers of a recreational fishing licence (n=77,905) and a small list of community stakeholders (n=650). The second component comprised an open call for responses. The two surveys generated a significant level of interest with a total of 6607 people completing the survey.

The respondents used ocean beaches more than rocky headlands. Popular uses included fishing, swimming, snorkelling, diving, surfing and walking. There were also people who enjoyed sitting or relaxing at these places. Survey respondents could be categorised into two groups:

- 'fishers', who fish from the shore or from a boat
- 'non-fishers' who are most likely to swim, surf and walk on their own.

Natural beauty and the suitability of an area for a preferred use were values common to both groups. Not surprisingly, fishers valued accessibility for fishing. Activities that were identified as most likely to positively affect values for non-fishers were snorkelling, diving and surfing. Both respondent groups indicated that four wheel drives and jet skis can have a negative impact on their enjoyment, while non-fishers also identified fishing as negatively impacting on their values.

The majority of fishers felt the amnesty should stay in place, while the majority of non-fishers would like to see the amnesty removed from these areas. Ten per cent of those respondents who identified themselves as fishers felt the amnesty should be lifted completely, while almost a quarter felt that the amnesty should be lifted in some sanctuary zones. Of the non-fishers, ten per cent said the amnesty should not be lifted at all sites, and about a quarter felt that that amnesty should be lifted in some sanctuary zones. The findings of the survey are consistent with the views identified in both the economic and social interviews as outlined above.

### Other social issues

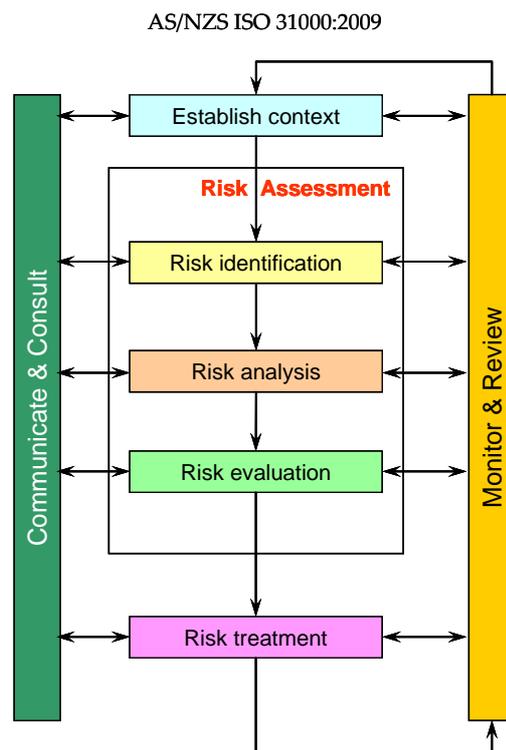
In order to qualitatively evaluate the level of potential social risk and access conflict at the sites being assessed, the number of known non-fishing social uses was assessed for each sanctuary zone and ranked as minimal (0–2), low (3–5), moderate (6–8), and high (more than 8).

Each sanctuary zone was also assessed in terms of the current levels of monitoring or scientific study, and ranked as low, moderate or high based on the following criteria:

- Low – locations where neither scientific monitoring occurs or surveys of ecological assets have been conducted.
- Moderate – locations where the habitats, fish assemblages or threatened species have been surveyed in order to document the ecological assets.
- High – locations that are part of a regular and ongoing scientific monitoring program examining changes in habitats, fish assemblages or threatened species between areas of varying zoning arrangements.

### Ecological risk assessment

The ecological risks associated with shore-based recreational fishing in marine park sanctuary zones was assessed using a qualitative assessment approach that determines the most appropriate levels of consequence and likelihood from which a risk level is calculated. This assessment uses the international standard definition of risk which is defined as ‘the impact of uncertainty on achieving objectives’ (ISO, 31000; 2009). The risk analysis process involves several stages: risk identification, analysis and evaluation (Figure 2). This process follows the establishment of the risk context, which defines the undesirable outcome that occurs as a result of an activity that will have an effect on the objectives. The risk analysis stage combines the scores from the ratings of consequence (levels of impact) and the likelihood (levels of probability) of a specific consequence to generate a risk score and risk rating. These were then grouped into four ratings of minimal, low, moderate and high (Table 1). The relative level of impact and likelihood levels were determined within a five-year time frame given the current management controls that are already in place.



**Figure 2: Outline of risk analysis and management process applied to assess the ecological risk marine assets in this assessment**

The habitats under consideration were intertidal and subtidal ocean soft-sediments (beaches) and rocky reefs (headlands). The extent and distribution of these habitats were mapped, and the direct impacts on these habitats as a result of shore-based recreational fishing assessed, while the secondary impacts of such things as changes to predator–prey relationships were not considered. In each sanctuary zone the dominant habitats were assessed, which in some locations included both beach and rocky reef habitats. Captured fish assemblages and a number of key threatened fish and shorebird species associated with these habitats that were likely to interact with shore-based fishers were also assessed. Threatened fishes include grey nurse shark, white shark and black rockcod, and threatened shoreline bird species included pied and sooty oystercatchers, osprey, beach stone-curlew and the little tern.

A number of stressors of shore-based recreational fishing that can interact with these habitats and species, directly or indirectly were assessed, namely direct capture through harvesting, catch and release, bait collection and use, non-compliance with fishing rules, or indirectly through lost gear, and disturbance (including physical damage or disruption, litter, fish cleaning). The level of shore-based recreational fishing pressure, together with the levels of resilience of the different marine habitats and associated species, resulted in estimates of risk levels for the range of ecological assets in the sanctuary zones. The resilience characteristics of fishes that were considered in the assessment relate to their ecology and life history characteristics such as their distribution, habitat use, movement, and age and growth.

The results of this risk assessment are presented for each mainland marine park ocean beach and headland sanctuary zone in the following sections of this report. Only the highest ecological risk component is presented, including the key components that are attributed to this risk level. Several sanctuary zones have multiple shoreline locations, and these were assessed separately. If both beach and rocky reef habitats were assessed at a location, risk levels are only reported separately if they differed.

Both consequence (C) and likelihood (L) levels for each ecological asset are provided. For example, this is presented as:

*Risk: C2 L3 (Minimal)*

Where the C2 refers to the consequence level of ‘minor’ in Table 1, and the L3 refers to the likelihood level of ‘possible’ in Table 1.

**Table 1: Risk levels determined in the assessment of risks to ecological assets**

LIKELIHOOD	LEVEL OF RISK				
ALMOST CERTAIN					HIGH
LIKELY					
POSSIBLE			LOW	MODERATE	
UNLIKELY					
RARE	MINIMAL				
CONSEQUENCE LEVEL	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC

## Assessment limitations

There are limitations to estimating risks to the economic and social values and ecological assets associated with shore-based recreational fishing in ocean beach and rocky headland sanctuary zones.

Firstly, the ecological risks estimated during this assessment assessed only the risks of direct impacts on individual fish populations and direct impacts on habitats from physical damage. Consequential or indirect impacts, such as changes to predator-prey relationships, have been shown to occur as a result of fishing activities and to have significant effects on habitat effects associated with rocky reefs; however, these ecological risks were not able to be considered during this assessment. The assessment also addressed only the risks of impacts associated with a single human activity (shore-based recreational fishing) in marine habitats that occur on beaches and rocky headlands, and therefore it was not possible to assess the cumulative impacts from other users and threats to these areas.

Shore-based recreational fishing on its own in a small portion of the coastline might appear to have little effect on habitats and fish assemblages, but in combination with other human pressures, it could lead to negative consequences that will go undetected in this narrowly focused ecological risk assessment, and the issues needing to be addressed to reduce the risks might not be identified. Also, risk levels could be underestimated because the potential negative consequences of shore-based recreational fishing might become apparent only at larger temporal or spatial scales. Therefore, it is important that the results for this component of the project are not assessed out of context.

Secondly, there was only limited time and resources available to evaluate the economic and social risks. This meant there was a restricted capacity to conduct stakeholder assessments across all marine parks and sanctuary zones; and the capacity to evaluate risks to secondary components was also restricted. For example, the estimated cost of restricting shore-based recreational fishing at amnesty sites was assessed for the fishers only, although any change in the distribution of fishers along the coastline could also represent a cost or benefit to other recreational users. Therefore, it is important that the results for these components of the project are not assessed out of context.

In addition, the risk associated with hand gathering while conducting spearfishing activities was not assessed. It related specifically to the risks to fish associated with the use of a speargun.

## Cape Byron Marine Park – assessment of fishing in sanctuary zones

The Cape Byron Marine Park is located on the far north coast of NSW in the shires of Byron and Ballina. It extends from Lennox Head in the south to the northern breakwall of the Brunswick River in the north. The marine park covers an area of around 22,000 hectares from the mean high water mark and upper tidal limits of coastal estuaries for three nautical miles to the limit of the NSW State waters. It was declared on 1 November 2002; the current zone plan commenced in May 2006.

The marine park contains a diverse range of estuarine and ocean habitats, including sandy beaches, rocky shores, subtidal soft sediments and reefs, and emergent rocks and islands, the largest being Julian Rocks. The Brunswick River is the largest estuary in the marine park at around 220 hectares, and it contains large areas of seagrass, saltmarsh and mangroves. There are two smaller creeks that are open only intermittently. Marine life includes many species of fish, marine reptiles and mammals, seabirds, and seabed-associated invertebrates such as sponges and corals. Threatened marine species that occur in the marine park include grey nurse shark, black cod, several shorebirds and sea turtles.

Aboriginal people continue to obtain social, cultural and non-commercial benefits from the marine environment in and adjacent to Cape Byron Marine Park. Sites of cultural significance to Aboriginal people include Julian Rocks, Cocked Hat Rocks (known as the Three Sisters), Cape Byron, and beaches around Broken Head. Maritime heritage is represented in the park, and the most notable wrecks in the area are the Wollongbar and the Tassie II. There are also two old jetties adjacent to Belongil Beach, one dates back to 1888.

Tourism is a significant contributor to the local economy, and marine tourism is a major focus for visitors. Swimming, walking and running, and beach-going are popular activities. Surfing is one of the most popular pastimes in Byron Bay, attracting many visitors to the region annually. Several renowned surf breaks, such as The Pass, Broken Head and Lennox Head, are located within the marine park. Some locals and visitors are recreational fishers.

Surveys to inform the development of the Cape Byron Marine Park zoning plan identified this broad range of recreational users in the park, with recreational fishers ranked as the sixth most prevalent user group, after swimmers, walkers and runners, beach-goers, whale and dolphin watchers, and surfers. Pre-zoning surveys of user groups identified recreational fishing to be mainly concentrated in the Brunswick Heads estuary, the adjoining Brunswick Beach, Tallow Beach, Broken Head, Seven Mile Beach and Lennox Head.

Whale and dolphin watching is a popular and economically important activity, and Cape Byron is recognised as one of the premier land-based whale watching sites on the NSW coast. The marine park attracts national and international visitors to dive and snorkel in its waters. Snorkelling is most popular within the Byron Bay embayment. The Wreck, Middle Reef, Julian Rocks, Lennox Head and White's Beach have been identified as popular locations for this activity. The majority of scuba dive sites are in the vicinity of the Byron Bay embayment and the majority of divers use one of the two charter operators in Byron Bay or another charter operator from Brunswick Heads.

Commercial fishers operate in the marine park on a regular basis and participate in the following fishing activities and methods: prawn trawling, spanner crab netting, trap and line fishing, commercial bait gathering and beach hauling.

Table 2: Summary of risk associated with allowing recreational line fishing in ocean beach and headland sanctuary zones in Cape Byron Marine Park

Sanctuary Zone	Habitat/location Main type	Direct risk to habitats & captured fish assemblages	Risk to threatened species	Social risk to line fishers*	Social risk/access conflict	Risk to scientific reference sites	Economic risks to fishers if fishing is not allowed **	Comments: Including notable diving or snorkelling sites
Byron Bay	Beach: Tyagarah	Minimal	Minimal	Low	Low	Low	Low	
	Beach: Belongil	Minimal	Moderate (birds)	Low	Low	Low	Low	
	Beach: Wategos/ The Pass	Minimal	Low (fish)	Low	Moderate	Low	Low <sup>(1)</sup>	Snorkelling
	Rocky reef: East Cape Byron	Minimal	Low (fish)	Low	Minimal	Low	Low	
Broken Head	Beach and rocky reef	High (fish)	Low (fish and birds)	Low	Low	Low	Low	Snorkelling
Lennox Head	Rocky reef	Low (habitats)	Low (birds)	Low	Minimal	Low	Low	Snorkelling
The Moat/ Bream Hole	Rocky reef	High (fish)	Low (birds)	Low	Moderate	Moderate	Low	Snorkelling

\* Note: this relates to the social risk to recreational fishers of maintaining the amnesty – i.e. allowing shore fishing in these in these areas (estimated from online survey that over 60% of fishers indicated that they supported maintaining the amnesty).

\*\* Note: this is the economic risks to fishers if the amnesty is removed and fishing is not allowed in these areas.

(1) While costs were considered low, this site accounted for the majority of costs associated with restricting access within Cape Byron Marine Park.

## The Byron Bay Sanctuary Zone

The Byron Bay Sanctuary Zone is a large zone that includes the Byron Bay embayment; approximately 3.6 kilometres of Tyagarah Beach near Brunswick Heads; offshore waters of Tyagarah Beach; a small section of beach 500 metres either side of Belongil Creek mouth; Julian Rocks; a small section of Cape Byron; and a transect east of Cape Byron to the outer boundary of the marine park. The shoreline components of this sanctuary zone consist of four separate sections that have a total coastline length of 6.5 kilometres, including northern Tyagarah Beach, the section of beach adjacent to Belongil Creek mouth, The Pass and Wategos Beach, a section of the eastern side of Cape Byron.

### Northern Tyagarah Beach

Part of the Byron Bay Sanctuary Zone.

#### *Ecological assets – habitats and fish assemblages*

The intertidal and nearshore subtidal habitats in this area contain only soft sediment habitats.

*Habitat risk: C1 L4 (Minimal)* – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk: C2 L3 (Minimal)* – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’. This reflects the relatively remote location of this zone, the similar beach habitat open to fishing on either side of the zone, and the relatively high resilience and abundance of the likely harvested species, which includes tailor, dart and yellowfin bream. It was considered ‘possible’ that this level of impact would occur from shore-based recreational fishing due to the level of access and the ability to fish along its length once the location is accessed.

#### *Ecological assets – threatened species*

The area possibly has white sharks and grey nurse sharks traverse it. Pied oyster catchers (vulnerable) and little terns (endangered) inhabit Tyagarah Beach.

*Risk: C2 L3 (Minimal)* – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing due to the possibility of sharks traversing through the area. It was considered ‘possible’ that this level of impact would result due to the level of activity and type of fishing.

*Risk: C2 L3 (Minimal)* – In terms of consequence, the potential impact on birds (pied oyster catchers (vulnerable) and little terns (endangered) of shore-based recreational fishing was considered ‘minor’ due to levels of disturbance on resting and foraging area. It was considered ‘possible’ that this level of impact would result due to the level of access.

#### *Social values – social uses*

This beach is relatively inaccessible except by walking, and provides the user the closest experience to a wilderness experience in the marine park.

*Risk: Low* – The main social risk of maintaining the amnesty at this sanctuary zone relates to the likely pressure to re-open the beach to motorised vehicles, although this risk could be managed by declaring a marine park closure to motorised vehicles in this area.

#### *Social values – scientific reference site*

The area is used at times for assessing pipi populations.

*Risk: Low* – The level of recreational pipi harvest is not expected to affect monitoring.

### **Belongil Beach – the section of beach adjacent to Belongil Creek mouth**

Part of the Byron Bay Sanctuary Zone.

#### *Ecological assets – habitats and fish assemblages*

The intertidal and nearshore subtidal habitats in this area are dominated by soft sediment habitats and a relatively small area of subtidal reef.

*Habitat risk:* C1 L4 (Minimal) – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C2 L3 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’. This reflects the fact that similar beach habitat is open to fishing on either side of the zone, and the relatively high resilience and abundance of the likely harvested species, which includes tailor and dart. It was considered ‘possible’ that this level of impact would occur from shore-based recreational fishing due to the ability to fish along its length once the location is accessed.

#### *Ecological assets – threatened species*

Beach stone curlews (critically endangered) occur in this area. Pied oyster catchers nest at this location. Little terns rest here in significant numbers during the summer migration. This is an important location for these species in the region.

*Risk (fish):* C2 L2 (Minimal) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing due to the possibility of sharks traversing through the area. It was considered ‘unlikely’ that this level of impact would result due to the level of activity and type of fishing.

*Risk (birds):* C3 L4 (Moderate) – In terms of consequence, the potential impact on several threatened shorebirds of shore-based recreational fishing was considered ‘moderate’ due to levels of disturbance to nesting (pied oyster catchers), and resting and foraging areas (little terns). It was considered ‘likely’ that this level of impact would result as the site is easily accessed and disturbance easily occurs.

#### *Social values – social uses*

This area is valued as a wildlife observation point (seabirds and shorebirds).

*Risk:* Low – The risk is conflicting use between wildlife observers and recreational fishers.

#### *Social values – scientific reference site*

Regular bird monitoring occurs here.

*Risk:* Low – Recreational fishing might contribute some risk to ongoing bird monitoring.

## The Pass and Wategos Beach

Part of the Byron Bay Sanctuary Zone.

### *Ecological assets – habitats and fish assemblages*

The intertidal and nearshore subtidal habitats in this area are dominated by soft sediment habitats, with small areas of intertidal and subtidal reef.

*Habitat risk:* C1 L4 (Minimal) – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C2 L4 (Low) – The potential impact of shore-based recreational line fishing and spearfishing on fish assemblages was considered ‘minor’. This reflects the easy access to this location, and the relatively high resilience and abundance of the likely harvested species, which includes tailor, dart and yellowfin bream. It was considered ‘likely’ that this level of impact would occur from shore-based recreational fishing due to the ability to fish along its length once the location is accessed.

### *Ecological assets – threatened species*

Sooty oyster catchers feed on the rocky shore section of this sanctuary zone, and grey nurse sharks and white sharks are known to occur here.

*Risk (fish):* C3 L3 (Low) – In terms of consequence, the potential impact of shore-based recreational line fishing and spearfishing was considered ‘moderate’ for line fishing due to the known presence of sharks traversing and feeding in the area. It was considered ‘possible’ that this level of impact would result due to the level of activity and type of fishing.

*Risk (birds):* C2 L3 (Minimal) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ on birds (sooty oyster catchers) due to the levels of disturbance. It was considered ‘possible’ that this level of impact would result due to the relative level of access by all others users.

### *Social values – social uses*

The main use at these beaches and headlands is surfing and swimming. The number of recreational fishers is low. The area is also used for commercial kayak tours.

*Risk:* Moderate – There is a moderate number of uses of the areas associated with The Pass and Wategos Beach. There is a risk of increased recreational line fishing numbers related to increased competition with other users (principally surfers) for access (parking). There would also be moderate–high risk associated with spearfishing.

### *Social values – scientific reference site*

Regular dolphin monitoring occurs here.

*Risk:* Low – Recreational fishing might contribute a low risk to ongoing dolphin monitoring.

## Eastern Cape Byron

Part of the Byron Bay Sanctuary Zone.

### *Ecological assets – habitats and fish assemblages*

The intertidal and nearshore subtidal habitats in this area are dominated by soft sediment habitats, with small areas of intertidal and subtidal reef. Grey nurse sharks, white sharks and turtles occur here.

*Habitat risk: C1 L4 (Minimal)* – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk: C2 L3 (Minimal)* – The potential impact of shore-based recreational fishing and spearfishing on fish assemblages was considered ‘minor’. This reflects the difficulties in access to this location, and the relatively high resilience and abundance of the likely harvested species, which includes tailor and luderick. It was considered ‘likely’ that this level of impact would occur from shore-based recreational fishing due to the ability to fish along its length once the location is accessed in this small part of the sanctuary zone.

### *Ecological assets – threatened species*

Sooty oyster catchers feed on the rocky shore section of this sanctuary zone, and grey nurse sharks, white sharks and turtles are known to occur.

*Risk: C3 L3 (Low)* – In terms of consequence, the potential impact of shore-based recreational fishing and spearfishing was considered ‘moderate’ for line fishing due to the known presence of sharks traversing and feeding in the area. It was considered ‘possible’ that this level of impact would result due to the level of activity and type of fishing and small area of the zone.

### *Social values – social uses*

The only current use is wildlife observation from the headland.

*Risk: Minimal* – This reflects the safety risk of opening this sanctuary zone, which would conflict with the *Cape Byron Headland reserve plan of management* intention to discourage access to this site on the grounds of safety.

### *Social values – scientific reference site*

This zone has not been used as a scientific reference site.

*Risk: Low.*

## Broken Head Sanctuary Zone

The Broken Head Sanctuary Zone extends between the northern end of Kings Beach and the eastern-most point on the rocky headland at the southern end of Brays Beach (approximately 100 metres north of Snapper Rock). It incorporates Cocked Hat Rocks, which are islands that were included in the amnesty. The shoreline component consists of five separate sections that have a total coastline length of approximately 1.7 kilometres, including Kings Beach (which has two separate sections) and Brays Beach.

### Ecological assets—habitats and fish assemblages

Habitats include the rocky reef surrounding Cocked Hat Rocks, three beaches that represent intertidal and subtidal soft sediment habitats, and sections of rocky shore that are adjacent to these.

*Habitat risk:* C2 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection) against background variations. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C4 L4 (High) – The potential impact on local fish assemblages as a result of shore-based recreational fishing and spearfishing was considered ‘major’ for mulloway and other species such as blue groper, yellow spotted sweetlip and mangrove jack. This reflects the overall stock status of mulloway, which is found on both reef and sand. Broken Head and the Cocked Hat Rocks are a locally unique collection of headlands and rocky islets and reefs with large numbers of fish. Fish that have been observed to be illegally taken from the site include: mulloway, snapper, yellow spotted sweetlip, trevally, drummer, luderick, surgeon fish, red morwong, whiting, flathead, and bream. It was considered ‘likely’ that this level of impact would occur from both line fishing and spearfishing due to the relative ease of access that allows fishing to occur along its entire length. The level is expected to increase over the next five years given its proximity to several large townships and high visitor numbers to the region.

### Ecological assets – threatened species

Grey nurse sharks and white sharks (critically endangered) and sooty oyster catchers (vulnerable) are known to occur in this sanctuary zone.

*Risk (fish):* C2 L4 (Low) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing and spearfishing due to the known presence of sharks traversing and feeding in the area (which is specifically related to Cocked Hat Rocks). It was considered ‘likely’ that this level of impact would result due to the level of activity and type of fishing.

*Risk (birds):* C3 L3 (Low) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘moderate’ for birds (sooty oyster catchers) due to levels of disturbance (including entanglement). It was considered ‘possible’ that this level of impact would result due to the level of access for line fishers.

### Social values – social uses

The Cocked Hat Rocks are known by the local Bundjalung People (Arakwal) as The Three Sisters, and in 1987 the area was declared an Aboriginal Place due to its special significance to Aboriginal culture. This provides recognition of the significance of the area to Aboriginal traditions, observances, customs, beliefs or history.

*Risk:* Low – The risk relates to diversity of uses and the issues of making management decisions regarding this site without consulting the traditional owners of the area.

### Social values – scientific reference site

This zone has not been used as a scientific reference site.

*Risk:* Low

### Lennox Head Sanctuary Zone

The eastern margin of this sanctuary zone commences at the mean high water mark at the southern boundary of the marine park and continues in a generally north north-easterly direction offshore for approximately 1.8 kilometres. The zone has one small section of approximately 0.7 kilometres that is continuous to shore (this is included in the assessment).

#### Ecological assets – habitats and fish assemblages

The intertidal habitats in the sanctuary zone are restricted to intertidal and subtidal reef that extends for up to 200 metres offshore. It is continuous with reefs either side of the zone.

*Habitat risk:* C2 L4 (Low) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection) against background variations. It was considered ‘likely’ that this level of impact would result due to the small area of habitat that is present in this 700-metre long zone.

*Fish assemblage risk:* C2 L3 (Minimal) – The potential impact of shore-based recreational line fishing and spearfishing on fish assemblages was considered ‘minor’. This reflects the relatively high resilience and abundance of the likely harvested species, such as tailor. This level of impact was considered ‘possible’.

#### Ecological assets – threatened species

Sooty oyster catchers forage at this location.

*Risk:* C3 L3 (Low) – In terms of consequence, the potential impact on sooty oyster catchers of shore-based recreational fishing was considered ‘moderate’ due to levels of disturbance (including entanglement). It was considered ‘possible’ that this level of impact would result due to the level of access for line fishers and small area of habitat concentrating fishers and their impacts.

#### Social values – social uses

Due to the dominance of rocky reef at this location, and the presence of more sheltered habitat at The Moat, use is restricted primarily to snorkelling.

*Risk:* Minimal.

#### Social values – scientific reference site

This zone has not been used as a scientific reference site.

*Risk:* Low.

## The Moat Sanctuary Zone

This sanctuary zone includes the waters of The Moat (also known as Bream Hole) that are bounded by the southern side of the Lennox Head boat channel, the subtidal reef edge and beach adjacent to The Moat, and the boulder foreshore which occurs adjacent to Lennox Head. The shoreline components of this sanctuary zone consist of a single section that has a total coastline length of approximately 0.2 kilometres. For practical purposes, the adjacent Special Purpose Zone was treated as part of the amnesty.

### Ecological assets – habitats and fish assemblages

The intertidal habitats in the sanctuary zone are restricted to the intertidal reef that extends into an area of subtidal reef (which is continuous with that further offshore) and with reefs either side of the zone. The site has a relatively high intertidal reef species diversity, and it is considered the only rocky shore of its type in the bioregion. This zone contains the only known location of the seagrass *Halodule universis* in NSW.

*Habitat risk:* C2 L4 (Low) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection) against background variations. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C4 L4 (High) – The potential impact of shore-based recreational fishing and spearfishing on fish assemblages was considered ‘major’. This reflects the overall life-history characteristics and natural variations in abundance of the harvested species (mulloway) and other sedentary species that are less abundant in the overall marine park, which would include species found on the reef. The Moat supports a diverse assemblage of fish, many of which are targeted by certain user groups. This assemblage is unique to the area; it includes labrids and acanthurids. It was considered ‘likely’ that this level of impact would occur due to the ease of access and sheltered nature of the site for both line and spearfishing along its length and throughout the small zone.

### Ecological assets – threatened species

Sooty oyster catchers are common at this location.

*Risk:* C2 L4 (Low) – In terms of consequence, the potential impact on birds (sooty oyster catchers) of shore-based recreational fishing was considered ‘minor’ due to levels of disturbance (including entanglement). It was considered ‘likely’ that this level of impact would result due to the level of access for line fishers.

### Social values – social uses

This is an important snorkelling site, including for educational groups such as tertiary marine studies students. It is a common site for underwater photography.

*Moderate* – This risk relates to the type of uses that dominate this site.

### Social values – scientific reference site

The habitats and biota of this site have been extensively studied since 1990. Recent surveys conducted in 2012 have provided comprehensive baseline surveys of the habitat, biota, and water quality of The Moat. Studies of its biodiversity are ongoing.

*Risk:* Moderate

## Solitary Islands Marine Park – Assessment of fishing in sanctuary zones

The Solitary Islands Marine Park covers an area of approximately 71,000 hectares and extends for approximately 75 kilometres from Muttonbird Island in the south to Plover Island in the north, and from the mean high water mark and upper tidal limits of coastal estuaries to the limit of the NSW State waters. The Marine Park was declared in 1998. Before this, a smaller area was a multiple-use marine reserve that was initially declared in 1991.

The marine park contains a diverse range of habitats, including intertidal and subtidal reefs, soft-sediments, beaches, seagrass beds, mangroves, saltmarsh, and pelagic waters, which all support distinct groups of plants and animals. As the park extends from the high-tide mark to at least 70 metres depth and 20 kilometres offshore in some areas, there is considerable diversity in flora and fauna due that are primarily to the variations in depth, dominant sessile assemblage, oceanographic influences, and the presence of offshore islands. These factors have resulted in a unique environment where tropical, subtropical and temperate marine fauna and flora co-exist. As a result, the region supports a biologically diverse range of marine species.

There are five main islands in the marine park: North Solitary Island, North West Solitary Island, South West Solitary Island (Groper Island), South Solitary Island and Split Solitary Island. Other significant rocky outcrops and submerged reefs are dispersed throughout the marine park. The Solitary Islands Marine Park caters for many different recreational and commercial activities, including beach walking, swimming, surfing, other beach activities, commercial and recreational fishing, scuba diving, whale and dolphin watching, research, boating, and other water sports. Revenue generated from the local fishing and tourism industries benefits the region economically, and it is a valuable asset to the community. The area is culturally important to local Aboriginal communities, with many significant cultural and spiritual sites located within or adjacent to the marine park.

Table 3: Summary of risk associated with allowing recreational line fishing in ocean beach and headland sanctuary zones in Solitary Islands Marine Park

Sanctuary Zone	Habitat/ location Main type	Direct risk to habitats & captured fish assemblages	Risk to threatened species	Social risk to line fishers*	Social risk/access conflict	Risk to scientific reference sites	Economic risks to fishers if fishing is not allowed **	Comments: Including notable diving or snorkelling sites
Northern Section – southern area	Beach	Minimal	Minimal	Low	Low	Moderate	Low	
Jones Beach and Jones Point	Beach Rocky reef	Minimal Moderate (fish)	Minimal Minimal	Low	Minimal	Low Moderate	Low	
Central Section – northern box	Rocky reef	Moderate (fish)	Low (birds)	Low	Minimal	High	Low	
Flat Top Point	Rocky reef	Moderate (fish)	Low (fish)	Low	Low	High	Low	Snorkelling
Southern Section	Beach	Minimal	Minimal	Low	Low	High	Low	Snorkelling

\* Note: this relates to the social risk to recreational fishers of maintaining the amnesty – i.e. allowing shore fishing in these in these areas (estimated from online survey that over 60% of fishers indicated that they supported maintaining the amnesty).

\*\* Note: this is the economic risks to fishers if the amnesty is removed and fishing is not allowed in these areas.

## Northern Section – southern area Sanctuary Zone

This sanctuary zone extends along Minnie Water Back Beach from approximately 500 metres south of the northern tip of the beach for about 2.4 kilometres south, then seaward to the outer boundary of the marine park. The entire zone is adjacent to the Yuragir National Park, and access is limited.

### Ecological assets – habitats and fish assemblages

The shoreline components of this sanctuary zone consist of the one defined beach. It does not include any intertidal or subtidal rocky reef habitat.

*Habitat risk:* C1 L4 (Minimal) – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that results in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C1 L3 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘insignificant’. This reflects the limited access to this location and the relatively high resilience and abundance of the harvested species, which include tailor, salmon and dart. It was considered ‘possible’ that this level of impact would occur from shore-based recreational fishing due to the ability to fish along its length once the location is accessed.

### Ecological assets – threatened species

Pied oyster catchers inhabit this location and use the beach zone as a feeding and resting area.

*Risk:* C2 L3 (Minimal) – In terms of consequence, the potential impact on birds (pied oyster catchers) of shore-based recreational fishing was considered ‘minor’ due to the low levels of disturbance on resting and foraging areas. It was considered only ‘possible’ that this level of impact would result due to the limited level of access.

### Social values – social uses

The main use at this location is surfing, swimming and beach walking, although due to limited access, these use levels are not high.

*Risk:* Low – The risk is conflicting use between other users and recreational fishers.

### Social values – scientific reference site

Subtidal reef further offshore in this sanctuary zone is monitored using baited underwater video.

*Risk:* Moderate.

## Jones Beach and Jones Point Sanctuary Zone

Jones Beach and Jones Point Sanctuary Zone extends along the 1.3-kilometre shoreline between the southern Woolli River breakwall south to a point on the southern side of Jones Point and to a distance 200 metres offshore. The entire zone is adjacent to the Yuraygir National Park and has limited direct access. This area has been a 'no-take' reserve since 1991.

### Ecological assets – habitats and fish assemblages

The shoreline components of this sanctuary zone consist of one defined beach, which is approximately 630 metres in length, and an area of intertidal and subtidal reef adjacent to the headland. The rocky reef contains a large area of the intertidal algae Neptunes necklace (*Homosira banksii*).

### Habitat and fish assemblage risk (beaches)

**Habitat risk:** C1 L4 (Minimal) – The potential impact on habitats was considered 'insignificant' for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered 'likely'.

**Fish assemblage risk:** C1 L4 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered 'insignificant'. This reflects the limited access to this location, and the relatively high resilience and abundance of the likely harvested species, which include tailor, yellowfin bream, salmon and dart. It was considered 'likely' that this level of impact would occur from shore-based recreational fishing due to the ability to fish along its length once the location is accessed.

### Habitat and fish assemblage risk (headlands)

**Habitat risk:** C2 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered 'minor'. This reflects the potential levels of impact of the defined stressors from shore-based line fishing on intertidal reefs (e.g. trampling on *Homosira*, entanglement) against background variations. It was considered 'possible' that this level of impact would result due to the limited access to the headland.

**Fish assemblage risk:** C3 L4 (Moderate) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered 'moderate' for mulloway and other species such as blue groper, red morwong, drummer, mangrove jack, estuary cod and moses perch. This reflects the overall stock status of the species (mulloway) and the life-history and ecological characteristics of several of these harvested species, which indicates relatively low resilience. It was considered 'likely' that this level of impact would occur from line fishing and spearfishing (which includes red morwong and excludes blue groper) due to the small area of rocky reef adjacent to a single headland, and hence the ability to fish its entire length due – thereby concentrating impacts. It was also considered likely that, while access is limited, there would be sufficient line fishing and spearfishing to result in this level of impact.

### Ecological assets – threatened species

Sooty oyster catchers occur on the rocky shore section of this sanctuary zone, and pied oyster catchers inhabit the beach areas. The rocky reef area has suitable habitat for sub-adult black cod.

**Risks (beaches):** C2 L3 (Minimal) – In terms of consequence, the potential impact on pied oyster catchers of shore-based recreational fishing was considered 'minor' due to the levels of disturbance. It was considered 'possible' that this level of impact would result due to the level of access.

*Risks (headland):* C2 L3 (Minimal) – In terms of consequence, the potential impact on black cod and birds (sooty oyster catchers) of shore-based recreational fishing was considered ‘minor’ due to the levels of disturbance (including entanglement). It was considered ‘possible’ that this level of impact would result for line fishers due to the limited level of access but small area of the habitat.

**Social values – social uses**

Due to the limited direct access, the main use is walking.

*Risk:* Minimal – relates to low range of uses.

**Social values – scientific reference site**

This is a proposed reference site for eastern rock lobster monitoring, but it has not yet been surveyed.

*Risk:* Moderate on rocky reefs

## Central Section Sanctuary Zone

The Central Section Sanctuary Zone extends along the shoreline from about 1.5 kilometres south of Jones Point to the southern end of Freshwater Beach. The entire zone is adjacent to the Yuragir National Park. It is remote and has limited but increasing levels of access. The zone has a total coastline length of approximately 3.0 kilometres.

### Ecological assets – habitats and fish assemblages

The shoreline is dominated by intertidal and subtidal rocky reef in the northern section, with several smaller patches of rocky reef adjacent to the shore in the southern section. The zone is assessed as rocky reef because of the dominance of rocky reef habitat in the shoreline components of this zone (some of which is transient due to sand movement). The fish assemblage is likely to contain mulloway, blue groper, drummer, mangrove jack, gold spotted sweetlip, estuary cod, and Moses perch.

*Habitat risk:* C2 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based line fishing on subtidal reefs (e.g. entanglement, debris) against background variations. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C3 L4 (Moderate) - The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘moderate’ for mulloway and other species such as blue groper, drummer, mangrove jack, gold spotted sweetlip, estuary cod and Moses perch. This reflects the overall stock status of mulloway and the life-history characteristics of several of these harvested species, which indicates relatively low resilience and abundance. It was considered ‘likely’ that this level of impact would occur from line fishing and spearfishing (which includes red morwong and excludes blue groper) due to the ability to fish its entire length once the location is reached. It was also considered likely that while access is limited, this is likely to increase over a five-year time frame, and there would be sufficient line fishing and spearfishing for this level of impact.

### Ecological assets – threatened species

Pied oyster catchers inhabit the beach areas. The zone has suitable habitat for sub-adult black cod (rocky reef). White sharks and grey nurse sharks are also likely to traverse the area.

*Risk (fish):* C2 L3 (Minimal) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing (black cod, white shark, grey nurse shark) and spear fishing (black cod) due to the presence of these species in the area. This level of impact was considered ‘possible’ because of the level of activity and type of fishing.

*Risk (birds):* C2 L4 (Low) – In terms of consequence, the potential impact on threatened birds (pied oyster catchers) of shore-based recreational fishing was considered ‘minor’ due to the levels of disturbance on feeding and resting areas. It was considered ‘likely’ that this level of impact would result due to the level of access.

### Social values – social uses

Due to the access and characteristics of the location the main use is walking.

*Risk:* Minimal – This is due to the low range of uses.

### Social values – scientific reference site

Subtidal reef fishes in this sanctuary zones are monitored using baited underwater video.

*Risk:* High on rocky reef.

## Flat Top Point Sanctuary Zone

The Flat-Top Point Sanctuary Zone extends from the mean high water mark to 200 metres around the northern, eastern and southern parts of the Point. The zone has a total coastline length of approximately 1.3 kilometres. The location is relatively easily accessed and is close to a large township.

### Ecological assets – habitats and fish assemblages

It is one of two tombolos present in the Solitary Islands Marine Park. The majority of the intertidal and subtidal habitats are rocky reef, apart from a small section on the western margin. The location has the highest relative species richness of intertidal invertebrates that has been recorded in the marine park. It also has the most-southern coastal record of giant clam *Tridacna maxima* on the eastern Australian mainland. Subtidal rocky reef contains both kelp and sponge dominated assemblages. There is high fish diversity and juvenile habitat for several harvested species.

*Habitat risk:* C2 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based line fishing on subtidal reefs (e.g. entanglement, debris) against background variations. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C3 L4 (Moderate) - The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘moderate’ for species (such as blue groper and drummer) and the ecological and life-history characteristics of these harvested species, which indicates relatively low resilience. It was considered ‘likely’ that this level of impact would occur from both line fishing and spearfishing (excludes blue groper) due to accessibility of the zone’s entire length and the level of approved local development associated with increased population.

### Ecological assets – threatened species

Threatened species recorded at this location include black rock-cod and sooty oystercatchers.

*Risk (fish):* C3 L3 (Low) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘moderate’ for line and spear fishing due to the known presence of black cod occurring in the area. It was considered ‘possible’ that this level of impact would result due to the level of activity and type of fishing.

*Risk (birds):* C2 L3 (Minimal) – In terms of consequence, the potential impact on sooty oyster catchers of shore-based recreational fishing was considered ‘minor’ due to levels of disturbance (including entanglement). It was considered ‘possible’ that this level of impact would result due to the relatively easy level of access for line fishers.

### Social values – social uses

Uses include walking, passive use and snorkelling.

*Risk:* Low

### Social values – scientific reference site

Subtidal reef in this sanctuary zones is monitored using underwater visual census.

*Risk:* High

## Southern Section Sanctuary Zone

The Southern Section Sanctuary Zone extends along the shoreline of Moonee Beach from 1.5 kilometres north of Moonee Creek to 500 metres south of Look- At-Me-Now Headland, then from Diggers Point along Fiddamans Beach to the most eastern point of Bare Bluff. The entire sanctuary zone is adjacent to the Moonee Beach Nature Reserve and consists of Back Sandy Beach and Moonee Beach, which have a combined length of approximately 4.3 kilometres. The central part of Moonee Beach is remote because it can be accessed only by crossing Moonee Creek at the southern end of the beach. The northern end can be accessed from Emerald Beach.

### Ecological assets – habitats and fish assemblages

The intertidal and subtidal habitats are dominated by soft-sediments and consist of two beaches (Back Sandy Beach and Moonee Beach). Moonee Beach has high species richness and biomass of macro-invertebrates on the beach. Shallow sand habitat contains whiting species, long-spine and blue-spotted flathead, eastern shovelnose ray, fiddler ray and southern eagle ray, which are all south-eastern Australian endemics. Rocky reef habitat occurs as small areas of rocky shore and subtidal habitat adjacent to Bare Bluff and Diggers Point. A known mullock hole is present on the southern side of Bare Bluff.

*Habitat risk:* C1 L3 (Minimal) – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C2 L3 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’. This reflects the low levels of current and future access to this location, and the overall high resilience of the life-history characteristics and natural variations in abundance of the likely harvested species. It was considered ‘possible’ that this level of impact would occur from shore-based recreational fishing due to the expected low levels of fishing along most of the shoreline zone area. Impacts are not expected to be higher on the small area of rocky reef adjacent to the headland at Bare Bluff.

### Ecological assets – threatened species

The area is used by pied oyster catcher (beach) and black cod.

*Risk (fish):* C2 L2 (Minimal) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line and spear fishing due to the known presence of black cod occurring in the area. It was considered ‘unlikely’ that this level of impact would result reflecting the lower habitat use by the species.

*Risk (birds):* C2 L2 (Minimal) – In terms of consequence, the potential impact on pied oyster catchers of shore-based recreational fishing was considered ‘minor’ due to levels of disturbance. It was considered ‘unlikely’ that this level of impact would result due to the low level of access for line fishers.

### Social values – social uses

Uses include walking, surfing and swimming on the beach sections, with snorkelling common on the headlands.

*Risk:* Low

**Social values – scientific reference site**

Subtidal reef fishes in this sanctuary zones are monitored using baited underwater video and underwater visual census. Shallow inshore beach fishes are monitored using baited underwater videos.

*Risk:* High

## Port Stephens–Great Lakes Marine Park – Assessment of fishing in sanctuary zones

The Port Stephens–Great Lakes Marine Park covers approximately 98,200 hectares of marine and estuarine habitats from Forster in the north to the northern end of Stockton Beach. The marine park extends from the mean high water mark offshore to the three nautical mile limit of NSW waters and includes all of Port Stephens and the Karuah River, the Myall River, Myall and Smiths Lakes and all of their creeks and tributaries to the limit of tidal influence. The Marine Park was declared on 1 December 2005.

The Port Stephens–Great Lakes Marine Park caters for many different recreational and commercial activities, including beach walking, swimming, surfing, other beach activities, commercial and recreational fishing, scuba diving, whale and dolphin watching, research, boating and other water sports. Revenue generated from the local fishing and tourism industries benefits the region economically, and it is a valuable asset to the community. The region is culturally important to local Aboriginal communities, with many significant cultural and spiritual sites located within or adjacent to the marine park.

Port Stephens is regarded as the ‘dolphin watch’ capital of Australia, and is believed to carry the highest number of clients on dedicated dolphin watching trips anywhere in the world. Many forms of commercial fishing occur in the marine park, including fish and prawn trawling, beach hauling, purse seining, line fishing, trapping (fish, crab, lobster, eel), hand gathering, long-line and drop-lining, estuary prawn netting, and estuary mesh and haul netting.

Table 4: Summary of risk associated with allowing recreational line fishing in ocean beach and headland sanctuary zones in Port Stephens–Great Lakes Marine Park

Sanctuary Zone	Habitat/location Main type	Risk to ecological assets (habitats & fish assemblages)	Risk to threatened species	Social risk to line fishers if maintained*	Social risk/access conflict	Risk to scientific reference sites	Economic risks to fishers if fishing is not allowed **	Comments: Including notable diving or snorkelling sites
The Pinnacle	Beach	Minimal	Moderate (fish)	Low	Minimal	Low	Low	Snorkelling
Celito South	Beach	Minimal	Minimal	Low	Minimal	Low	Low	Snorkelling
Fiona	Beach	Minimal	Minimal	Low	Low	Low	Low	
Yacaaba	Rocky reef	Minimal	Minimal	Low	Low	Low	Low	Dive site, snorkelling
Zenith	Beach	Moderate (fish)	Minimal	Low	Moderate	Low	Low	Snorkelling
Fingal Is	Rocky reef	Minimal	Minimal	Low	Minimal	High	Low	

\* Note: this relates to the social risk to recreational fishers of maintaining the amnesty – i.e. allowing shore fishing in these in these areas (estimated from online survey that more than 60% of fishers indicated that they supported maintaining the amnesty).

\*\* Note: this is the Economic risks to fishers if the amnesty is removed and fishing is not allowed in these areas.

## The Pinnacle Sanctuary Zone

The Pinnacle Sanctuary Zone extends along the shoreline between the south-eastern tip of Cape Hawke to the point on the rocky headland approximately 800 metres north-east of the northern end of Seven Mile Beach. The sanctuary zone has a total coastline length of approximately 2.5 kilometres. The entire zone is adjacent to the prominent headland in the Booti Booti National Park, and while shoreline access is limited to a small section of the coast, the zone is adjacent to the township of Forster.

### Ecological assets – habitats and fish assemblages

The shoreline components of this sanctuary zone consist of two defined beaches, although these are small and only one contains soft-sediments. The almost continuous rocky shore is characterised by steep topography, which results in little intertidal habitat. The subtidal habitat adjacent to the rocky shoreline in the northern section is primarily soft-sediment, with only small areas of narrow rocky reef present in the south. Due to these characteristics, the zone was assessed as beach habitat.

*Habitat risk:* C1 L4 (Minimal) – The potential impact on habitats as a result of shore-based recreational fishing was considered ‘insignificant’ for soft-sediment habitats. This reflects that dominance of exposed shallow sand habitat that has characteristics that result in a high inherent capacity to respond to disturbances. This habitat is also common throughout the region. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C2 L3 (Minimal) – The potential impact on soft-sediment fish assemblages as a result of shore-based recreational fishing was considered ‘minor’. This reflects the overall life-history and ecological characteristics of several of these harvested species, which indicates relatively high resilience, including tailor, salmon and yellowfin bream. It was considered ‘likely’ that this level of impact would occur primarily from spearfishing because of the accessibility from the southern end of the zone, the ability to spearfish along its length, and because the site was previously a popular location for spearfishing.

### Ecological assets – threatened species

This zone is within the published range of movement around the grey nurse shark aggregation sites at Latitude Rock and The Pinnacle (critical habitat). The zone has suitable habitat for sub-adult black cod, with defined ‘hot spot’ sites at the adjacent Latitude Rock and The Pinnacle.

*Risk:* C3 L4 (Moderate) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘moderate’ for both line and spearfishing due to the zone’s proximity to grey nurse shark aggregation sites and presence of suitable black cod habitat close to shore. It was considered ‘likely’ that this level of impact would result from line fishing (grey nurse sharks) and spearfishing (black cod) due to the accessibility from the southern end of the zone, the ability to spearfish along its length, and the zone’s previously popularity as a location for spearfishers.

### Social values – social uses

Uses are restricted to snorkelling and kayaking due to shore access and characteristics.

*Risk:* Minimal – This relates to low range of uses.

### Social values – scientific reference site

This locality has not been used as a scientific reference site.

*Risk:* Low

## Celito South Sanctuary Zone

The Celito South Sanctuary Zone extends 2.7 kilometres along the shoreline between the rocky headland immediately south of Smiths Lake to the northern end of Number One Beach. The entire zone is adjacent to the small headlands at the northern end of the Myall Lakes National Park. There is limited access from both the southern and northern ends.

### Ecological assets – habitats and fish assemblages

The shoreline components of this sanctuary zone comprise five small defined beaches, which are separated by narrow headlands that have steep topography. The result is that there is only a very small intertidal habitat along much of the shoreline. The subtidal habitat is dominated by soft sediments, with only small areas of rocky reefs adjacent to some of the headlands. Due to these characteristics, the zone was assessed as beach habitat. The site is close to and accessible from the township of Seal Rocks, and hence it is possible that it will become a popular fishing location.

*Habitat risk:* C1 L4 (Minimal) – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C2 L3 (Minimal) – The potential impact on soft-sediment fish assemblages was considered ‘minor’. This reflects an overall life-history and ecological characteristics of several of these harvested species (including salmon and tailor), which indicates relatively high resilience. It was considered ‘possible’ that this level of impact would occur due to the accessibility from the southern and northern ends of the zone, and the ability to spearfish along its length.

### Ecological assets – threatened species

The area is likely to have grey nurse sharks traverse it.

*Risk:* C2 L3 (Minimal) – The potential impact on threatened assemblages was considered ‘minor’. This reflects the absence of information on threatened fish species at this locality. The result is that the consequence of activities on threatened species is minor rather than insignificant. This level of impact was considered possible.

### Social values – social uses

Uses are restricted to snorkel and kayaking due to shore access and characteristics.

*Risk:* Minimal – relates to low range of uses

### Social values – scientific reference site

This locality has not been used as scientific reference site.

*Risk:* Low

## Fiona Sanctuary Zone

The Fiona Sanctuary Zone extends 8.3 kilometres along the shoreline between the northern end of Submarine Beach and Big Gibber Headland (the rocky headland at the southern end of Fiona Beach). The entire zone is adjacent to the central section of the Myall Lakes National Park, and access is limited. The zone has a small area as it extends only a short distance offshore.

### Ecological assets – habitats and fish assemblages

The shoreline components of this sanctuary zone consist of the two defined but continuous beaches that extend into subtidal sand habitat. This is the only beach in the entire bioregion that has a high level of protection, so it could be considered a representative scientific reference site.

*Habitat risk:* C1 L4 (Minimal) – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C3 L2 (Minimal) – The potential impact on soft-sediment fish assemblages was considered ‘moderate’. This is because the zone is small, and shore-based recreational fishing potentially affects a large proportion of the zone. It was considered ‘unlikely’ that this level of impact would occur due its remote location and the difficulty of access.

### Ecological assets – threatened species

The location is a known region for the presence of juvenile white sharks as it is in close proximity to important nursery areas (Hawks Nest and Mungo Brush beaches). The beach is a likely habitat for nesting shorebirds (little terns, oyster catchers).

*Risk:* C2 L3 (Minimal) – The potential impact of shore-based recreational fishing was considered ‘minor’ due to the vicinity of adjacent juvenile white shark nursery areas, but the potential for interactions is considered low. This level of impact was considered ‘possible’.

### Social values – social uses

Uses are restricted to surfing and passive beach use due to shore access and characteristics.

*Risk:* Low – This relates to low range of uses.

### Social values – scientific reference site

This locality has not been used as scientific reference site, but it could be used to monitor an example of an open ocean beach habitat.

*Risk:* Low

## Yacaaba Sanctuary Zone

The Yacaaba Sanctuary Zone extends along 1.6 kilometres of shoreline between the northern and southern side of Yacaaba Heads. The entire sanctuary zone is adjacent to a southern section of the Myall Lakes National Park. Access is limited.

### Ecological assets – habitats and fish assemblages

The shoreline consists exclusively of rocky shore, which is characterised by steep topography, resulting in a tidal zone that is either narrow or absent along much of the shoreline. The subtidal habitat adjacent to the rocky shore is mostly continuous fringing reef, but it is narrow and patchy around the headland. These habitats have high exposure. It is a very difficult site to access for shore-based fishing.

*Habitat risk:* C1 L4 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘insignificant’. This reflects the potential levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection) against background variations. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C2 L3 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’. This reflects the overall life-history and ecological characteristics of several of these harvested species, which indicates relatively high resilience, and which would include species found on both reef and sand such as tailor, yellowfin bream, salmon and luderick. It was considered ‘possible’ that this level of impact would occur primarily from spearfishing due to the ability to fish along its length once the site is accessed.

### Ecological assets – threatened species

The area has juvenile white sharks frequently move through it because it is close to a juvenile white shark nursery area in NSW (Hawks Nest beach). White sharks move from this beach past this headland into the Port Stephens estuary and further south.

*Risk:* C2 L3 (Minimal) – The potential impact of shore-based recreational fishing was considered ‘minor’ for threatened species due to the adjacent juvenile white shark nursery areas that result in some individuals moving through the zone. This level of impact was considered ‘possible’.

### Social values – social uses

Due to access limitations and dominance of rocky reef, the use of this location is restricted principally to boating and kayaking.

*Risk:* Low – This relates to low range of uses.

### Social values – scientific reference site

This locality has not been used as scientific reference site.

*Risk:* Low

## Zenith Sanctuary Zone

The Zenith Sanctuary Zone extends along the shoreline between the northern end of Zenith Beach and the southern end of Wreck Beach. The entire sanctuary zone is adjacent to a section of the Tomaree National Park, and it consists of three defined beaches of very different lengths, the largest being Zenith Beach at approximately 350 metres. The location has easy access, and it is adjacent to the major townships in Port Stephens. The sanctuary zone has a total coastline length of approximately 1.1 kilometres.

### Ecological assets – habitats and fish assemblages

The intertidal habitats are characterised by sand-dominated beaches separated by headlands with small areas of rocky shore. The subtidal habitat is dominated by soft-sediments, with only a small area of rocky reef adjacent to some of the headland in the most southern section of the sanctuary zone.

*Habitat risk: C1 L4 (Minimal)* – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. It also reflects the very easy access to this site from an adjacent major township.

*Fish assemblage risk: C3 L4 (Moderate)* – The potential impact on fish assemblages (such as drummer) as a result of shore-based recreational fishing was considered ‘moderate’. This reflects the life history characteristics of the species, in particular their movement patterns and their common occurrence and preference for exposed nearshore reefs areas. It was considered ‘likely’ that this level of impact would occur from both line fishing and spearfishing due to the ability to access a significant proportion of the sanctuary zone from along its entire length. It also reflects the very easy access to this site, which is adjacent to a major township. It is highly likely that the site would be a popular destination for spearfishers and line fishers based on historical information on use.

### Ecological assets – threatened species

Juvenile white sharks and grey nurse sharks infrequently use this location.

*Risk: C2 L3 (Minimal)* – The potential impact on threatened assemblages was considered ‘minor’. This reflects the fact that juvenile white sharks and grey nurse sharks are known to infrequently use this location and the potential for interactions is considered low. It also reflects the very easy access to this site from an adjacent major township.

### Social values – social uses

The very easy access to this site from an adjacent major township that has high levels of coastal tourism activities results in a large number of uses at this location.

*Risk: Moderate* – This reflects the large number of uses.

### Social values – scientific reference site

This locality has not been used as scientific reference site.

*Risk: Low*

## Fingal Island Sanctuary Zone

The Fingal Island Sanctuary Zone extends 4.0 kilometres along the shoreline on the southern side of Fingal Island. The entire sanctuary zone is adjacent to a section of the Tomaree National Park, and access is limited because it is possible to reach the location only by landing a boat on the other side of the island and walking to the zone.

### Ecological assets – habitats and fish assemblages

The shoreline consists exclusively of rocky shore, which is characterised by moderate topography, resulting in a narrow tidal zone along much of the shoreline. The subtidal habitat adjacent to the rocky shore is continuous around the headland. Within 100 metres of the shore, the habitat is dominated by macroalgae (*Ecklonia raditata* and *Phyllospora*). Fish diversity at site is lower than other monitored sites in the marine park.

*Habitat risk: C1 L4 (Minimal)* – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘insignificant’. This reflects the potential levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection) against background variations. It was considered ‘likely’ that this level of impact would result because the difficult access is expected to result in a low level of activity.

*Fish assemblage risk: C2 L3 (Minimal)* – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’, which primarily reflects the difficult access to this location. It was considered ‘possible’ that this level of impact would occur from shore-based recreational line and spearfishing because visitors will be able to fish along the site’s length once they can access it.

### Ecological assets – threatened species

Not a known area for marine threatened species to frequent.

*Risk: C1 L4 (Minimal)* – The potential impact on threatened assemblages was considered ‘insignificant’. This reflects the fact that juvenile white sharks, grey nurse sharks and black cod are not known to frequent this location, and the potential for interactions is considered low. This level of impact was considered ‘likely’.

### Social values – social uses

Due to the restrictions on access to this location, there are few uses.

*Risk: Minimal*

### Social values – scientific reference site

This site has been regularly monitored (annually) since 2006 using baited underwater video and underwater visual census. The site had been found to have a low diversity of reef associated fishes.

*Risk: High*

## Jervis Bay Marine Park – Assessment of fishing in sanctuary zones

The Jervis Bay Marine Park was declared in 1998 and its first zoning plan commenced in October 2002. The marine park covers an area of approximately 220 square kilometres and encompasses Jervis Bay and the coast from Kinghorn Point (north of the bay) to the northern headland of Sussex Inlet (in the south). The boundary of the marine park extends from the high-tide mark to 1.5 kilometres offshore and contains the tidal waters of the estuaries within these boundaries.

There are both exposed and sheltered waters in Jervis Bay Marine Park. These support many recreational and commercial activities. Recreational activities include swimming, fishing, boating, diving and snorkelling, and beach activities. Other activities and uses of the marine park include Aboriginal traditional uses, Department of Defence activities, research and education activities, and maintenance of facilities such as wharves, jetties and moorings. The Commonwealth manages the land and water in the adjacent Booderee National Park. Commercial activities provide an important source of income for the local and regional community. Tourism is the main commercial activity, and it includes dive charters, charter boat fishing, sightseeing and dolphin watching cruises, whale and seal watching cruises in season, kayak hire and tours, surfing schools, and intertidal discovery and eco-tours. Commercial films and photographs are occasionally shot in the marine park. Other commercial activities that benefit the local economy include commercial fishing.

Table 5: Summary of risk associated with allowing recreational line fishing in ocean beach and headland sanctuary zones in Jervis Bay Marine Park

Sanctuary Zone	Habitat/location Main type	Direct risk to habitats & captured fish assemblages	Risk to threatened species	Social risk to line fishers*	Social risk / access conflict	Risk to scientific reference sites	Economic risks to fishers if fishing is not allowed **	Comments: Including notable diving or snorkelling sites
Hammer Head	Beach	Minimal	Minimal	Low	Low	High	Low	
Point Perpendicular/Crocodile Head	Rocky reef	Minimal	Low	Low	Minimal	High	Low	Dive site
Bowen Island	Rocky reef	Minimal	Low (birds)	Low	Minimal	Low	Low	Dive site, Snorkelling
St Georges Head/Steamers Head	Rocky reef	Minimal	Minimal	Low	Minimal	High	Low	Dive site

\* Note: this relates to the social risk to recreational fishers of maintaining the amnesty – i.e. allowing shore fishing in these in these areas (estimated from online survey that more than 60% of fishers indicated that they supported maintaining the amnesty).

\*\* Note: this is the economic risks to fishers if the amnesty is removed and fishing is not allowed in these areas.

## Hammer Head Sanctuary Zone

The Hammer Head Sanctuary Zone extends 3.0 kilometres along the mid-section of the Warrain Beach in the southern section of Crookhaven Bight. The entire shoreline component of the zone is adjacent to the Jervis Bay National Park.

### Ecological assets – habitats and fish assemblages

The zone is dominated by a north easterly facing sandy beach with a very small section of subtidal reef present in the southern section of the zone.

*Habitat risk: C1 L4 (Minimal)* – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk: C2 L3 (Minimal)* – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’ for mulloway and other species such as yellowfin bream and blue morwong. This reflects the overall stock status of the species (mulloway) and the overall life-history and ecological characteristics of the other harvested species, which indicates relatively high resilience. It was considered ‘possible’ that this level of impact would occur from line fishing along the entire length of the site and a significant proportion of the sanctuary zone.

### Ecological assets – threatened species

Grey nurse sharks are known to traverse this area.

*Risk: C2 L3 (Minimal)* – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing due to the known presence of grey nurse sharks traversing through the area. This is due to there being suitable guttered habitat on the adjacent rocky reefs and nearby Whale Point and Beecroft Head. The potential for interactions is considered low. It was considered ‘possible’ that this level of impact would result due to the level of activity and type of fishing.

*Risk: C2 L3 (Minimal)* – In terms of consequence, the potential impact on birds (pied oyster catchers) of shore-based recreational fishing was considered ‘minor’ due to levels of disturbance on resting and foraging areas (including entanglement). It was considered ‘possible’ that this level of impact would result due to the level of access.

### Social values – social uses

Common uses at the location include beach driving, surfing, swimming, and walking.

*Risk: Low*

### Social values – scientific reference site

This zone has been used as a scientific reference site using baited underwater video and underwater visual census.

*Risk: High*

## Point Perpendicular/Crocodile Head Sanctuary Zone

Point Perpendicular/Crocodile Head Sanctuary Zone extends along the eastern side of Beecroft Peninsula from near the tip of Point Perpendicular north for a distance of approximately 3.7 kilometres.

### Ecological assets – habitats and fish assemblages

The shore is generally made up of sheer vertical cliffs, and hence access to the shoreline is very restricted. The extensive subtidal rocky reef is highly complex as it consists of vertical cliffs, large boulders and overhangs and descends to 40 metres depth within a few hundred metres of the shore. There are no beaches within this zone. Commonly encountered pelagic and demersal fish species include snapper, blue morwong, kingfish, sharks (hammerhead, mako, whalers, gummy) and black marlin.

*Habitat risk:* C1 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘insignificant’. This reflects the potentially low levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection) against background variations. The difficult and restricted access to this area contributes to this level of impact. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C2 L3 (Minimal) – The potential impact on fish assemblages (primarily snapper) as a result of shore-based recreational line fishing was considered ‘minor’, This is mainly due to the restricted access to this location, and the overall life-history and ecological characteristics of several of these harvested species, which indicates relatively high resilience, in particular the longevity and movement patterns. It was considered ‘possible’ that this level of impact would occur from line fishing because only a small number of specific rock ledges are accessible to fishers only when public access to the Department of Defence weapons range is allowed. Access is also likely to occur by way of boat access to rock ledges.

*Fish assemblage risk:* C2 L4 (Low) – The potential impact on fish assemblages as a result of shore-based spearfishing was considered ‘minor’. This relates primarily to snapper, which can be fished easily from the shore due to the access to deep water. This reflects the life history characteristics of the species. It was considered ‘likely’ that this level of impact would occur from spearfishing because the entire length of the zone can be accessed from several key shoreline locations.

### Ecological assets – threatened species

Grey nurse sharks are known to traverse this rocky reef system.

*Risk:* C2 L4 (Low) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing as grey nurse sharks traverse this area, but the potential for interactions is considered low. This level of impact was considered ‘likely’ because of the type of gear used at this location, which has also been an important location for land based gamefishers.

### Social values – social uses

The main use at this location is scuba diving.

*Risk:* Minimal – Higher levels of conflict are possible with line fishers.

### Social values – scientific reference site

This site has been regularly monitored since 2010 using baited underwater video.

*Risk:* High

## Bowen Island Sanctuary Zone

Bowen Island Sanctuary Zone is on the south-eastern side of Bowen Island, which is in the southern section of the opening of Jervis Bay. The shoreline component of the zone extends for only 100 metres on the northern end of Governor Head. There is limited access to the zone. This zone provides complementary management to the contiguous sanctuary zone along the western shoreline of Bowen Island, which lies within the Commonwealth jurisdiction of Booderee National Park.

### Ecological assets – habitats and fish assemblages

The shoreline consists entirely of intertidal rocky reef, which extends into continuous subtidal rocky reef that surrounds the eastern section of the island. There are no beaches within this zone.

*Habitat risk:* C2 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection, marine debris) against background variations. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C1 L4 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational line fishing was considered ‘insignificant’. This is due to the small extent of shoreline available for line fishing in the amnesty compared with the extent of similar adjacent habitat. This level of impact was considered ‘likely’. Spear fishing equipment is not allowed in the Booderee National Park.

### Ecological assets – threatened species

Grey nurse sharks traverse this rocky reef system. Sooty oyster catchers occur on the shoreline.

*Risk:* C2 L3 (Minimal) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing due to the known presence of grey nurse sharks traversing through the area. It was considered ‘possible’ that this level of impact would result due to the level of activity and type of fishing.

*Risk:* C2 L4 (Low) – In terms of consequence, the potential impact on sooty oyster catchers of shore-based recreational fishing was considered ‘minor’ due to low levels of disturbance (including entanglement). This level of impact was considered ‘likely’ due to the small area and level of access for line fishers.

### Social values – social uses

The main uses at this location are snorkelling and scuba diving.

*Risk:* Minimal – Although, higher levels of conflict with line fishers are possible.

### Social values – scientific reference site

This zone has not been used as a scientific reference site, although the contiguous sanctuary zone in the Commonwealth Booderee National Park is used as a reference site.

*Risk:* Low

## St Georges/Steamers Head Sanctuary Zone

St Georges/Steamers Head Sanctuary Zone extends 4.3 kilometres along the eastern side of Bherwerre Peninsula from near the tip of St Georges Head north. There is limited access to the zone because the adjacent Booderee National Park restricts access to formed walking trails.

### Ecological assets – habitats and fish assemblages

The shore is generally made up of sheer vertical cliffs and steep vertical rocky platforms; hence the intertidal rocky reef is small. The subtidal rocky reef is continuous along the shore, but narrow in most places, and it extends only into large areas of reef in a few locations along the zone. There are no beaches in this zone.

*Habitat risk:* C2 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection, marine debris) against background variations. The level of access to this area contributes to this level of impact. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C2 L2 (Minimal) – The potential impact on fish assemblages (primarily snapper) as a result of shore-based recreational line fishing was considered ‘minor’. This reflects the overall life-history and ecological characteristics of the species, which indicates moderate resilience. It was considered ‘unlikely’ that this level of impact would occur from line fishing because a high proportion of the area cannot be accessed. Spear fishing equipment is not allowed in the Booderee National Park.

### Ecological assets – threatened species

White sharks have been reported in this area.

*Risk:* C2 L2 (Minimal) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing as white sharks occasionally traverse this area, but the potential for interactions is considered low. It was considered ‘unlikely’ that this level of impact would result due to the characteristics of the gear and bait used at this location.

### Social values – social uses

The main use at this location is scuba diving.

*Risk:* Minimal

### Social values – scientific reference site

This zone has been used as a scientific reference site since 2010 using baited underwater video and underwater visual census.

*Risk:* High

## Batemans Marine Park – Assessment of fishing in sanctuary zones

The Batemans Marine Park covers an approximately 85,000 hectares of marine and estuarine habitats and extends from near Bawley Point in the north to the southern side of Wallaga Lake ocean entrance. The marine park includes all embayments, estuaries, rivers, creeks and lakes (excluding Nargal Lake) to the limit of tidal influence, and it extends from the high water mark to three nautical miles offshore, including Montague Island. The marine park was established in April 2006 and the current zoning plan commenced in June 2007.

The Batemans Marine Park caters for many different recreational and commercial activities, including beach walking, swimming, surfing, other beach activities, commercial and recreational fishing, scuba diving, research, boating and other water sports. Revenue generated from the local fishing and tourism industries benefits the region economically: it is a valuable asset to the community. The region is culturally important to local Aboriginal communities, with many significant cultural and spiritual sites located within or adjacent to the marine park.

**Table 6: Summary of risk associated with allowing recreational line fishing in ocean beach and headland sanctuary zones in Batemans Marine Park**

Sanctuary Zone	Habitat/location Main type	Direct risk to habitats & captured fish assemblages	Risk to threatened species	Social risk to line fishers*	Social risk/access conflict	Risk to scientific reference sites	Economic risks to fishers if fishing is not allowed **	Comments: Including notable diving or snorkelling sites
North Head	Rocky reef	Low (fish)	Low (fish)	Low	Low	High	Low	Dive site, snorkelling
Burrewarra SZ (North Section)	Rocky reef	Low (fish)	Low (fish)	Low	Low	High	Low <sup>(1)</sup>	Dive site, snorkelling
Burrewarra Point SZ (South Section)	Rocky reef	Low (fish)	Low (fish)	Low	Low	High	Low	Dive site, snorkelling
Broulee Island	Rocky reef	Minimal	Minimal	Low	Low	High	Low	Dive site, snorkelling
Mullimburra	Beach and rocky reef	Minimal	Minimal	Low	Low	Low	Low	
Brou Beach	Beach Rocky reef	Minimal Low (fish)	Minimal	Low	Minimal	Low	Low	
Bullengella Lake-Corunna Lake Sanctuary Zone	Beach and rocky reef	Minimal	Minimal	Low	Low	Low	Low	

\* Note: this relates to the social risk to recreational fishers of maintaining the amnesty – i.e. allowing shore fishing in these in these areas (estimated from online survey that over 60% of fishers indicated that they supported maintaining the amnesty).

\*\* Note: this is the Economic risks to fishers if the amnesty is removed and fishing is not allowed in these areas.

(1) While costs were considered low, this site accounted for the majority of costs associated with restricting access within Batemans Marine Park.

## North Head Sanctuary Zone

The North Head Sanctuary Zone extends along the shoreline between the northern end of the headland of Oaky Beach to Three Island Point in the south and has a total coastline length of approximately 4.8 kilometres. The entire zone is adjacent to the Murramarang National Park, and easy access is limited to a small section of the coast.

### Ecological assets – habitats and fish assemblages

The shoreline components consist of three defined beaches, but it is dominated almost entirely by intertidal and subtidal rocky reefs.

*Habitat risk: C2 L3 (Minimal)* – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potentially low levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection). The levels of access to this area and the extent of intertidal rocky reef contributes to this level of impact. This level of impact was considered ‘possible’.

*Fish assemblage risk: C3 L3 (Low)* – The potential impact on fish assemblages (such as drummer) as a result of shore-based recreational fishing was considered ‘moderate’. This reflects the overall life-history and ecological characteristics of several of the harvested species, which indicates moderate resilience, in particular the movement patterns, the species common occurrence, and their preference for exposed nearshore reefs. It was considered ‘possible’ that this level of impact would occur from both line fishing and spearfishing because the entire length of the zone is accessible, as is a significant proportion of the overall sanctuary zone. There is a high level of uncertainty relating to the fish assemblage structure at this location.

### Ecological assets – threatened species

Grey nurse and pied oyster catchers are likely to occur at this location.

*Risk: C2 L4 (Low)* – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for both line fishing due to the vicinity of grey nurse shark aggregation sites and presence of suitable black cod habitat close to shore. This level of impact was considered ‘likely’ due to the accessibility of the zone.

*Risk: C2 L2 (Minimal)* – In terms of consequence, the potential impact on birds (pied oyster catchers on Oaky Beach) of shore-based recreational fishing was considered ‘minor’ due to levels of disturbance to nesting, resting and foraging areas. It was considered ‘unlikely’ that this level of impact would result due to the level of access.

### Social values – social uses

Uses include walking and swimming on the beach sections, with snorkelling and scuba diving common on the headlands.

*Risk: Low* – Although, higher levels of conflict with line fishers is possible.

### Social values – scientific reference site

Shallow reef fish and habitat are monitored using underwater visual census.

*Risk: High*

## Burrewarra (North Section) Sanctuary Zone

The Burrewarra (north section) Sanctuary Zone extends along the shoreline between the northern end of the headland adjacent to Rosedale for approximately 4.7 kilometres to the southern end of Guerilla Bay Beach. The zone is easily accessed from a number of locations, and it is adjacent to several townships.

### Ecological assets – habitats and fish assemblages

This zone contains five defined beaches, which are small (several are less than 100 metres long), but it is dominated almost entirely by intertidal and subtidal rocky reefs.

*Habitat risk:* C1 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potentially low levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection) against background variations. The moderate access to this area contributes to this level of impact. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C3 L3 (Low) – The potential impact on fish assemblages (drummer and blue groper) as a result of shore-based recreational fishing was considered ‘moderate’. This reflects the overall life-history and ecological characteristics of these harvested species, which indicates relatively moderate–low resilience, in particular the longevity and movement patterns. It was considered ‘possible’ that this level of impact would occur from both line fishing and spearfishing due to the zone’s accessibility along its entire length.

### Ecological assets – threatened species

Grey nurse sharks occur at this location.

*Risk:* C2 L4 (Low) – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing because grey nurse sharks use nearby sites at Burrewarra Point (albeit not frequently and not in high numbers); and some interactions with fishing are likely to occur. This level of impact was considered ‘likely’ because of the accessibility of the zone, and the type of gear being used to target fish species.

### Social values – social uses

Uses include walking and swimming on the beach sections. Snorkelling and scuba diving are common on the headlands.

*Risk:* Low – Although, higher levels of conflict with line fishers is possible.

### Social values – scientific reference site

Subtidal reef fishes in this sanctuary zones are monitored using baited underwater video and underwater visual census.

*Risk:* High

## Burrewarra (South Section) Sanctuary Zone

The Burrewarra Sanctuary Zone (south section) extends from 700 metres on the southern shore of Burrewarra Point to Long Nose Point for a distance of approximately 2.8 kilometres.

### Ecological assets – habitats and fish assemblages

This section contains four defined small beaches, several of which are dominated by pebbles and cobbles. Intertidal and subtidal soft sediment habitat is restricted to several small areas north of Long Nose Point. The rest of the area in this sanctuary zone contains rocky shore or subtidal rocky reef that is mostly continuous and extends a considerable distance offshore. Subtidal rocky reefs contain a range of kelp, coralline turfing and foliose algae, and large areas of encrusting coralline algae.

*Habitat risk: C1 L3 (Minimal)* – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘insignificant’. This reflects the potential levels of impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, bait collection). This level of impact was considered ‘possible’ and is due to the level of use and the area’s accessibility.

*Fish assemblage risk: C3 L3 (Low)* – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘moderate’ for species such as drummer and blue groper. This reflects the overall life-history and ecological characteristics of these harvested species, which indicates relatively moderate–low resilience, in particular the longevity and movement patterns. It was considered ‘possible’ that this level of impact would occur from both line fishing and spearfishing due to the area’s accessibility and ability to fish a large proportion of the sanctuary zone.

### Ecological assets – threatened species

Grey nurse sharks are likely to occur at this location because its aggregation sites are nearby. Suitable black cod habitat is also close to shore.

*Risk: C2 L4 (Low)* – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing due because of nearby sites at Burrewarra Point that grey nurse sharks are known to use. This level of impact was considered ‘likely’ due to the accessibility of the zone, and the type of gear being used to target fish species.

### Social values – social uses

Uses include walking and swimming on the beach sections, with snorkelling and scuba diving common on the headlands.

*Risk: Low*

### Social values – scientific reference site

Subtidal reef fishes in this sanctuary zones are monitored using baited underwater video.

*Risk: High*

## Broulee Island Sanctuary Zone

The Broulee Island Sanctuary Zone extends around the majority of the island to a line several hundred metres east of the mainland coast. The zone has a coastline length of approximately 2.1 kilometres.

### Ecological assets – habitats and fish assemblages

The majority of the zone contains rocky shore or subtidal rocky reef that is mostly continuous around the island, and the intertidal reefs are particularly extensive. The zone also contains *Posidonia australis* seagrass beds that are very uncommon on the open coast of NSW.

*Habitat risk: C2 L3 (Minimal)* – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based line fishing on subtidal reefs (e.g. entanglement, debris) against background variations. This level of impact was considered ‘possible’.

*Fish assemblage risk: C2 L3 (Minimal)* – The potential impact on fish assemblages (such as drummer) as a result of shore-based recreational fishing was considered ‘minor’. This reflects the overall life-history and ecological characteristics of these harvested species, which indicates relatively moderate resilience, in particular the movement patterns, but also the large amount of habitat available for the species. It was considered ‘possible’ that this level of impact would occur from line fishing because the entire length of the zone can be accessed.

### Ecological assets – threatened species

Grey nurse sharks are likely to occur at this location.

*Risk: C2 L2 (Minimal)* – In terms of consequence, the potential impact of shore-based recreational fishing was considered ‘minor’ for line fishing because grey nurse sharks traverse the area. It was considered ‘unlikely’ that this level of impact would result due to the level of activity and type of fishing.

### Social values – social uses

Uses include walking and surfing, snorkelling and scuba diving common on and adjacent to the headland. The location also has Aboriginal significance.

*Risk: Low*

### Social values – scientific reference site

Shallow reef fish and habitat are monitored using underwater visual census.

*Risk: High*

## Mullimburra Sanctuary Zone

The Mullimburra Sanctuary Zone contains two areas of shoreline to the north and south of the Meringo region. The northern area extends from approximately 2 kilometres south of Congo Point to the mouth of Meringo Lake. The southern area extends from the southern end of Mullimburra Point to approximately mid-way along Bingie Beach. The entire sanctuary zone is adjacent to the Eurobodalla National Park, and access is limited to several sections of the coast.

### Ecological assets – habitats and fish assemblages

The northern shoreline comprises four defined beaches, the longest being a 650-metre length of the southern end of Congo Beach. This section is dominated by intertidal and subtidal soft-sediment habitat, although around 500 metres of rocky shore exists between the beaches. The southern area consist of six defined beaches, the longest being the section of Bingie Beach at 1.0 kilometres. There are small sections of intertidal and subtidal reef adjacent to the most prominent headlands.

#### *Habitat and fish assemblage risk (beaches)*

*Habitat risk: C1 L4 (Minimal)* – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk: C2 L3 (Minimal)* – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’ for species such as tailor and salmon. This reflects the overall life-history and ecological characteristics of the species, which indicates relatively high resilience. It was considered ‘possible’ that this level of impact would occur from line fishing because the entire length of the beach can be accessed.

#### *Habitat and fish assemblage risk (headlands)*

*Habitat risk: C2 L3 (Minimal)* – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based line fishing on subtidal reefs (e.g. entanglement, debris) against background variations. This level of impact was considered ‘possible’.

*Fish assemblage risk: C2 L3 (Minimal)* – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’ for species such as yellowfin bream, tailor and salmon. This reflects the overall life-history and ecological characteristics of these harvested species, which indicates relatively high resilience. It was considered ‘possible’ that this level of impact would occur from line fishing because the entire length of the headland can be accessed.

### Ecological assets – threatened species

There are no known threatened species values for fish at this location.

*Risk: Minimal*

### Social values – social uses

Uses include swimming, surfing and walking common on the beach sections, with snorkelling common on the headlands.

*Risk: Low*

**Social values – scientific reference site**

This locality has not been used as scientific reference site.

*Risk: Low*

## Brou Beach Sanctuary Zone

The Brou Beach Sanctuary Zone extends along the long section of shoreline from Jemisons Point to the mouth of Brou Lake. The sanctuary zone has a coastline length of approximately 3.0 kilometres, and it is adjacent to the Eurobodalla National Park, with access limited to several sections of the coast

### Ecological assets – habitats and fish assemblages

The shoreline consists of one defined beach that is approximately 2.5 kilometres long, and a section of rocky shore adjacent to the headland in the north. A small area of subtidal reef is adjacent to the rocky shore, with the rest of the subtidal habitat being sand. Only a small area of subtidal reef occurs in this sanctuary zone adjacent to the rocky shore on Jemisons Point, and this was assessed separately.

### *Habitat and fish assemblage risk (beaches)*

*Habitat risk:* C2 L3 (Minimal) – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C1 L3 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘insignificant’ for species such as salmon, whiting and yellowfin bream. This reflects the life history characteristics of the species, in particular the longevity and movement patterns. It was considered ‘possible’ that this level of impact would occur from line fishing because the entire length of the beach can be accessed.

### *Habitat and fish assemblage risk (headlands)*

*Habitat risk:* C2 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based line fishing on subtidal reefs (e.g. entanglement, debris) against background variations. It was considered ‘possible’ that this level of impact would result due to the small area of reef habitat in the zone.

*Fish assemblage risk:* C3 L3 (Low) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘moderate’ for species such as drummer and blue groper. This reflects the overall life-history and ecological characteristics of these harvested species, which indicates relatively moderate–low resilience. It was considered ‘possible’ that this level of impact would occur from both line fishing and spearfishing due to the small area of reef habitat that can be accessed along its entire length.

### Ecological assets – threatened species

There are no known threatened species values for fish at this location.

*Risk:* Minimal

### Social values – social uses

Common uses at this location include walking and swimming.

*Risk:* Minimal

### Social values – scientific reference site

This locality has not been used as scientific reference site.

*Risk:* Low

### **Bullengella Lake–Corunna Lake Sanctuary Zone**

The Bullengella Lake–Corunna Lake Sanctuary Zone extends 5.8 kilometres along a section of coast from just south of Glass House Rocks in the north to Loader Beach in the south. This sanctuary zone encloses the Handkerchief Beach Habitat Protection Zone, which permits recreational fishing while on the shore. Most of the southern section of the sanctuary zone is adjacent to the Eurobodalla National Park, and there is limited access to several sections of the coast.

#### **Ecological assets – habitats and fish assemblages**

The shoreline consists of six defined beaches: the longest is in the southern end of the zone and is 1 kilometre long. Overall, the sanctuary zone is dominated by intertidal and subtidal soft-sediment habitat. There is around 900 metres of rocky shore adjacent to Bogola Head, and this was assessed separately.

#### *Habitat and fish assemblage risk (beaches)*

*Habitat risk:* C1 L4 (Minimal) – The potential impact on habitats was considered ‘insignificant’ for the exposed shallow sand habitat that dominates the area being assessed. This habitat is common throughout the region and has characteristics that result in a high inherent capacity to respond to disturbances. This level of impact was considered ‘likely’.

*Fish assemblage risk:* C1 L3 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘insignificant’ for species such as salmon and yellowfin bream. This reflects the life history characteristics of the species, in particular the longevity and movement patterns. It was considered ‘possible’ that this level of impact would occur from line fishing because the entire length of the headland can be accessed.

#### *Habitat and fish assemblage risk (headlands)*

*Habitat risk:* C2 L3 (Minimal) – The potential impact on rocky reef habitats as a result of shore-based recreational fishing was considered ‘minor’. This reflects the potential levels of impact of the defined stressors from shore-based line fishing on subtidal reefs (e.g. entanglement, debris) against background variations. This level of impact was considered ‘possible’.

*Fish assemblage risk:* C2 L3 (Minimal) – The potential impact on fish assemblages as a result of shore-based recreational fishing was considered ‘minor’ for species such as drummer. This reflects the life history characteristics of the species, in particular the limited movement patterns. It was considered ‘possible’ that this level of impact would occur from both line and spear fishing.

#### **Ecological assets – threatened species**

There are no known threatened species values for fish at this location.

*Risk:* Minimal

#### **Social values – social uses**

Common uses at this location include walking, surfing and swimming.

*Risk:* Low

#### **Social values – scientific reference site**

This locality has not been used as scientific reference site.

*Risk:* Low

## Decisions to allow or not allow shore-based recreational fishing

The Marine Estate Expert Knowledge Panel (MEEKP) assessed shore-based recreational fishing of sanctuary zones included in the amnesty, including the risks associated with allowing spearfishing from headlands, noting that existing rules preventing spearfishing from ocean beaches would remain. The assessment included a risk assessment of ecological values from shore-based recreational fishing activities (including spearfishing), a survey of social values of these areas, and an assessment of economic costs to fishers associated with the removal of the amnesty.

The ecological risk assessment was informed by a review of the literature by NSW Department of Primary Industries, which described the ecological characteristics of ocean beach and headland habitats and assemblages, the known ecological assets in each sanctuary zone, and the factors that impact on the habitats, fish assemblages and threatened species as a result of shore-based recreational fishing. The level of shore-based recreational fishing pressure, together with a characterisation of the levels of resilience of the different marine habitats and associated species resulted in estimates of varying risk levels for the defined ecological assets across the sanctuary zones over a five-year timeframe. The resilience characteristics of fishes that were considered in the assessment relate to their ecology and life history characteristics such as their distribution, habitat use and availability, movement, and age and growth.

The review of the literature found no studies that specifically address the impact of recreational shore-based fishing at the amnesty sites or at similar sites in NSW. In general, such studies are often based on the comparison of habitats or fish assemblages between fished and unfished areas, and such studies in NSW are limited in their extent or duration. The review did identify a range of information on the habitats and other ecological assets associated with the sites, include relating to key threatened fish and shorebird species, which when considered together, does provide an evidentiary basis for an assessment of the ecological risks associated with shore-based recreational fishing from ocean beaches and rocky headlands. The risk levels for all components assessed in all amnesty sanctuary zones are summarised in Table 6.

Overall, the assessment found that, for the majority of the sanctuary zones that were assessed, the increased ecological risk of recreational shore-based fishing is minimal or low, primarily because of the following:

- The ecological risk is inherently lower in intertidal and subtidal ocean beach habitats because they are naturally highly disturbed from waves and currents, and they have a higher inherent resilience to disturbances. This is due, in part, to the functional differences in the structure of nearshore soft-sediment habitats, which generally have less complex seafloor structure due to the absence of sessile macrofauna and flora.
- The majority of fish species harvested off ocean beach habitats have ecological and life-history characteristics that result in relatively high resilience to impacts from shore-based recreational fishing.
- In many locations, the areas that are subject to the amnesty are relatively remote or otherwise have limited or restricted access: they therefore were assessed as only 'likely' to attract relatively low levels of shore-based fishing over the five-year time frame. This includes some rocky reef dominated locations where the ecological assets generally have lower levels of resilience.

Moderate levels of ecological risk were determined at six locations in three of the marine parks, with this level attributed to risks to fish assemblages at four of these locations, threatened fish at one location, and threatened shorebirds at one location.

The factors that were assessed to result in this risk level include:

- some of the target fish species associated with rocky reefs and headlands have more limited home ranges

- risks to the threatened grey nurse shark from incidental catch at one location in the Port Stephens-Great Lakes Marine Park due to the sites' proximity to grey nurse shark aggregation sites
- risks to several threatened shorebirds (pied oyster catchers and little terns) at one site in Cape Byron Marine Park, as it is an important location for these species, the site is easily accessed, and disturbance easily occurs.

High levels of ecological risk were determined at two locations, Broken Head and The Moat sanctuary zones in Cape Byron Marine Park. Both locations have unique characteristics. The higher risk at both of these locations was attributed to impacts on fish assemblages associated with:

- the overall stock status of harvested species
- the ecological and life-history characteristics of the species, which results in relatively lower resilience
- levels of current and future access to this location, which is expected to increase over the next five years given its proximity to several large townships and high visitor numbers to the region.

The literature also supports the conclusion that the reduction of species population levels is a direct ecological impact, which can also lead to indirect ecological effects. Depending on the habitat present and the relative levels of historic and current recreational fishing, these impacts are expected to be present to various degrees in the sanctuary zones that are the subject of this review.

It was also considered that there is a potential for a higher level of risk from spearfishing at some rocky headlands in situations where waters that are inaccessible to a shore-based line fisher could be accessible to spearfishers.

In most circumstances, the amnesty has not led to significant social or economic costs to the community, and therefore, allowing fishing and the access rights of recreational fishers in those situations could provide direct benefits to fishers, without loss of benefits to other users of the areas.

It was found that the community highly values:

- opportunities for fishing for recreation, sustenance and cultural purposes
- opportunities to access beaches and headlands without being negatively impacted by shore-based recreational fishing activity
- levels of recreational fishing that do not reduce resource sustainability.

The assessment also identified that community benefits would be enhanced by not allowing fishing at some sites for social, ecological protection or scientific reference purposes.

In summary, based on the available information, shore-based recreational fishing was not generally found to adversely impact on the ecological assets in most sanctuary zones. When combined with likely increases in a range of resource access pressures brought about by population growth and coastal development, the decision to establish scientific reference sites and increased monitoring will increase the likelihood that the levels of future impacts will be able to be adequately assessed to ensure biologically diverse and resilient ecosystems are maintained.

The current review of the shore-based recreational fishing in marine park sanctuary zones is only a partial assessment for a five-year timeframe, and it was done in advance of a broader threat and risk assessment of the NSW marine estate. That forthcoming review will consider the full range of threats to community values. It will also provide an important opportunity to consider the most efficient and equitable mix of management options.

**Table 7: Risk levels for all ecological, social and economic values for each sanctuary zone by marine park determined in the assessment**

Sanctuary Zone	Habitat/location Main type	Risk to direct habitat effects	Risk to captured fish assemblage	Risk to threatened species	Social risk to line fishers*	Social risk /access conflict	Risk to scientific reference sites	Economic risks to fishers if fishing is not allowed **
<b>Cape Byron Marine Park</b>								
Byron Bay	Beach :Tyagarah	Minimal	Minimal	Minimal	Low	Low	Low	Low
	Beach: Belongil	Minimal	Minimal	Moderate (birds)	Low	Low	Moderate	Low
	Beach: Wategos/The Pass	Minimal	Low	Low (fish)	Low	Moderate	Low	Low <sup>(1)</sup>
	Rocky reef: East Cape Byron	Minimal	Minimal	Low (fish)	Low	Minimal	Low	Low
Broken Head	Beach and rocky reef	Minimal	High	Low (fish and birds)	Low	Low	Low	Low
Lennox Head	Rocky reef	Low	Low	Minimal (birds)	Low	Minimal	Low	Low
The Moat	Rocky reef	Low	High	Low (birds)	Low	Moderate	Moderate	Low
<b>Solitary Islands Marine Park</b>								
Northern Section – southern	Beach	Minimal	Minimal	Minimal	Low	Low	Moderate	Low
Jones Beach /Jones Point	Beach	Minimal	Minimal	Minimal	Low	Minimal	Low	Low
	Rocky reef	Minimal	Moderate	Minimal			Moderate	
Central Section – northern	Rocky reef	Minimal	Moderate	Low (birds)	Low	Minimal	High	Low
Flat Top Point	Rocky reef	Minimal	Moderate	Low (fish)	Low	Low	High	Low
Southern Section	Beach	Minimal	Minimal	Minimal	Low	Low	Moderate	Low

Sanctuary Zone	Habitat/location Main type	Risk to direct habitat effects	Risk to captured fish assemblage	Risk to threatened species	Social risk to line fishers*	Social risk /access conflict	Risk to scientific reference sites	Economic risks to fishers if fishing is not allowed **
<b>Port Stephens-Great Lakes Marine Park</b>								
The Pinnacle	Beach	Minimal	Minimal	Moderate (fish)	Low	Minimal	Low	Low
Celito South	Beach	Minimal	Minimal	Minimal	Low	Minimal	Low	Low
Fiona	Beach	Minimal	Minimal	Minimal	Low	Low	Low	Low
Yacaaba	Rocky reef	Minimal	Minimal	Minimal	Low	Low	Low	Low
Zenith	Beach	Minimal	Moderate	Minimal	Low	Moderate	Low	Low
Fingal Island	Rocky reef	Minimal	Minimal	Minimal	Low	Minimal	High	Low
<b>Jervis Bay Marine Park</b>								
Hammer Head	Beach	Minimal	Minimal	Minimal	Low	Low	High	Low
Pt Perpendicular /Crocodile Head	Rocky reef	Minimal	Minimal	Low	Low	Minimal	High	Low
Bowen Island	Rocky reef	Minimal	Minimal	Low (birds)	Low	Minimal	Low	Low
St Georges Head/ Steamers Head	Rocky reef	Minimal	Minimal	Minimal	Low	Minimal	High	Low
<b>Batemans Marine Park</b>								
North Head	Rocky reef	Minimal	Low	Low (fish)	Low	Low	High	Low
Burrewarra (North)	Rocky reef	Minimal	Low	Low (fish)	Low	Low	High	Low <sup>(2)</sup>
Burrewarra Point (South)	Rocky reef	Minimal	Low	Low (fish)	Low	Low	High	Low
Broulee Island	Rocky reef	Minimal	Minimal	Minimal	Low	Low	High	Low
Mullimburra	Beach and rocky reef	Minimal	Minimal	Minimal	Low	Low	Low	Low
Brou Beach	Beach Rocky reef	Minimal Minimal	Minimal Low	Minimal	Low	Minimal	Low	Low

Sanctuary Zone	Habitat/location Main type	Risk to direct habitat effects	Risk to captured fish assemblage	Risk to threatened species	Social risk to line fishers*	Social risk /access conflict	Risk to scientific reference sites	Economic risks to fishers if fishing is not allowed **
Bullengella Lake- Corunna Lake	Beach and rocky reef	Minimal	Minimal	Minimal	Low	Low	Low	Low

\* Note: this relates to the social risk to recreational fishers of maintaining the amnesty – i.e. allowing shore fishing in these in these areas (estimated from online survey that over 60% of fishers indicated that they supported maintaining the amnesty).

\*\* Note: this is the Economic risks to fishers if the amnesty is removed and fishing is not allowed in these areas.

- (1) While costs were considered low, this site accounted for the majority of costs associated with restricting access within Cape Byron Marine Park.
- (2) While costs were considered low, this site accounted for the majority of costs associated with restricting access within Batemans Marine Park.

## Management implications and implementation

The assessment of recreational fishing access on ocean beaches and headlands in marine park sanctuary zones is a small part of the much wider new approach to marine estate management announced by the NSW Government in March 2013. This assessment will inform decisions relating to the amnesty on shore-based recreational fishing in ocean beach and headland sanctuary zones, which will result in fishing being either allowed or not allowed in these zones. Further assessment of all threats and risks, including other fishing methods in all marine park zones, will occur during the development of management plans for each NSW marine park. A broader assessment of the entire marine estate will also be carried out to underpin the development of the marine estate management strategy planned to commence in 2014.

There are existing examples where specific forms of recreational fishing are allowed and other fishing methods restricted under marine park regulations, for example, the Handkerchief Beach Habitat Protection Zone in Batemans Marine Park that allows for recreational line fishing from the shore only.

Implementing similar regulations in the areas covered by this assessment would take time to conduct a mandatory consultation processes. As a result the continuation of the amnesty may be required to allow on-going shore-based recreational fishing where appropriate in the short term until changes to the legislation and the development of new marine park management plans.

Recommendations to allow or not allow fishing in the particular sanctuary zones assessed has involved social, economic and environmental evaluations. It is recommended that community consultation and engagement be carried out to provide comment on this assessment and the proposed management options.

