



# Jervis Bay Marine Park

## Summary of research and monitoring

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### Introduction

Evaluating the effectiveness of marine protected areas in conserving marine biodiversity is a key priority of the NSW Government.

Knowledge of spatial distributions and changes in species, habitats, and ecosystem processes is crucial to effective conservation planning. Information on social, economic and cultural values will assist in understanding and managing conflict, improve consultation, education and compliance, and optimise the benefits to the community.

The Strategic *Framework for Evaluation and Monitoring of NSW Marine Parks 2004* identifies two over-arching priorities for research and monitoring:

- the need to identify and select the location and nature of marine parks and their zones
- the need to monitor and evaluate the effectiveness of marine park zoning and related management arrangements.

This summary briefly presents the main research findings and results from studies conducted within the Jervis Bay Marine Park during the five year period (2002 to 2007), that have direct relevance to planning and management of the marine park, or which lead to a better understanding of the conservation value of marine protected areas. Many groups and individuals have undertaken research projects within the marine park. Where relevant, their results have been included.

### Research on biodiversity and ecological processes

Research into the biodiversity and ecological processes within marine parks is important for determining whether the size, boundaries and location of parks are adequate to maintain biodiversity and ecological processes. It also provides the basis for sustainable management of human uses and associated impacts.

Biological diversity is strongly influenced by habitat. Therefore classification and mapping of habitats is essential for understanding the spatial patterns of biodiversity. Recent advances in technology have allowed increased resolution and spatial coverage of the seabed to examine bio-physical extent and structure. A number of large-scale seabed habitat mapping programs are providing important information for the planning and assessment of marine park zones.

The current zoning plan was developed using a habitat classification system, based on habitats and depth, as a surrogate for biodiversity. Subsequent research has indicated that as distance from shore increases, the assemblage of species also changes. The habitat classification system has been updated to take this into consideration, and also to incorporate environmental influences, such as ocean currents.

Combining maps of seabed habitats with information on species distribution will allow improved assessment of the effectiveness of zoning arrangements for representing diversity.

In order to improve the spatial biodiversity information available for the assessment of zoning arrangements in Jervis Bay Marine Park, a number of comprehensive surveys have been conducted over the past five years. These build on other surveys conducted prior to the development of the current zoning plan. The research has focused on examining:

- shallow and intermediate reefs and their associated fish, invertebrate and algal assemblages
- soft-sediment habitat in estuaries and associated polychaetes, molluscs and crustaceans
- the effect of zoning on the recreational use of the marine park, including recreational fishing effort and catch rate, and the long-term monitoring of usage patterns
- the structure of pelagic fish assemblages
- the distribution and behaviour of dolphins.

Ecological processes can influence assemblages at local scales through various mechanisms associated with population dynamics and species life histories. These include dispersal, recruitment and settlement; density dependence, competition and predation; and trophic-dynamics and partitioning. Various studies have contributed to increasing knowledge of ecological processes operating within the marine park.

## Habitat mapping

There have been a number of seabed habitat mapping projects conducted within the marine park over the past 5 years that build on earlier work on soft-sediment habitats and near-shore reefs.

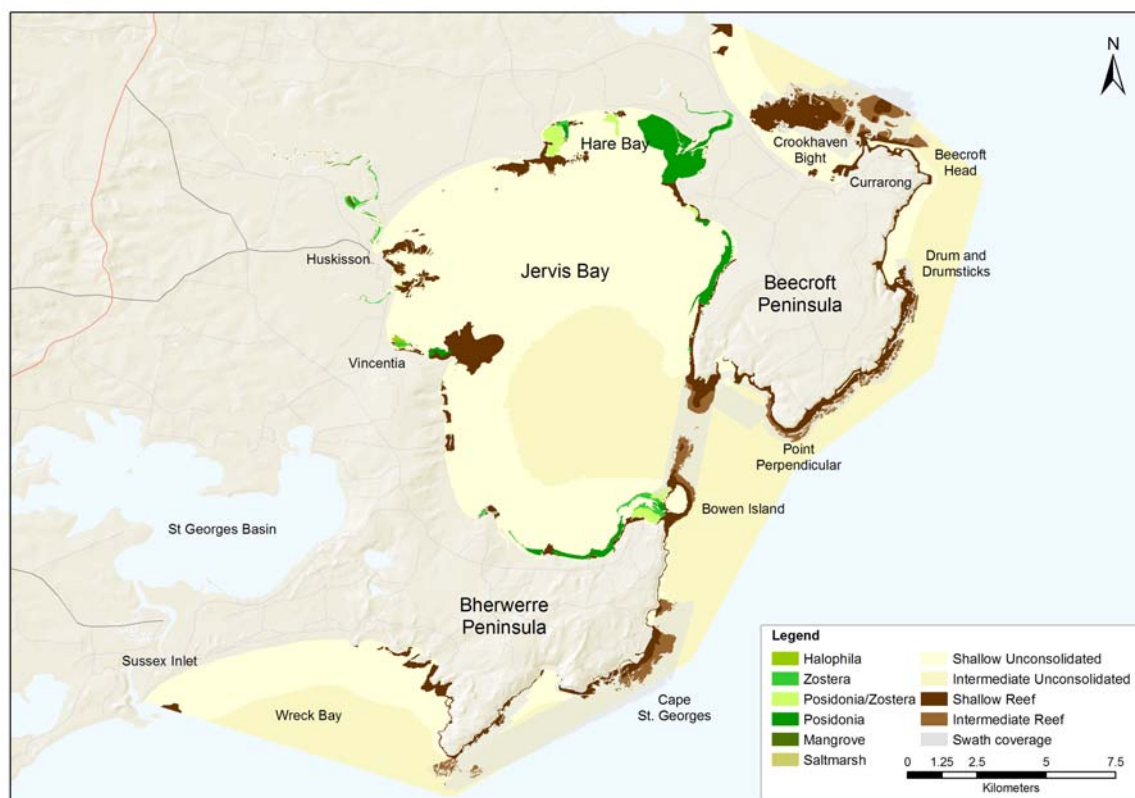
Recent high resolution acoustic mapping has provided further details on the extent, distribution and structure of seabed habitats, particularly rocky reefs, throughout the Jervis Bay Marine Park. There are extensive subtidal rocky reefs throughout the marine park, with many extending immediately adjacent from the Bherwerre and Beecroft Peninsulas and offshore from Currarong Beach and Wreck Bay (Figure 1). The reefs offshore of the north and south headlands are characterised by steep drop-offs, large boulders, caves, overhangs and complex relief.

Outside of estuaries, subtidal habitats in the marine park have been categorised into consolidated (rocky reef) and unconsolidated (primarily sand and seagrass) areas, within three depth zones: shallow (0–20 m), intermediate (20–60 m) and deep (more than 60 m). The available information was combined to provide a map of the known distribution of seabed habitats within the marine park (Figure 1).

## Biodiversity assessments

Jervis Bay Marine Park is widely recognised as an area of high biodiversity containing a range of habitats including intertidal and subtidal reefs, soft-sediments, beaches, seagrass beds, mangroves, saltmarsh, and pelagic waters.

Mammals, reptiles and birds are a distinct part of the fauna that include permanent residents, seasonal visitors and individuals during annual migrations. A number of these are threatened species that benefit from the resources and condition of the marine park.



**Figure 1: Known seabed habitats within Jervis Bay Marine Park**

## Reef habitats and assemblages

Reef habitats are extensive within parts of the marine park, and vary considerably in terms of their depth, complexity, exposure, distribution, structure and distance from shore. Consequently, the flora and fauna reflect this habitat diversity in their assemblage structure.

Surveys of subtidal rocky reefs have recorded a diverse fish fauna totalling 216 species. Site attached species such as wrasse, damselfishes, red morwong and rock cale provided the most temporally, and spatially, stable components of the fish assemblage. More mobile pelagic and schooling species such as snapper and bream, were highly variable between sites and between years. Newly-recruited juveniles of tropical species, which presumably die each winter, also added considerable variation between years.

The invertebrate fauna was dominated by the long-spined urchin while other species such as *Turbo* snails and red-throated ascidians were locally abundant. Commercially and recreationally important abalone and rock lobster species were rare on survey transects.

## Intermediate and deep reef fish assemblages

Research in intermediate reefs indicated the presence of several less encountered species, including hogfish, wrasse, leatherjacket, butterfly perch and mosaic leather jacket, which showed the variability of deep reef assemblages. Intermediate reef assemblages are very different to shallow reef assemblages, with greater diversity and a higher abundance of reef fish recorded in the deep habitats. This finding is consistent with research elsewhere, confirming the need for a range of reef depths for adequate reef biota representation in sanctuary zones.

## Fauna of estuarine tidal flats

Tidal flats are a vital part of estuarine and marine ecosystems, transforming food and nutrients that run off from coastal catchments and provide new food for marine ecosystems and fish resources. They are also part of a network of important nursery habitats for many species. Therefore, in light of the diminishing number of healthy estuarine systems, tidal flats were a target for protection in the marine park.

Research (in tidal flats) provided clear information on the distribution of 80 species of fauna, within the dominant groups of polychaete worms, molluscs, and crustaceans. Assemblages of animals living in the sediment could change dramatically from one spot in a tidal flat, to another only 100 m away. This indicates that it is important to protect a whole habitat, rather than sections, to achieve representation of the whole suite of biodiversity.

The research also found that Currumbene Creek was a species rich and abundant tidal flat that represented the diversity of tidal flats in the region. Apart from being important nursery areas, these tidal flats provide important feeding grounds for species higher up the trophic chain, for example, whiting, mullet, bream and stingrays.

## Ecologically sustainable use

### Assessing marine park zoning

Since establishment of the marine park zoning plan in October 2002, surveys of the biological community of sub-tidal rocky reefs have been conducted yearly as part of a broader study into the effectiveness of marine protected areas in Australian temperate waters.

Preliminary results from the more recent surveys show some divergence between 'no take' sanctuary zones and fished reference sites. One exploited fish species the red morwong, exhibited trends for population increase in sanctuary zones. This is constant with other research that indicates red morwong is a species that may recover quickly in sanctuary zones. Other patterns being monitored for included divergence between fished and unfished zones for the abundance of invertebrates and the total cover of kelp.

While numbers were low, the reestablishment of grey nurse sharks within a sanctuary zone in Jervis Bay was an encouraging sign that general protection from fishing may help protect this threatened species.

For these results more time is required to properly determine the biological significance of trends, and 7–10 years is probably a more appropriate timeframe for reporting on the performance of the zoning plan. The expected recovery of some species such as abalone and rock lobsters which have responded strongly to protection in other marine protected areas has not been observed yet in the rocky reef monitoring program. Longer time-frames may be required for recovery to become apparent.

### Assessment of sanctuary zone influences on an estuarine tidal flat

Sampling of an estuarine tidal flat in the year before and during the two years following protection as a sanctuary zone, demonstrated that there was a shift in the macrofaunal assemblage from before to after protection. This was mostly due to an increase in the abundance of a range of small, less mobile, filter feeding species, such as the juvenile Venus shell (*Bivalvia*; *Eumarcia fumigata*), which showed a close to six-fold increase in abundance across the protected tidal flat. In contrast, there was a reduction in some of the more mobile,

predatory and scavenging species that might have benefited from regular sediment disturbance through bait-pumping.

In addition to biological effects, there were changes to the sediment characteristics in the sanctuary zone. These results add to the growing amount of evidence for marine protected area effects on fauna, that are not the targeted species of human activity, but that are somehow affected as a secondary effect of the activity. Such changes affect whole ecosystems, the consequences of which are largely unknown, but will challenge the future research in marine protected areas. The implications are small on a local scale, but very important at the national and global scale.

## Recreational fishing monitoring project

The waters of the marine park have a long history of recreational fisheries research. Since the marine park zoning plan came into force, an assessment of the transfer of fishing effort outside sanctuary zones has been possible.

The bay's 14 identified recreational fishing types have a strong correlation to habitat and are concentrated into sub-sections of habitat where intense fishing effort occurs at scales less than 500 m<sup>2</sup>. This is especially pronounced for anglers targeting pelagic fish. It is clear that sanctuary zones are effective in reducing the effort in those areas.

In terms of zoning effects on overall fishing patterns, fishing effort peaked some time between 1990 and 2000 before the introduction of the marine park zoning. In 2000–2001, fishing effort at Jervis Bay had doubled compared to 1988–1990 levels, however, effort, for all months surveyed, has since declined and returned to effort levels similar to the late 1980s. Therefore, increased pressure in areas outside of sanctuary zones was not evident. Rather a total reduction in effort was observed, which is consistent with the trend that started prior to marine park zoning.

## Population biology and assessment

### Monitoring the dolphin population

Bottlenose dolphins are an iconic species of the Jervis Bay Marine Park and are valuable, not only because they have a key role as a top predator in the local ecosystem, but also because they are important for public appreciation and the local economy.

When the data from the commercial operators was analysed, no overall differences in dolphin sighting rates were detected between seasons or years (1998–2007). This is an encouraging indication that the dolphin population is relatively stable. At shorter periods of days or weeks however, dolphin sighting rates fluctuated greatly. Environmental factors that may impact the sightings of dolphins in the bay, other than weather conditions, could include changes in the abundance of the dolphin's prey.

### Small pelagic fish distribution, abundance and habitats

Pelagic fish are not generally thought to benefit from marine protected areas because they are perceived to be highly migratory or with a large home range, well beyond the usual scale of marine protected area boundaries. However, fishing effort for pelagic fish is often highly concentrated within the coastal zone, indicating that pelagic fish habitat in coastal regions may be predictable, and that pelagic stocks may benefit from marine parks sited in these areas. Sustainable management of coastal stocks of small pelagic fish requires data on their distribution, abundance and habitat associations.

By combining video data with oceanographic measurements and chemistry work on the bones of fish, it was possible to determine the distribution, abundance and habitat associations of two small pelagic fish within the marine park, the yellow tail scad and the slimy mackerel.

The specific coastal habitats observed for these two species suggest that appropriate marine park zoning could benefit small pelagic fish stocks, and that traditional views on movements of pelagic fish may be incorrect. Location of sanctuary zones should also be considered in light of some pelagic fish being located very close to shore, but with a switch of species as the water depth increases offshore.

## Specific impacts

### Monitoring of mangrove and saltmarsh

Monitoring on the eastern shore of Jervis Bay indicates that mangroves and saltmarshes are found within all of the four main creeks: Currambene Creek, Carama Inlet, Moona Moona Creek, and Callala Creek. Mangroves were found to have encroached on the saltmarsh by up to 700 metres. Some of this encroachment was also evident in the pristine Carama Inlet. These movements of saltmarsh and mangroves have occurred over the short-term and are in the opposing direction to the longer-term trend identified in the palaeo-stratigraphy record, which was one of saltmarsh replacing mangrove over the past few thousand years.

The sites which exhibit the greatest change in mangrove and saltmarsh were those with the highest rates of relative sea-level rise, and upper-level marsh subsidence.

### Effects of boat noise on bottlenose dolphins

The research found that dolphins altered their surface behaviour when exposed to the powerboat approach and also changed their direction of travel. These changes occurred when the power boat was greater than 100 meters from the dolphins. This information was used, in part, when determining new angles of approach (side on only) and minimum approach distance to dolphins (50–150 m depending on presence of calves) for recreational and commercial vessels by the New South Wales National Parks and Wildlife Service.

### Recreational fishing impacts

One of the objectives of the marine park is to provide for ecologically sustainable use. The long-term recreational fishing surveys that were established in 1988, and continue today, provide some insights into the effect of fishing effort on fish stocks in the bay. These surveys include interviews with recreational fishers and identification and measurements of fish caught.

Analysis of this data showed that before the zoning plan came into effect there was a trend of declining fish diversity in the catch, as well as decreased catch per unit effort.

## Socio-economic influences

Understanding socio-economic influences of marine parks is essential for management planning. It has direct application for allocating resources, for interpreting research data, for developing educational and communication materials, and for compliance assessment.

## Recreational activities in Jervis Bay Marine Park

A total of 33 recreational activities were identified inside and around the Jervis Bay Marine Park. The range of activities recorded was diverse, including swimming, rock exploring, fishing, sea kayaking, picnics, kite surfing and yoga. Passive recreation such as walking and enjoying the coastline (swimming and sitting) topped the list as the most popular activities, followed by vessel and shore-based fishing.

The data set that was used extended from 2001 to 2006, and within that period the biggest increase in effort was in sea-kayaking, although this activity fluctuates widely between years as do other activities such as scuba diving. Other recreational activities have shown a decreasing trend in effort such as jet skiing. The variability and trends in usage patterns may be attributed to a range of effects from the seasonal and annual weather patterns, the zoning plan and local business operators.

## Perceptions of small operator implementation of sustainable practices

There are a range of small businesses that operate within and/or adjacent to the marine park. One study undertaken along the NSW South Coast looked at how tourists perceived the application of ecologically sustainable development, such as marine parks, within the marine tourism industry; specifically the fishing, diving and marine mammal observation sectors.

The study found that the marine tourism opportunities, although key components of attraction, were part of a larger suite of tourism activities that brought tourists to the area. Diversity of activities was the key to tourism marketing in the region. Of note was that 80% of respondents felt that the small business operators contributed to a sense of cohesion in the surrounding community. It was evident that many tour operators value sustainability as a business objective. This is consistent with the findings that tourists in Jervis Bay were identified as being appreciative of ecologically sustainable activities. Despite this, it was found that there was great variability in the value placed on ecological sustainability.

### Notes

This document provides a brief summary of research carried out by the Marine Parks Authority and external groups and individuals in the Jervis Bay Marine Park. For further information, go to [www.mpa.nsw.gov.au](http://www.mpa.nsw.gov.au), or

Jervis Bay Marine Park  
PO Box 89  
Huskisson NSW 2540  
Phone: (02) 4441 7752  
Fax: (02) 4441 7756  
Email: [jervis.bay@mpa.nsw.gov.au](mailto:jervis.bay@mpa.nsw.gov.au)

Published by: Marine Parks Authority New South Wales

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DECC 2008/177  
ISBN 978 1 74122 797 0  
March 2008