

Port Stephens-Great Lakes Marine Park



RESEARCH WORK PLAN 2009-10

Port Stephens-Great Lakes Marine Park

INTRODUCTION

The Port Stephens-Great Lakes Marine Park covers approximately 982 km² of marine and estuarine habitats and extends south from the Cape Hawke Surf Life Saving Club near Forster to Birubi Beach Surf Life Saving Club at 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 tidal limit. The Port Stephens-Great Lakes Marine Park was declared in December 2005 and the zoning plan commenced in April 2007.

The extent of the Marine Park was identified for its many outstanding ecosystems, habitats and species; its high degree of naturalness and catchment protection; recommendations from previous assessments; and the extent to which it complements existing Marine Protected Areas and conservation management strategies. These specifically include Port Stephens and the Karuah River estuary, Myall Lakes and Smiths Lake; and the adjacent exposed coast and ocean to the limit of State Coastal Waters (~3 Nm offshore); including the whole range of mapped marine ecosystems and the greatest area and number of mapped island, subtidal reefs, intertidal rocky shore and beach habitats in the bioregion.

The marine component of the park contains a diverse range of habitats including soft sediments, beaches, rocky reefs of varying depth and open waters which all support somewhat distinct groups of plants and animals. As the park extends from the high tide mark to at least 80 metres deep and 10 kilometres offshore in some areas, there is considerable diversity in flora and fauna. Such diversity is due to the variations in depth and seabed geomorphology, various dominant sessile assemblages, 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.

Estuarine habitats and species are particularly diverse in the marine park due to the presence of a tide dominated drowned river valley (Port Stephens), a brackish barrier lake ecosystem (Myall Lakes) and an intermittent coastal lagoon (Smiths Lake). These ecosystems are dominated by seagrass, mangrove, aquatic macrophyte and saltmarsh habitats that provide important structural habitats for many species of fish, invertebrates, filamentous algae and birds. The deeper sections of these areas also contain unvegetated areas that often contain habitat for a different suite of species.

Due to the high habitat diversity the region supports a high diversity of fish and other benthic fauna. Some of these are threatened or protected, some have high conservation value due to their endemism or their ecological role, and some are valued by fishers. Mammals, reptiles and birds are also a distinct part of the fauna, being permanent residents, seasonal visitors, or individuals just passing through.

Ecological processes throughout the region are interconnected with both resident and migratory marine species relying on specific habitats for breeding, feeding and protection. The region also caters for a wide range of user groups and is of social, cultural and economic importance to both local communities and tourists.

The strategic framework includes two overarching priorities for research and monitoring. These are the need to:

1. Identify and select the location and nature of marine parks and their zones
2. Monitor and evaluate the effectiveness of marine park zoning and related management arrangements

The program also aims to expand our knowledge and understanding of the marine environment, detect unforeseen changes to the health of marine ecosystems and also report on the nature and extent of activities occurring in the Marine Park. All of this information is essential in order to maximise the effectiveness of zoning and other management actions while minimising socio-economic and cultural impacts.

The research and monitoring projects are categorised under five overall areas.

- 1. Biodiversity and ecological processes**
- 2. Indigenous and non-Indigenous culture and heritage**
- 3. Ecologically sustainable use**
- 4. Specific impacts**
- 5. Socio-economic impacts**

This 2009-10 Research Work Plan outlines the research and monitoring projects that the Marine Parks Authority intends to undertake directly, or through collaboration with external research providers. It refers specifically to projects funded or supported by the Marine Parks Authority and does not include research conducted within the Marine Park that is funded solely from other sources. The Marine Parks Authority actively works with other government agencies and universities to identify priority projects and seek external funding for research. Additional projects may be added to the plan during the year as further resources become available.

Evaluating the benefits of protection to fish and macroinvertebrates on shallow rocky reefs within the Port Stephens-Great Lakes Marine Park

Background

Currently most marine parks in the State have conducted underwater visual census projects examining densities and size frequency of reef fishes and selected mobile macroinvertebrates. Those within several other NSW marine parks have collected several years of data in order to measure the effectiveness of biodiversity conservation in marine parks. This monitoring network has been designed to provide critical information for decisions relating to issues such as appropriate number and configuration of Sanctuary Zones within marine parks.

A number of Underwater Visual Census (UVC) surveys of shallow rocky reefs have previously been conducted within the Port Stephens region. These surveys have provided some information on the composition of fish assemblages and densities of a number of species of macroinvertebrates. The power to detect spatial variations in abundance has also been examined providing some basis for designing an effective UVC survey in Port Stephens-Great Lakes Marine Park.

There is a clear need to monitor the effectiveness of marine park zoning within the Port Stephens-Great Lakes Marine Park, and the establishment of baseline information on the abundance of fish and mobile macroinvertebrates on shallow rocky reefs is one component of this evaluation. It is a program that is expected to continue as part of a core monitoring program to evaluate the effectiveness of the marine park zonings.

Objectives

- To test the general hypothesis that entire assemblages (diversity, composition and abundance) as well as individual species abundances will differ among zones and that these differences will increase over time.
- To test the hypothesis that the size and abundance of targeted fish and invertebrates will increase in sanctuary, relative to non-sanctuary zones and outside the park over time.

Methods

The surveys will consist of four transects undertaken in three Sanctuary Zones and an identical sampling effort in control areas (Habitat Protection Zones). This will result in 24 sites (transects) in the areas of Tomaree Head, Point Stephens and Broughton Island.

Mobile fishes are first counted in a 5 x 25 m strip and cryptic and juvenile fishes counted in a 1 x 25 m strip parallel to the larger strip. Mobile macroinvertebrates are counted at the same time as fishes using 5 x 1 m replicate transects at each site. The density and estimated size-class of the various fish species within 5 m of each side of the transect line are recorded by a trained diver. Lengths of fish >1 m length are individually estimated. Calibration of size estimates are based on comparison of observed fish lengths with a scale-bar on the underwater slates carried by divers. Other habitat variables are recorded during the surveys, including reef profile and rugosity.

Contacts

David Harasti – NSW Marine Parks Authority

Assoc. Prof. William Gladstone – University of Newcastle

This project address the following issues identified in the Strategic Research Plan:

Biodiversity and Ecological Processes

- Conduct biodiversity assessments of selected taxa
- Assess the spatial and temporal patterns of assemblages

Ecologically Sustainable Use

- Examine the optimum design of marine parks
- Abundance of key species of fish and invertebrates

Assessment and monitoring of urchin barrens on shallow and deep reefs within Port Stephens-Great Lakes Marine Park

Background

Rocky reef areas devoid of foliose algae (barrens habitat) are known to be widespread throughout areas of NSW, and the extent and persistence of patches of barrens have important implications for the ecology of many species of algae, fishes and invertebrates. The development of barren reef area due to the over-grazing of macroalgae by sea urchins can result in part from the reduction in the number of urchin predators due to fishing. Studies of a sanctuary zone in New Zealand found that once the numbers and average sizes of snapper and rock lobsters had recovered, these large predators began controlling the local sea urchin (*Evechinus chloroticus*), which had eaten extensive areas of kelp (predominantly *Ecklonia radiata*) resulting in barren areas.

There is limited information on the distribution and temporal variability in extent of barrens along the NSW coast, although evidence suggest they are maintained with only low levels of urchin grazing. In particular, there is little information on the extent of barrens in depths greater than around 15 m, although they commonly occur on deeper reefs in other temperate waters of Australia. There is a clear need to understand the extent of barrens habitat on rocky reefs within Port Stephens-Great Lakes Marine Park in order to evaluate habitat condition and provide a baseline in which to assess change over the long term. Monitoring of barrens would involve mapping the extent of barrens from SCUBA and/or video surveys at a number of reef locations within the marine park.

This initial assessment of urchin barren extent is funded primarily by the Hunter-Central Rivers Catchment Management Authority.

Objectives

- To determine the distribution and extent of seabed habitat types on both shallow and deep rocky reefs in the marine park
- To compare the extent and distribution of barrens at several sites within Sanctuary and Habitat Protection Zones

Methods

A submersible digital colour video camera will be deployed at a minimum of 10 transects covering an approximate distance of 100 m each transect. The video camera contains around 40 kg of weight and towed at a speed of 1 knot to ensure the camera is positioned as close to the GPS antenna as possible. Differential GPS location, time, date and water depth will be overlaid onto the video from the GPS sounder.

The video will be analysed for estimates of total algal cover scored into 25% bins (i.e. 0%, 1-25%, 25-50%, 50-75% and 75-100%). Each of the dominant algal species or groupings will be determined and classified into defined habitat types (e.g. *Ecklonia*, *Phyllospora*). It is planned to survey two locations (Broughton Island and Point Stephens), both with two zone types (Sanctuary and Habitat Protection Zones) with 5 randomly located transects in each zone.

The extent of barrens will be mapped into ArcInfo as point data that will be converted into polygons using knowledge based interpolation procedures. Spatial extent and distribution of barrens will be estimated and used as a basis for comparisons in future years.

Contacts

David Harasti – NSW Marine Parks Authority

Assoc. Prof. William Gladstone – University of Newcastle

This project aims to address the following specific research issues identified in the Strategic Research Plan:

Biodiversity and Ecological Processes

- Map and assess the spatial extent and structure of seabed habitats and key taxa

Ecologically sustainable use

- Examine the optimum design of marine parks
- Assessment of impacts and threats of anthropogenic activity on habitats

Evaluating benthic fish assemblages in deep water habitats of the Port Stephens-Great Lakes Marine Park

Background

Seabed habitats are frequently used as a surrogate for spatial patterns in marine biodiversity, however, there is little information on the fish diversity and composition associated with many habitats in intermediate depths (20 -60 m) within the Port Stephens-Great Lakes Marine Park. The recent swath mapping of the region has identified considerable areas of rocky reef in depths >20 m throughout the marine park, some of which is represented within Sanctuary Zones.

Differences in species composition and population structures of fish in deeper reefs will be investigated using Baited Remote Underwater Video (BRUV) systems, a technique commonly used throughout Australia to examine fish assemblages at sites not suitable for diving. Standardised baits are used to attract fish to a viewing area, being recorded horizontally by a video camera. Using this system, information can be obtained on relative abundance and fish diversity on habitats deeper than can be routinely accessed through diver visual census.

The use of depth to divide rocky reefs into different habitat types for marine park zoning purposes assumes that assemblages of fish differ at increasing depths across the continental shelf. This has been commonly found at many sites throughout world but requires testing within the Port Stephens region to ensure zoning arrangements provide adequate protection to the full range of fish species. This is particularly important as deep reefs are commonly targeted by commercial and recreational fishers and BRUV allows for monitoring of these deeper benthic habitats. The study will also provide useful data on the abundance of fish in several of the sanctuary zones prior to and after the enforcement of the zoning plan. It is a program that is expected to continue as part of a core monitoring program to evaluate the effectiveness of the marine park zonings.

Objectives

- To test the hypothesis that there are differences in fish assemblages (diversity, abundance and size frequency) between sanctuary, general use and habitat protection zones and areas outside the park on deep subtidal rocky-reef and that these differences will increase over time

Methods

Four Baited Remote Underwater Video Stations (BRUVS) are deployed simultaneously for at least 30 mins. Video cameras are housed in custom-made housings and baits are mashed into a plastic mesh bait bag and wired to the end of each bait-pole (approximately 1.5 m distance from the frame). Sponge reef habitat (15-30 m depth) are sampled in two Areas (Broughton Island and Fingal Bay), and within each Area, sampling will be divided into two Locations (Sanctuary and Habitat Protection Zones) with 9 replicate BRUVS within each, using a spacing of at least 200 m. This gives a total of 36 replicates (18 per Area).

All observed fish species are recorded to provide total species richness. An index of relative abundance is determined using the maximum number (MaxN) of individual fish (of a particular species) in the frame at any one time during the 30 min set. Time of MaxN (TmaxN) is also recorded. The time of first sighting (TFS) and the time at first feeding (TFF) are also recorded. Multivariate analysis will be conducted to examine the factors of Area and Zone. Target fish

that feed on the bait bag and are perpendicular to the camera are measured for total-length and screen shots are captured of all important fishery species.

Contacts

David Harasti – NSW Marine Parks Authority

Assoc. Prof. William Gladstone – University of Newcastle

This project aims to address the following specific research issues identified in the Strategic Research Plan:

Biodiversity and ecological processes

- Conduct biodiversity assessments of selected taxa
- Assess the spatial and temporal patterns of assemblages

Ecologically sustainable use

- Abundance of key species of fish and invertebrate
- Examine the optimum design of marine parks

Towards the long-term management of the dolphin population in the 'Dolphin-Watching Capital of Australia'

Background

Research into the dolphin population in Port Stephens has included analyses of abundance, group and social structure, site fidelity, genetics, usage patterns, and boating impacts. The Port Stephens dolphin population is small and genetically distinct from the adjacent coastal dolphins, with four main female bands in the area and several male alliances. Three of the bands, as well as several male alliances, concentrate their activities in the eastern section of the Port where high levels of commercial dolphin-watching and recreational boating activity occurs.

Dolphin responses to interactions with boats in this area include disruption to their social structure and changes in time allocated to different behavioural activities. Similar short-term changes in behaviour to those reported in Port Stephens have been recently linked to long-term impacts on relative abundance, and possibly reproductive success of Indo-Pacific bottlenose dolphins in a population exposed to a small number of boats in Shark Bay, WA. The study showed that as the number of dolphin-watch boats increased from one to two, there was a significant decline in local dolphin abundance of about 15%. There is a clear need for information on population size and use of habitats by the dolphins when formulating management options for the dolphin-watching industry in Port Stephens.

Objectives

The main goal of this project is to continue to obtain scientific data pertinent to the long-term management of the bottlenose dolphin population in Port Stephens.

The specific objectives are to:

- assess trends in bottlenose dolphin population size using a long-term photo-identification dataset
- identify ecologically important habitat through an integrated GIS approach

Methods

Systematic photo-identification boat surveys have been conducted in Port Stephens for seven summer and three winter seasons (ranging from 1998 to 2007) by Macquarie University (MU). During this project (MQECRG) one additional year of surveys is proposed (summer and winter). The combined dataset will include 8 summers and four winter seasons.

Abundance estimates for the Port Stephens' dolphin population have been conducted for the summers 1999-2002. In addition, transect surveys and photo-identification data have been collected for summers 2005-07, and for winters 2002 and 2006-07. Estimation of abundance will be calculated following the mark-recapture method.

An integrated GIS approach will be used to provide an overall picture of habitat use for Port Stephens' dolphins. Spatial associations between dolphins and environmental characteristics will be investigated to identify areas of ecological significance to the dolphins, taking into account their social structure. Data on dolphin habitat use will be derived from the transect surveys. Comparisons between summer and winter seasons will be made to investigate potential seasonal variation in habitat use. The area covered by transects during the surveys will be divided into quadrats to enable habitat use to be quantified using GIS. In addition, the range of individual dolphins and social groups will be estimated using fixed kernels.

Contacts

Dr Luciana Möller - Macquarie University

Assoc. Prof. Rob Harcourt - Macquarie University

This project address the following issues identified in the Strategic Research Plan:

Ecologically Sustainable Use

- Interactions with marine mammals
- Abundance of key species

Establishment of a monitoring program for Black Cod within the Port Stephens-Great Lakes Marine Park

Background

The Black Cod (*Ephinephelus daemelli*) is listed as vulnerable under Part 7A of the NSW *Fisheries Management Act* 1994. This species is known to occur along the entire NSW coast however very little is known about its distribution and abundance. The NSW DPI draft recovery plan for black cod recommends scientific assessment of distribution and abundance as a high priority for the species. The Hunter Central Rivers CMA has provided NSW DPI with funding to implement threatened marine species research in the CMA region. In order to progress this the MPA aims to conduct a study to investigate the distribution and abundance of black cod (*Ephinephelus daemelli*) within the Port Stephens-Great Lakes Marine Park (PSGLMP), with funding from the HCRCMA via DPI. This project will address these research objectives through underwater visual census (UVC) and establish baseline information on this species.

The establishment of these monitoring sites will contribute towards a long term monitoring program for threatened species in the PSGLMP. A community education program will be established to assist local divers in the identification of black cod (and other protected cod species such as estuary cod and Queensland groper) as well as the establishment of a reporting system where divers can report sightings of black cod, and other key species. The additionally collection of fish data will assist in the establishment of a long term fish monitoring program for assessment of marine park zoning (sanctuary zones vs habitat protection zones). Divers from the Great Lakes Underwater Group (GLUG) and local dive clubs in Port Stephens will be involved. This project will lead to the establishment of a threatened and protected species sighting database for the PSGLMP. Marine park staff will also implement the monitoring program by conducting scuba dives at various sites throughout the Marine Park. Preliminary site selection has been undertaken, although advice will also be sought from local divers and fishers about black cod occurrence. Sites are within sanctuary zones and habitat protection zones to provide an assessment of the effectiveness of the marine park zoning plan for black cod protection.

Objectives

- Through the use of underwater visual census (timed swims), provide an assessment of the distribution and abundance of black cod in the PSGLMP
- Collect data on other reef fish species within sanctuary and habitat protection zones in the Port Stephens-Great Lakes Marine Park

Methods

Survey methodology will involve two trained scientific divers swimming along each site for 30 mins searching for black cod and recording any individuals as well as the habitat they are found in. Other parameters to be recorded will include site depth, habitat cover and structure. Divers will also record other protected cod species (such as estuary cod and Queensland groper) and input sighting info into the NSW DPI threatened and protected species database. In addition to recording threatened species, divers will record target fish species. Divers will tow a surface float with a GPS attached to record the distance travelled and to mark the exact location of any black cod sightings. Data analysis will be undertaken to assess the abundance of black cod throughout the marine park and their occurrence within sanctuary and non sanctuary zones.

Contacts

David Harasti – NSW Marine Parks Authority

This project aims to address the following specific research issues identified in the Strategic Research Plan:

Biodiversity and ecological processes

- Assess threatened, protected and endemic species

Ecologically sustainable use

- Abundance of key species of fish