

Solitary Islands Marine Park



RESEARCH WORK PLAN 2009-10

Solitary Islands Marine Park

INTRODUCTION

The marine environment in the Solitary Islands Marine Park is biologically diverse and contains a unique mix of tropical, subtropical and temperate species. Within the Marine Park these species are found in a variety of habitats, including estuaries, intertidal rocky shores, island fringing and subtidal reefs, sandy beaches, subtidal soft substrate and open ocean. Ecological processes throughout the Marine Park are interconnected with both resident and migratory marine species relying on specific habitats for breeding, feeding and protection. Assessment of marine pollution and marine pests is critical to the conservation and protection of habitats and species found in the marine park.

The marine park also caters for a wide range of user groups and is of social, cultural and economic importance to the area. It is also culturally significant to local Aboriginal communities, with many spiritually significant sites occurring within and adjacent to the marine park, coupled with a continuing tradition of cultural resource use.

Research is a key component in the management of the Solitary Islands Marine Park and the research program seeks to expand our knowledge and understanding of the marine environment, provide a regular update on the health of marine ecosystems and the nature and extent of activities occurring in the marine park, and indicate the effectiveness of zoning and other management actions.

Monitoring and research provide information to make informed management decisions at the SIMP for the conservation and sustainable use of the park mandated by the *Marine Parks Act 1997*. Marine Parks Authority research and monitoring programs are guided by a strategic research framework and a strategic research plan. This provides a vision and structure for the development of research and monitoring programs that contribute to a 'whole-of-government' approach to the sustainable management of marine resources in NSW.

The strategic framework includes two overarching priorities for research and monitoring:

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.

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 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.

Reef fish and benthic program, Solitary Islands Marine Park

Background

The current zoning plan for the Solitary Islands Marine Park has been in place since August 2002. A monitoring program on reef fish density was established at that time to assess the effect of sanctuary zones (SZ). Fish densities are compared within and between sanctuary zones and other zones (where fishing can occur) using established transect methods on scuba. A variety of fish categories are used as indicators. The first baseline or benchmark survey was carried out during June – July 2002 immediately prior to commencement of the current zoning plan. Additional methods are used to increase the strength of comparisons, including baited remote videos and timed counts.

Objectives

- Assess the effects of zoning and associated management on specific reef-fish abundance and size composition
- Determine differences in reef-fish community structure on reefs throughout the Solitary Islands Marine Park
- Evaluate the representation of reef-fish communities within higher protected areas within the marine park
- Assess the status of threatened, protected and endemic species such as black cod, grey nurse shark and blue groper within the Solitary Islands Marine Park and monitor their status through time
- Obtain a reef-fish species list (including relative abundance) for the Solitary Islands Marine Park

Methods

Sixteen sites are surveyed annually using diver transects, although they were not surveyed in 2008, and are proposed to be surveyed biennially in future. The design is balanced for statistical analysis, with half the sites being sanctuaries following rezoning. The influence of size of sanctuary zone can also be examined through this study with smaller sanctuary zones (established in 1992) able to be compared with larger sanctuary zones (established in 2002). The same sites are resurveyed in winter each year. Six 25m transects are haphazardly placed and surveyed at each site. These transects will next be re-surveyed in winter 2009. Benthic video transects are also carried out every 2 to 3 years at the sixteen sites to examine changes in benthic cover. Baited underwater video monitoring is also conducted in four locations annually, with nine 30-minute baited video drops in each area. Two of the locations are in SZ.

Reef-fish diversity has been surveyed at 70 sites within the marine park using timed counts to determine spatial patterns in assemblages and indicate unique sites. Eighteen sites were examined annually over three years to assess stability in assemblage patterns within the marine park through time.

Contacts

Hamish Malcolm - NSW Marine Parks Authority

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

- Examine the optimum design of marine parks: size, patterns of zoning
- Abundance of key species of fish and invertebrates
- Assess threatened, protected and endemic species

Mud crab (*Scylla serrata*) monitoring program

Background

This project measures the density and relative abundance of mud crabs *Scylla serrata* within three estuaries in the Solitary Islands Marine Park. Each estuary includes areas that are both open and closed to crabbing. The project commenced in 1999 so it can compare changes in abundance before and after the current marine park zoning scheme was adopted in 2002. The current field survey program was completed in 2007, but can be resurveyed as required. Analysis and write-up for results to date are currently underway.

Mudcrabs are a useful species as an indicator in this marine park, as they are a popular target species for both commercial and recreational fishers in areas open to crabbing, and not crabbled in the closed areas. Mud crabs also have a short life span (3 to 4 years) and their numbers can (potentially) increase quickly in response to changes in zoning protection. This information will be useful for assessing how the current zoning scheme is performing and for showing the benefits of sanctuary zones. Results to date have already shown strong benefits to mudcrab numbers in sanctuary zones in all three estuaries.

Objectives

- Monitor and compare mudcrab densities in zones 'open' and 'closed' to crabbing, before and after zoning changes in 2002, to assess the influence of sanctuary zones in the three largest barrier estuaries in the Solitary Islands Marine Park
- Monitor and compare relative abundance of mudcrabs in four ICOLL's in the Solitary Islands Marine Park to assess the influence of the sanctuary zone in Station Creek and the trapping closure in Arrawarra Creek
- Assess the influence of marine park zones by comparing the size (length, width) and sex ratio of mud crabs within and between different zones
- Monitor mudcrab populations (density / relative abundance) within areas open to fishing, as a locally important fisheries resource
- Obtain information on patterns of use and compliance by fishers

Methods

The three largest barrier estuaries have been monitored: the Woolli Woolli River since December 1998 and the Sandon and Corindi Rivers since 1999–2000. Each estuary is sampled twice per annum (April, December) for three nights, with three traps sampled at three sites in each zone (sanctuary zone, habitat protection zone) in each estuary per night. An additional three sites in the Woolli Woolli River are sampled in the southern fork, which changed from sanctuary zone (no crabbing) to habitat protection zone (crabbing permitted) in 2002, following a decade of protection under the previous zoning scheme.

Captured crabs are temporarily marked to identify them if they are re-caught on the subsequent two nights. December gives pre-holiday (lower fishing pressure) data, while April is a major recruitment period when small crabs enter the fishery. April data also can indicate change in populations after the Christmas (higher fishing pressure) period. Standardised commercial crab traps are used with similar bait (fresh, whole dead fish) used per trap. This program also included monitoring the relative abundance of mudcrabs in 4 ICOLL estuaries twice per year using nine traps per ICOLL over a single night.

Contacts

Dr Paul Butcher – National Marine Science Centre

Hamish Malcolm - Solitary Islands Marine Park

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

Ecologically Sustainable Use

- Examine the optimum design of marine parks
- Investigate the effectiveness of marine parks in increasing propagation, identifying areas of sources or sinks, extent of spillovers
- Age, growth, reproductive biology and movement of selected fish, shark and invertebrates
- Abundance of key species of invertebrates

Assessing patterns of human activity and use in Solitary Islands Marine Park

Background

Understanding patterns of human use and activity within the marine park is an essential tool for management planning, for interpreting research data, and for compliance assessment. This project to date has established broad patterns of human activity and use in various habitats in the marine park by combining information recorded during routine patrols as well as from questionnaire and observation surveys.

A questionnaire survey carried out over 5 summers since the marine park was rezoned in 2002 provided valuable and specific information on the existing marine parks advisory material, facilities provided by the MPA (e.g. moorings and signage), demographics, and levels of user satisfaction. This was enhanced by a study on human perceptions and demographics in the northern end of the marine park in 2003, and a telephone survey on attitudes.

In 2008-2009, in line with a review of the current zoning plan, the future direction of this program will be re-examined, and a modified program, directed towards the next 10 year review, will be developed. It is envisaged this will include attitudinal surveys, analysis of commercial fishing data, economic assessment, and patterns of use surveys including aerial surveys. The synthesis of the information from all of these components will continue to increase our understanding and knowledge of patterns of human use and activity in the marine park. This has direct application to management in allocating resources and developing communication materials, and in planning.

Objectives

- To describe broad patterns of human demographics, activity and use within the marine park, using a combination of observational mapping and questionnaires.
- To assess vessel use and activity on reefs with marine park monitoring sites
- To assess the extent of illegal activity at specific locations
- To assess levels of user satisfaction with the marine park and improve management strategies and allocation of resources
- To evaluate the existing program and modify, as determined, with direction towards the 10 year review

Methods

This project will establish broad patterns of human activity and use in various habitats in the marine park by combining information recorded during routine patrols as well as from questionnaire and observation surveys. This includes information from a study on vessel activity in the southern end of the marine park.

A questionnaire survey, carried out over the past 3 summers since the marine park was rezoned, provides valuable and specific information on the existing marine parks advisory material, facilities provided by the MPA (e.g. moorings and signage), demographics, and levels of user satisfaction. This is enhanced by a study on human perceptions and demographics in the northern end of the marine park. This information has direct application to management in allocating resources and developing communication materials.

Contacts

Nicola Johnstone - Manager, Solitary Islands Marine Park

Hamish Malcolm – Solitary Islands Marine Park

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

Ecologically sustainable use

- Examine the distribution and composition of recreational and commercial fishing catch and effort
- Assessment of human usage, impacts and threats of anthropogenic activity on habitats

Assessment of deep reef fish composition

Background

Knowledge of deeper reef habitat in some parts of the Solitary Islands Marine Park over the past three years has increased considerably through swath mapping providing detailed bathymetry and seabed habitat maps. However, the biodiversity of intermediate reefs (25 to 60 m) and deep reefs (>60 m) and the relationships between reef habitat and spatial patterns of faunal assemblages, are still poorly known. Increasing knowledge of this relationship will provide an indication as to whether these reefs should be treated as a single 'habitat' type, which will assist planning, as 'habitat' forms a cornerstone of representative planning in NSW MPA's.

The swath maps have provided the ability to pre-select sites on which to survey different types of reef using baited video and correlate physical and environmental data with biotic patterns. Baited video has now been proven as a standard method for comparing fish assemblages, and 20 sites were surveyed in 2007-2008. This was expanded in 2008-2009 to another 36 sites (56 sites in total) including sites selected from swath mapping undertaken in 2008.

Patterns will be correlated against a number of physical and environmental factors including distance-from-shore, latitude, depth, habitat characteristics, and dominant benthos. The benthic community at each BRUVS replicates was qualitatively described from the video footage. The most-influential factors will be used to develop the Habitat Classification System (HCS). These surveys will also provide 'benchmark' information as to relative abundance of reef fish target species that are usually found on deeper reef (such as pearl perch). These data will also be utilised in systematic planning using Marxan analyses.

Objectives

- Compare 'baited video' reef fish assemblages between a range of shallow (15 to 25 m) intermediate (depth 30 to 60 m) and deep (>60 m) reef sites in SIMP and correlate any patterns to a range of environmental and physical variables.
- Evaluate the influence of benthic assemblage and 'habitat complexity' on fish assemblages
- Test the depth-category component of the HCS against biotic pattern
- Examine the representation of deeper reef fish assemblages in sanctuary zone.
- Obtain a benchmark for relative abundance of targeted species on deeper reefs in SIMP/SIMR

Methods

The BRUV sites will be based around 4 defined reef habitat types; high relief continuous, low relief continuous, low relief patchy, cobble/gravel. Three 30 minute replicates per site will be conducted at each, resulting in a total of 48 BRUV sets. 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 and univariate analysis will be conducted to examine the factors of habitat type.

Contacts

Hamish Malcolm – Solitary Islands Marine Park

Dr Alan Jordan - NSW Department of Environment, Climate Change and Water

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

Biodiversity and Ecological Processes

- Examine habitat condition
- 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

Mapping and classifying seabed habitats in Solitary Islands Marine Park

Background

The primary goal of the Marine Parks in NSW is to establish a comprehensive, adequate and representative (CAR) system to protect marine biodiversity and maintain ecological processes. In order to maximize the goals of the CAR principles in the Marine Parks design it is important to include biological information at the largest scale practical in the planning process to ensure that all major benthic habitats and communities are represented within Sanctuary Zones.

Current knowledge of offshore reef and benthic communities within the Solitary Islands Marine Park is based on drop-video, grab and sounder information along a set of transects that in reality cover a very small component of the marine park. In particular, the area of offshore reef that is currently protected within Sanctuary Zone is unknown. As well, the benthic communities on this habitat type are highly variable and this needs to be taken into account to ensure biodiversity is adequately represented within highly protected areas. There is increasing evidence that habitats may act as effective 'surrogates' for species diversity in the planning process provided they are appropriately validated and all representative habitats are included. Therefore, mapping of seabed habitats may be a cost-effective method of diversity assessment for Marine Parks planning and is an important component of the information required for assessment of the effectiveness of the existing zoning arrangements within the Solitary Islands Marine Park. Comprehensive mapping will also facilitate systematic planning using Marxan analyses.

Objectives

- Obtain detailed bathymetric and seabed habitat maps for the Solitary Islands Marine Park using a bathymetric side-scan sonar
- Develop a habitat classification system for seabed habitats reefs and other deeper habitats
- Produce a ground-truthed mapping overlay using the habitat classification system

Methods

Extensive field surveys will be conducted with the DECC's GeoSwath bathymetric sidescan throughout the marine park area. The location of the survey areas will consist of a combination of fixed transects providing full coverage and targeted tracks, the spacing of which will be determined by assessment of habitat distribution from knowledge of geomorphology, bathymetry, hierarchical level of classification required and available survey time. In most cases this will allow identification of the offshore extent of reef habitats in order to complement the existing nearshore reef spatial layers that were defined thru assessment of aerial photographs.

Depth data will be used to produce contour layers and a Digital Elevation Model (DEM) for use in the GIS analysis. Depth measurements taken from the sounder will be used to construct a contour layer corrected to Mean Sea Level after the depths have been corrected for tidal variation. These images will be used to examine reef roughness, slope and depth. Habitat categories determined from the sidescan backscatter will be defined within a hierarchical classification scheme for subtidal seabed habitats that are based on either abiotic or biotic structuring variables, or a combination of the two. The resulting habitat map will be draped over the DEM to provide a visual 3D representation of the substrate surface. A submersible digital colour video camera will be deployed to confirm habitat boundaries and obtain information on sessile biota. The resulting maps will be a combination of raster layers of bathymetry and rugosity, and vector layers of defined habitat categories.

Contacts

Dr Alan Jordan - NSW Department of Environment, Climate Change and Water

Dr Peter Davies - NSW Department of Environment, Climate Change and Water

Hamish Malcolm - NSW Marine Parks Authority

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
- Identify unique & sensitive marine habitats and communities

Ecologically Sustainable Use

- Examine the optimum design of marine parks

Assessment of reef habitat condition in Solitary Islands Marine Park

Background

Low levels of coral bleaching have occurred throughout the past 8 years in the Solitary Islands Marine Park, with occasional minor elevation of bleaching in some species at some sites. A major bleaching event did not occur during that time, although extensive bleaching occurred on the Great Barrier Reef in 2002 along with regional bleaching in the Capricorn-Bunker Group in 2007. Sea temperature is being monitored throughout the Marine Park, and at other sites in northern NSW to gain an understanding of variability in sea temperature both spatially and through time, and provide a link between elevated temperature and bleaching should such an event occur. A disease (that causes rapidly spreading mortality through a colony) was also detected through a tagging study conducted from 2000 – 2002 to examine bleaching. At least 18% of tagged colonies were affected by the spreading disease, and in 10% of tagged colonies this disease resulted in total mortality by December 2002. This disease has caused extensive mortality in tabulate *Acropora*'s and Turbinarians at some locations in some seasons, and these corals are important components of coral communities. Two PhD studies have subsequently examined coral disease in the Solitary Islands Marine Park.

A number of other coral habitat-modifying influences observed during the bleaching program and other studies including corallimorph coverage increasing (anecdotal observations) and out-competing hard coral communities. This can result in reduction in habitat complexity and habitat availability to other biota. Corallimorphs are being studied by the Solitary Islands Underwater Research Group. The status of host-anemone habitat is also being investigated. The synthesis of these various components, in combination with benthic monitoring will examine the above processes and their effect on reef condition in the Solitary Islands Marine Park.

Objectives

- Increase knowledge of coral communities in this area and benchmark current reef habitat condition using indicators such as hard coral coverage and anemone density and coverage
- Gain increased understanding of processes that are potentially (negatively) modifying coral reef habitat in this area
- Increase understanding of spatial differences and temporal patterns in sea-temperature in the marine park through a long-term monitoring program

Methods

There are a number of components to this study. Sea temperature is monitored at 7 sites using loggers recording every 30 minutes. Benthic monitoring, especially for hard coral cover is monitored biennially at the 16 sites surveyed as part of the Reef Fish Monitoring Program, with 6 x 25m video transects are conducted at each site. A PhD study has examined the ecology of white disease on corals, with minor financial support from the MPA. A range of methods have been used in this study including tagging colonies. Fixed quadrats and haphazard transects have been used by SURG to assess corallimorph interactions and dynamics as well as coral bleaching, with broad-scale assessment for corallimorphs conducted during the 30-minute timed count surveys for reef fish. Anemone density and cover was benchmarked in 2008, using a combination of video transects (6 x 25m) and 10 of 1m x 1 m quadrats per site at 6 sites at North Solitary Island.

Contacts

Hamish Malcolm - Solitary Islands Marine Park

Steve Dalton – National Marine Science Centre

Assoc. Prof. Steve Smith – National Marine Science Centre

Bob Edgar - Solitary Islands Underwater Research Group

Dr Anna Scott – Southern Cross University, National Marine Science Centre

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

Biodiversity and Ecological Processes

- Examine habitat condition
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