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# RESEARCH WORK PLAN 2008-09

## Solitary Islands Marine Park



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### INTRODUCTION

The marine environment in the Solitary Islands Marine Park (SIMP) 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**

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This 2008-09 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.

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## Reef fish and benthic program, Solitary Islands Marine Park

### Background

The current zoning plan for the Solitary Islands Marine Park (SIMP) 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. 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, include baited remote videos and timed counts.

Sixteen sites are surveyed annually using diver transects, although they have not been surveyed in 2008. 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. The same sites are resurveyed in winter each year. Six transects are haphazardly placed and surveyed at each site. These transects will be re-surveyed in 2009. Benthic video transects are also carried out biennially 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 sanctuary zone. Reef-fish diversity is surveyed at 70 sites from 46 locations within the Marine Park using timed counts to determine spatial patterns in diversity and indicate unique sites. Eighteen sites have been monitored annually over three years to assess diversity within the Marine Park through time.

### 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 SIMP
- 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 SIMP and monitor their status through time
- Obtain a reef-fish species list (including relative abundance) for the SIMP

### Contacts

Mr Hamish Malcolm - Solitary Islands Marine Park

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

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## 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 SIMP. Each estuary includes areas that are both open and closed to crabbing. Mud crabs are fished using 18 traps in each estuary for 3 nights, twice per year. 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 survey program was completed in 2007, but can be resurveyed as required. Analysis and write-up for results to date are currently underway.

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 mud crab numbers in sanctuary zones in all three estuaries.

Mud crabs are an ideal 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 program also included monitoring the relative abundance of mud crabs in 4 ICOLL estuaries twice per year using nine traps per ICOLL over a single night.

### Objectives

- Monitor and compare mud crab 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 SIMP
- Monitor and compare relative abundance of mud crabs in four ICOLL's in SIMP 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 in SIMP, as a locally important fisheries resource
- Obtain information on patterns of use and compliance by fishers

### Contacts

Dr Paul Butcher                      National Marine Science Centre

Mr 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

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## 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 Marine Parks Authority (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 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 (anticipated to commence August 2017).

### Contacts

Ms Nicola Johnstone                      Manager, Solitary Islands Marine Park

Mr 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

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## Assessment of deep reef fish composition

### Background

Knowledge of deeper reef habitat in some parts of the 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 marine protected areas.

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 will be expanded in 2008-2009 to potentially include another 29 sites identified from swath acoustic mapping, including deep reef sites selected from swath mapping undertaken in 2008.

Towed drop video transects will also be conducted at each site to further investigate the diversity of each reef type, examine differences between sites and reefs, and to explore the influence of benthic communities on reef fish patterns. 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).

### 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.
- Compare benthic assemblages between sites
- Evaluate the influence of benthic assemblage and 'habitat complexity' on fish assemblages
- 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

### Contacts

Mr Hamish Malcolm                      Solitary Islands Marine Park

Dr Alan Jordan                              NSW Department of Environment and Climate Change

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

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## 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 higher protected areas (sanctuary zones).

Current knowledge of offshore reef and benthic communities within SIMP 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 SIMP.

### Objectives

- Obtain detailed bathymetric and seabed habitat maps for the SIMP using a bathymetric side-scan sonar
- Develop a habitat classification system for offshore reefs and other deeper habitats
- Produce a ground-truthed mapping overlay using the habitat classification system
- Determine the proportion of those habitats within higher protected areas
- Potentially identify habitats and benthic communities that have not been previously described within SIMP, and identify habitats not represented within higher protected areas

### Contacts

Dr Alan Jordan	NSW Department of Environment and Climate Change
Dr Peter Davies	NSW Department of Environment and Climate Change
Mr Hamish Malcolm	Solitary Islands Marine Park

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

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## 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 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 one did occur on the Great Barrier Reef. Sea temperature is being monitored throughout SIMP, 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 in this area. Two PhD studies have now examined coral disease in SIMP.

A number of other coral habitat-modifying influences that were observed during the bleaching program and other studies including coralimorph coverage increasing (anecdotal observations) and out-competing hard coral communities. This can result in reduction in habitat complexity and habitat availability to other plants and animals. Coralimorphs 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 will increase understanding of 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
- Increase community capacity, knowledge and understanding of local marine systems and linkages, including strengthening collaborative ties

### Contacts

Mr Hamish Malcolm	Solitary Islands Marine Park
Mr Steve Dalton	National Marine Science Centre
Assoc. Prof. Steve Smith –	National Marine Science Centre
Mr 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
- Conduct biodiversity assessments of selected taxa