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# RESEARCH PROJECT SUMMARIES

## Lord Howe Island Marine Park

This document provides a collation on non-technical summaries for research projects conducted within Lord Howe Island Marine Park with support from the NSW Marine Parks Authority. Further additional funding was provided for some projects by State and Commonwealth agencies and universities.



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## Baseline assessment of marine invasive pest status

Lord Howe Island is located 590 km east of the NSW north coast and has been declared a marine park due to its natural biodiversity values. The island has a rich maritime history and currently receives regular shipping from Yamba in NSW and annual visits of 90-130 recreational yachts of wide-ranging domestic and international origins. There is a risk that these vessels may act as vectors for translocation of exotic marine pests to the island and hence compromise its natural biodiversity values. Similarly, historic shipping activities posed risks of introductions, although no previous survey of exotic marine pests has been performed at the island. The current study was therefore commissioned to survey exotic marine species and recommend suitable monitoring and response protocols for detecting and treating invasions.

The survey was performed during February 2006 using methodologies outlined in Port Survey Protocols developed by the Centre for Research on Introduced Marine Pests (CRIMP) at CSIRO. Sites were selected and rated on the basis of risks of introductions, with most intensive surveying performed at the highest risk sites. The field survey of Lord Howe Island identified no target pest species and no non-target introduced species, however 19 cryptogenic species (cryptogenic = unclear if the species is native or introduced) were recorded. The algae, *Caulerpa taxifolia* was identified, which is listed as a target pest for Australian waters, however the strain present at Lord Howe Island is considered to be native. While some of the species identified as cryptogenic have been classified in certain literature as 'introduced', consultation with taxonomic experts shed doubts on their status as native or introduced. Cryptogenic species identified consisted of two compound ascidians, three hydroids, two bryozoans, four crustaceans, one echinoderm, one polychaete and six algal species. Several of the cryptogenic species, including one hydroid and three crustacean species, were only recorded on the hull of a visiting yacht, and hence their occurrence in marine habitats at Lord Howe Island remains uncertain.

When the field survey findings were amalgamated with the results of a literature review, a total of 54 cryptogenic species was recorded, with 50 of these confirmed as occurring in marine habitats of the island. With the exception of one crustacean species, all of the cryptogenic species recorded from the literature and not the field survey were algae. This reflects the intensive nature of previous studies of this group at Lord Howe Island and also the limited knowledge on native distributions of many algal species. While the subtropical conditions and sheltered nature of the western lagoon of the island suggest suitable habitats for a range of pest species, a number of factors reduce the susceptibility of Lord Howe Island to invasions. In particular, the relatively low levels of anthropogenic development and associated environmental impact, absence of permanent estuaries and high flushing rate of the lagoon reduce the compatibility of the marine environment with environments in potential 'donor' ports. This, combined with a history of low export volumes

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relative to imports, and hence small and infrequent ballast discharges, may explain the current absence of exotic marine pests. Added to this is the recent introduction of the zoning plan for the marine park in State waters, which prohibits the discharge of ballast water. Hull fouling communities remain a possible vector for new translocations, although the zoning plan provides powers to expel heavily fouled vessels from the park. A survey of the cargo ship operating from Yamba found that its hull was devoid of fouling species, while a similar survey of a visiting yacht, which appeared clean from the waterline and had been slipped just 2 months prior, recorded seven cryptogenic species. While sea chests of the cargo vessel could not be surveyed due to technical constraints, and it is unknown if its hull is consistently clean over time, the above findings suggest that the greatest risks of introductions may be posed by recreational yachts. Customs data for 2004-2005 indicates a multitude of domestic and international ports of origin for visiting yachts and hence a wide range of potential donor ports.

The requirements documented in the marine park zoning plan have already contributed significantly to reducing the likelihood of future marine invasions. Some additional recommended management measures include: requirements preventing hull fouling waste from visiting vessels being disposed of in park waters; underwater as well as waterline inspections of visiting yacht's hulls; consultation with cargo ship operators to facilitate surveys of sea chests; identification, mitigation and monitoring of nutrient sources impacting on the northern part of the lagoon, and a monitoring program to raise awareness and provide for early detection and response for any future invasions. It is also recommended that the current marine pest and introduced species-free status of the island be promoted to emphasise the importance of preventing any future introductions. This status is unique in the context of the majority of Australian ports, with the island's lagoon one of the few port environments remaining in an apparent 'baseline' state with regards to marine invasions.

It is recommended that future monitoring be two-tiered. A survey design has been suggested for annual surveys to be performed by marine park staff and members of the community. This design targets highest risk areas and utilises a small number of sampling techniques that could readily be implemented by marine park staff, local divers and other members of the community. The proposed monitoring program is tailored to identification of target pest species and is described in terms of the following phases: collation of new data (i.e. relevant data collected prior to the proposed survey but subsequent to the current survey), revision of the survey design on the basis of any new information, implementation of the survey, data and specimen management, reporting and response. In addition to the annual monitoring program, it is recommended that a more detailed survey, similar to the current study, be implemented every ten years. This is in keeping with current national thinking on required frequency of surveying for marine pests. In addition to compiling information and recommendations on marine pests, one of the aims of the current study,

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as outlined in the project brief, was to enhance knowledge of the biodiversity of the Lord Howe Island Marine Park and expand the holdings of the park's photographic species inventory. This was achieved in two ways: samples collected during the marine pests survey included a wide range of native species that were identified to the lowest taxonomic level feasible, with a total of 574 native species identified.

Long term marine pest monitoring programs are important to detect and respond to the arrival of introduced species and assess their impact on local reef communities, and document any long-term influences associated with changes in oceanographic conditions and climate change.

#### Reference

Exotic marine pests survey of Lord Howe Island, New South Wales. Report from Aquenal Pty Ltd to the NSW Marine Parks Authority, July 2006.

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## Preliminary evaluation of coral stressors (disease, bleaching and predation) at Lord Howe Island Marine Park

The objectives of this study were to determine the level of disease in the hard corals at Lord Howe Island, identify which species were affected by bleaching, determine the level of predation from crown-of-thorns starfish (COTS) and determine the benthic (bottom) community structure of lagoon and exposed sites. The study found that coral disease (white syndrome) and bleaching were present at all sites, but no COTS were found to be preying on corals. The level of disease found (1.29% of all observed colonies) was similar to that seen within areas of the Great Barrier Reef. It is unknown if this level of disease is natural or indicates the potential for future outbreaks. The level of coral bleaching was higher than previously noted, with 4.72-6.89% of corals bleached at all sites. The community structure was found to consist of a few dominant hard corals at lagoon sites, with deeper sites showing greater diversity.

This research is important as it represents a benchmark. Future studies can now monitor the incidence of bleaching and disease to determine if the coral community is becoming more stressed with higher incidences of disease and bleaching. Additionally, the community composition of corals can be monitored to determine if that is changing over time as well and factors that may be driving that change.

### Reference

Dalton, S.J. and Godwin, S. (2005). Preliminary evaluation of coral stressors (disease, bleaching and predation) at Lord Howe Island Marine Park. Unpublished report to the NSW Marine Parks Authority from the National Marine Science Centre, University of New England.

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## How connected are marine populations? Comparing life histories of endemic and non-endemic reef fishes to investigate the mechanisms behind self-recruitment

The objective of this project was to elucidate differences in life history characteristics (e.g. egg size, hatchling size, recruit size) in endemic (species with a restricted geographic range) and non-endemic (species that are widely dispersed) reef fishes in order to better understand self-recruitment (fish joining the same population from which they were spawned). This study also included work on the otolith (ear stone) chemistry of non-endemic species (i.e. comb wrasse, wide-band anemone fish) and compared the chemical signatures of the otoliths from Lord Howe Island with signatures from other areas where these species occur (coast of NSW, Norfolk Island, New Caledonia) to determine the origins of the fish. This is possible because different water masses create different signatures in the otoliths of fish, allowing information on where a fish has been to be extracted.

This work was significant in that it sheds light on the little understood process of how marine population maintain themselves. Endemic species must be self-sustaining by definition, but the mechanisms that make this possible are largely unknown. This project also addressed the issue of how non-endemic populations maintain themselves in an isolated situation like Lord Howe Island (do new recruits originate on Lord Howe Island similar to endemic species or do they come from elsewhere). These are fundamental questions in marine ecology and also relate to conservation issues such as the design of marine parks.

The outcomes of this project to date have included several published scientific papers, most notably preliminary results showing that the comb wrasse population on Lord Howe Island may derive new recruits from the island (self-recruitment) as well as mainland populations. Samples and data are still being processed and more results are expected in the near future.

### References

Patterson, H.M. and Swearer, S.E. (in press) Long-distance dispersal and local retention of larvae as mechanisms of recruitment in an island population of a coral reef fish. *Austral Ecology*

Patterson, H.M., Lindsay, M. and Swearer, S.E. (in press) Use of sonar transects to improve efficiency and reduce potential bias in visual surveys of reef fishes. *Environmental Biology of Fishes*

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## Hydrodynamic modelling of Lord Howe Island coastal waters

The purpose of this study was to examine the oceanographic process in the Lord Howe Island lagoon and couple that data with data on the recruitment of reef fish collected at the same time. This was accomplished by generating hydrodynamic models (models detailing the flow of water) of the lagoon and ground-truthing those models using oceanographic instruments to take measurements throughout the lagoon. Larval fish samples were collected simultaneously. This work was important and relevant to Lord Howe Island because it not only provided much needed data on the oceanography of Lord Howe Island, but is also increased our understanding of reef fish recruitment. The final report from this project is pending and further details will be provided on completion.