

# EXECUTIVE SUMMARY

## Termination Report for ACIAR Project No. FIS/1994/117

### Project Title

Testing the Use of Marine Protected Areas to Restore and Manage Tropical Multispecies Invertebrate Fisheries at the Arnavon Islands, Solomon Islands

### Commissioned Organisation

The commissioned organisation was The Great Barrier Reef Marine Park Authority, who contracted The International Centre for Living Aquatic Resource Management (ICLARM) and The Ecology Lab Pty Ltd to implement field studies and prepare reports.

### Collaborating Institutions

- The Nature Conservancy (TNC).
- The Solomon Islands Division of Fisheries.

### Project Leaders

- Australia ñ Dr Marcus Lincoln Smith, Director, The Ecology Lab Pty Ltd.
- Solomon Islands ñ Dr Johann Bell, ICLARM; George Myers, TNC and Peter Ramohia and Michelle Lam, Division of Fisheries.

### Date of Commencement

October, 1994

### Date of Completion

February, 2000

### Aim of the Project

To determine if the number and size of commercially important invertebrates (e.g. trochus, sea cucumbers and giant clams) increases as the result of the declaration of the Arnavon Islands Marine Conservation Area (MCA) relative to fished areas.

### Description of the Work

A pilot study was done in October 1994 to assist in selecting sampling sites and refining sampling methodology. Three surveys were then done at the Arnavon Islands, and at three reference areas, from January to August 1995, before the MCA was declared. Interim surveys after declaration were done in September 1996 and 1997. Three final surveys, were done in September 1998, January 1999 and April 1999. In all eight surveys, invertebrates were sampled in two habitats, shallow reef terrace (depths 0.5 to 3.5 m) and deep slope (15 to 22 m). For each habitat, four sites were surveyed at each of two islands within each of four areas, i.e. the MCA and three reference areas (Suavanao, Ysabel and Waghena).

In the shallow habitat, six transects (each 50 m long) were laid across the reef terrace and invertebrates were counted within 1 m either side of each transect, giving an area per transect of 100 m<sup>2</sup>. Invertebrates of interest included trochus, sea cucumbers, giant clams and pearl oysters. In the deep habitat, six 50 m long transects were laid roughly parallel to the depth contours and invertebrates were counted over a 5 m wide strip (total area per transect = 250 m<sup>2</sup>). The invertebrates of interest in the deep habitat were sea cucumbers.

All invertebrates of commercial importance observed within transects were counted and measured. In addition, some invertebrates seen outside transects were measured to increase the data available for analysis of length-frequency distributions.

The data obtained for the three surveys done prior to declaration of the MCA, and those obtained

for the last three surveys, were used to test the effectiveness of the MCA. Data for the two habitats were analysed separately.

Asymmetrical analysis of variance (ANOVA) was used to compare abundances of invertebrates within the Arnavon Islands to the three reference areas before and after declaration of the MCA. This approach provided an indication of the spatial (i.e. area or group, island, site and transect) and temporal (i.e. before vs after and individual surveys) scales at which the greatest changes occurred. This type of experimental design is frequently used to monitor the impacts of human activities on the marine environment and its use here represents a significant innovation in studying the effectiveness of marine reserves. Unfortunately, this approach was generally not available for analysis of length-frequencies, due to a paucity of data. For the length frequency data, modified designs were used, or data were interpreted graphically.

## Results, Conclusions & Assessments

- 1 Four categories of results were observed for abundances of invertebrates. Numbers increased at the Arnavons from before to after the declaration of the MCA and numbers remained similar, or declined at the reference locations. This was observed for *Trochus niloticus* in the shallow habitat and for white teatfish in the deep habitat. These results indicated that the establishment of the MCA had led to an increase in the number of commercially important invertebrates of these species.
- 2 Numbers remained similar at the Arnavons from before to after the declaration of the MCA, but numbers declined at the reference locations. This was observed for total holothurians in the deep habitat and, although the evidence was not conclusive, for amberfish in the deep habitat. This indicated lack of recruitment during the study and the ongoing effects of harvesting of these species at the reference areas (i.e. where fishing was not prohibited).
- 3 Similar changes in abundance occurred at both the MCA and reference locations from before to after the declaration of the MCA. This was observed for all giant clams combined, *Tridacna maxima* and greenfish in the shallow habitat and for elephant trunkfish in the deep habitat. This indicated no effect of the MCA for these species.
- 4 Numbers remained similar at the Arnavon Islands and increased at the reference locations from before to after the declaration of the MCA. This was observed for *Tectus pyramis*, the only non-commercial species examined. This finding is difficult to interpret, but the trend may be due to less competition for space between *Tectus* and *Trochus* at reference areas, due to the small numbers of the latter.

Results of size analyses were varied. The mean size of *Trochus niloticus* increased after the declaration of the MCA, however the mean size of white teatfish decreased, due to recruitment of small individuals into the population. The MCA appeared to have no effect on sizes of other species.

Overall, the declaration of the MCA has led to success in restoring abundances and sizes of some invertebrates at the Arnavon Islands. The findings of the study, however, demonstrate that more time is necessary to identify the period needed for recovery of several species and strongly support the continuation of the MCA and the monitoring program.

## Publications

One paper has been published from the study and three are in preparation. Several progress reports during the study, together with a manual outlining sampling locations and methods were also prepared. The title of the paper is:

Lincoln Smith, M. P., Bell, J. D., and Mapstone, B. D. (1997). Testing the Use of a Marine Protected Area to Restore and Manage Invertebrate Fisheries at the Arnavon Islands, Solomon Islands: Choice of Methods and Preliminary Results. In: *Proceedings of the 8th International Coral Reefs Symposium, Panama, 1996*, Volume 2: 1937 - 1942.

Of the three papers being written, one is being prepared for submission to *NAGA* on the topic of management issues associated with the study. The others are scientific papers on the full results of the study.

### **Follow-up**

There are three main areas that should be considered for follow-up; two of these are related to the studies at the Arnavon Islands, the third is related to expansion into other areas.

The first is to continue the present study at the MCA and reference areas, preferably for a further three years (with surveys in September 2001, September 2002, January 2003 and April 2003). This would enable us to measure possible further increases in the abundance of trochus in the MCA and, hopefully, to identify when a stronger effect would be detected for sea cucumbers.

Continuing the study under this framework would result in an almost continuous annual set of data from 1996 to 2003. It would also provide a third temporal component to the asymmetrical ANOVA (using the September 2002 and January and April 2003 surveys), by enabling a comparison of pre-MCA with three years post-MCA and six years post-MCA. This would provide a powerful basis for assessing the effectiveness of the MCA.

The second area of follow-up is to commit some extra resources to sampling additional sites within the MCA. This is because great variation in recovery rates were observed among sites and it would be beneficial to examine whether the variability examined among sites encompassed the range of natural variability observed within the MCA. This would be outside the framework of the asymmetrical approach, but, given the importance of individual sites in recolonisation of the MCA, it could provide a much clearer pattern of changes in abundance and richness through the MCA. Previously, eight sites were sampled in each habitat within the MCA. It is recommended that sampling be done in a further eight sites within the MCA in September of 2001, 2002 and 2003 (i.e. 16 sites in total).

These two areas of follow-up both need the support of the local communities and would require that harvesting of marine invertebrates in the MCA continue to be prohibited. It also requires continued use of Conservation Officers to patrol and monitor activities within the MCA. In order to facilitate this, the TNC and Solomon Islands Government would need to maintain their support for the project.

The third area of follow-up involves expanding the study to other areas within the region, country and possibly to other Pacific Island nations. During the study, some of the local communities expressed interest in setting aside other coral reefs as marine reserves. The Arnavons MCA could form the nucleus and/or model for a series of marine reserves within the region, which, in turn, could be a valuable experience applicable to other nations in the tropical Pacific. The best approach for achieving this will be to ensure that appropriate scientific and managerial rigour are applied to any further reserves and that the findings of the present study are properly disseminated.