

5.0 RESEARCH RESULTS AND OUTCOMES

5.1 Progress of Research Work for the Project's Lifetime

The progress of research was generally as planned through the project, with suitable time allocated for planning and preparation of each field trip. The methods developed worked well and would be suitable for continued studies in the area. Given that the species and habitats studied occur throughout the tropical Pacific and Indian Oceans, the methods developed would be adaptable to studies elsewhere. Moreover, the sampling equipment is simple and inexpensive, increasing its applicability for use in developing nations.

As in any large study, some problems were encountered. These were generally limited to poor weather at times, occasional mechanical problems (e.g. with the air compressor and the Daula) and some staff illness (e.g. malaria). However, no major logistical problems occurred throughout the project and the necessary sampling was always completed.

The most serious research problem encountered was the illegal taking of invertebrates within the MCA. Several incidents of poaching were reported by the COs and some animals were confiscated and returned to the water. It appears that the only species targeted was trochus. Clearly if poaching continues, it will threaten the success of the MCA and the monitoring program. TNC have made concerted efforts to address this problem and have recently succeeded in prosecuting those involved (Appendix 1). Poaching appears to have been limited to a minority of sites in the MCA which means that long term monitoring is still valid.

As discussed in Section 7, several reports have been prepared for the project and one scientific paper published in the Proceedings of the 8th International Coral Reef Symposium. The paper focused on the design of the study and presented the results of the surveys prior to declaration of the MCA. Two other papers are being prepared. One addresses management issues and will be submitted to NAGA in 2000. The other paper is a more complete statistical analysis and detailed interpretation of results. It will be submitted to an international journal by mid-2000. Aspects of the findings of the study will be presented at the 9th International Coral Reef Symposium and published in the proceedings.

5.2 Impact and Future Directions of the Project

There are several major impacts of the project. These are:

- 1) Involvement of communities - the local communities have shown a strong interest in the project and an appreciation of the role of the MCA. Presentations of information at annual visits to villages in the area have been well attended and engendered thoughtful discussions.
- 2) The Management Committee for the MCA has delayed its decision on extending the three year closure until the results of the study have come to hand.
- 3) The existence of a rigorous monitoring program has helped TNC to obtain additional funding for the Management Committee.
- 4) The MCA has been used by the Government of Solomon Islands as justification for planning the establishment of additional marine reserves.
- 5) The presentation of findings in the scientific literature has contributed to the general knowledge on the effectiveness of marine reserves, particularly in terms of designing rigorous monitoring programs to test their effectiveness. The manuscripts in preparation will make a similar contribution to our understanding of the recovery of harvested stocks and to protocols for managing marine reserves.

The findings of the study strongly support the continuation of the MCA and the monitoring program for marine invertebrates. Decisions about the duration of the fishing closure and continued monitoring should include the following considerations.

- 1) The fact that a considerable length of time may be needed to restore stocks, or to assess whether the MCA is effective for all species, especially holothurians.
- 2) The operation of the Management Committee. Arrangements must be made to ensure that it continues to operate and that it can deter poaching effectively.
- 3) The continued participation of the Division of Fisheries and use of the *Daula*.

6.0 USE OF RESULTS

It is expected that the results will be used to argue for continued maintenance of the Arnavon Islands MCA. Without some indication of success, it would be very difficult (and possibly unwarranted) to continue with the project, but at this stage, there are several benefits still to be achieved. These include obtaining further scientific information and application of the principals of the reserve to other areas. More specifically, the results should be used in the following ways:

- 1) By the Management Committee and TNC to extend the closure at the Arnavon Islands. By the Government of Solomon Islands to declare more marine reserves throughout the country, at least for trochus at this stage.
- 2) By ICLARM to demonstrate why a sampling design of the nature used here is necessary to demonstrate to Fisheries Departments of developing Indo-Pacific nations how to detect the effects of marine protected areas.
- 3) By the project scientists and Solomon Islands Fisheries Officers to prepare scientific papers on the findings of the study.

7.0 PUBLICATIONS AND REPORTS

One scientific paper has been published from the study and three others are in preparation. Several progress reports were also prepared during the study and a manual was produced for project staff outlining sampling locations and methods.

Scientific Paper

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.*

Reports

Lincoln Smith, M. P. (1994). Testing the use of marine protected areas to restore and manage tropical multispecies invertebrate fisheries at the Arnavon Islands, Solomon Islands: report on pilot investigations. Prepared for Great Barrier Reef Marine Park Authority, Canberra and the Australian Centre for International Agricultural Research, Sydney.

Lincoln Smith, M. P. (1995). Arnavon Islands Survey Of Commercially Exploited Invertebrates: Field Manual And Pictorial Guide To Common Invertebrates Recorded. Unpublished report prepared by The Ecology Lab Pty Ltd, Sydney.

Lincoln Smith, M. P. and Bell, J. D. (1996). Testing the use of marine protected areas to restore and manage tropical multispecies invertebrate fisheries at the Arnavon Islands, Solomon Islands: Abundance and size frequency distributions of invertebrates, and the nature of habitats, prior to declaration of the Marine Conservation Area. Prepared for Great Barrier Reef Marine Park Authority, Canberra and the Australian Centre for International Agricultural Research, Sydney.

Lincoln Smith, M. P. (1996). Testing the Use of Marine Protected Areas to Restore and Manage Tropical Multispecies Invertebrate Fisheries at the Arnavon Islands, Solomon Islands: Abundance of Invertebrates One Year After Declaration of the Marine

Conservation Area. Prepared for Great Barrier Reef Marine Park Authority, Canberra and the Australian Centre for International Agricultural Research, Sydney.

Lincoln Smith, M. P., Ramohia, P. and Astles, K. (1997). Testing the Use of Marine Protected Areas to Restore and Manage Tropical Multispecies Invertebrate Fisheries at the Arnavon Islands, Solomon Islands: Abundance of Invertebrates Two Years After Declaration of the Marine Conservation Area. Prepared for Great Barrier Reef Marine Park Authority, Canberra and the Australian Centre for International Agricultural Research, Sydney.

8.0 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 the time needed for recovery of several of the commercially important sea cucumbers.

Continuing the study under this framework would result in an almost continuous annual set of data from 1996 to 2003. This is important for monitoring recovery rates for commercially valuable species and is also important in maintaining the enthusiasm and interest of local communities. The three surveys in September 2002 and January and April 2003 would also provide a third temporal component to the asymmetrical ANOVA, by enabling a comparison of pre-MCA with three years post-MCA and 6 years post-MCA. This would benefit the study in two ways. If recovery of species continues, then the magnitude of differences in abundance from before to six years after the establishment of the MCA will be larger and, therefore, easier to detect. Adding a second series of "After" surveys will also increase the statistical power of the design which should also increase our ability to detect an effect of the MCA. This would provide a very powerful basis for assessing the effectiveness of a marine reserve for marine invertebrates.

The second area of follow-up is to commit extra resources to sampling additional sites within the MCA. This is because there was great variability in rates of recovery among sites and it would be useful to determine whether the variation observed among sites encompassed the range of variability within the MCA. Moreover, field observations suggested that other sites within the MCA may be more favourable to some species, such as greenfish (Section 4.1.3.1.1). Therefore, there may be some sites within the MCA which experienced even greater rates of recovery than were measured in this study. These data would augment data collected in the current study but would not be included in the main asymmetrical analysis. Sampling of additional sites should be done in a quantitative manner, however, to enable rigorous comparison of abundances among sites. 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.

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, TNC and the Government of Solomon Islands would need to maintain their support for the project.

The third area of follow-up involves disseminating the results of the study to other areas of the country and elsewhere in the region. 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. This

component of the follow-up would, therefore, require project staff to visit other sites to inform stakeholders of the benefits of the MCA and to assist them to implement well designed monitoring programs. In relation to this, it is interesting to note that the Government of Solomon Islands, in collaboration with the Asian Development Bank, is applying for funding from the Global Environment Facility (GEF) to increase the number of marine protected areas in the country.

9.0 TRAINING AND CAPACITY BUILDING

Training of Solomon Island participants occurred at a number of levels. First, Conservation Officers, and Scientific Officers from Fisheries Division, were trained to SCUBA dive and to conduct underwater visual census of invertebrates. Important components of this training included:

- field preparation,
- diver safety (including code of practice provided by ICLARM),
- species identification, and measurement of specimens underwater,
- deployment of transects underwater, ensuring that:
 - appropriate habitat was sampled, and
 - biases were not introduced by non-random allocation of the transect lines,
- transcription of data from slates to data sheets and checking of results,
- ensuring the security of the data.

During the first few surveys, time was allocated at the beginning of each trip for training, and then later for revision of methods. One very important aspect of training was to ensure that all those participating in the surveys understood the importance of collecting data for all the required transects (i.e. sample replicates). It is particularly pleasing to note that, for the total of 3,072 replicates required for the entire study, not a single replicate was missed, or one data sheet lost. This is a strong indicator of the conscientious attitude and enthusiasm of the participants.

Second, Mr Peter Ramohia visited Sydney in June 1999 as part of a training exercise. The specific aims of the trip were to:

- assist with computer entry and data checking for the last three surveys,
- prepare a manuscript for submission to the ICLARM journal NAGA, with emphasis on management issues associated with the study, and
- visit ACIAR offices in Sydney and tour facilities at the NSW Fisheries Research Institute and the University of Sydney.

Capacity building was evident in the way that the Solomon Island participants and ICLARM were able to plan and conduct four of the surveys without direct attendance of the Project Scientist. This was achieved by training of staff and by providing a specific itinerary for each field trip, which included a day-by-date schedule of sampling, the most efficient routes of travel to the sites and a suitable number of rest days.

At the request of TNC, the Project Scientist and Fisheries Officers visited four local communities to present information on the study during the last two surveys. The focus of these presentations was on the general importance of the study, sampling methods, preliminary results and management issues. During every visit there was a large attendance (usually 20 to 100 people) and numerous questions were asked. Whilst not strictly "training", this aspect of the study was an important means of maintaining local interest in the study.