Discussion

In the last decade, spatial data analysis has become a powerful technique for examining, understanding and displaying environmental relationships in complex data sets. The ability to identify ecological patterns in the context of hydrodynamic, chemical, biological and physical oceanographic properties has improved through the ability to attach data to maps displaying geophysical and man-made features.

The work carried out in Manihiki utilised this enhanced interpretive capability in the process of meeting the goals of the project. Combined with routine data-collection methods, spatial data management facilitated the development of the LEMMP in which ecologically sound black-lipped pearl oyster farming practices were identified to ensure that the industry is managed in a sustainable manner.

The results of the data presented in this paper show that in Manihiki Lagoon, given the prevailing hydrodynamic regime and farmed oyster density at or below 0.7 oysters per square metre, the impacts of the primary productivity and water quality were ameliorated 200 metres down current from the farm. It has also been shown that no discernible impacts existed in the oxygen demand associated with the sediment under a pearl oyster farm wherein farming intensity is maintained at these low levels. In developing a management plan, these data were used to recommend a 200-metre buffer zone between farms and an optimum farmed-oyster density.

When applying the results of this work to estimate the risk of environmental impact from pearl oyster farming in other areas, including other lagoons, hydrodynamic regime must be a primary consideration. Closed and semi-closed lagoons, open lagoons, bays and estuaries, sheltered coasts and open coasts progressively experience more water exchange and thus the risk of detrimental impact to water quality resulting from any perturbation is lessened respectively.

The study in Manihiki Lagoon exemplifies a situation in which the probability of degradation to water quality is exceptionally high due to the low rate of exchange of lagoon water with the open ocean. Therefore, the information presented in this report can be applied with significant margin when comparing it to environments typified by hydrodynamic regimes in which the rate of water exchange is greater.

This discussion represents only a small portion of the surveys that were addressed during the two-year field study. Subsequent to the completion of the LEMMP, the MEL continues to collect water quality and other data on a routine basis. The data is periodically reviewed for long-term trends that contribute to fine tuning the management strategies as the pearl production industry in Manihiki Lagoon matures.

New ACIAR-funded pearl oyster project: pearl oyster resource development in the Pacific Islands

by Paul Southgate [1]

The Australian Centre for International Agricultural Research (ACIAR)-funded project 'Pacific Island Pearl Oyster Resource Development' ran from June 1993 to June 1996 with a further period of bridging finance between July 1996 and March 1997 (see *Pearl Oyster Information Bulletin*, 9: 6-8, 1996).

This project, which focused on the pearl oyster resources of Kiribati, involved James Cook University (JCU) as the commissioned organisation, collaborating with the Ministry of Environment and Natural Resource Development in Kiribati, the ICLARM Coastal Aquaculture Centre (ICLARM-CAC) in the Solomon Islands, Fiji Fisheries and the Secretariat of the Pacific Community (SPC).

The major objectives of the Project were:

- to assess the natural stocks of pearl oysters in Kiribati and Fiji and the rates of spat-fall of blacklip pearl oysters in the atoll lagoons of Kiribati.
- to develop appropriate low-technology methods for hatchery and nursery culture of blacklip pearl oysters.
- to improve the yield of gem-quality and average-quality pearls through better bead insertion and oyster management practices.

During the Project, appropriate hatchery and nursery techniques were developed for *P. margaritifera* and a pilot-scale hatchery was constructed in

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Kiribati. The hatchery produced four batches of spat and demonstrated the feasibility of hatchery-based pearl oyster production in Kiribati. A review of the project was completed in April 1996 and a second-phase project was recommended.

In January 1998, a replacement ACIAR-funded project 'Pearl Oyster Resource Development in the Pacific Islands' was commenced. This new project has the following major objectives:

- to further develop and refine hatchery-culture techniques developed for *P. margaritifera* during the first-phase project;
- to investigate nursery and juvenile culture methods suitable for use in the atolls and open-reef systems of Kiribati and other Pacific nations;
- to examine the rate of spat collection of *P. margaritifera* and *Pteria penguin* in areas of Fiji and determine growth rates of spat and juveniles under culture conditions;
- to produce a simplified manual on the mariculture methods developed for *P. margaritifera* during this Project; and
- to develop an appropriate business plan for the establishment of a cultured pearl industry in Kiribati.

The collaborating institutions are James Cook University (JCU) [Commissioned Organisation]; Ministry of Natural Resources Development, Kiribati; Abaiang Island Council (Ministry of Home Affairs and Rural Development, Kiribati); Fisheries Division, Ministry of Agriculture, Fisheries and Forest, Fiji; ICLARM-CAC, Solomon Islands, and Ministry of Marine Resources, Cook Islands.

Research into hatchery and nursery culture methods will be conducted at JCU in collaboration with ICLARM-CAC. The results of this research will be immediately transferred to Kiribati, and to the Solomon Islands and Fiji where appropriate. Transfer of new technology during the Project will also occur through training courses to be held in Australia and Kiribati.

Research in Kiribati will be directed towards the development of site-specific nursery and grow-out techniques and will be focused on Abaiang Atoll. Experiments will be conducted to assess the most suitable culture methods and the best sites within the lagoon for pearl oyster culture. This research will be carried out by Kiribati Fisheries personnel assisted by an Australian ACIAR-OSB project scientist based on Abaiang Atoll and will be conducted in collaboration with the Abaiang Island Council. The pearl oysters used in these experiments will be produced in the pilot hatchery in Tarawa.

Spat-collection research in Fiji will be carried out by Fisheries Division, Fiji, assisted by staff from ICLARM-CAC. In the Solomon Islands, the results of this research will allow identification of the best option (ie. hatchery versus wild spat collection, and appropriate nursery techniques) for the establishment of village-based pearl oyster production. In Fiji, the feasibility of establishing pearl oyster farming based on wild collected spat will be determined.

Results of the research will be disseminated through the SPC *Pearl Oyster Information Bulletin* and through publication in international journals, trade magazines and newsletters.

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Polishing pearl oyster culture in Micronesia

Source: *CTSA Regional Notes*, Vol #9, Fall 1997, p. 6

The US-affiliated Pacific Islands have a great potential to culture pearl oysters, with abundant pristine waters and inexpensive labour costs. Government entities and private aquaculturists in the region have been keen to exploit that potential.

To ensure fledgling efforts get off to a good start, the Center for Tropical and Subtropical Aquaculture's (CTSA) regional aquaculture extension specialist, Simon Ellis, studied pearl oyster culture techniques under the tutelage of Dr Maria Haws, an expert in pearl oyster culture. Readers in the US-affiliated Pacific Islands may remember Haws from the Summer of 1996, when she served as the CTSA Aquaculture Extension Specialist to Amercian Samoa, the Commonwealth of the Northern Mariana