

Contract Number: C01X0209
Title: Sustainability and Enhancement of Coastal Reef Fisheries of Economic and Cultural Importance
Allocation: \$708,000 + NSOF \$25,000
Research Leader: Dr Alison MacDiarmid

PARLIAMENTARY REPORT

The purpose of this programme is to sustain and enhance those iconic reef fisheries that have particular economic and cultural importance to New Zealand. This is achieved by increasing the breadth of knowledge of New Zealand coastal reef ecosystems and fisheries, building better models to allow Maori and other stakeholders to evaluate the costs and benefits of alternative coastal management strategies, and developing mitigation tools which allow for the enhancement of fishery harvests. This research contributes to the decision-making process that allows end-users to better manage coastal reef ecosystems and fisheries.

This programme involves a high degree of collaboration with other researchers and end-users in New Zealand, Australia and the US. We are collaborating closely with the Department of Conservation (DoC) on aspects of its Departmental Contestable Research funded project, "Māori methods and indicators of marine protection". This includes sharing information from a range of research available within this programme and by meeting jointly with Ngāti Kere of Porangahau who are directly involved in the DoC project. The dynamics of protected populations in marine reserves is of critical interest to DoC, which has provided funds to increase the breadth of research on larval dispersion within the programme. Supervision, jointly with the University of Auckland, is also being provided for a DoC staff member undertaking PhD research on the effects of changes in the abundance of a top predator on the dynamics of benthic prey species. Supervision is being provided jointly with the Universities of Auckland, Waikato and Tasmania for a further two PhD students and one MSc student. Collaboration with Victoria University of Wellington on aspects of reef fish ecology in the Cook Strait region has also been established.



Mr Bill Ruru inspects kaoura koopuha ready to be assembled and installed on reefs in the Gisborne region.

Strong relationships have also been built with a number of iwi, hapu and other Māori organisations. There has been ongoing joint work with Ngāti Koata to map and display the shallow habitats in a proposed mahinga mataitai reserve at D'Urville Island, determine growth rates of paua transplanted from low to high growth areas and estimate the yield from alternative customary management regimes. There has also been a flood of Māori groups

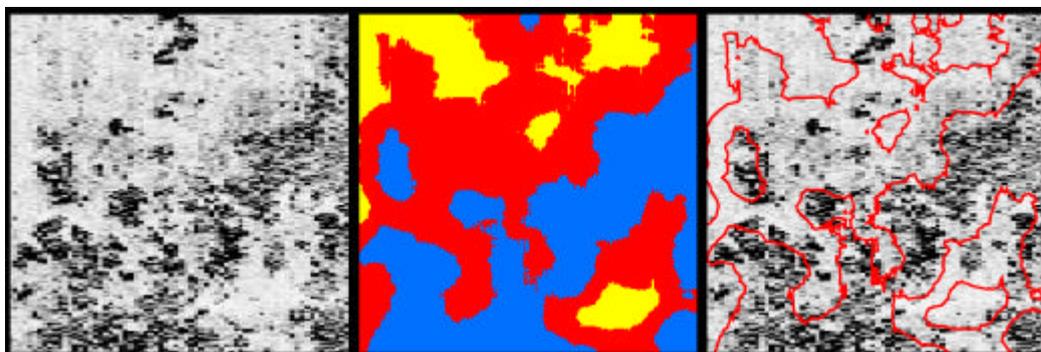
wishing to use the kaimoana kits developed by NIWA, although the planned workshops have been impeded by a lack of co-funding from other government agencies. This programme is also providing training and work experience to Ngāti Porou and Te Rununga o Turanganui a Kiwa (TROTAK) to dive and monitor scientific equipment at Gisborne and further north along the coast.

With NSOF support, collaboration is being developed with a wide range of New Zealand scientists in order to explore if the changes in New Zealand's coastal reef ecosystems that have occurred since humans first permanently settled here less than 1000 years ago can be adequately investigated and modelled. A workshop for November 2003 has been planned.

New Zealand shares some important commercial and cultural reef species with southern Australia and we have established strong links with the Tasmanian Aquaculture and Fisheries Institute (TAFI) in Hobart. This involved successful joint application to the Australian Fisheries Research Development Corporation (FRDC) for funds to investigate the feasibility of enhancing rock lobster stocks by seeding hatchery raised 1 year-old juveniles onto reefs. This was supplemented by a PhD fellowship from the University of Tasmania to a Wellington based student jointly supervised by NIWA and TAFI staff. The research on lobster reproduction in this programme is of intense interest around the world and this forms the basis of an on-going collaboration with US colleagues with joint field and modelling work on spiny lobster populations in the Florida Keys, USA. We are also collaborating with a California based US research group to improve methods of describing reef fish assemblages in temperate kelp forests.

Much new fundamental knowledge of key elements of New Zealand's coastal reef fauna and flora, essential to their management, has been obtained and overall the programme has made good progress towards achieving the outcome of improved management and harvests. For the first time important basic demographic information such as growth rates, longevity and mortality is being collected for *Lessonia variegata*, one of the most abundant large kelps of exposed southern rocky shores. This information is fundamental to understanding the importance of local primary production to reef ecosystems and thus is of strategic interest to the Department of Conservation and other groups managing reef environments, especially in southern and central New Zealand.

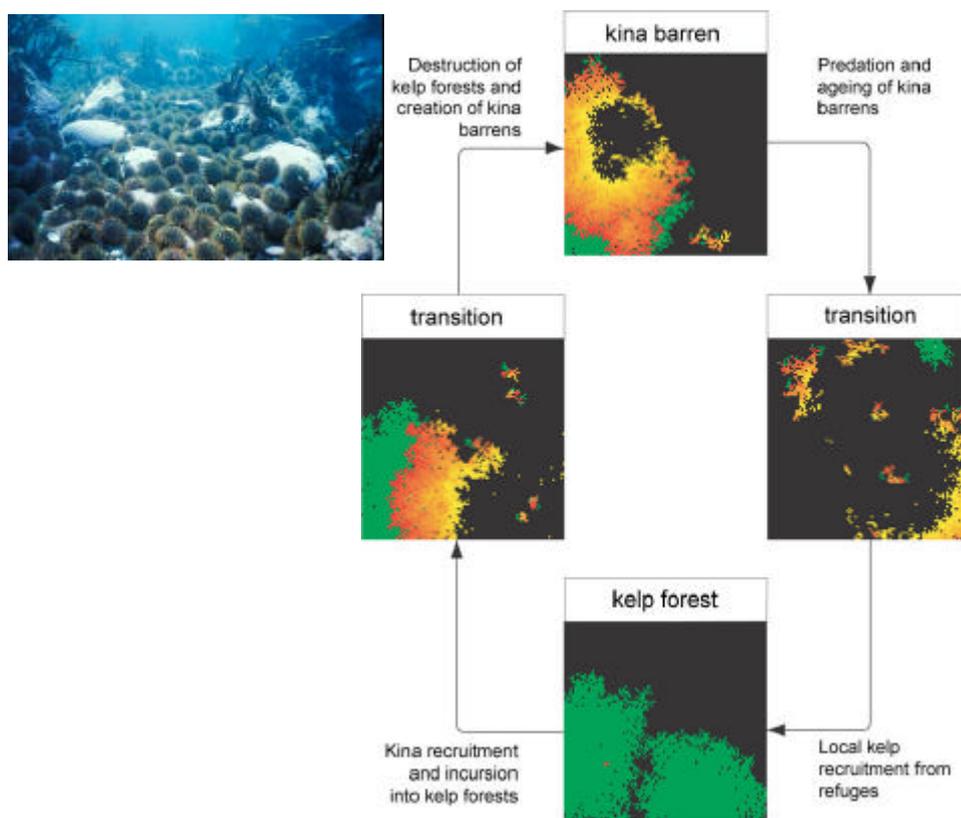
To enable rapid monitoring and assessment of the state of reef ecosystems, in particular the extent of seaweed forests, new techniques to rapidly extract habitat information from aerial photography and acoustic survey methods have been developed. These methods are of particular interest as there is an increasing need by local communities, and local and central government for detailed knowledge of the spatial extent of coastal resources.



The classification of sidescan sonar data using texture analysis; Left) raw sidescan imagery of epibenthic reefs dominated by the horse mussel *Atrina zealandica*, Centre) results of texture analysis, right) habitat polygons derived from unsupervised classification.

Comparisons of fish counts made by scuba divers with those made by divers using rebreathers suggest that the cheaper, standard method of scuba produces results comparable with those by "quiet" rebreather divers. This result justifies the use of scuba, which is the standard technique used by researchers internationally. Furthermore, the results were consistent inside and outside three marine reserves where the behaviour of fishes towards divers may differ. Owing to keen national and international interest in marine reserves, we anticipate the study will be widely cited in justifying sampling programmes. We assessed reef fish populations in three regions of New Zealand that were poorly known. Analysis of those data has shown that habitat features can be used to predict abundances of some fishes successfully. Local groups will be able to use these results to undertake habitat rehabilitation, and predict consequences of alterations to management. Analysis of gut contents and patterns of biomass indicates considerable variation among regions within a species. Models of fish populations will therefore have to be developed locally, in order to accurately predict responses of fish populations to habitat changes.

A large field experiment is underway on the coast north of Gisborne to determine if there is a bottleneck in the supply of rock lobsters caused by a lack of suitable shelter for juveniles up to 1 year old. Other laboratory and field experiments have indicated that juvenile rock lobsters raised in captivity for up to a year develop suitable anti-predator behaviour upon release thereby increasing the prospects for populations to be enhanced. These initiatives are of particular interest to iwi and hapu and they have been involved in setting up and monitoring the habitat enhancement experiments. Laboratory experiments have determined the basis of mate choice and competition in spiny rock lobsters and the bias baited traps cause when they are used to estimate the extent of non-mated female in wild stocks. These

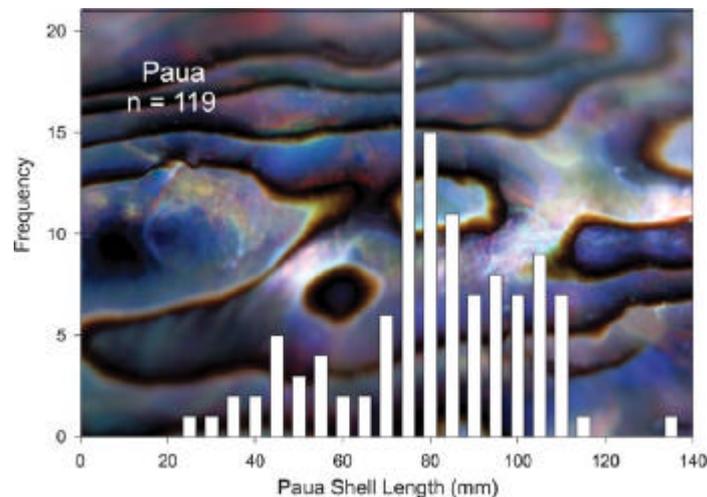


The transition cycle showing sample pictures of the transitions between states for a simulated population of kelp and kina.

findings are relevant to the management of the rock lobster industry as the fishery lands mainly males and smaller remaining males may not be able to successfully fertilise all mature females.

The fundamental knowledge generated by the programme has been incorporated in modelling approaches to explore how the coastal reef ecosystem responds to natural and human induced changes. One model has been developed to allow relationships to be explored between the important reef herbivore kina and the kelp it grazes upon. Another model incorporates various population parameters to determine population growth of key species under various harvest strategies. A third model is being developed jointly with US collaborators to explore the effects of fishing for mainly male rock lobsters on egg and larval production.

Considerable effort has been put into developing tools and methodologies to better protect and restore coastal reef ecosystems and fisheries. Much of this has been for and in collaboration with Māori. For instance, in collaboration with Ngāti Koata, surveyed a proposed Mahinga mataitai reserve and produced an interactive CD ROM that allows users to explore each of the identified habitats on a map through a series of still photographs and video-clips. Also in collaboration with Ngāti Koata we have re-sampled a paua population previously transferred from a purported low growth site to a high growth site and through modelling are estimating the gain in overall yield that results from such customary management methods. This modelling also allows other management initiatives such as instituting rahui or temporary closures of various sizes and time periods to be explored before being implemented. Much effort has been put into securing co-funding to run a series of workshops to teach the use of the kaimoana sampling kits developed previously.



Size frequency bar graph of paua measured during a kaimoana monitoring workshop held at Porangahau.

There have been many requests by hapu, iwi and community groups for training in use of the kaimoana monitoring kits developed previously. Much effort was put into obtaining co-funding to run training workshops. While funding applications to date have been unsuccessful, Greater Wellington Regional Council has expressed strong interest and workshops are expected to proceed in the spring and summer of 2003/04.

Further information may be obtained from the NIWA website www.niwa.co.nz, and selected publications include:

Booth, J.D (2002) Enhancing lobster survival. *The Lobster Newsletter* 15(1): 14-15

Booth, J.D. (2002). Enhancing juvenile koura, *Aniwaniwa* 20:2

Cole, R.G., McComb, P.J., & Black, K.P. (in press). Relating benthic habitat distribution to physical oceanography and sediments on a complex near-shore temperate reef. *Estuarine Coastal Shelf Science*

Dunn, A. & Andrew, N. (2003). The chaotic world of our reefs. *Water and Atmosphere* 11(2).

MacDiarmid, A.B. (2002). Kaimoana monitoring kit : communities taking control. *Aniwaniwa* 20:1-2.

Stewart, R., Oliver, M.D. MacDiarmid, A.B., Gardner, C. & Mills, D. (2002). Enhancing reefs with juvenile lobsters may be possible. *Fisheries and Aquaculture Update* 5 (2).

Oliver and Garner (2002). Lobster survival assessment turns to high-tech surveillance. *Fishing Today*