aggregation sites were given any consideration when the boundaries of most Indo-Pacific tropical marine reserves were drawn. Palau is a rare exception; the presence of an important spawning aggregation site is the main reason that the Palauan Government set up the Ngerumekaol marine reserve.

Spawning aggregations and associated sites are very poorly documented in the Indo-Pacific, except for certain Pacific Islands such as Palau. There is a great need for marine biologists in the region to locate reef fish spawning aggregations and to determine local spawning seasons (which vary from place to place within the region). There seems to be no scientific literature at all on grouper spawning aggregations in South-East Asia, although reports from South-East Asian fishermen indicate that they are well known to some.

This is an example of the fact that fishers often know far more about the location and timing of spawning aggregations than researchers. Indeed more than 20 different researchers have acknowledged in their publications that it was fishers who enabled them to locate the reef fish spawning aggregations that they subsequently studied. For this reason help from the latter should be sought when searching for and characterising these aggregations. Spawning seasons can often be determined simply by sampling at the market.

# Live reef fisheries activities in the Republic of the Marshall Islands

*by Dr Andrew J. Smith* [1]

The following is based on information collected during a brief visit to Majuro, Republic of the Marshall Islands (RMI) in late June 1997, and subsequent communications with the Marshall Islands Marine Resources Authority (MIMRA) and RMI Environmental Protection Authority (RMIEPA).

Since late 1994 there have been three known live reef fish (LRF) operations in the Republic of the Marshall Islands. The first involved the arrest and prosecution of a LRF vessel operating illegally, and its subsequent re-arrest for possession of cyanide after obtaining a fishing licence. The other two are on-going joint-venture operations with local partners: one a Hong Kong-based company, the other based in Taiwan. From the perspective of the Director of the MIMRA, these two operations are still on a trial basis, and MIMRA is continuing to assess the fishery to ensure that maximum benefit accrues to RMI, with the minimum of negative effects.

*Ocean Glory* / Trekrona Ltd.: The M/V *Ocean Glory II* was arrested in early November 1994 near Ujelang (the westernmost atoll of RMI) by the RMI patrol boat for fishing without a licence. It was also suspected of fishing with cyanide, due to the way the vessel was set up, but none was found on board. The owner was fined US$ 250,000 and the vessel released after payment was made. The owner then applied for local government fishing permits (for Ujelang and Enewetak atolls) and a Foreign Fishing Agreement from the RMI Government in late 1995 and early 1996. Before it could start fishing, cyanide was found stored in plastic bags inside 55 gallon drums of oil, and the vessel was re-arrested in May 1996. The owner forfeited the vessel to the RMI Government. The vessel was built in 1968, has a steel hull, gross tonnage of 219.51 t, a length of 40.3 m, an engine capacity of 950 hp, fuel capacity of 110,000 l, a speed of 10.5 knots, and can carry a crew of up to 36.

Pacific Marine Resources Development Inc. (PMRD) is a locally incorporated company and was approved for a Foreign Fishing Agreement in November 1996 for an experimental live reef fish operation. It has a local government fishing permit for Maloelap, and is proposing to obtain a permit for fishing Ujelang in the near future. With this operation, PMRD charters a vessel from the Hong Kong partner, catches the fish, and transports it to Hong Kong for sale. To date two shipments have been made.

1. The Nature Conservancy, P.O. Box 1738, Koror, Palau

Marshall Islands Ocean Development, Inc. (MIOD) is a partnership between a Taiwanese company and local partners. It received approval for a Foreign Fishing Agreement in January 1997. The company was originally established as a tuna longlining operation to be based in Majuro, and installed fish handling and freezing equipment in a building adjacent to MIMRA. It was granted 10 longlining licences and was going to airfreight to Japan as well as loin the catch. For unknown reasons this did not eventuate and the company applied for an experimental live fish agreement. The current operation has been fishing Mili, Arno, Aur and Majuro. The company is chartering its vessel from the Taiwanese owners. This vessel, the *Lien Fu Tsai No. 2* (CT4-2131), is a fish carrier/longliner built in 1991 with a gross tonnage of 99.8 t, a length of 18.95 m, an engine capacity of 750 hp, a fuel capacity of 78,122 l, a speed of 11 knots, and a crew of up to 23. (*Note: On June 13, 1997, the FSS* Micronesia *(FSM patrol boat) arrested the* Lien Fu Tsai No. 2 *for illegally fishing in the Yap State Fishing Zone, while en route from Majuro to Taiwan for maintenance*.).

The live reef fishing operations in RMI are still in the experimental/trial stage, according to the MIMRA Director, and management and enforcement mechanisms are being developed as more experience is being gained in this form of fishery. The RMI Environmental Protection Authority is currently working with MIMRA and the International Marinelife Alliance–Philippines (IMA) to sample and test fish caught for traces of cyanide. IMA is a non-profit organisation based in Manila that has a contract with the Philippine government to test live reef fish for cyanide. It has offered to assist RMI in testing its samples.

# Grouper aquaculture in Australia

*by M. Rimmer [1], M. O'Sullivan [2], J. Gillespie [3], C. Young [4], A. Hinton [5] & J. Rhodes [6]*

## Abstract

Australia has an established wild capture fishery for grouper species in northern Australia. The major fishery is in Queensland, where the reef line fishery targets coral trout (*Plectropomus* spp.). The current commercial catch is estimated at about 1,200 t/yr with an additional 1,100 t caught by the recreational sector. In 1994, about 43 t of the commercial catch was exported as live product, most of which was air freighted to Hong Kong. Higher-valued species (barramundi cod (*Cromileptes altivelis*) and Maori wrasse (*Cheilinus undulatus*)), are uncommon.

Grouper aquaculture has only recently commenced in Australia, with two commercial hatcheries and one government hatchery commencing research on estuary cod (*Epinephelus coioides*) and barramundi cod. To date, no significant commercial production has been achieved. Because of the developing market for high-value live reef fish in South-East Asia, there is increasing interest in aquaculture of reef fish species, particularly groupers.

A feasibility study was carried out by the Queensland Department of Primary Industries (DPI) during 1995–96 to assess the potential to develop a reef fish aquaculture industry in Queensland to supply the high-priced live fish markets in Hong Kong and China. The overall plan for the feasibility study is shown in Figure 1 (see next page). A series of seven studies was carried out:

1. Present and future markets for selected live reef fish in Hong Kong and China;

2. Queensland's current reef line fishery and its potential to supply live fish, particularly coral trout;

3. Case studies of similar projects worldwide including time taken, development costs and difficulties;

1. Department of Primary Industries, Northern Fisheries Centre, P.O. Box 5396, Cairns, Queensland 4870, Australia.
2. Department of Primary Industries, G.P.O. Box 46, Brisbane, Queensland 4001, Australia.
3. Department of Primary Industries, Fisheries Group, G.P.O. Box 3129, Brisbane, Queensland 4001, Australia.
4. Department of Fisheries, P.O. Box 1625, Adelaide 5001, South Australia, Australia.
5. Department of Primary Industries, P.O. Box 1054, Mareeba, Queensland 4880, Australia.
6. 76 Bowen St., Cardwell, Queensland 4849, Australia.