Conclusion of Research on Capture and Culture of Pre-settlement Fish for the Marine Aquarium Trade in Solomon Islands

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Between February 1999 and December 2003 the WorldFish Center, Solomon Islands, carried out research on a new artisanal fishery based on the capture and rearing of pre-settlement coral reef fish (Hair et al. 2002). This work was funded by the Australian Centre for International Agricultural Research (ACIAR). Environmentally friendly methods (light traps and crest nets) were used to capture postlarval fish as they settled from the plankton. Simple aquaculture techniques were used to grow these fish to marketable size. The key factor is that fish are plentiful at this stage of their life cycle, but high mortality accompanies the transition from a planktonic to benthic lifestyle (i.e. settlement) (Doherty et al. 2004, Phillips et al. 2003). By harvesting fish immediately prior to or at settlement, adequate numbers of pre-settlers can be taken for aquaculture without affecting natural replenishment to the reefs since the large majority of those harvested would not have survived to adulthood anyway. The new fishery can therefore assist in addressing concerns of over-fishing for marine ornamentals (Sadovy and Vincent 2002, Wabnitz et al. 2003) and has potential to provide a vital source of cash income for coastal communities in the Pacific and Asian regions.

In the first phase of the research light traps and crest nets sampled postlarval supply for a week before and a week after the new moon every month from October 1999 to September 2001. Light traps were deployed in shallow water near submerged reefs and predominantly sampled competent, positively phototactic pre-settlers (Doherty 1987). Crest nets were set behind the surf zone on a shallow reef to capture fish passing between oceanic and lagoonal habitats (Dufour 1993). Very few species of value to the live reef food fish trade were recorded but ornamental species comprised 15% and 5% of the light trap and crest net catches, respectively. Only one species, lobster (*Panulirus* sp.) showed any seasonal trend in settlement rate, being more common from June to September in both years. Grow-out to market size was initially done in land-based concrete raceways, but later in sea-cages as this is a more appropriate technique for a village situation. Growth and survival of all teleosts (i.e. fin-fish) improved when rearing was transferred to floating sea-cages, although survival of crustaceans was higher in stationary, benthic cages. Fish and crustaceans were fed small amounts of minced fish, fish roe, crustacean and mollusc meat – items readily available in a coastal village.

In the first phase of the study a suite of species suitable for capture, rearing and sale to the marine aquarium trade were identified. Surprisingly, although the study originally proposed to catch and rear teleosts, banded cleaner shrimp (*Stenopus* spp.) and lobster (*Panulirus* sp.) were the most valuable component of the catch in Solomon Islands. Crest nets were chosen as the method with most potential for an artisanal fishery as they caught significant numbers of high-value crustaceans, yet were relatively cheap and simple to build and operate. Unfortunately, mortality in the nets was very high because animals caught in the soft cod-end either dried out at low tide or were crushed against the mesh during strong current flow. The second research phase was carried out in 2003 with the principle aims of (i) developing a cheap and simple "fish-friendly" harvest method for village use (based on the crest net); and (ii) developing ways to enhance survival and growth rates of fish in sea-cages.

Several modifications of the crest net were tested in an effort to improve survival at capture. The cheapest and most versatile of these comprised a cod-end constructed from a plastic bin or wooden box with mesh sides and roof. The solid cod-end retained water at low tides and provided shelter for fish during strong currents. Fish were guided into the cod-end via a hand-sewn, knotless 3 mm mesh net attached to the front of the box (Fig. 1). The effectiveness of the new "fish friendly" cod-end was well demonstrated by the improved survival rates: teleosts increased from 5 to 64%, shrimp from 10 to 97% and lobster from 85 to 97%.

A novel technique used to boost catches of lobster pueruli in 2003 was coconut logs drilled with holes (Fig. 2) and deployed in approximately 2 m depth on the reef flat behind the crest nets. The logs were a modified form of a fishing method used in Vietnam (K. Williams, pers. comm.). This was the first time the method had been used in the Pacific and it was very successful. The log collectors were mostly occupied by clear pueruli, although occasionally a pigmented puerulus was recorded. Logs were checked every morning during the new moon sampling periods of July, August and September 2003. During August, the peak recruitment month for lobster, abundance in the crest traps and logs was the same (mean = 1.8±0.3 se per device per night). The highest overnight log catch was 31 pueruli (mean

Figure 1: Larvae trap

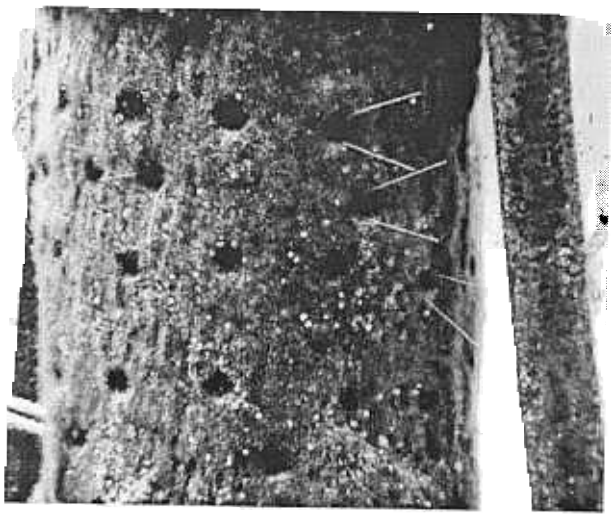

Figure 2: Lobster pueruli trap

= 6.0±1.7 per log). Floating artificial seaweed puerulus collectors were also deployed during the lobster recruitment season but were unsuccessful, possibly due to insufficient conditioning or strong currents.

Efforts to enhance the survival and growth of valuable species through improved grow-out techniques had mixed results. Banded cleaner shrimp were the most abundant and valuable species collected. With careful handling they were easily kept in good condition between collection at the reef crest and transfer to their grow-out habitat. Rearing cleaner shrimp was problematic due to fierce intra-specific aggression. All attempts to grow them en masse resulted in poor survival (12-60% in three weeks); the best survival was achieved through growing them individually in jars (80-100% in four weeks). The highest survival and growth were obtained in jars that were painted black to reduce exposure to sunlight that caused algal growth on the exoskeleton. The jar-rearing technique, however, was only suitable for *Stenopus hispidus* (banded cleaner shrimp). Two of the less abundant but higher-value species of banded cleaner shrimp, *S. zanzibaricus* and *S. tenuirostris*, survived but did not grow well in jars. Future work will investigate whether a combination of jar culture to nurse them through the first week, followed by rearing on an artificial reef is more appropriate for these species. Lobster were generally easy to rear and were successfully grown en masse in cages on the seafloor as long as sufficient food was provided (average survival was greater than 70% over three weeks). Problems with teleost grow-out were experienced due to the location of the sea-cage in deeper, exposed water. Small fish in the floating cages were subjected to strong currents moving through the nets and further disturbance in rough seas, forcing them to swim vigorously for extended periods to maintain their position in the water column. During rough sea conditions, mortalities in sea-cages were higher than in calm weather. A fixed sea-cage in shallow, sheltered water near-shore is proposed as a more acceptable alternative.

A draft manual explaining how to catch and rear these species has been produced and the methodology will be proposed for Marine Aquarium Council approval under the Mariculture Standards that are to be drafted soon (P. Holthus, pers. comm.). A computer model of the fishery using estimated start-up costs, production (calculated from three years of fish collection) and local farmgate prices indicated that a fishery for marine ornamental species based on pre-settlers is economically viable. Furthermore, similar fisheries are operating commercially in other areas of the Pacific (Dufour 2002, X. Neyrat pers. comm.). The Solomon Islands artisanal model is based on fishing with two crest traps that would sample a total of three metres of reef. However, these methods are yet to be tested in a village situation and at a profitable scale (i.e. production of 200-300 high-value animals per month). A new project to support aquaculture development in the Pacific is commencing in early 2004. The project, funded by ACIAR and run jointly by Queensland Department of Primary Industry Northern Fisheries Centre, Secretariat of the Pacific Community and the WorldFish Center, will oversee transfer of the postlarval fish capture and culture technology to a demonstration farm in a Solomon Islands' village. This exciting stage of the work will be the ultimate proof of the feasibility of the new fishery. The draft manual will be rewritten to reflect the lessons learned during this process and be made available to assist in adoption of the techniques by other Pacific Island and Asian countries.

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Seed Production of Sand Bass (*Psamoperca weigensis*, Cuvier & Valenncciennes)

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The Fisheries University of Nha Trang, Vietnam, with funding support from the "Support to Brackish and Marine Aquaculture Component (SUMA)" component of the DANIDA/Ministry of Fisheries Sector Program Support has successfully produced the seed of sand bass (*Psamoperca weigensis*, Cuvier & Valenncciennes). The local names for this fish in Vietnam are "ca chem mom nhon" (pointed snout