CRISP

Coral Reef InitiativeS for the Pacific
Initiatives Corail pour le Pacifique

COMPONENT 3C - Project 3C4
Support to PCC development for the ornemental fish trade in FSM

December 2010

TECHNICAL REPORT

Development of Post-larval Capture and Culture (PCC) in Pohnpei for the ornemental fish market

Photo: Simon Ellis MERIP

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The CRISP Coordinating Unit (CCU) was integrated into the Secretariat of the Pacific Community in April 2008 to insure maximum coordination and synergy in work relating to coral reef management in the region.

SPREP/PROE

The CRISP Programme is implemented as part of the policy developed by the Secretariat of the Pacific Regional Environment Programme to contribute to the conservation and sustainable development of coral reefs in the Pacific.

The Initiative for the Protection and Management of Coral Reefs in the Pacific (CRISP), sponsored by France and established by the French Development Agency (AFD), is part of an inter-ministerial project that began in 2002. CRISP aims to develop a vision for the future of these unique ecosystems and the communities that depend on them and to introduce strategies and projects to conserve their biodiversity, while developing the economic and environmental services that they provide both locally and globally. CRISP also, has a role in fostering greater integration in this area between developed countries (Australia, New Zealand, Japan, USA), French overseas territories and Pacific Island developing countries.

The initiative follows a specific approach designed to:

- associate networking activities and fieldwork projects;
- bring together research, management and development endeavours;
- combine the contributions of a range of scientific disciplines, including biology, ecology, economics, law and social sciences;
- address the various land and marine factors affecting coral reefs (including watershed rehabilitation and management);
- avoid setting up any new body but supply financial resources to already operational partners wishing to develop their activities in a spirit of regional cooperation. This is why the initiative was established on the basis of a call for proposals to all institutions and networks.

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This approach is articulated through a series of thematic objectives:

Objective 1: Improved knowledge of the biodiversity, status and functioning of coral ecosystems.

Objective 2: Protection and management of coral ecosystems on a significant scale.

Objective 3: Development of the economic potential represented by the use values and biodiversity of coral ecosystems.

Objective 4: Dissemination of information and know-ledge; and capacitybuilding and leadership with local, national and international networks.

The CRISP Programme comprises three major components:

Component 1A: Integrated coastal management and watershed management

- 1A1: Marine biodiversity conservation planning
- 1A2: Marine Protected Areas
- 1A3: Institutional strengthening and networking
- 1A4: Integrated coastal reef zone and watershed management

Component 2: Development of coral ecosystems

- 2A: Knowledge, beneficial use and management of coral ecosytems
- 2B: Reef rehabilitation
- 2C: Development of active marine substances
- 2D: Development of regional data base (ReefBase Pacific)

Component 3: Programme coordination and development

- 3A: Capitalisation, value-adding and extension of CRISP programme activities
- 3B: Coordination, promotion and development of the CRISP programme
- 3C: Support to alternative livelihoods
- 3D: Vulnerability of ecosystems and species
- 3E: Economic task force

CRISP is funded by the following partners:

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WWF
Conservation International
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IFRECOR

A COLLABORATIVE PROJECT FOR THE DEVELOPMENT OF POST-LARVAL CAPTURE AND CULTURE (PCC) IN POHNPEI AS A SUSTAINABLE WAY OF SUPPLYING THE ORNAMENTAL FISH MARKET

Final Report on Accomplishments and Activities

Submitted by Simon Ellis, Director of MERIP

Executive Summary

Between January 18 and December 16, 2010 MERIP conducted trapping trials for PCC in Pohnpei lagoon. In total trapping was conducted over 61 days around the new moon periods and a total of 171 individual traps were set. A mixture of crest net and CARE traps were used, although the predominant focus was on the CARE trap. A total of 8368 fish (mean 49 fish per trap) were collected over the trial period of which 66% were Apogonids and 25% were Pomocentrids. Trapping occurred at several different locations in Pohnpei lagoon but nearly exclusively inside the sheltered lagoon rather that in open ocean conditions. Despite a great number of variables, number of fish caught seemed to be seasonal (September – March) and reliant on proximity to the new moon.

As a result of funding from CRISP, great strides have been made toward establishing MERIP as a viable facility for the collection and export of PCC. The facility has been upgraded and improved to be able handle 4000 post-larvae per month. Staff and fishermen are now proficient in the use of two kinds of PCC traps, the CARE trap and crest net. In addition, MERIP staff are proficient at identifying larvae to family level, *Artemia* hatching, weaning and husbandry techniques, and shipping techniques for PCC products. In total, 1229 fish have been exported and the packing and shipping processes are understood. In effect, MERIP is now mostly equipped to take advantage of PCC as a complimentary activity to coral and giant clam farming for community farmers in Pohnpei.

A best case scenario for export costs based on catch data and export costs during the study showed a minimum cost of US$0.73 per fish produced and a further US$1.27 to export to Hawaii. These figures would make it unlikely PCC could be economically viable on Pohnpei in its current form. However, all major sources of cost can be addressed and significantly reduced with further research. The main hindrances to economic viability are, in order of priority: the cost of freight per fish; the way in which the fish are marketed; the existing technology; and the cost of husbandry and handling during capture and rearing. A new form of trapping has developed by Hawaiian SeaLife during the project period. While not fully tested, this method seems to offer a greater volume and variety of fish with much lower fishing effort. Not only would this method cut costs of capture but the increased volume of fish for export would also qualify MERIP for lower freight rates, which are currently very high. It will be important also to consider sustainability issues for this new method of fishing.

Accomplishments and Activities

Facilities

The MERIP facility in Pohnpei has undergone improvements to make it more amenable to fish holding and culture. Four shallow raceways (0.5 m x 4 m x 0.25 m) were installed and 6 existing aquaria refurbished for holding fish. A larger aerator was also installed on site. Running seawater can now be supplied to the tanks 24 hours per day. At present the holding capacity of the facility is at least 4000 fish per month. This can also be easily expanded.

Figure 1. New raceways installed at MERIP for holding PCC fish.

Figure 2. New raceways installed at MERIP for holding PCC fish.

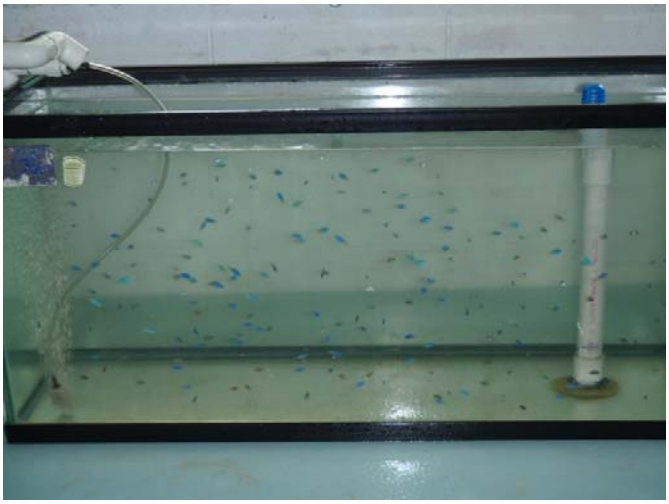


Figure 3. Aquaria installed at MERIP for holding PCC fish.

Traps and technology improvements

Two CARE traps were kindly given to MERIP at the beginning of the project by Gilles Lecaillon of Ecocean and a further two used CARE traps were obtained from a PCC project that was no longer operational in Majuro, RMI. A series of new lights were tested and using fisherman feedback it was determined that a new 12 V, 180 LED (E27) light was more effective than the compact fluorescent originally supplied. These lamps are available from www.horizonstarenergy.com. A maximum of 4 CARE traps were used at any one time. One trap was lost during bad weather in September 2010.

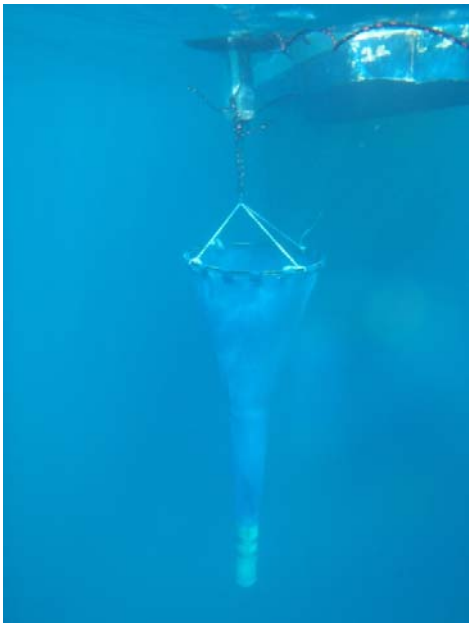


Figure 4. CARE net developed by Ecocean used during the study.

A crest net was also tested. The net was constructed with the help of Antoine Teitelbaum of SPC who also made a technology transfer visit to MERIP in March of 2010. After some initial

problems associated with site selection and trap structure it was used with some success during the months of September, October and November of the project.

Figure 5. Crest net used during the PCC trials.

Figure 6. Location of crest net used during the PCC trials in comparison to the reef crest.

Post-larval Capture

CARE Traps

The CARE traps used were easy to deploy and relatively rugged. However, the units did need constant maintenance in terms of fixing the inner tube floats, replacing the float holders and constantly charging the batteries. There is a definite cost to keeping CARE traps in operation and the relatively high level of technology and constant need to charge and replace batteries may make their use beyond the scope of many people in Micronesia. This was cited as a similar problem in the Solomon Islands by Hair and Doherty, 2003.

In total trapping was conducted over 61 days around the new moon periods and a total of 171 individual traps were set. CARE traps were fished all year, around the new moon period for the months of January – December 2010. A total of 8368 fish were captured during this period for an average of 49 fish per trap set. The majority of the catch was low value species such as

Apogonids (66%) and Pomocentrids (24.3%). Higher value fish such as surgeon and butterfly fish were also captured but in much smaller numbers. Table 1 shows the percentage of important families that were present in the catch.

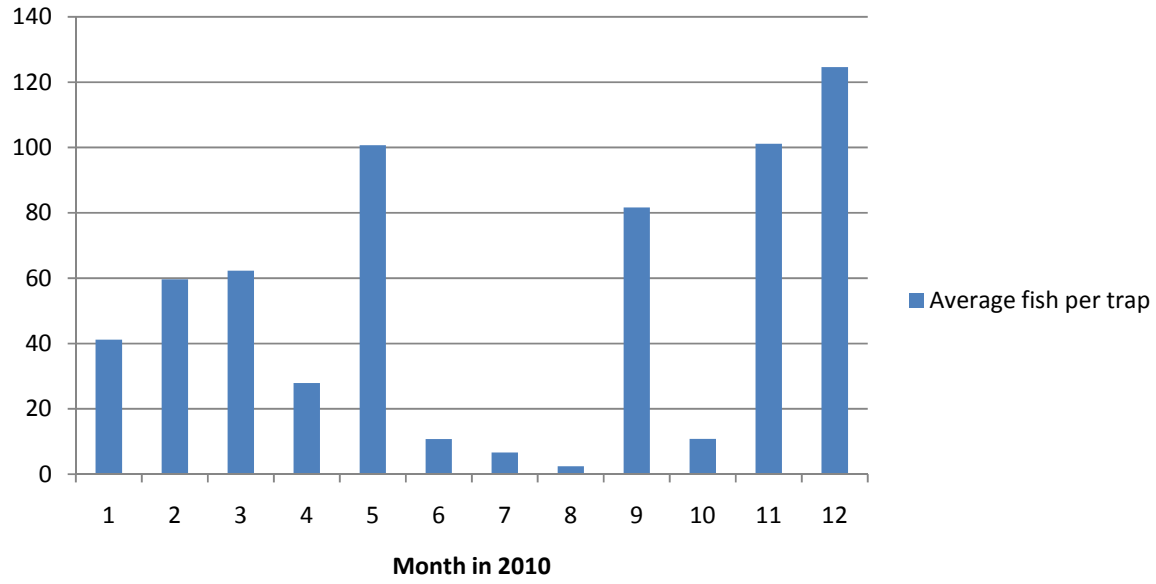
Table 1. Percentage of major fish families caught in the CARE traps between January and December 2010.

Family	% of Catch
Apogonidae	66.03
Pomocentridae	24.27
Holocentridae	2.38
Acanthuridae	1.79
Chaetodonidae	1.30
Mullidae	0.94
Siganidae	0.62
Serranidae	0.44
Bothidae	0.43
Lutjanidae	0.38
Tetradontidae	0.26
Blennidae	0.11
Scorpionidae	0.07
Gobidae	0.06
Labridae	0.06
Lethrinidae	0.01
Others	0.88

In total 11sites, all on the windward (Eastern) side of the island, which is close to MERIP, were tested for the first 6 months of the project. From this, one single area was selected that yielded higher fish catches. In the last 6 months of the project fish were captured only at this site and a combination of crest net and light traps were simultaneously tested. These were not replicated studies but instead relied on the observations and intuition of the fishermen involved.

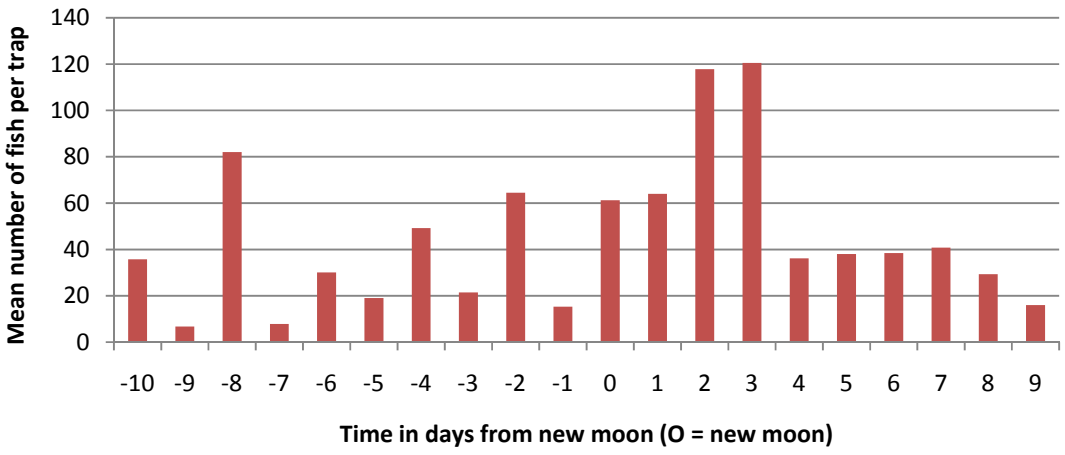
Although only one year of data was collected over a number of different sites there seemed to be a seasonal trend for capture quantity and makeup in Pohnpei. Catch rates were lowest in the Northern summer months of April-September and were higher in the November – March period (Figure 7). Pulses of most major families were also witnessed.

Figure 7. Average number of fish caught per CARE trap in each month of 2010



The quantity of fish caught relative to the phase of the moon seemed to also show a trend. Number of fish caught per trap after the new moon was 65.2 (n = 74) compared to only 33.7 fish per trap before the new moon (n = 78). Mean number of fish per trap caught on the new moon day was 61.3. Highest catches of fish seemed to occur 2-3 after the new moon (Figure 8 below)

Figure 8. Mean number of fish caught per trap in relation to proximity to the new moon.



Crest net

Following the visit by Mr. Teitelbaum to Pohnpei the crest needed some additional modifications, namely a catch flap installing toward the cod end of the trap to stop captured fish swimming out and also modifications were needed to the cod end. Once the crest net construction was completed it was only deployed on 8 further occasions. The main problem it seems is that the fishermen found the net hard to deploy as it required 3 people to set it and only 2 fishermen tended to go out per night. A further problem with the crest net was that due to security reasons the net could not be left out during the day so it had to be set up every evening and taken down every morning. Because trapping was carried out during the new moon period, when the fishermen went out in the late afternoon the areas where they could set the net were usually in 0.5-1 m of water depth with very strong currents, making it extremely difficult to set the net. Gilles Lecaillon in his PCC Pre Feasibility Study on PCC in Pohnpei in May 2009 made the following comments "Crest netting is possible but on the East coast, where we suggest developing PCC and where the trade winds are blowing strongly, the crest nets will have to withstand very big waves…….Unfortunately, no small and narrow hoa (shallow channels) exist at the locations visited". For these cultural and geographic reasons it would seem that the crest net will have limited application on the Eastern side of Pohnpei and probably throughout the entire island.

The fishing success of the crest net was also mixed. Of the 8 sets that were done, 3 yielded no fish at all and the average catch per set was 39.6 fish. The net did catch some species not normally seen in the CARE trap, namely the coral banded shrimp (*Stenopus hispidus*). Otherwise the majority of the catch was again Apogonids. Another downside to the net was that of mortality and trauma for the captured animals. Of the 317 animals caught in the crest net, 89 (28%) were dead or moribund.

The small number of net sets combined with the difficulties encountered by the fishermen in setting the net leaves the data inconclusive on the catching capability of crest nets on Pohnpei. This is unfortunate as studies in both the Solomon Islands (Hair et al., 2004) and Cook Islands (Malpot et al., 2008) indicate the crest net to be a better option than the CARE net. One solution to this might be to use the smaller crest nets, similar to those used in the Solomon Islands that can be set and tended by one or two people person (Hair and Doherty, 2003).

Post-larval Culture

Fishermen collected the post-larvae from the nets in the early morning and transported them back to MERIP in insulated ice chests with battery powered aerators. MERIP staff then sorted the fish and identified them to family (Figure 9.) Staff were also trained in hatching techniques for *Artemia*, weaning methods, and husbandry (Figure 10). Very few mortalities occurred with the exception of a power outage in August where more than 1000 fish were lost.

Figure 9. MERIP staff working on identifying post-larvae.

Figure 10. MERIP staff working on post-larval husbandry.

Export and Economics

Three shipments of fish were made to Hawaiian SeaLife in Honolulu during the project period (May 2010, October 2010 and February 2011). A total of 1229 were shipped to Hawaii. A fourth shipment would have been possible without the single mass mortality event caused by a power outage in July 2010. Fish were exported at ages from a few days post-capture to 2 months post capture. Shipment trials were conducted prior to the first shipment to ensure stocking densities in the bags would be safe. Richard Xie of Hawaiian SeaLife (HSL) assisted and advised in what stocking densities to use.

The economics of capturing and exporting PCC fish from Pohnpei is now better understood based on the capture data and pricing of activities related to capture, rearing and export. However, this is a complex issue and price per fish is highly variable based on the types and number of each species captured, time of the year when fishing takes place, and size of the

animal at shipment. Table 2. shows some general costs associated with capture, rearing and shipping.

Table 2. Approximate costs of various aspects of PCC and export based on the experiences at MERIP over a one year period.

Activity	**Cost is USD**
Fisherman payment per night of fishing	$30
Fuel cost per night of fishing	$15
Trap maintenance materials per night of fishing	$3
Staff labor to sort and grade fish/night of fishing	$20
Staff labor to maintain the fish in the facility/day	$12
Electricity for pumping per day	$3
Filters, pumps, feed and other facility materials use per day	$5
Box charge to ship 120 fish	$20
Cost per Kilo to ship from Pohnpei to Hawaii	$8.70
Total cost to ship 120 fish from Pohnpei to Hawaii	$152

Best Case Scenario

The following is a best case scenario for capture, production and shipping costs based on the data collected during the study. The scenario makes the following assumptions:

1. Capture only takes place during the best 6 months of the year which is September – February with a mean number of fish per trap of 76 fish per trap.
2. Fish are held for three weeks prior to shipment and shipments occur every month.
3. Fishermen use 5 traps per night and fish for only 6 nights per new moon period.
4. Only 50% of captured fish are shipped out with higher value specimens being selected for shipment.

Using this scenario, an average of 380 fish is caught per night for a total of 2280 per new moon period and a total of 13680 per season. Cost per six month season to capture these fish is a total of $2160. Cost per six month season to sort and maintain the fish in the facility for 3 weeks prior to shipping is a total of $2862. Cost to ship 50% of fish captured (6840 fish) to Hawaii is $8664. Using this scenario the total cost to capture and raise a saleable fish at MERIP would be US$0.73. The cost for the buyer in Hawaii to land that fish would then be a further US$1.27. This, coincidentally, amounts to US$2.00 exactly to capture, raise and export a fish to Hawaii. Given that most of these fish have market values in the regular marine ornamental trade of below US$1.00 it is currently not economically feasible to produce and export these fish using the current technologies and shipping costs.

It is highly likely that all these costs can be significantly reduced to make the process cheaper. The main hindrances to economic viability are, in order of priority: the cost of freight; the way in which the fish are marketed; the existing technology; and the cost of handling and rearing. During the study MERIP staff contacted Continental Airlines, the only freight carrier out of Pohnpei to Hawaii to discuss freight rates. Commodity freight rates currently don't exist out of Pohnpei but a Continental Cargo representative from Guam said that rates could be lowered as

export volume increased. Another way to save on the cost of shipping would be to do extensive shipping trials on reducing water volume in the shipping bags through the use of compounds that sequester ammonia in the shipping water. In this was more fish could be shipped per liter of water. The way the fish are marketed will also be important to address if PCC is to become a viable industry in Hawaii and elsewhere. This is already being addressed by Hawaiian SeaLife in Honolulu who has set up the Living Arts Center close the Honolulu airport. This center acts as a marine "edutainment" venue for school groups and other visitors. Part of the program includes an "Adopt a baby fish program" where students can set up a marine aquarium using PCC fish. This adds value to PCC fish making them more valuable than normally caught fish and opens a new market for the fish.

Figure 11. PCC promotion pamphlet used at the Living Arts Center in Honolulu, currently using fish from MERIP.

Existing technology also remains a hindrance to the success of PCC. Currently PCC technology catches reasonably few fish per trap and also generally catches fish of low value to the marine ornamental trade. It is clear that there needs to be a paradigm shift in trapping methods if PCC is become commercially viable. While the potential remains huge, the results to date do not make it possible to run PCC as a business out of Pohnpei. Hawaiian SeaLife has done some preliminary work using higher power lighting and more active methods of capture to greatly increase amounts of post-larvae taken. Catches of up to 5000 PL's per night have been recorded to date. However, this technology is still in need of long term testing to see what species are being caught, and in what quantities, over a period of at least a year. There also remain

sustainability issues to be considered if increased numbers of PL's are to be consistently collected from one area

Finally there is the issue of capturing and rearing costs at MERIP to consider. Over time it is highly likely these costs could be reduced. The introduction of newer more efficient technologies would reduce the nights of fishing per moon phase. Staff would also become more accustomed to caring for and identifying fish. In addition, low value species would be removed from the rearing tanks very soon after capture in order to reduce husbandry time and feed used, thereby reducing production costs.

Training and technology transfer

Seven members of MERIP staff have been trained in the following aspects of PCC: CARE and Crest net assembly and deployment; handling of fish during transport; *Artemia* hatching and feeding to post-larvae; weaning and feeding techniques; post-larval identification; general husbandry; packing and shipping techniques. In addition 5 local fishermen were hired and trained at various times over the project period to deploy traps, collect the fish from the traps, and transport the fish safely back to MERIP.

One technical visit was made by Antoine Teitlebaum, an SPC technical officer, to MERIP in March 2010. This was most helpful and the following techniques were transferred to MERIP staff: site selection for crest nets; crest net components and deployment; CARE trap placement; continuous feeding of *Artemia;* and general husbandry techniques.

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