

Post Larval Capture Collection (PCC) and rearing of ornamental shrimp and lobster species in Kavieng, Papua New Guinea

Antoine Teitelbaum¹, Thane Militz², Colette Wabnitz³, Casper Dako⁴, Jeff Kinch⁴



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¹AQUARIUM FISH NC - ²JCU – ³SPC- ⁴NIMRF/NFA



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**FONDS FRANÇAIS POUR
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ABBREVIATIONS

NIMRF	Nago Island Marine research Facility
PNG	Papua New Guinea
FFEM	Fond Français pour L'Environement Mondial
SPC	Secretariat of the Pacific Community
NFA	National Fisheries Authority
JCU	James Cook University
ACIAR	Australian Center for International Agricultural research
NFC	Northern Fisheries Center
NM	Nautical Miles

INTRODUCTION

Brief overview of aquarium trade in Papua New Guinea

While there are currently no exports for the aquarium trade out of Papua New Guinea (PNG), it has been documented that the country has development potential in this industry (EcoEZ, 2007; Teitelbaum *et al*, 2013). High freight and operating costs have thus far been highlighted as the two main limiting factors.

The country offers abundant and a wide range of resources that are in high-demand, partly as a result of a very varied range of habitats; and man power is available and wages relatively cost-effective compared to other countries in the region.

In recent years, a number of projects have attempted to develop a sustainable and viable aquarium trade in and out of PNG: the SEASSMART programme (owned by PNG's National Fisheries Authority (NFA)) and EcoAquarium (private sector). Unfortunately, both companies seized operations for a number of reasons including high freight and operating costs, which did not allow for the commercial viability of operations over the long term.

In parallel, the Nago Island Mariculture Research Facility (NIMRF) from the NFA together with institutional partners (James Cook University (JCU) / the Australian Centre for International Agricultural Research (ACIAR) / The Secretariat of the Pacific Community (SPC)) has taken the lead in documenting the potential to develop the aquarium trade from both cultured and wild-caught sources in the Kavieng area. A few examples of activities include:

- commercial resource survey for fish export (Teitelbaum *et al*. 2013);
- small scale coral culture trial for small polyp stony (SPS) corals mostly (2012-ongoing) (Teitelbaum *et al* 2012; Militz pers com); and
- development for aquarium fish species hatchery (2014-on going) (Militz ;www.facebook.com/marineaquariumtraderesearch?fref=ts)

Potential for aquarium trade lobsters and/or shrimp aquaculture in Kavieng

The NIMRF in Kavieng has a vocation, amongst other duties, to propose and develop sustainable aquaculture projects that benefit Papua New Guinea's coastal population through increased employment opportunities and cash income generating activities. Aquaculture research and conservation are a key part of NIMRF duties. NIMRF recently identified the culture of lobsters, shrimps and other aquarium products as a medium level priority (Teitelbaum and Kinch 2011).

While traded in lower quantities than corals, clams or fish, crustaceans are in demand for the aquarium trade. While shrimps and lobsters command a relatively small market share, demand is steady. Shrimps such as species belonging to the genera *Lysmata* and *Stenopus* for example together with a species of sea anemone accounted for 15% of all invertebrates traded in 2003 (Wabnitz *et al* 2003).

Those species were targeted for a culture and grow-out project in the Solomon Islands by Hair *et al* (2004). Indeed, early 2002, capture and culture trials of shrimps and lobster larvae were conducted in the Solomon Islands by the WorldFish Center (Hair et al 2002). Lobsters and shrimps were collected, grown out and exported through a local shipper (Aquarium Arts). While the project met with success initially, it failed eventually owing in part to high freight costs, lack of overall cost-effectiveness, and destruction of key recruitment habitat following the 2007 tsunami. In other parts of the world, lobster aquaculture is based on collecting the pueruli with traps such as in Vietnam, Indonesia (Ducroq and Sephar 2014) and some recent trials in the Pacific include New Caledonia with some interesting results (Ducroq *et al* 2013).

Based partly on the experience gleaned from trials in the Solomon Islands and the potential for shrimp and lobsters in the aquarium trade as described above, a project coordinated by the Secretariat of the Pacific Community and funded by the Fonds Français pour l'Environnement Mondial (FFEM) sought to conduct similar trials in Kavieng. The project's main aim was generate basic and relevant information on the recruitment, collection and culture potential of juveniles of shrimp and lobster species of interest for the marine aquarium trade around Kavieng. It was hoped that data generated from this study shall inform the future assessment of the feasibility and viability of developing a small-scale aquaculture business in the area for these commodities. These trials were meant to build on earlier trials implemented at Kavieng, implemented under the ACIAR funded project FIS/2010/017 as well as to integrate lessons learned in the Solomon Islands and other localities in the region, particularly with regards to improvements in capture methods. Specific objectives included:

- Choice of materials for the area that would optimise recruitment;
- Site location that proves favourable for recruitment as well as maintenance and access;
- Capture rates; and
- Parameters that are important to consider when culturing larvae such as water quality, feeds and rearing methods.

In Kavieng the main exploited species (for food) is *P. penicillatus*. While present *Panilurus versicolor* is less abundant, as per local observations. There are also occasional reports of *P. ornatus* (Hair pers. comm.). Most of these lobsters are of commercial interest in the food trade due to their high value as a restaurant/food item, but as juvenile *P.versicolor* is an aquarium item that can reach a retail price of 15-20USD (www.liveaquaria.com).

Coral shrimps are also prized commodities on the aquarium trade market. Species such as *Stenopus* spp., *Lysmata* spp., *Periclimenes* spp. are particularly sought after. They can reach retail prices of 10-15USD (www.liveaquaria.com).

A description of shrimps and lobsters in the aquarium trade is included in annex 1 (www.liveaquaria.com).

Potential for community involvement

Numerous communities in PNG depend on marine resources for their livelihoods, but do not maximize potential economic opportunities that such resources offer. For example, there is very limited tradition of mariculture in the coastal communities of PNG. The NIMRF offers opportunities for communities to capitalize on the development of such activities. It is also intended as a training centre for students from the National Fisheries Centre (NFC), various PNG universities and communities.

In the case of the capture and culture of lobsters, the technique for capturing larvae is very simple and can be deployed at village level. Further, and because customary marine tenure systems still exist in PNG, communities that have access to good collecting waters will be in a good position to deploy their own devices and reap the fruit from their efforts without fearing that collectors may be vandalised or stolen.

Grow-out can easily be undertaken at village level, given the small amount of feeding required: animals traded for aquarium purposes are usually small in size and numbers required to establish trade relatively low (50-100 of pieces at a time as opposed to several tons for commercial food aquaculture). Moreover, techniques required to hold the crustaceans in small floating cages are easily achievable.

MATERIALS AND METHODS

In this study we constructed and deployed crustacean collectors at 3 different sites and used three different collecting methods. All materials were build and deployed between the April and September 2015.

Collectors used for the study

Wood

Sixty (60) cm wood sticks made of local 'rot proof' hard wood were used. They were drilled on each of their 4 sides, for a total of 50 holes of approximately a 7mm diameter (Fig. 1). A tin-full of cement was used at one end to allow for the wood to initially sink (Fig. 2). We constructed and deployed a total of 35 wood collectors.

This type of collector is renowned to provide good results in many different places, such as Vietnam, mostly when used for lobster collection. It has also been used in different parts of the Pacific such as in the Solomon Islands (Hair *et al* 2002) and New Caledonia (Ducrocq *et al* 2013).



Figure 1: Preparing wood collectors



Figure 2: Casper Dako adding weights to wood collector

Shadecloth

Two pieces of shade cloth were placed on top of each other and wrapped around a rock to avoid floatation (Fig. 3). This type of collector is widely used in Asia (Fao *et al* 2009) and has been trialled in other parts of the Pacific such as New Caledonia where it was successfully used with *P. ornatus* (Ducroq *et al* 2013). These are fast to make, the required material was readily available in Kavieng and they are easy to handle. Thirty five (35)pieces were made for the study.



Figure 3: Shade cloth or maiden-dress collectors

Onion bags

Regular onion bags were filled with coconut leaves and weighed with a rock (Fig. 4). These collectors are very cheap and fast to make. While they are not typically deployed for the collection of lobsters and shrimps, their use is widespread for bivalve spat collection. We felt that it was worth having those included in the

experiment in case some ornamental shell or other organism of interest to the aquarium trade would settle on them. Again, 35 pieces were made for the study.



Figure 4: Peksy filling onion bag collectors with coconut fronds

Lobsters and shrimps in Kavieng

A quick qualitative local survey amongst workers and local people in Nago and Kavieng allowed us to determine the main crustacean species in the area. These were the following:

1. Lobsters:

- *Panulirus penicillatus*: Kavieng has a big fishery targeting this species for food. This species is probably of least interest to the aquarium trade. Local price range from \$10-20 PNG kina per kg.
- *Panulirus versicolor* (Fig. 5) : this species is of most interest to the aquarium trade due to its coloration. Local price range from \$10-20 PNG kina per kg.
- Occasional records of *Panulirus ornatus* (no interest to the trade).

2. Shrimps:

- *Stenopus hispidus* (Fig. 6): very popular in the aquarium trade. No current local value.
- Occasional reports of *Lysmata* sp. (Fig. 7), also very popular in the aquarium trade. No current local value.

Our main target species for this project were *P. versicolor* (also referred to as ornated lobster) and *S. hispidus* (also referred to as banded shrimp) as previous trials conducted in Solomon Islands demonstrated reasonable recruitment rates of both species.



Figure 5: *Panulirus* lobsters (C. Hair)

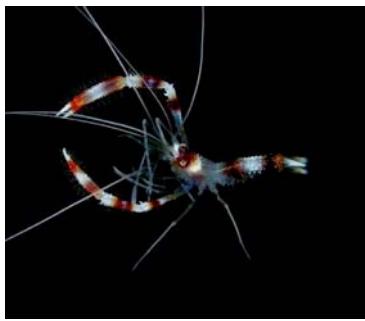


Figure 6: *Stenopus* shrimp



Figure 7: *Lysmata* shrimp

Site selection

A total of three sites were selected according to three key criteria:

- **Literature:** lobsters supposedly settle in nutrient rich areas that carry a lot of food and provide ample shelter. In New Caledonia, Vietnam, and Indonesia for example collectors are usually deployed in bays with dirty water. We searched for similar sites in Kavieng with proximity to reefs and mangroves when and where possible (Fig. 8).
- **Proximity to Nago:** Since sites had to be monitored regularly required, we did not want to select locations that were further than 30 minutes away by boat from the research station. As logistics dictated that all sites had to be monitored within 1 day, they were placed in a mangrove to reef gradient that allowed easy monitoring without impacting the experiment's design or the potential efficacy of collectors.
- **Clues of lobster and crustacean settlement:** Potential sites were carefully inspected for cues of lobster or shrimp settlement before the deployment of longlines. However, at the time of the trial, we had a feeling that we were late in the season as the only observed versicolor lobsters were probably 2 month-old already.



Figure 8: one of the sites where longlines were deployed, Kavina/river. Reefs on the forefront with mangroves in close proximity are a sign that this should be a good collecting area.

Deployment

All traps were deployed with the assistance of a boat, a driver and 2 staff (Fig. 9-11) according to the following protocol:

The first longline anchor is dropped from the boat after checking for depth (optimal between 5 and 15m). It is attached to the 'anchor line' with a slip knot that has to be tight. The anchor line (the length of which depends on the depth the line will be moored at) is then connected to the main line (30 m total length) using another knot. The first float is connected to this point (Fig. 9).

LONGLINE DIAGRAM

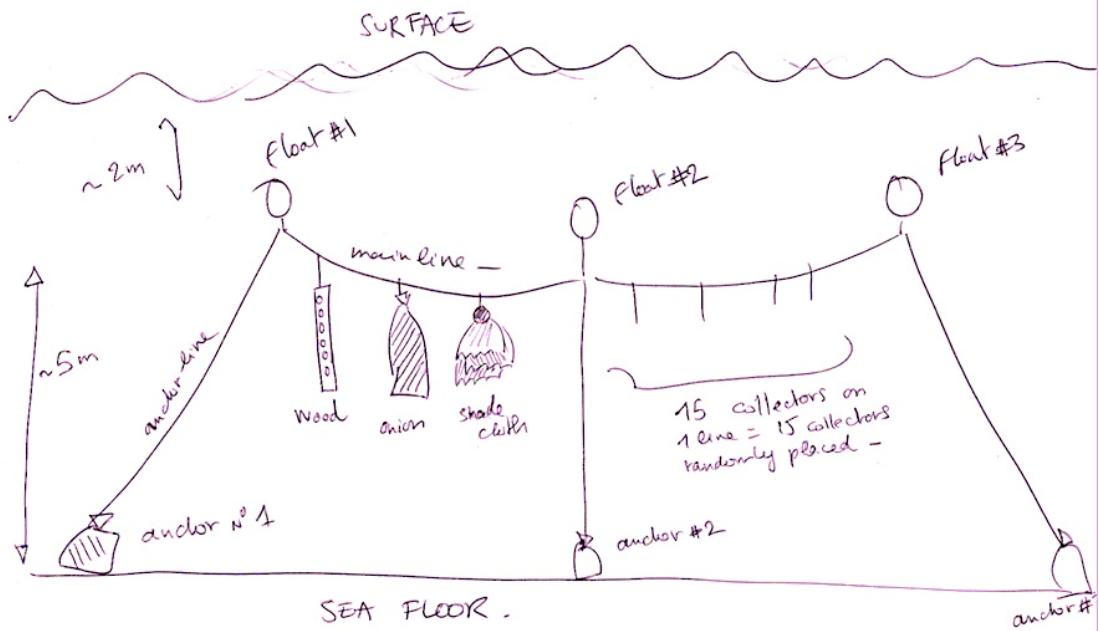


Figure 9: Diagram of a longline's position in the water column

1. The boat is set to drift downwind and collectors are attached to the longline at 2 meter intervals. A total of 15 collectors, five of each type, attached in alternating order, were deployed on one longline at each site.
2. Once all the equipment is deployed a second anchor line is attached to the main line at one end and to the second anchor at the other end. The boat is then used to stretch the line tight and the anchor dropped (Fig. 10). Both floats and anchors are adjusted, if and where necessary, by divers. To stabilise the setup, another (smaller) anchor and float are deployed in the middle of the line (Fig.9).



Figure 10: Deployment team ready to put out 2 longlines



Figure 11: Stretching the longlines downwind and placing alternately all three types of collecting devices.

Monitoring

Monitoring was undertaken by local staff twice a month. The first visit was done a day or two before the New Moon (NM), while the second check was done at NM+4/5 days. This was to find out whether there was more recruitment before or after the new moon, the time at which crustaceans usually settle on long lines. Monitoring of long lines began in May 2015 (roughly one month after deployment) and concluded in September 2015.

Lobster growth trials

In order to kick-start the survival and growth trials of lobsters/shrimps of aquarium interest, some specimen of *P. versicolor* were caught (4 to 8 cm) on one of the piers in town. A total of 20 lobsters were collected with 18 of them used for this trial.

The specimens (Fig. 12) were placed individually into 50L tanks and fed to satiation once daily (5pm) over a period of 5 weeks. All lobsters were given constant aeration, flow through of filtered seawater, and a flower pot hide. The lobsters were fed a commercially used diet for shrimp aquaculture (INV-NRD G8).

Molts and incidence of mortalities were recorded daily with growth rates being measured weekly.



Figure 12: Lobsters collected and used for growth trial

RESULTS

Sites

Description and location

We deployed a total of 7 collector lines, each with 15 collectors of the three material types, which were placed in random combination along the line, for a

total of 105 collectors. The individual sites are described succinctly below, mapped in Fig. 12 and information about them summarized in Tables 2 and 3.

River -Kavina: This site is under high nutrient influence due to the proximity of a river. The water was turbid (visibility = 2 m). Nevertheless, the area boasts reefs with live coral cover. There is a mangrove nearby. The bottom is silty/muddy. Two collector lines were deployed in this area with a total of 15 collectors each in 6 m of water and submerged to 3 m.

Goldmine-Lienpukatuk: This site is protected from the trade winds and has a mangrove nearby. It has more reefs than the previous site with greater diversity. Two lines were deployed with a total of 15 collectors each in 8 m of water and submerged to 4 m. Visibility was about 4-5 m. The bottom is silty.

Hospital-Paip: This site is deeper (10-15 m) than the two previous ones and has more oceanic influence. It is more exposed to wind and swell. It is also in close proximity to mangroves and reefs, and boasts greater diversity of reef species than either of the previous sites. Two lines were submerged to 5 m depth (15 x 2 collectors). Visibility is about 10 m.

Nago – Nango: This is a test site where a longline was deployed (15 collectors) near the reef on the sand right in front of NIMRF (depth 7 m). It was very different to the other sites as there is no mangrove in close proximity, visibility is great and it is located near one of Kavieng's lagoon entrances (strong oceanic influence).

The sites were selected as per the description in “Materials and Methods” above.

Table 1: longline names, locations and key information

SITE NAME	VISIBILITY	SUBSTRATE	DEPTH (m)
KAVINA 1	3	MUD/SILT	6
KAVINA 2	3	MUD/SILT	6
LIENPUKATUK 1	4	SILT	10
LIENPUKATUK 2	4	SILT	8
PAIP 1	10	SAND	15
PAIP 2	10	SAND	10
NANGO 1	15	SAND	7



Figure 13: Map of Kavieng and areas where the longlines were deployed.

Environmental data

Some key environmental data such as temperature and salinity were recorded at each site while deploying the collectors (Table 3). Both were found to be generally stable amongst the sites, with the exception of lower salinity at Kavina, demonstrating the strong riverine influence at this site.

Table 2: Environmental data taken in April 2015 while deploying the long lines.

SITE	TEMP (°C)	SALINITY (‰)
KAVINA 1	30.5°	32
KAVINA 2	31	34
LIENPUKATUK 1	30.5	34
LIENPUKATUK 2	31	34
PAIP 1	31	34
PAIP 2	31	34
NANGO 1	31	35

Lobster growth trials

The growth trials were undertaken on 18 lobsters over the course of 5 weeks, with mortality, molting and growth rates recorded weekly. Table [Table 3](#) summarizes the results of this trial.

Table 3: Growth rates of the lobsters during trial

Date	Week	Mean Size	Std Error
20/04/15	0	18,22	0,76
27/04/15	1	17,83	0,65
04/05/15	2	18,27	0,70
11/05/15	3	18,58	0,69
18/05/15	4	18,29	0,67
25/01/00	5	18,31	0,67

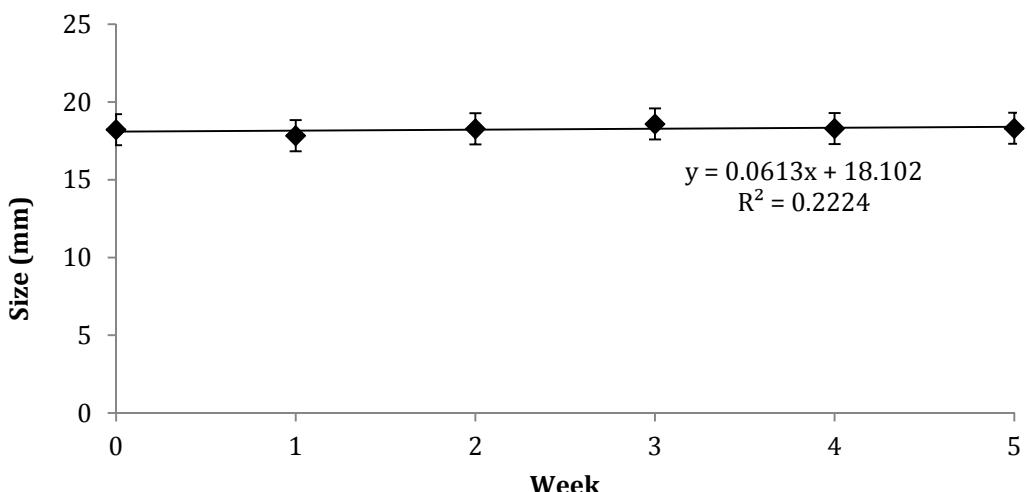


Figure 14: growth of the lobsters during the 5 week study period

During the course of the trial, there was no significant difference between the size of lobsters at the start of the study (18.22 ± 0.76 mm) and the end of the study (18.31 ± 0.68 mm) (T-Test, $T = -0.09$, $P = 0.93$). Also, 2 lobsters died (11%) and 66% of the lobsters moulted over the course of the study.

Collectors

While the purpose of this study was to focus on aquarium lobsters and shrimps, we seized the opportunity of regular monitoring activities to check for and record other aquarium animals of potential commercial interest (e.g., fish, crabs and other shrimps).

Lobsters, shrimps and other crustaceans.

Over the 2-month monitoring period we recorded no lobster recruitment in any of the collectors. We did however encounter shrimps especially in the second month. Only five individuals of the genus *Stenopus* (2) and *Lysmata* (3) were seen. The main species encountered were of the genus *Periclimenes*. It was recorded a total of 457 times (Table 4).

Table 4: Recruitment of crustaceans

Species	Total	%
<i>Saron</i> sp.	1	0,2
<i>Stenopus hispidus</i>	2	0,4
<i>Lysmata vittata</i>	3	0,7
<i>Periclimenes</i> sp.	457	98,7
Total	463	

The most efficient longline for collection were those at Paip/hospital. The ones in the bay and near the rivers (Kavina/Lienpukatuk) weren't very productive and neither was the Nago test line in clear water near the station. Table 5 summarizes the total number of shrimps recorded on collectors by location over the course of the study period.

Table 5: Number of shrimps harvested at each longline

Location	Total Number Encountered
KAVINA1	33
KAVINA2	22
LIENPUKATUK1	34
LIENPUKATUK2	29
PAIP1	219
PAIP2	107
NAGO	22

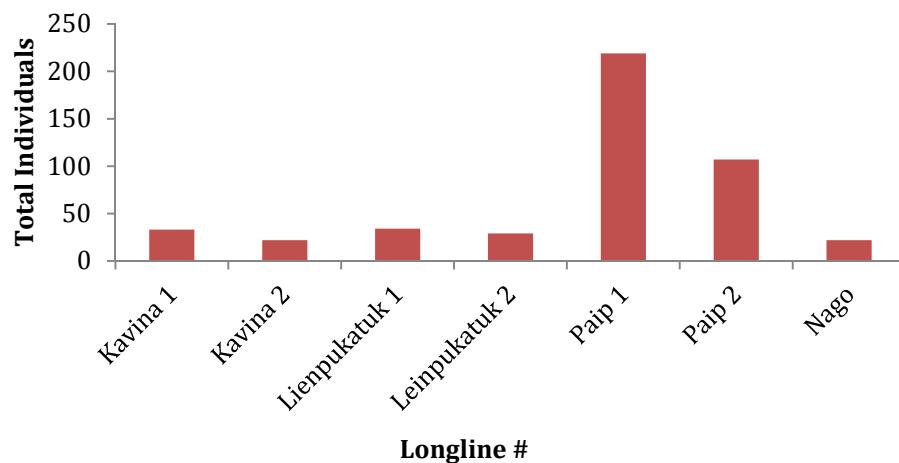


Figure 15: Efficiency of each longline

Out of the three types of collector materials used, the ones made out of shade cloth yielded the best results for shrimps, accounting for 92% of catches (Table 7). The onion bags proved difficult to inspect and fouling of the bags exterior hindered water movement inside of them, creating anoxic conditions probably

unsuitable to shrimp recruitment. All shrimp observed on the onion bag collectors were found on the bags exterior surface.

Table 6: Number of shrimps harvested for each type of collector

Collector	Total	%
Wood	7	1.5
Onion Bag	29	6.3
Shadecloth	345	92.2

Of the shrimps spotted on the collectors, 98.7% were found to be glass shrimp (*Periclimenes* spp.) with species of commercial value to ornamental trade (*Lysmata vittata* and *Stenopus hispidus*) comprising only 1.1% of individuals.

All individuals were initially detected as juveniles with specimens belonging to the *Periclimenes* genus observed to grow and reside on longlines over time.

Lysmata vittata and *Stenopus hispidus* were only observed on longlines as juveniles and were not found again on subsequent monitoring visits, suggesting these might have migrated to nearby reefs.

Most shrimp observed were at Paip 1, this line also had the 2 *Stenopus hispidus* and 2 of the *Lysmata vittata* observed.

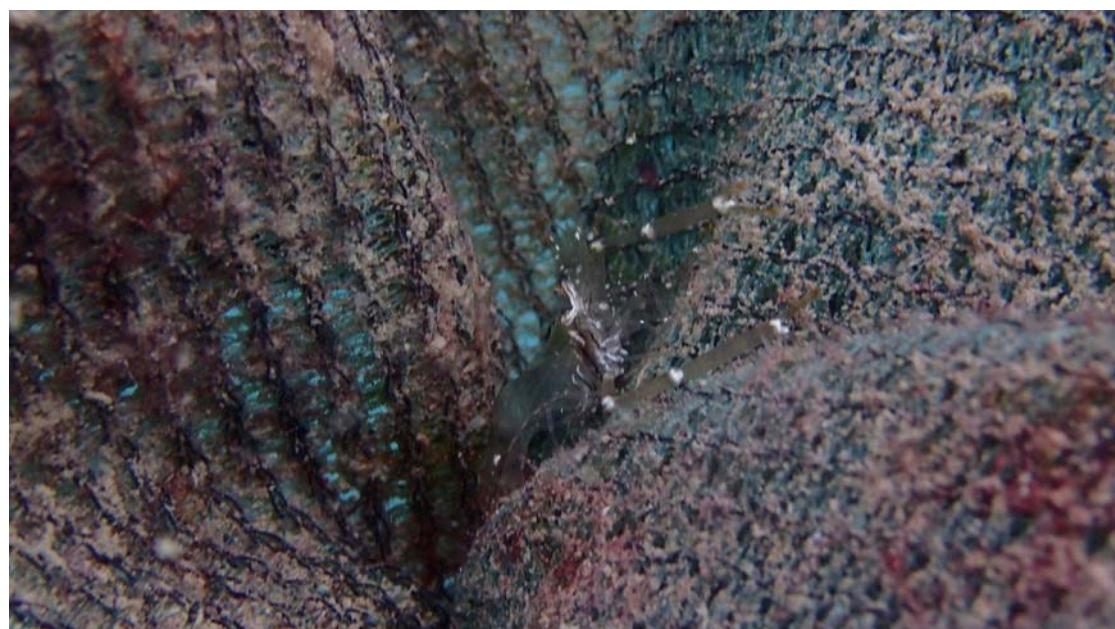


Figure 16: Picture of a shrimp settled inside a shadecloth collector.

A by-product of the study: presence of fish

Fish were not initially targeted by this study but the occurrence of one aquarium species of fang blenny is worthy of reporting here.

The longlines were effective at attracting a single species of fish, *Meiacanthus grammistes*, a species traded for aquariums (see description in annexes). This

was always the most prevalent fish species associated with longlines. Similarly to shrimps, the fish were most commonly associated with shade cloth collectors.

Figure 17 summarizes the number of striped blennies (*Meiacanthus grammistes*) encountered on the longlines over the first two months of the study. They were found to aggregate consistently along the rope of the anchor and longlines themselves (Fig. 18).

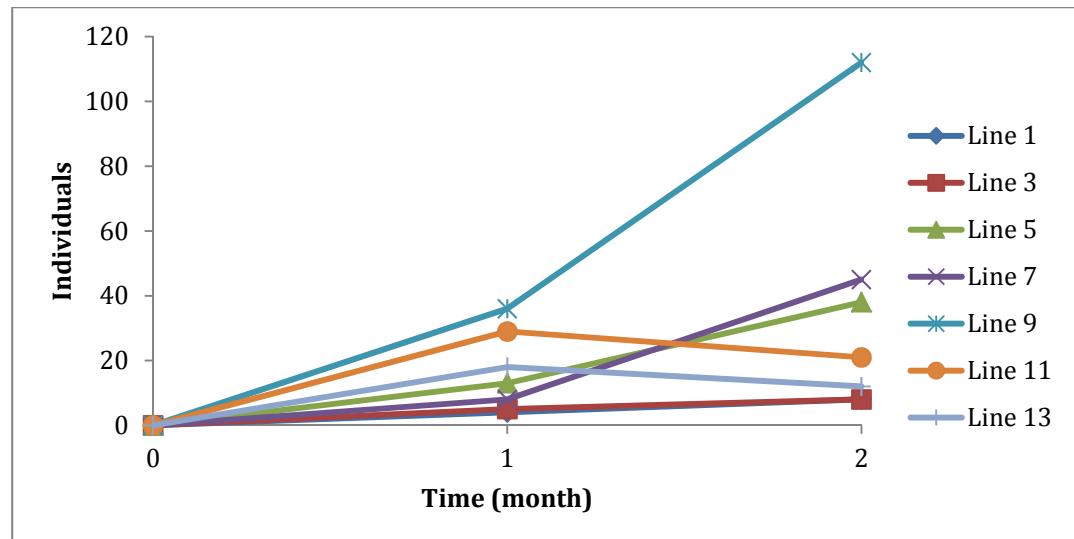


Figure 17: Number of blennies recorded during the first two months of the study

This finding brings to light the potential for mini FADs to attract fish in demand by the ornamental trade and/or light trapping devices. However, it is worthy to note that initiatives developed on such principles focusing solely on fish species have proven to be not economically viable (e.g., French Polynesia, Vanuatu, Cook islands, Mauritius), mostly owing to irregular recruitment patterns of diverse species and the fact that the species recruiting in highest numbers are typically not worth very much on the aquarium trade market.

For this species, like for the shrimps, there was a clear site impact on effectiveness, with the deepest site near reef habitat being the most effective (Line 9=Paip1)

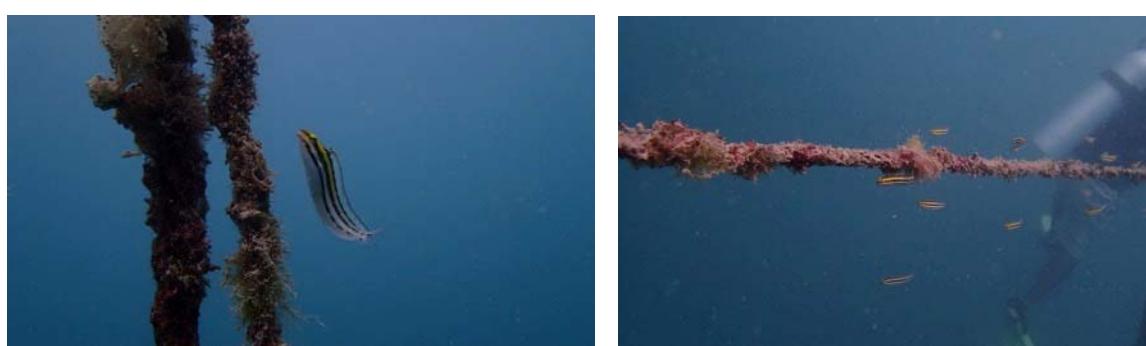


Figure 18: *Meiacanthus grammistes* on the long lines

CONCLUSIONS

Lobsters

The lack of lobster recruitment observed over the course of the study may be due to the fact that:

- The longlines were deployed outside of recruitment season and it would require a few more months before they start settling in;
- The density of lobsters in Kavieng is too low and collectors are not the appropriate tool for them or if they do recruit in the area, they may only be present in very low numbers;
- The longlines were placed at the wrong spots or the collectors were not appropriate.

→ Given experience in other parts of the world and clues observed on the reefs of Kavieng, we hypothesize that lobster recruitment is seasonal (probably November-February). Moreover, it is likely that *Panulirus versicolor* also only recruits in small numbers.

Shrimps

The number of glass shrimps and other shrimp species found on the collectors indicates there is potential for collecting crustaceans in the area, although the species may not be of particular interest to the aquarium trade and they may not be available in commercial quantities.

→ The longlines should be left for a full year cycle to examine seasonality/density and species more thoroughly. The sample is too small to draw definite conclusions so far.

Fish

The fact that fang blennies were around in good numbers and recruited fairly rapidly to the collectors at some sites shows that there may be potential of trapping some commercial aquarium species using alternative methods such as mini-fads or light traps onsite; though this would have to be tested more thoroughly and would need to include the trialling of other collection methods.

→ Fang blennies of the type encountered are of low value and one would not be able to ship large quantities. As such they would not constitute the back bone of an export business, but could potentially be included within a stocklist, if an aquarium export business was to develop in the future based on other more lucrative species.

Impact of the equipment used

There was a clear impact of two factors during this study so far: the shade cloth collectors were by far the most efficient and the onion bag collector was not appropriate, most likely due to its anoxic state after a few weeks in the water.

While the wood collectors has worked best for lobsters in other studies it would need to be trialled during recruitment season for the relevant species. Further, one site yielded better result and we would recommend that this type of area be focused on for future trials (hospital).

→ **Trials demonstrated a clear impact of type of collector and site**

Lobster growth trials

The lobster growth trial showed that there was no significant growth during a 5 week study period.

→ **Tank trials showed that lobsters could survive and be fed on commercial shrimp diets, indicating that lagoon grow out trials in low tech sea cages could be a successful next step.**

Since there were only 4 aquarium shrimps collected during the study, no growth trials were carried out on those individuals. It was observed that they grew on the longline to adult sizes.

RECOMMENDATIONS

Monitoring of the deployed longlines would need to continue for another 6-12 months to better assess recruitment seasonality. Since we did not observe any lobsters on the longlines, we hypothesize that the lines were deployed outside of recruitment season. Shrimps, although present on the lines, weren't of the right species, except for 4 individuals.

Deploying more lines at a series of different new sites might yield interesting results, but their effect might not be as relevant as seasonality.

Although larvae/spat/juvenile collection for grow-out is of commercial interest in many different industries (milkfish, mussels, edible and pearl oysters, etc.) success depends exclusively on the suitability of the site (it can sometime be a very small area of a lagoon or mangrove). In the case of lobsters, pueruli collection has proven commercially viable in a few different areas of the tropics such as Vietnam, Indonesia and other isolated sites. In New Caledonia, only one site was found to be commercially suitable out of many trials.

A next step to growing out lobster is cage trials. It was trialed in different areas of the pacific (in hapa nets in NC or in meshed covered buckets in Solomon). Shall there be recruitment of *P.versicolor* in the future in Kavieng, then a method of in situ grow out should be developed using locally available equipments.

Unless the trial were to continue for another 8 months and lead to significantly different results (i.e., high recruitment in species of interest for the aquarium trade) at this stage **we recommend that this activity not be transferred to the private sector and remain within the scope of research only.**

ANNEX

All reference material included below was obtained from www.liveaquaria.com

Banded coral shrimp (*Stenopus hispidus*)

The Banded Coral Shrimp has striking red and white bands across its body with fairly long pinchers and extra long white antennae. Combined with its prickly

body texture, this peaceful member of the Stenopodidae family brings interest to any marine aquarium. However, most hobbyists praise *Stenopus hispidus* for its active nature as it scampers around the aquarium in search of food.



Interestingly, members of the Stenopodidae family are known as "Boxing Shrimp" because of the large pinchers on their third set of legs.

These pinchers are often held erect and give the Banded Coral Shrimp the appearance of a boxer ready to fight. Though the Banded

Coral Shrimp can be aggressive towards other Banded Coral Shrimp and smaller shrimp of different species, most are peaceful towards fish, corals, and invertebrates within your aquarium. Because of its aggressive disposition towards other Banded Coral Shrimp, the Banded Coral Shrimp should be housed individually or kept as a true mated pair.

Native to the oceans of Indonesia, *Stenopus hispidus* is perhaps the most widely distributed shrimp in the sea. It usually hangs upside-down in caves or crevices, with only its antennae emerging from the hole. While molting, the Banded Coral Shrimp will often hide from sight for 1-2 days in the rocks of the reef. In the home aquarium, provide sufficient room for the Banded Coral Shrimp so it can move about freely without its long antennae touching neighboring corals or anemones.

The Banded Coral Shrimp is relatively hardy and boasts an aquarium-suited length that rarely exceeds 3 inches, 6 inches with the antennae. The male Banded Coral Shrimp is usually smaller. Breeding the Banded Coral Shrimp is usually not successful. Larvae generally succumb to filtration and skimming.

Like other invertebrates, the Banded Coral Shrimp is intolerant of high nitrate or copper levels. Be sure to maintain proper iodine levels in the aquarium to help ensure proper molting. The Banded Coral Shrimp must be acclimated slowly to avoid any salinity and/or pH shock.

In the wild, the Banded Coral Shrimp is a scavenger. In the home aquarium, it will accept most flaked and frozen foods.

Painted lobster (*Panulirus versicolor*)

Panulirus versicolor is known by many names using a combination of the adjectives, "blue", "spiny", and "painted"; for instance, Painted Spiny Lobster or Spiny Blue Lobster. The Blue Spiny Lobster or Painted Crayfish, has distinctive markings of azure blue stripes on its legs.

The carapace is greenish-blue, and the dorsal surface is darker blue with a reticulated pattern. The tail fin is also blue. The abdominal segments have white bands and the antennae is very long. It lacks the large claws found on most other lobsters.



It is peaceful and multiple specimens may be kept in a large tank. It generally will not bother other inhabitants of the aquarium, except for sessile or other bottom dwelling animals. Live rock with multiple crevices and hiding places would provide a good environment. It may be shy when first introduced, but once acclimated, will be more visible.

It is capable of making a sound that is very similar to a cicada (locust). It may perform a dance-like maneuver, whipping its long, split white antennae as it moves about the tank.

It will eat most all types of meaty foods that are placed in the aquarium. It is sensitive to high levels of copper-based medications. It is extremely difficult to breed in an aquarium.

Striped blenny (*Meiacanthus grammistes*)

The Striped Blenny is also referred to as Gammistes Blenny, Striped Fang Blenny, or Striped Poison-Fang Blenny. It has alternating black and yellow stripes that run the entire length of the body.

It tends to do well in an aquarium if housed in a 30 gallon or larger aquarium with live rock. The live rock provides places to hunt and feed on small crustaceans as well as places to hide.



It is not usually aggressive unless the tank mates appear to have a similar shape as it does. Its fangs are more of a defense mechanism used for biting an aggressive fish back.

The Striped Blenny diet consists of chopped crustaceans, vitamin-enriched brine shrimp, and

frozen food preparations for herbivores.

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