



Black Pearls, Inc.

Kona, Hawaii

Producers of Hawaiian Black Pearls™

P.O. Box 525, Holualoa, HI 96725, U.S.A. • Tel: (808) 331-1188 • Fax: (808) 331-8689 Website: www.blackpearlsinc.com

SK-GRANT FINAL REPORT

REPORT TITLE:

TRAINING OF MARSHALL ISLANDS

PEARL FARM WORKERS

AS PEARL CULTURE SEEDING TECHNICIANS

AUTHORS:

Neil Anthony Sims and Dale J. Sarver, Ph.D.

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LIST OF ABBREVIATIONS USED

BPOM	Black Pearls of Micronesia, Inc.
BPI	Black Pearls Inc.
CMI	College of the Marshall Islands
CTSA	Center for Topical and Sub-Tropical Aquaculture
RRE	Robert Reimers, Enterprises, Inc.
FSM	Federated States of Micronesia
PATS	Pohnpei Agriculture and Trades Schools
MIMRA	Marshall Islands Marine Resources Authority
RMI	Republic of the Marshall Islands
UH	University of Hawaii

II. ABSTRACT:

This project sought to provide alternative employment opportunities for Hawaiian and Pacific Island fisherfolk by training them in the exacting skill of pearl seeding. Local pearl seeding technicians would also help foster the fledgling small-scale pearl culture industry in these areas, by reducing the reliance on foreign seeding technicians. The original project plan was modified to provide formal training for five Marshallese – all employees of the two main pearl farm companies in the Marshall Islands. The master seeding technician, Ms Berni Aquilina, conducted three seeding training sessions in the Marshall Islands: the first at the BPOM farm site in Bikirin, Majuro, the second at the BPOM farm site in Arno, and the third at the RRE farm site in Arno. The master seeding technician was very pleased with the progress of the seeding trainees over the course of the training. However, there was attrition of two of the better trainees, for social and professional reasons unrelated to the seeding itself (the relocation of the BPOM farm from Majuro to Arno). Catch bag results by the trainees from the final seeding session were disappointing, but reflect the need for continuing guidance and practice. The two remaining trainees hope to continue with additional training, and will eventually earn the confidence of the pearl farm owners to allow them to assume a leading role in the industry development in the U.S.-affiliated Pacific Islands.

III. EXECUTIVE SUMMARY

This project sought to provide alternative employment opportunities for Hawaiian and Pacific Island fisherfolk by training them in the exacting skill of pearl seeding. Local pearl seeding technicians would also help foster the fledgling small-scale pearl culture industry in these areas, by reducing the reliance on expensive foreign seeding technicians.

Because of the difficulties in attracting suitable candidates for traineeships, the project was modified to provide formal training for five Marshallese – all employees of the two main pearl farm companies. The master seeding technician, Ms Berni Aquilina, conducted three seeding training sessions in the Marshall Islands. The first, in February, 2002, was held at the BPOM farm site in Bikirin, Majuro. Oyster condition was sub-optimal, but three of the four trainees performed very well, with retention rates approaching that of the master seeding technician. The second training session at the BPOM farm site in Arno, was held in February, 2003. Because of a health crisis with the BPOM farm manager, reliable catch bag results were not obtained from this session. By the time of the third session at the RRE farm site in Arno, in February 2004, two of the leading trainees had left BPOM's employment, because of the social difficulties they encountered in relocating the farm to Arno.

With the continuing ill health of the BPOM farm manager, there was inadequate logistical support for Berni at the BPOM site for the third seeding session. This session was therefore held at the RRE farm site in Arno, with logistical support provided by CMI and RRE. Catch bag results by the trainees from the final seeding session were disappointing, but reflect the need for continuing guidance and practice. A general rule-of-thumb is that trainee technicians usually only achieve reasonable success rates after seeding 10,000 oysters. These Marshallese trainees have only seeded several hundred each, and they may still make considerable improvement in the retention rates.

Demonstration seeding sessions were also held at the BPI farm site in Oahu, while the seeding technician was in transit to the Marshall Islands, on each occasion. These provided opportunity for the first ever harvest of Hawaiian pearls cultured in the native sub-species of *Pinctada margaritifera galtsoffi*.

The two remaining trainees in the Marshall Islands hope to continue with additional training, and hope to eventually earn the confidence of the pearl farm owners to allow them to assume a leading role in the industry development in the U.S.-affiliated Pacific Islands. Additional training sessions are planned for the coming year.

In our overall assessment, the project exemplified many of the developmental challenges working in the remote Pacific Islands region: it was difficult to attract and retain sufficiently skilled or committed candidates, logistical challenges were significant, and over-reliance on one key co-ordinating person on site led to poor flow of information and project co-ordination when that person was not able to fully function, because of severe health problems.

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IV. PURPOSE

A. Detailed description of problem or impediment of fishing industry that was addressed:

This project directly addressed the priority area C. (Fishing Community Transition). Ever-increasing fishing pressure in U.S. insular areas – both Pacific Island atolls and the Hawaiian Islands – is leading to an increasingly urgent need for alternative employment for fisherfolk from these areas. Pearl farming presents a lucrative, ideal opportunity: the technology is in hand, the first harvests have been obtained, and significant U.S. investment had backed the expansion of this industry. The speed and breadth of this expansion, however, might be constrained by the lack of trained seeding technicians to operate on these oysters. This project proposed to train former fisherfolk from Hawaii and the Marshall Islands in the pearl seeding skills. The successful trainees were originally to be contractually bound to work on other small farms within the region, as well as extending their skills through working elsewhere in the black pearl industry, as time allowed. The successful trainees were also to be bound to accept other trainees as apprentices, to ensure ongoing expansion of these benefits to the region.

The original title of this project reflected its broader intent: “Re-Training Of Hawaiian And Micronesian Fisherfolk As Pearl Culture Seeding Technicians”. For reasons described below, however, the project was modified due to a series of contingencies. It was not possible to obtain any Hawaiians who were willing to undertake the travel and the period of relatively low paying apprenticeship/internship that was required of the trainee. Furthermore, despite extensive advertising within the Marshall Islands, there were no applicants for the trainee seeding technician positions from former “fishermen”, per se. The only serious candidates for traineeships were existing employees of the BPOM farm operation. The intent of this project was therefore adapted to the realities that we faced, as reflected in the title of this report: “Training Of Marshall Islands Pearl Farm Workers As Pearl Culture Seeding Technicians”.

1. The promise of black pearls

Pearl culture is the single-most lucrative aquaculture industry in the Pacific Islands. Black pearl production in French Polynesia alone is worth over US\$150 million p.a. In the Cook Islands, the annual harvest from a single atoll is worth an estimated US\$5 million p.a. In both the Cooks and French Polynesia, pearl culture is the second greatest earner of foreign exchange, after tourism.

Pearl culture is also an ideal development activity for remote atolls and rural areas. Pearl farming is very labor intensive, offering alternative employment opportunities. It yields a non-perishable crop, and it thrives in clear lagoon waters. The filter-feeding pearl oysters are environmentally benign. Where past histories of overfishing have led to local extirpation of stocks, farming can even be beneficial by fostering stock re-establishment (Rogers, Sims, Sarver, and Cox, 1999; Sims, 2004).

The industry reverses rural urban drift, and sustains broader development of secondary economic activities. There are many diverse spin-off socio-economic and cultural benefits to these remote

fishing communities (Newnham, 1989). Pearl culture also fosters a greater sense of stewardship over lagoons, and is also often closely linked with reaffirmation or re-establishment of traditional lagoon tenure mechanisms (Sims, 1992), leading to more involvement by fisherfolk in coastal resource management.

In French Polynesia and the Cook Islands, the profusion of natural oysters led to rapid, broad-based development, with farms ranging in size from extended-family co-operatives to large corporate concerns. The same species of pearl oyster that forms the basis of the industry in Tahiti and the Cooks, *Pinctada margaritifera* (L.), also occurs throughout the U.S. insular Pacific. It is less common in the Hawaiian and Micronesian areas, however, due to a combination of both past overfishing, and oceanographic conditions that are unsuitable for larval retention. Research and development efforts by Black Pearls, Inc. (BPI) and other entities are attempting to replicate the success of Polynesian pearl culture by establishing local pearl industries in Hawaii, the Marshall Islands, and the Federated States of Micronesia (FSM). First, however, the natural scarcity of oysters in these sites had to be overcome by refinement of hatchery culture and nursery rearing techniques.

The success of these efforts culminated in 1998 with the investment of over US\$2.1 million from a U.S. firm into Black Pearls of Micronesia, Inc. (BPOM), the Marshall Islands subsidiary of Hawaii-based BPI. In October, 1998, the first pearls were harvested from BPOM's Majuro, Marshall Islands, farm site. The crême of this crop were then sold to Harry Winston, Inc., a prestigious Fifth Ave, New York jewelry house. Winston is credited with having almost single-handedly established the market for Tahitian black pearls (Federman, 1994) and this sale signified the acceptance of this new, distinctive product from the Marshall Islands at the highest market level. BPOM's operations were continuing to expand, with over 20,000 oysters ready for seeding in 2000.

Simultaneously, BPI had identified several ideal pearl farm sites within the Hawaiian Islands, and had adapted the grow-out technology from South Pacific lagoons to suit the more exposed bays and reef areas in Hawaii. The last significant obstacle to pearl farming in Hawaii was the lack of secure tenure for a farm, with neither precedent nor clear legal pathway for commercial ocean leasing. In June, 1999, however, a significant breakthrough was achieved, with the passage into law of a major revision of an ocean leasing bill to permit commercial pearl farming in the state. BPI's final Environmental Assessment for our application for a pearl farm site within a few miles of Waikiki was approved, offering potential for setting up of the first Hawaiian pearl farm.

2. The role of the pearl seeding technician

To create a pearl, oysters are removed from the water, cleaned, pried open gently and then pegged with a small wooden peg. The seeding technician holds the pegged oyster in a stand, and makes a long, narrow incision through the gonad. A small (1 – 2 mm) piece of carefully selected mantle tissue (from a sacrificed donor oyster) is inserted, followed by a nucleus of the appropriate size, which is pressed up against the mantle donor piece. The nucleus is a perfectly spherical piece of fresh water mussel shell, ground and polished to a highly finished surface. Spherical nuclei are used as round pearls are more valuable than other shapes (they are preferred in necklaces). Freshwater mussels are used because the nacreous material of these bivalves is

considered best in terms of specific gravity, hardness and ability to be drilled without chipping or cracking.

Once the operation is complete, the oyster is placed inside a fine mesh pouch (“catch bag”), and returned to the water. The oysters are cultured on subsurface longlines, either in panels or on droplines (vertical lines hung from the horizontal longline, as in scallop culture). After 28 days, the oysters are brought to the surface again, and the catch bags removed. The bead is recovered from the catch bags in those oysters that have rejected the nucleus. These oysters are removed. Dead oysters are also removed from the line or panel. This post-operation “catch bag” data gives a good indication of the success of the seeding. There is negligible rejection or mortality after 28 days.

Almost all of the nuclei that are retained at catch bag will yield a pearl. However, a significant percentage of these are worthless, and are discarded, while others are malformed, or possess severe surface blemishes. Some proportion of the harvest will be round or semi-round, with fine to good luster, and nacre surface with few or no blemishes. These are designated round to semi-round “A” grade and “B” grade, and usually comprise between 2% and 10% of the crop. These pearls attain the highest valuations, and may represent between 30 - 50% of the total value of any one harvest. The great majority of the pearls harvested fall somewhere between these two extremes. These are of various shapes: either drops, circles (with dark latitudinal striations around the pearl), buttons (ovoid), or baroque (irregularly shaped). Drops and buttons can still be very valuable, but circles and baroques are worth significantly less, even if surface quality and color are comparable. Colors vary widely depending on the species, variety and the location. *P. margaritifera* colors range from steel silver to black, with some pearls showing green, gold or rose hues.

3. Pearl seeding and the politics of Pacific pearl farming

Although the basic techniques of pearl culture are now more widely known (Gervis and Sims, 1992), there is still a mystical aura surrounding the critical role of the pearl seeding technician (also known as the pearl “grafter”, or “operator”). The best technicians are very much in demand, and at times charge usurious rates (sometimes up to 50% of the harvest). In some instances, these excessive fees have contributed heavily to the failure of smaller, poorly-financed farms. Excessive seeding fees and the lack of technicians who are willing to travel to remote locations, or to seed small numbers of oysters also prevents new operations from even getting started. In the past, the high prices of these rare pearls could withstand these very high seeding prices. However, with the overall decline in pearl prices since the Asian economic crisis, and rampant uncontrolled production out of French Polynesia, the high seeding prices were becoming more and more untenable.

Only a very small cadre of seeding technicians outside of French Polynesia have any experience in seeding black-lip pearl oysters. This scarcity of technicians helps to support the seeding price structure. With the Tahitian black pearl industry expansion, it was becoming increasingly difficult to attract skilled seeding technicians to the smaller, more remote areas of the U.S. insular Pacific. The French Polynesian industry was also adopting an increasingly defensive

stance towards the growth of black pearl culture outside of their country, and was actively discouraging the training of other Pacific Islanders as seeding technicians in French Polynesia.

As of the start of this project, the development of the two pearl farms in the Marshall Islands and the one pearl farm in FSM, had relied almost exclusively on a single self-taught Cook Islands technician, Mr John Lyons. Mr. Lyons was then in increasing demand in the Cooks, as the industry expanded to a second atoll there. He had been compelled to curtail his seeding activities, limiting himself to BPOM's one operation in the Marshall Islands. BPOM's arrangement with Mr. Lyons would have supported our growth over the next few years. Nevertheless, our long term expansion plans – and the prospects for development of a broader industry in the outer atolls of the Marshall Islands – all hinged on having technicians available who were affordable, and willing to travel to new farming areas. Outside of Mr. Lyons, there were almost no other seeding technicians who were willing to travel to remote atoll farm sites, particularly where there were few oysters available for seeding on the start-up farms, and the farmers were still developing their skills and their infrastructure.

This shortage of technicians left the fledgling black pearl culture industries of Marshall Islands and FSM vulnerable, and threatened the potential developments in Hawaii, Palau, and other US insular areas.

4. The project goals: a cadre of seeding technicians from US insular areas

To address this potential bottleneck in the development of a viable black pearl culture industry, Black Pearls, Inc. and our Marshall Islands subsidiary, Black Pearls of Micronesia, Inc., sought to train a minimum of two seeding technicians from U.S. insular areas. We sought Federal assistance in these efforts because of the broader benefits that trained technicians could bestow on the U.S.-affiliated pearl culture industry, and because of the wider economic impacts that such an industry might foster.

This project directly addressed the S-K priority area of Fishing Community Transition. The pearl culture industry is probably the best example available of sustainable aquaculture in the Pacific context. The Pacific islands suffer from increasing rural-urban drift from the outer atolls to the crowded population centers, such as Majuro and Ebye, in the Marshall Islands. Much of the attraction is the lure of finding employment in these centers. The unemployment rates in these areas are usually very high, however, leaving many of the new residents with few alternative sources of food or income. These underutilized workers usually turn to the sea to meet these needs. In these more populated atolls, heavy artisanal and commercial fishing pressure is leading to a significant depletion of nearshore stocks, especially inside the lagoon. There is a dramatic difference in near-shore fish populations between the crowded urban centers and rural atolls. Catches decline, fishermen are forced to travel further afield, greater investments are required in boats and other capital, and returns continue to spiral downward.

In Hawaii, the near-shore fish populations have also suffered greatly from over-exploitation. No fishing license is required, and there are relatively few regulations. Large-scale gill-netting is still allowed, and enforcement of catch and size limits is essentially non-existent. Anecdotal and

scientific evidence confirms the drastic reductions of the fish and invertebrate populations over the past few decades. Hawaii also has a wide variety of highly sought-after aquarium species. At the time of submitting this proposal, this fishery was essentially unregulated and unmonitored, but thousands of reef fish were captured and exported every day. There was little industry coordination or management. (There has since been set up a West Hawaii Aquarium Project monitoring plan, and a Management Plan for the entire West Hawaii coastline, with closure of over 30% of the Kona coastline to aquarium-fish collecting. Kona is the prime aquarium-fish collecting area in Hawaii).

There is a sense of both pessimism and urgency among these aquarium-fish divers, as they scramble for ways out of the fishery and into other jobs. Some are turning to fishing edible species, using techniques such as night SCUBA spearfishing, and gill netting, which can be even more devastating to the inner reef areas.

Pearl culture can provide economic alternatives to these fisherfolk in both Hawaii and the U.S.-affiliated atolls. However, pearl culture expansion in these new areas is already being limited or slowed by the shortage of experienced seeding technicians. Through this project we intend to begin training local fisherfolk from Kona and Majuro in these seeding techniques, and to eventually set up a cadre of seeding technicians from these areas. While these technicians will be encouraged to seed overseas and gain broader experience, their allegiance and contractual responsibility will be, in the first instance, to their homeland areas, where they can support the local industry development, and train others to follow in their path.

In as much as pearl culture is feasible within Federal waters (such as some of the more remote Pacific Atolls, such as Midway, Wake, and Johnston), this project also was relevant to priority area D. Marine Aquaculture in the Offshore Environment.

B. Objectives of the project.

The immediate objective of the project was to train at least two seeding technicians to work under contract for BPI/BPOM for an agreed period of time, seeding on both the Majuro farm and the Hawaiian pearl farm (as it came on line). During this time the technicians were also to seed other oysters at start-up farms throughout Hawaii and the U.S.-affiliated Pacific Islands, at some discounted rate. During periods when they were not required to work in U.S. areas, the technicians were to work in other Pacific Islands, or Australia, to develop their expertise further.

By assisting the development of a broader-based pearl culture industry, this project sought to impact all of the atoll communities and other potential pearl farm sites within the US insular areas. These impacts were to be primarily over the long term, through the establishment of small privately owned, extended-family or community co-operative pearl farms. The remoteness and size of these farm operations would render them unattractive for established seeding technicians from Japan, French Polynesia, or Australia. Therefore, without the availability of local seeding technicians, these small outer atoll farms would probably fail, or not even begin operations.

To ensure that this project conferred a permanent solution to the problem faced by these remote island farms, the seeding technicians employed by BPOM were to be contractually bound to

further share their knowledge by taking on other apprentice seeding technicians. This was meant to guarantee that the impacts from this project would be broadly spread, and would continue to increase over time, as this industry grows.

V. APPROACH

A. Detailed description of the work that was performed

1. Delayed Start-up

Start-up of the project was initially deferred, as BPOM operations and corporate structure were undergoing reorganization during the latter half of 2000. It was considered imprudent to commit to a long-term seeding technician training program until the final framework for BPOM's reorganization was agreed upon, and the ability to meet the in-kind commitments by BPOM were assured. The reorganization was completed, in-kind commitment issues were resolved, and the project was ready to begin recruiting for the traineeships in early 2001.

2. Changes to original project work plan

Once recruitment of trainees began, it quickly became evident that we would need to revise some aspects of the project, to better match the situation at the pearl farm in Majuro and Hawaii, and to better accommodate the goals and aspirations of the seeding technician trainees.

The availability of these traineeships had been widely publicized, both in Hawaii and in Majuro. Advertisements were placed in the local Majuro paper, and notices were circulated throughout Hawaii marine science and training networks by email. We believe that this covered all of the potential pool of trainees in both places.

In Hawaii, we only had two applicants for the positions: each of these had serious concerns with the time commitment required to work on the farm in Majuro, as part of the proposed traineeship. Both applicants had family obligations that demanded that they not leave the U.S. for extended periods, and that they earn an income significantly greater than the \$6,000 p.a. stipend that was originally offered.

In the Marshall Islands, the greatest level of interest was shown by BPOM's own farm workers. There was virtually no response beyond this circle of existing employees. There were four applicants from among BPOM farm staff, and two other applicants who showed a significantly lesser degree of interest and commitment. This limited response may have been because these farm workers had seen first hand the potential increased earning power and the position of prestige attained from learning to seed the oysters, or it may have been because of some other cultural or social constraints that we could neither recognize, nor surmount.

BPI therefore proposed the following changes to the work plan for the project. Instead of demanding that Hawaiian trainees take full-time attachment training at BPOM's Majuro pearl farm, we proposed to allow them to remain in Hawaii for most of the trainee period. During this

time, the intention was for the trainees to work at BPI's various experimental and pilot-scale sites around Hawaii Island and Oahu. Additional training was to be offered through Maria Haws and the University of Hawaii at Hilo. The trainees were also to travel to Majuro for the seeding training sessions there, where they would participate in the hands-on training with the Master Seeding Technician.

The lease application process for the Hawaiian pearl farm, at that stage, appeared to be reaching a satisfactory conclusion, and we hoped to be able to offer the trainees full-time positions on our Hawaiian farm before the end of the training period. As it turned out, however, the lease application process became enmeshed in a logjam with a single State bureaucrat (where it still lies pending). The momentum for commercial development of the pearl farm in Hawaii was therefore lost, and the training opportunity and employment possibility for Hawaiian trainees also disappeared.

The lack of suitable trainee candidates in Hawaii was discussed with Federal Program Officer, Ray Clarke, on 5/10/01. Hawaiian candidates were unwilling to commit to the long training period on the relatively low stipend rate. The decision was therefore made to proceed with four full-time Marshallese trainees, with the possibility of Hawaiian candidates attending seeding training sessions in the Marshall Islands, on a short-term basis, or for short-term seeding instruction at the Hawaiian pearl farm pilot-scale operations.

3. Implementation of modified project plan

The project finally became active as of July 1, 2001, once the operational and management changes in BPOM were fully in effect. Four Marshallese workers at BPOM began work under the seeding technician trainee program – two at the Majuro farm site, and two at the Arno farm site. These trainees were :

Sha Longtak and Redley George from Bikirin, Majuro farm,
Amon Hiram and Brandon Jim from Arno farm.

The first seeding trial was scheduled for February, 2002, with master seeding technician Berni Aquilina committed to the work. Berni had an extensive track record of training in Manihiki lagoon, in the Cook Islands, and came very highly recommended for both her seeding skills, and her ability to communicate effectively across language and cultural barriers in the work and training environment.

4. First seeding training session in Majuro

The first formal seeding training session took place at the Bikirin farm site, in Majuro, from February 23 through March 15, 2002, under the tutelage of Berni Aquilina. Dr Dale Sarver (BPI President, BPOM Vice-President) was also in attendance, and participated in some of the training activities. The Master Seeding Technician, Berni Aquilina, was very pleased with the progress of the trainees, and the overall farm management, but had serious concerns about the health of the oysters themselves. Berni indicated that this was probably related to water quality in

the Majuro lagoon (see Appendix 1). A full description of this seeding training session is included in this appended report.

Catch bag data from the February-March seeding and trainee sessions is presented below in Table 1. The analysis of this data, and of the seeding session and husbandry practices at the BPOM farm site is presented in Appendix 1.

**Table 1: Catch-bag data summary –
Feb/March 2002 seeding**

Harvest/re-seed

	Berni	Sha	Redley	Amon	Brandon
Dead	420 18%	8 22%	8 16%	16 27%	9 37%
Vomit	639 27%	9 25%	15 30%	15 25%	6 25%
Good (retained)	1320 55%	19 53%	27 54%	29 48%	9 37%
Total	2379	36	50	60	24

1st op/reject op

	Berni	Sha	Redley	Amon
Dead	547 37%	64 45%	104 68%	97 66%
Vomit	543 36%	41 29%	33 22%	32 22%
Good (retained)	398 27%	34 24%	15 10%	17 12%
Total	1488	139	152	146

While these results were encouraging from the perspective of the trainees' progress (with retention rates approaching that of the master seeding technician), the condition of the shell was highly variable. Many of the shell were weakened and were not able to be seeded. Others that were seeded were evidently compromised. This resulted in the high rejection rates and excessive mortalities for the master seeding technician, as well as the trainees. The reseeded of the previously-operated shell was particularly disappointing. Pearl quality also appeared to be compromised.

Three of the four trainees that were originally selected (Sha Longtak, Redley George from the Bikirin farm, and Amon Hiram from Arno) continued working on the farms after the seeding sessions. Brandon Jim from Arno had difficulty adjusting to the pressure of the traineeship (as described in the attached report from the Master Seeding Technician), and left the traineeship after one week of seeding. Brandon continued to work on the farm.

Unfortunately, Sha Longtak, the most promising of the three remaining trainees, took an extended leave from the Majuro farm duties for personal reasons. It was understood that part of

the problem was the social relocation that was involved with increasing commitments to the new BPOM farm site on Arno. The two other candidates remained working at the Majuro farm site, with occasional visits across to the Arno farm site.

5. Second seeding training session

BPOM moved most of its operations from the Bikirin farm site in Majuro to the Arno farm site, because the growth and survival of the oysters in Arno was proving to be far superior to that recorded at Bikirin. The second seeding session was therefore held exclusively at the Arno farm site, in February, 2003.

Sha Longtak, BPOM assistant farm manager, remained on extended leave from farm duties, and did not participate in the 2003 seeding session. The two other candidates, Redley George and Amon Hiram had continued with the farm work, and participated in the second seeding session.

The report from the Master Seeding Technician (Ms Berni Aqulina) on the seeding session and husbandry practices at the Arno farm site is presented in Appendix 1. BPOM's capacities were seriously diminished shortly after this seeding period by the series of heart attacks suffered by the BPOM farm manager, Mr Virgil Alfred. This meant that catch bag data reporting was not properly accomplished. Later information indicated that Amon Hiram achieved a 75% success rate (20% vomit and 5% mortality over 300 shell seeded). This was an excellent result for a trainee.

While in transit to Majuro in 2003, the master seeding technician also spent two days in Hawaii, where she harvested and reseeded BPI's Hawaiian pearl oysters held on long-lines in Keehi lagoon and Kawaihae Harbor. This was also the first ever harvest of Hawaiian black pearls™ (Figure 1). During this seeding session, Berni reinforced her training of Dr Dale Sarver, and spent instructional time with a Hawaiian trainee (Mr Gary Aldrich, Figure 2) to provide a basic understanding of the processes of seeding. Although the intention had been for Berni to also instruct Gary in mabe seeding methods, there was insufficient time available to begin this work.

A further no-cost extension was requested on December 9th, 2002, to allow for a third seeding training session in Majuro to be conducted in January-February 2004. This follow-up would provide further reinforcement for the trainees, and result in more effective completion of the project goals. Approval for this extension was received by BPI in March, 2003.

6. Third Seeding Training Session

The third and final session of pearl technician training was conducted at the RRE's Arno Farm in the Marshall Islands between 23 and 26 February, 2004. Black Pearls of Micronesia (BPOM) had experienced some upheaval during the past year, particularly with the ailing health of the Farm Manager, Virgil Alfred. Virgil had been too ill to be able to visit the Malel farm at Arno for some considerable time. There had also been some attrition amongst the trainees: Sha

Longtak and Redley George had both left BPOM's employment. Only Amon Hiram remained from the original trainees.

Because of other commitments, neither BPOM President Bobby Muller, nor the other principals in BPOM were able to provide the logistical support needed for accommodating the final seeding training session. BPOM therefore requested the assistance of Dr Maria Haws, from UH Hilo, to facilitate a broadened seeding training session at Robert Reimers Enterprise (RRE) pearl farm at Medrik, Arno. Maria also included the College of the Marshall Islands (CMI) in the preparation and logistical planning. BPI and BPOM would like to gratefully acknowledge the much-needed logistical assistance that was provided by the other partners in this seeding training session. RRE provided the oysters, and their farm site, as well as food and accommodation, while CMI covered fuel and boat expenses for transporting the master seeding technician and the trainees from Majuro to Arno.

As well as completing the training for Amon Hiram, then, an additional goal of this seeding session was also to extend the training to other local pearl technician aspirants. Three other students were identified as trainees. Joban Reimers had been on two previous training sessions under Maria Haws trainer/pearl technician, Dai Kawachi, and had already shown promising aptitude for the job. The two other trainees had received no previous training, and were therefore included more for introductory familiarization. These two were Dial, a BPOM farm worker from Malel, and Tabwai, from the Aquaculture section of CMI.

A full report of the third seeding training session is appended. At the conclusion of this seeding session, Amon and Joban were to continue with the seeding program at Malel (the BPOM Arno site). As of the time of writing, this had not yet happened. Joban had obligations at the other RRE pearl farm site in Jaluit (120 miles from Majuro), and had not been able to spend any time at either Malel or Medrik. We understand that further seeding technician training opportunities are now being planned by Dr Haws, out of Hilo, with the assistance of CTSA. RRE also has plans for further seeding training of their staff, and have expressed interest in having Berni return to continue this work. This will hopefully provide the continuing training that may be necessary for the RMI trainees to achieve the confidence to continue seeding ... and for the RMI pearl farm operations to also be confident enough in the local technicians to allow them to seed their oysters.

Ultimately, this will be the real best measure of the success of this training program – if Marshallese farm workers can continue to seed their own pearl oysters – and those of other prospective pearl farmers in the Marshalls and elsewhere in Micronesia. This will then represent the overcoming of this significant impediment to industry development and greater profitability of small-scale pearl farms in the region.

In addition, the third seeding session in the Marshall Islands also provided a further opportunity for the master seeding technician to conduct two more days of seeding training/familiarization on the pilot-scale pearl farm site in Keehi lagoon, Oahu, while in transit, providing further instruction for Dr Sarver and Gary Aldrich in harvest and reseeded techniques.

B. Project management

The grant start-up was originally delayed, as noted above, because of uncertainties about the capacity for BPOM to support the project through to its completion, and to provide satisfactory in-kind commitments. These questions were eventually resolved, as BPOM came under a local Marshallese management team, and the project was eventually activated on July 1, 2001.

The originally-scheduled project completion date was Feb 1st, 2002, after which two training sessions should have been accomplished (Note: an error on the original grant award document: incorrectly showed the completion date as February 1st, 2001).

However, because of the delayed start to the project, and the difficulty in finding suitable trainees, an initial request for a no-cost extension was made and approved, to extend the project up to end of February, 2003 (allowing the two seeding training sessions in February 2002 and 2003). The February timing of seeding was preferred, as this was the season of low water temperatures in the Marshall Islands, which is usually the best time for harvest of pearls, and the best time for the seeding operation.

Prior to the second training session, discussions with the master seeding technician led to a reassessment of the project plan, to include a third training session in February, 2004, to provide additional follow-up for trainees. Thus, an additional no-cost extension was requested and approved, to extend the project up to the end of February, 2004.

BPI principals (Sarver and Sims) remained in charge of all project operations and budgeting (i.e. hiring of trainees, scheduling and logistics of training sessions) throughout the project, but worked in close consultation with the BPOM management. This co-ordination only broke down after the second seeding course, when no catch bag data was collected, and continuing into the last seeding training session, in 2004. This breakdown in communication was directly attributable to the continuation of the debilitating health problems by BPOM's Farm Manager, Virgil Alfred. Combined with this, the other commitments by the BPOM President, Bobby Muller, made it impossible for him to attend the seeding or co-ordinate the logistics for the seeding training session. This highlights the difficulties of implementing such training programs in remote regions, where operational logistics are often contingent on one or two key personnel.

VI. FINDINGS

A. Actual accomplishments and findings

This program has demonstrated that it is both practical and cost-effective to train local Micronesians in the sophisticated pearl seeding techniques, to overcome this major impediment to expansion of small-scale pearl farming in the Pacific Islands region. Admittedly, some of the practical challenges were very much in evidence in the latter two training sessions, with the problems brought on by the failing health of Virgil Alfred (see above).

The cost-effectiveness of this program should not be evaluated in the light of these few trainees, but rather in the contribution of having such locally-based skills available to the new fledgling industry. While ever pearl farm development in the Marshall Islands was limited to those islands and those farm sites where conditions and logistics were suitable for hosting foreign seeding technicians, then the industry would continue to be limited in its growth, and in the scale of individual farms. Only large, capital-intensive farms could have provided sufficient oysters and adequate facilities to attract the services of foreign seeding technicians. Smaller locally-owned farms would simply not have been feasible.

Programs such as this are crucial for the development of an in-country seeding capacity in new pearl farming areas. Once this seeding capacity is established, it will become more readily available by informal (or formal) sharing of skills and expertise by the local Marshallese seeding technicians.

B. Significant problems that resulted in less-than-satisfactory or negative results

There were several challenges with implementing this project. The main problem was the difficulty in attracting and retaining suitably-skilled and committed seeding technician trainees. Some of this may have been a function of the fledgling nature of the pearl culture industry in Hawaii and the Marshall Islands, such that pearl seeding technician is not a recognized career pathway (as opposed to islands such as Manihiki, in the Cook Islands, where the industry has been established since the late 1980's, and many of the local pearl farmers have been taught to seed their own oysters, and those of their neighbors).

Part of the difficulty in attracting suitably-qualified Hawaiian trainees was the low stipend (equivalent to \$6,000 p.a., plus room and board and all travel costs) that was offered. This arrangement was established on the basis of seeding technician training being a valuable skill that was highly desirable. This was perhaps a miscalculation on our part, given the nascent nature of the industry.

The difficulty in retaining the trainees in the Marshall Islands may also have been related to questions of pay-scale, but more likely is a function of personalities, and cultural and social issues. The pay-scale for the trainees was the same as that which they had received as farm workers, again, on the presumption that the skill they were being trained in was a valuable asset that would increase their earning power at some later stage. While ever they were trainees, their training represented a major cost to the company in terms of opportunity-cost (the value of the pearls that might have otherwise been produced if the oysters had all been seeded by an expert seeding technician, versus the value of the pearls that were produced by the trainees' operations).

Other problems that had some impact on the project included the compromised condition of the oysters at Bikirin and Kawaihae, and the initial reorganization and later lack of support from BPOM for completing the seeding training. As discussed above, the logistical problems faced in gathering catch bag data from the second seeding, and implementing the third seeding program were related to the health of the BPOM farm manager, and are representative of the larger development issues faced in locations such as Majuro, where projects are often heavily reliant on a single key man.

The oysters at the Bikirin site in Majuro and at the Kawaihae site in Hawaii's Big Island were considered by Berni to be unsuitable for seeding. This is reflected in the very low retention rates and high post-seeding mortalities recorded at both sites (in 2002 and 2003, respectively). The Kawaihae site was apparently unsuitable because of the heavy silt loading, which appeared to clog the gills of the oysters. It was not so simple to identify a single water quality parameter at the Bikirin site – the strong currents may have been a factor, but other unidentified factors may also have compromised the water quality in the lagoon at Majuro. Even though the initial seeding work at these sites was therefore less successful than it might otherwise have been, and resulted in significant impacts to farm profitability in the Marshall Islands, this actually had no major effect on the success or otherwise of the pearl seeding training program itself. The close similarity of results between the master seeding technician and the trainees at the Bikirin site was a good indication of the inherent skills of the trainees – and the trainer.

The only significant effect of the reorganization of BPOM at the start of the program was in the delays that ensued prior to program initiation. This had no major impact on the program's overall effectiveness.

Similarly, the problem of BPOM being unable to provide logistical and other support for completion of the seeding training session in 2004 did not, in and of itself, diminish the program's effectiveness. To the contrary, the fact that the BPOM Arno farm operation was not available for the seeding training compelled BPOM, RRE and CMI to all co-operate more closely than they had previously. This also led to diversification of the training effort (one of the original objectives of the project), with seeding of oysters on the other commercial farm site in the Marshall Islands, training of one of the RRE staff (to the point where Berni believed Joban could confidently seed the pearl oysters on the RRE and BPOM farms), and initiation of one of the CMI staff into basic seeding practices.

C. Description of need for additional work.

There is probably a need for continuing support and guidance from Berni or other Master seeding technicians for a longer period than this project originally envisaged. To this end, the continuation of these efforts by Dr Maria Haws, with CTSA support, is encouraging. The wider recognition of the need for, and the potential benefits from such training programs may be a further ancillary benefit from this project.

VII. EVALUATION

A. Describe the extent to which the project goals and objectives were attained

1. Were the goals and objectives attained? How? If not, why?

The original project proposal laid out the following criteria (underlined) for evaluating the project, at its conclusion. Short assessments are provided for each criterion :

1. “Of the several candidates considered who completed the training course, did at least two possess suitable skills and aptitude to become proficient seeding technicians within the training period?”

At least four of the five formal candidates possessed “suitable skills and aptitude to become proficient seeding technicians”, but unfortunately only one of these was able to complete the full training course. Berni considered both Amon and Joban to be fully competent and ready for pursuing ongoing seeding work at their own pace, separate from her tutelage, so in this respect, the project may be considered a success. Synoptic assessment of each of the formal trainees is :

Sha Longtak: Very skilled, and highly suited to the task. Berni was very impressed by Sha’s aptitude. The loss of Sha from the program when the BPOM farm operation moved to Arno was very disappointing.

Redley George: Competent, and a reasonable candidate for seeding. Redley could have been a very good addition to the seeding team, but again was not willing to relocate or continue with BPOM in Arno.

Amon Hiram: Competent, and committed. Completed the training program, and now ready for ongoing seeding work. As Amon was originally from Arno, this made the social adjustments easier. The degree of social dislocation appears to be a very important component in RMI, and should be factored in to future training programs. Poor retention results in third session (15%) may be anomalous, as Amon got very good results in the first session, with compromised oysters.

Joban Reimers: Came to the program with the previous seeding training experience, but adapted to Berni’s training style very well. Poor retention results in third session (32%) may be anomalous (see above, for Amon).

Brandon Jim: Brandon was unable to adjust to the pressures of seeding, and resigned from the program after the first week.

2. “Were the oyster survival rates and nucleus retention rates (at catch bags) from these technicians comparable with other seeding technicians employed elsewhere in the industry? Were shape and color of the pearls sampled considered satisfactory?”

Catch bag results were only collected from seeding sessions one and three. Because of the anomalous results during the first seeding session at Bikirin, the best measure of success is in comparing the trainee's results with those of the Master seeding technician. By this measure, Sha Longtak performed very well, as did both Redley and Amon. There was no means to adequately assess shape and color of pearls, as none of the trainee-seeded oysters were harvested during the project duration.

3. “Are these technicians now able to continue working on farms in the Marshall Islands, and other U.S insular areas? Can they also maintain their skills and extend their expertise by continuing work in the Cook Islands and French Polynesia, when not needed elsewhere in the U.S.-affiliated Pacific Islands?”

In Berni's assessment, both Amon and Joban are now capable of continuing on with seeding on their respective farms, and other farms that may be under development. It still remains to be seen whether they themselves have the confidence to pursue this path, and whether the farm management will be willing to allow them to continue. There may be some danger that if they both do not continue seeding, their skills will decline and they will be less confident. The continuing training is therefore to be welcomed.

“If successful, this project's impacts should be felt far beyond the proposed 18-month period. At some future date, between three and seven years hence, a more significant evaluation of the long-term impacts of this project will be possible. This evaluation would address the following questions :

4. “Did the availability of competent seeding technicians with an affinity for local cultures and a willingness to spend long periods of time on remote outer atolls, result in expanded development of the fledgling pearl culture industry in the U.S.-affiliated Pacific Islands?”
5. “Did these technicians transfer their skills to other seeding technician trainees, and has this led to a continuing growth in the availability of seeding technicians in the U.S. insular areas?”

It would be very instructive to follow up on these trainees in several years' time, and to obtain answers to these two critical questions.

2. Were modifications made to the goals and objectives? If so, explain.

Start-up of the project was initially deferred, till BPOM's operations and corporate structure were reorganized. In-kind commitment issues were resolved, and the project was ready to begin recruiting for the traineeships in early 2001.

The process of recruitment of trainees was also more difficult than anticipated. In Hawaii, the only two applicants had family obligations that conflicted with the plan, and neither were willing to accept the \$6,000 p.a. stipend. In the Marshall Islands, BPOM's own farm workers showed the most interest and commitment. The lack of suitable trainee candidates in Hawaii was discussed with Federal Program Officer, Ray Clarke, on 5/10/01, and the decision was made to proceed with four full-time Marshallese trainees, with the possibility of Hawaiian candidates attending seeding training sessions in the Marshall Islands, on a short-term basis, or for short-term seeding instruction at the Hawaiian pearl farm pilot-scale operations.

Two no-cost extensions were also obtained, to allow the second and third training sessions to be undertaken in 2003 and 2004.

B. Dissemination of Project Results

Hard copies of this report have been lodged at the following repositories.

NOAA Honolulu Fisheries Office

Hamilton Library, University of Hawaii,

University of Hilo Library

College of the Marshall Islands Library

Copies of this report in pdf format have been sent to the following persons, with notes that hard copies are available on request:

Dr Maria Haws, University of Hilo

Cheng-Sheng Lee, CTSA

Danny Wase, Director, MIMRA

Berni Aquilina, Master Seeding Technician

Bobby Muller, President, BPOM

Simon Ellis, PATS Pearl Project

Singeru Singeru, Land Grant Program, FSM College

Jessica Reimers, RRE, Majuro

A note will also be inserted in the upcoming issue of the Pearl Oyster Information Bulletin indicating that pdf copies are available upon request.

SUPPORTING DOCUMENTATION

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APPENDIX 1

Comments by Master Seeding Technician Berni Aquilina on Catch Bag Data from Majuro seeding

(provided in email correspondence, 9/12/02)

First my work:

Harvest re-seeds -

Average retention 55% (range 71% to 28%), dead 18%, vomit 27%. We got 71% retention on the first day when the shell had been cleaned a week beforehand and I had commented shell condition was "good". After that all shell were cleaned on the day we harvested which would possibly have caused extra stress, although the dead count didn't vary much. Spawn wasn't a big issue with the harvest shell. Most important, I think, was the shell condition and especially quality/strength of skin around the gonad. On the days we got about 60% success, I was always commenting that the shell condition was "mixed". On the last days shell condition worsened - third-last day retention 47%, condition "fair to poor"; second-last day retention 37%, condition "many poor"; last day of harvest retention only 28% and shell condition reported as "all poor". I don't have a clear idea about why the shell condition was so variable but it is likely to be linked with where the shell were being held on the farm. Virgil may be able to interpret this.

With blacklip oysters, re-seed retention seems to be mostly around 65%, from my discussions with farmers and other technicians (unlike for *P.maxima* where we expect over 90% success, because the pearl is growing more deeply in the oyster's body and so the re-seed nucleus is held in better). So I think we're on track, just need to improve shell condition.

1st ops/reject ops –

Very poor results. Average success 27%, dead 37% and vomit 36%. Dead - One day dead was up to 49% although I had noted shell condition to be "mostly good". Again, shell were being cleaned on the day we seeded. Because I was focused on the training and the seeding house, I never went to the end of the jetty to see how the shell were being handled out there, or how long shell were being kept out of the water, etc. However, all I did see of shell handling around the seeding house indicated that good care was being taken of the shell, and I wouldn't have expected the handling to produce elevated mortalities. Throughout the seeding I was observing mixed shell condition in a patchy way. By the end of the seeding we had established that this was due to panels being double hung from the lines, and shell in the lower panels were consistently in worse condition. This is likely to have had a negative impact on results. I think by now Virgil will have all the panels hung singly, so that should no longer be a problem. I am astonished that the dead count is twice that of the harvest re-seeds and I am led to wonder whether there is a problem with the catch-bags clogging up and suffocating the oysters. Catch

bags are on for 6 weeks instead of only 4 for the harvest re-seeds. There is a double layer because the catch-bags are hung inside the net panel so it could easily become heavily fouled. Maybe Virgil will have some observations about this, and whether the seeded oysters were dying soon after the operation, or after several weeks? (I notice that when he swam and checked our seeded shell while I was there, my dead count was only 4% after 10 days.) Vomits - There was some spawn, which makes seeding difficult - hard to see graft mantle piece and everything becomes very slippery, so vomits tend to be higher. I have already talked with Virgil about cleaning the shell about 5 weeks before seeding to break the spawning cycle (and reduce stress on day of seeding) so I hope there will be less spawn for future seedings. Apart from the spawn, vomits are also likely to arise from the often-poor condition of the oysters, which hopefully we will fix by hanging the panels singly and re-arranging the farm layout to take best advantage of water currents (which I have already talked about with Virgil). We need to remember that these shell were mostly quite old and previously seeded. Some were the Cook Island-X shell that seemed very poorly adapted and were extremely difficult to seed. The young virgin shell you still have should produce much better results.

Trainees -

For the harvest work the trainees all had similar results to mine (retention Sha 53%, Redley 54% and Amon 48%). There was more variation with the 1st ops/reject ops (retention Sha 24%, Redley 10% and Amon 12%). They all had lower percentage vomit than me but more dead. Sha had significantly less post-op dead than Redley and Amon. I think they had difficult shell to start on and, in my experience, results are likely to improve considerably next attempt.

Regards

Berni

APPENDIX 2

Pearl Technician Training for Black Pearls of Micronesia Inc.- Second Report

Berni Aquilina <berni@xtra.co.nz> 23 March 2003

Following on from my first training visit during Feb/March 2002 (reported 22 March 2002), I visited the Marshall Islands again in February 2003 to conduct further pearl technician training for Black pearls of Micronesia Inc (BPM). My first visit had been to Bikirin farm in Majuro lagoon where three trainees (initially four) had worked with me for three weeks. During the intervening year another trainee has resigned from employment plus a management decision has been made to close down the Bikirin farm.

1. Farm site

The farm at Bikirin has experienced regular high mortalities that are likely to be due to poor water quality in Majuro lagoon. Majuro is home to more than 30,000 people plus a major port so a lot of household and industrial waste enters the lagoon. To the best of my knowledge, whilst it is generally accepted that the lagoon suffers badly from pollution, specific water quality studies have not been conducted.

An alternative farm site at adjacent Arno atoll has been trialled in recent years, with excellent results. Speaking from memory Virgil Alfred, the farm manager, advised me that the lowest dead recorded for a monthly clean during 2002 at the Bikirin farm was 193 and the highest (probably in September 2002) was over 700. At Arno, for the same month and with about the same number of oysters, there were only 17 dead.

These relative performances have led to a decision to close down Bikirin farm. Consequently our training this time took place at the new Arno farm, a few hours boat ride from Majuro. The Arno farm site is in a protected part of the lagoon yet receives plenty of new ocean-water through reef channels to the east of the site. The human population density at Arno is low and there is no industrial activity to cause pollution. The only potential disadvantage of the site is a sandbar to the east which could be a cause of turbidity in rough weather. However the farm site is large and it is easy to situate the oysters well away from the sandbar.

2. Trainees

Sha Longtok has now left the employment of BPM so this visit I worked with the two remaining trainees, Redley George and Amon Hiram. They both showed diligence and enthusiasm for the seeding work and, by the end of the training period, it looked as though they could both sit and seed all day with no problem or loss of concentration. Redley came and watched me frequently to check on specific aspects of the operation and at this stage is probably having a little more difficulty with the operation technique than Amon. Amon expressed a strong desire to outperform me revealing, beneath his placid exterior, the competitive nature that marks a good

technician. He also showed his retention of last years instruction by asking a question about the byssus, using its English name easily and probably without having heard it in the past year.

3. Current training

At the time of my visit the Marshall Islands was without a working pearl oyster hatchery or source of spat. This means there is a limited number of seedable shell and uncertainty regarding future supplies. In these circumstances the farm is unable to supply large numbers of oysters for trainees to seed.

Consequently the style of training this time was for me to do most of the seeding while the trainees assisted in the seeding house and watched me work. We had two operation tables set up and from Day 2 the trainees prepared my graft mantle pieces and sharpened my operation knives. From Day 3 they began taking turns at seeding, beginning with one panel of 12 shell each and gradually increasing their seeding time and numbers in subsequent days. As we planned last year, we did not have any formal classroom sessions this time but used the training time for the students to experience a normal seeding program and develop their discipline for the work routine. I gave instruction informally as the need arose and opportunities presented themselves.

Upon completion of the seeding at Arno we spent a day at Bikirin farm where we had approximately 100 shell left over from last year's harvest. We used this shell as a review of harvest technique with Redley and Amon doing all the harvest work, under my supervision. This also gave us the opportunity to compare shell condition at the two farms and reinforce those aspects of the training.

4. Numbers seeded and pearl oyster condition

During the eight days of training plus two days employed directly by BPOM (i.e. in production, not training, and paid for separately by BPOM - NAS) we seeded a total of 4,028 virgin pearl oysters (Berni 3,644, Amon 303, Redley 78 and Virgil 3). There were only seven dead shell amongst those brought in for seeding and no sick oysters at all. All the shell presented were in very good condition and were growing actively. Some oysters were still too small for seeding and we returned 1417 of these to grow on. The minimum size for shell to be presented for seeding needs to be 90 mm dorso-ventral length, with 100 mm minimum preferred.

All the shell for seeding had been cleaned during a period of one week starting 13 January 2003 then seeding was conducted between 15 and 25 February 2003. This was approximately five weeks after cleaning had taken place, as I had recommended last year. The timing of cleaning and seeding worked very well with the oysters having strong skins from glycogen storage and little spawn to interfere with the operations.

Unfortunately it was still difficult to find excellent color for donor mantle shell, however the potential of the site was indicated by two sacrificed shell having brilliantly intense colour. As I recommended last year, shell color might be improved by holding the oysters closer to the surface, say at a depth of 8 to 10 feet, but the practicalities of doing so must be considered in the light of passing boat traffic, security and rougher conditions near the surface.

5. Nuclei

We had very little biocoated nuclei left and it looked to be in poor condition so we chose to use the newest regular third grade nuclei (supplied by Imai Seikaku) for this seeding. We used a size range of 2.2 to 2.7 bu with a mode of 2.2 to 2.5 bu, fairly evenly spread. As we lacked a balance to weigh the nuclei at the end of seeding I estimated their weight then calculated approximate numbers. I requested remaining old biocoated nuclei be thoroughly washed and used as regular nuclei in future. Thus (very approximate) numbers of nuclei remaining on hand with BPM are:

2.0 bu	5667 pcs	2.9 bu	360 pcs	3.8 bu	385 pcs	4.7 bu	15 pcs
2.1 bu	6849 pcs	3.0 bu	0 pcs	3.9 bu	200 pcs	4.8 bu	15 pcs
2.2 bu	2818 pcs	3.1 bu	148 pcs	4.0 bu	333 pcs	4.9 bu	15 pcs
2.3 bu	5230 pcs	3.2 bu	0 pcs	4.1 bu	126 pcs	5.0 bu	15 pcs
2.4 bu	1803 pcs	3.3 bu	248 pcs	4.2 bu	129 pcs	5.1 bu	5 pcs
2.5 bu	2145 pcs	3.4 bu	229 pcs	4.3 bu	122 pcs	5.2 bu	5 pcs
2.6 bu	2059 pcs	3.5 bu	280 pcs	4.4 bu	125 pcs	5.3 bu	5 pcs
2.7 bu	565 pc	3.6 bu	318 pcs	4.5 bu	122 pcs	5.4 bu	5 pcs
2.8 bu	398 pcs	3.7 bu	240 pcs	4.6 bu	15 pcs	5.5 bu	3 pcs
						5.6 bu	5 pcs

This gives a total of around 27,500 nuclei suitable for first operations and 31,000 for harvest re-seeding, all of it third-grade regular.

First operation results will be enhanced by using biocoated nuclei and I recommend BPOM purchase new biocoated nuclei for the next round of 1st op. seeding. The regular nuclei on hand can be used for back-up and will store indefinitely.

6. Equipment

All the seeding equipment supplied last time was intact and in good condition. I made some small changes to improve the kits:

- I had previously left two different kinds of scissors for cutting the byssus, one with a straight blade and one with a curved blade. As both the trainees preferred the straight blades I substituted my own to leave them with two sets of straight-bladed scissors.
- I had previously left two 2.4 bu nucleus inserters but substituted a 2.3 bu one of my own giving greater flexibility for the trainees to choose the appropriate size, depending on the shell they have to work with.
- The shell presented was mostly very small, and future hatchery grown spat is also likely to be seeded at the minimum size. I lent the trainees a set of smaller 'Akoya' shell-openers that are more suitable for these oysters and will either retrieve or be reimbursed for them on my next visit. (They also have two sets of 200 mm shell openers.)
- Due to the high humidity levels that can cause rust and mold, Virgil and I agreed that it would be better to store all the seeding equipment and nuclei in the airconditioned office at Majuro instead of on the farm.

Additional tools that are required are two spare side knives (first-operation scalpels) plus spare scissors for mantle and byssus. All these tools wear out and require replacement from time to

time. Also, for pearl harvesting, the Okada pearl tweezers are far superior to the cheap medical ones I supplied last year and I strongly recommend the purchase of two pairs even though they are expensive. Two sets of 'Akoya' shell-openers would complement the set of equipment and are available at a reasonable price from George Ventouras at Australian Netmakers.

If training funds allow for it I recommend purchase of the above items before the next round of seeding or harvesting. Approximate cost would be US\$700 (2 x side-knives \$100, 2 x mantle scissors \$100, 2 x byssus scissors \$90, 2 x pearl tweezers \$250, 2 x 'Akoya' shell-openers \$140, freight \$20). If BPM would like, I can purchase the goods on their behalf, bring them on my next visit and be reimbursed for the expense. (NAS Aside: *This has been confirmed with Berni*)

7. Further training

The trainees are making steady progress but I would still be hesitant about them running seeding operations on their own, due to their lack of experience. If it is possible I would like to make one further training visit at which time the trainees would basically conduct the first-seeding operations themselves, but with my guidance. They are unlikely to seed more than 150 shell a day, more likely 100, so we could run this session over 10 days using the oysters that have been put back to grow on. Perhaps some wild shell could also be collected and put on the farm to acclimatise for several months before the operations to add to variety and experience for the students. There will also be a few shell growing pearls from last years seeding at Bikirin farm that the trainees could harvest and grade.

I have been told that BPM would like to re-employ Sha. He had shown excellent potential as a pearl technician and, in the event of his re-employment, I would welcome him back onto the training program.

Dial, a young diver from the Arno farm, has made a request to be trained as a technician. He has already shown initiative by making the effort to join evening high school classes at Arno and he intends getting his High School Certificate. He watched our seeding and mantle preparation with an eagle eye. If BPM wanted, he could begin technician training on my next visit. Either I could teach him while the Redley and Amon seed or, perhaps better, Redley and Amon could take turns seeding and teaching him, under my supervision.

8. Virgil

The pearl technician training that has taken place at BPM's Bikirin and Arno farms would not have succeeded without the input of local owner and manager Virgil Alfred. Besides being a competent and completely reliable farm manager, Virgil has also done all the language translation throughout the training sessions. Not only that, he has cared for this visiting teacher-technician beyond necessity -- interpreting matters of culture, providing constant supplies of fresh fruit and vegetables, ensuring I have a dry mattress to sleep on.... So it is with extreme sadness that I hear of his unlucky heart attack just a week after our training session finished. I hope he will be okay and that, with time, he will achieve a full recovery.

APPENDIX 3

Pearl Technician Training for Black Pearls of Micronesia Inc.- Third Report

Berni Aquilina <berni@xtra.co.nz> 23 March 2004

Changes

The third and final session of pearl technician training under the current funding was conducted in the Marshall Islands between 23 and 26 February, 2004. Black Pearls of Micronesia (BPOM) have experienced some upheaval during the past year, particularly as Virgil has been ill and unable to visit the Malel farm at Arno. Trainee Redley George has left BPOM's employment, leaving only Amon Hiram from my original four students.

In the days before my arrival a decision was made that BPOM would be unable to host my visit. Rather than cancelling the trip altogether, other parties with an interest in pearl technician training were approached to take part, and a collaborative approach was taken.

New stakeholders

Maria Haws, from UH Hilo, has been developing a pearl technician training program in the Marshall Islands, in conjunction with the commercial Robert Reimers Enterprise (RRE) pearl farm at Medrik, Arno. The College of the Marshall Islands (CMI) is also involved in this program. They were pleased to have me work with them for this training visit.

Meeting

A meeting of stakeholders was held in Majuro after my arrival. People attending were:

Jessica Reimers	RRE	
Ramsey Reimers	RRE	
Norbert Reimers	RRE	
Virgil Alfred	BPOM	
Don Hess	CMI	
Rand Dybdahl		CMI
Manoj Nair	CMI	
Berni Aquilina	Trainer	

I gave a brief history of this training program and stated that my priorities were:

1. To complete the training with Amon Hiram,
2. To extend the training of other local pearl technicians.

After much discussion about logistics we agreed to conduct all four days of this training visit at RRE's Medrik farm. Agreement was made that RRE would provide the venue, food and

accommodation, BPOM would supply nuclei, and CMI would cover fuel and boat expenses. BPOM and CMI each loaned a set of seeding tools for the week.

Trainees

As well as completing the training with Amon, it was agreed that I would work with three other students. Joban Reimers had been on two previous training sessions under Maria Haws trainer/pearl technician, Dai Kawachi, and would now join me for this session. Emphasis would be on Amon and Joban as senior trainees focussed on practical seeding to the point where they could run their own seeding operations. Two other people would also begin training - Dial, BPOM's young farm worker from Malel who had asked to learn how to seed pearls last year, and Tabwai, who works in the Aquaculture section of CMI.

Apparently Tabwai was sick when we left for Arno the following day so he missed the boat and did not attend the training. There was also a miscommunication that left Amon and Dial stranded at Malel during the first of our four training days. Fortunately Frankie Pedro, the farm manager at Medrik, helped arrange hire of a Council boat to bring them down and they were able to attend for the remaining three days.

Practical training

The emphasis for all of the four days was on practical seeding. Details of the shell used are given in the table below:

Table 1: Numbers of shell used for training -

Day	Joban	Amon	Dial	Berni	Total seed- ed	Mant- le	Go- back	Kill	Total shell used
Monday 23 Feb 04	35	0	0	32	67	4	9	0	80
Tuesday 24 Feb 04	72	60	0	0	132	5	4	10	151
Wednesday 25 Feb 04	52	60	8	0	120	4	11	1	136
Thursday 26 Feb 04	52	52	16	32	152	6	24	2	184
Totals	211	172	24	64	471	19	48	13	551
%					85%	3%	9%	2%	

As there was only one table we took turns to seed. For the first day I worked alone with Joban and, because he has been working with another teacher, began by having him seed with the CMI tools he had been taught with, and as he remembered. He had difficulty manipulating those tools and soon switched to the BPOM tools which are bent differently, and which he preferred. I demonstrated my own operating technique by seeding 32 shell while Joban watched. Joban's

control of the tools and the actual seeding operation were quite good although I was surprised to discover that he hadn't learnt to prepare mantle tissue for grafting and had little concept of operations hygiene. We worked on all these aspects during the four days of training.

Amon easily slipped back into seeding and continued to show strong motivation for the work. He looked comfortable at the table and as though he could easily seed for long periods at a time. The shell was larger than he seeded last time, so he learned to adjust his cut to suit. Amon gave me his catch-bag numbers for last year's seeding which calculated as 75% success (20% vomit and 5% mortality over 300 shell) – an excellent result!

Dial helped with opening and catch-bags and watched Joban and Amon seed. Later he began cutting mantle, a task he picked up with ease. At the end of his first day (training day 2) Dial seeded, and then killed, six shell previously rejected by the others. This gave him practise holding the tools, then he seeded a few shell on each of the following days that were put in catch bags.

At the end of the last day I seeded a further 32 shell as a demonstration of routine seeding, to provide a comparison for student results, and to give the farm a little more seeded shell.

Theory

Only a little theory was taught this time, and most of that individually and informally. Amon and Dial know little English (and me less Marshallese!) so, without an interpreter, I was restricted in my ability to communicate. I would have liked to cover all the theory taught on my first visit over again, to Amon for revision and to ensure Joban and Dial had a good grounding. As it was, I discussed the plan for forthcoming seeding operations at Malel farm with Amon. We planned the nuclei requirements in relation to shell size and condition, discussed the need to wash the (regular) nuclei before use, and the importance of controlling all the small shell handling details around the seeding house that contribute to the success of operations.

Joban has excellent English so I was able to cover a reasonable amount of theory in conversation and discussion with him. It appeared that he had been taught little in the way of theory up to now. Whilst our discussion was patchy, topics we covered included nuclei and biocoatings, anatomy and life cycle, spawning cycle and preparation for operations, wound healing, pearl characteristics, plus farming and environment. Joban helped me prepare a diagram of pearl oyster anatomy by providing Marshallese names for parts of the shell, which I was then able to use with Dial.

On the third day I showed a presentation of 'How Pearls Grow', with microscope views of pearl sac formation, using my laptop computer. Frankie was present and translated parts of my commentary to Amon and Dial.

Pearl oysters and farm setup

The shells were large (range 140 – 160mm dorso-ventral length on the first day, decreasing to about 135mm by the end of training). They were healthy but, as there had been no advance

notice of this training session to RRE, the shell had not been cleaned in preparation for seeding and consequently had a lot of spawn. Cleaning took place immediately prior to seeding, using a water-blaster. Although the oysters didn't seem unduly affected by this practise I think it probably caused the gonad/bag to shrink, affecting the size of nuclei that could be implanted.

The Medrik farm has no walkway or platform over the water so seeded shell were placed in chest-deep water in the lagoon until transfer to a long-line later in the day. The water at the lagoon edge was sandy and became hot during the afternoons, so care was taken to avoid holding shell or taking water from there, in case it was detrimental to results.

Seeded shells were placed in mesh catch-bags, then into lantern nets with cut side up. Four shell were held in each net, positioned so the hinge was towards the centre and lips outward for better feeding. Identification of technician was done by tying knots in the rope at the bottom of the lantern net: Berni 1 knot, Joban 2, Amon 3 and Dial 4.

Catch-bags are to be removed 30 days from the end of the training, i.e. 27 March 2004, and then shell will be held in normal panels, heel down.

Possible risks that could reduce the success of the operations, besides the inexperience of the trainees, include:

1. Using old shell
2. High spawn content
3. Low grade of nuclei and removal of biocoating
4. Catch-bag system using lantern nets where shell are held horizontally, rather than vertically with heel up
5. Water blasting immediately prior to operation
6. Holding shell in shallow, warm water.

Nuclei

The nuclei we used were third grade, size range 2.3 – 2.5 bu inclusive. Some of it was old biocoated nuclei that we washed clean to use as regular nuclei.

An error was made on the first day when we inadvertently used some 2.6 bu plastic nuclei (I think intended to form pearl sacs and then be removed). Perhaps 10 of these may have been implanted, which means that a few of the pearls may end up with a plastic nucleus, which is not good from a marketing point of view. I apologise for that.

Altogether we used approximately 500 nuclei – 109 of 2.3 bu, 199 of 2.4 bu, 112 of 2.5 bu, plus about 80 of mixed sizes on the first day.

Seeding equipment

I had a spare new side-knife which I bent as a demonstration for Joban and which RRE later purchased from me at cost for Joban, as my tools are bent quite differently from Dai's.

Unfortunately one set of BPOM's seeding tools was stolen during the time that Virgil was incapacitated, so they only have one set now which is held by Virgil for safekeeping in Majuro, and which we used for this course. Because there are plans for immediate seeding operations at Malel, I made sure the set of seeding equipment is complete by donating a set of mantle scissors, byssus scissors, better pearl forceps, scalpel blades, sharpening paper and filter cloth for mantle preparation.

Recommendations and future plans

Amon is to conduct his own seeding program at Malel in the next few weeks, hopefully with Joban seeding as well, and Dial assisting. It also seems likely that I may be able to return again before the end of this year to seed and harvest at both the farms, alongside the new technicians. Whilst I am confident for their ability to successfully seed a pearl oyster, they still lack experience to interpret shell condition or understand all the peripheral things that affect seeding outcomes, so they will benefit by working under the guidance of experienced technicians.

A limiting factor continues to be a lack of shell. Until successful hatchery spawnings and farm grow-out occur, there is no chance for the Marshall Islands pearling industry to develop. Hopefully this problem will be rectified soon.

If capital improvements are to be made at RRE's Medrik farm I would strongly recommend construction of a walkway and platform or, alternatively, a floating raft for temporary holding of shell during seeding operations. Likewise, a cleaning machine would be more gentle and efficient than the water-blaster, and may be available second-hand from Japan. Perhaps RRE and BPOM could consider sharing a cleaning machine, month-about, while stocking numbers are low?

Collaboration

Whilst I was taken by surprise at the late change of plans for this round of training, I have been pleased by the outcome of collaboration by all pearling stakeholders of the Marshall Islands. With such a small industry it's essential that people work together to achieve common goals, such as this industry training. I hope the trend continues.

RESULTS FROM THIRD SEEDING SESSION, ARNO,

February, 2004

Table 1: Numbers of shell used for training

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Totals	211	172	24	64	471	19	48	13	551
%					85%	3%	9%	2%	

Table 2: Catch-bag results for three trainees and Berni Aquilina

Results per Frankie Pedro March 26, 2004

	<u>Joben</u> 200 seeded	<u>Amon</u> 173 seeded	<u>Dial</u> 24 seeded	<u>Bernie</u> 63 seeded
Survive	65	27	7	39
Vomit	79	50	7	16
Dead	56	96	10	8
%	32.5%	15.6%	29%	61.9%

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