

SPAT COLLECTION AND NURSERY METHODS FOR SHELLFISH CULTURE BY WOMEN

Quality Seedstock Development/Experiment/13QSD01PU

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ABSTRACT

Marine pearl culture in Zanzibar started in 2006. Currently, there is a growing interest in pearl culture among Tanzanian coastal communities as an alternative source of income. In order to make the activity sustainable, there was a need to find out where and when spat can be obtained instead of relying on adults. Thus, the objective of the current project was to develop best spat collection techniques and to determine the seasonality where spat can be obtained. The spat collection experiment produced a total of 3,354 *Pinctada margaritifera* spat and 3,861 *Pteria* spat at Bweleo and Nyamanzi respectively. The highest number of spat were observed from August to October 2016 and March to April 2017 for both sites. Three different types of spat collectors made of coconut shells, rubber tires, and black mesh were used during the study. There was significant variation on the number of spat produced from the three different spat collection materials ($P < 0.01$). Spat were most abundant on the new black mesh spat collectors than on coconut shells and rubber tires. Some of the spat captured from spat collectors were used for training purposes, specifically on how to culture and sustain such spat stocks. Based on the results of this study, it is possible to obtain pearl oyster spat and grow them in Zanzibar. The establishment of such an industry in Zanzibar would provide a much needed alternative livelihood among Tanzanian coastal communities, while utilizing coastal resources in sustainable way.

INTRODUCTION

Zanzibar has recently been the site for innovative work that combines development of aquaculture with integrated coastal management and fisheries management to implement alternative livelihoods. Zanzibar consists of two main islands and a number of small islands off of the east coast of Africa. The total area of both islands is 2,643 km² (Unguja is 1658 km² and Pemba is 985 km²). The population is estimated to be around 1,300,000 people, which grows roughly 3.1% annually. Fishing is the most common coastal activity and is 95% of the fishing is artisanal, mostly operating in shallow water using traditional vessels and gear. However, the fisheries accessible to artisanal fishermen have been overfished (Jiddawi, 2012, Jiddawi and Ohman 2002), which has stressed local villages and the economy. Finding sustainable alternatives to fishing are a high priority of the national and local governments.

The residents of Zanzibar suffer from multiple nutrition and health issues related to poverty and marginalization. Of children under five years of age, 35% are stunted, 25% are underweight and 6% are wasted, resulting in approximately 130 child deaths per day (Jiddawi and Lindstrom, 2012, ZPRP 2002). This is one of the highest rates within Tanzania. Bivalve shellfish are good sources of protein, vitamins (C, B1, B2, B3, D) and nutrients such as calcium, iron, copper, iodine, magnesium, zinc, manganese, and phosphorus. Hence, farming of bivalve shellfish represents an alternative to artisanal fishing, a direct means of improving nutrition through local consumption, as well as a means for women to earn income to support basic family needs.

This project built on eight years of efforts to develop a small-scale bivalve shellfish industry led by women in East Africa. These efforts have successfully resulted in over seven coastal villages engaging in some form of bivalve shellfish farming (Jiddawi, 2011; Jiddawi 2007). Coastal women have traditionally utilized reef-gleaning of bivalves, other invertebrates and small fish as one of their livelihoods, and as the principal source of high protein food (Frocklin et al. 2014; Crona et al., 2010). This traditional livelihood is threatened by 1) increasing populations; 2) migration of inland populations to the coast; 3) development for tourism, which frequently excludes villagers; 4) over-fishing; and 5) climate change.

This project has been modeled on the successful efforts to develop seaweed farming by women, which is now a major coastal industry on the East African coast. Many of the women shellfish farmers have also engaged in seaweed farming; hence, they have a basic knowledge of aquaculture. Shellfish farming has equal potential as previous seaweed farming efforts if technical support is provided to refine existing methods to increase the sustainability of such efforts. This project focused sustainable production of *Pinctada margaritifera* and *Pteria penguin*.

Pinctada margaritifera and *Pteria penguin* are marine bivalve mollusc in the family Pteriidae. *P. margaritifera* is commonly known as the black-lip pearl oyster and *P. penguin* is commonly known as the penguin's wing oyster. Both are used for the production of cultured pearls, meaning that these species are a valuable resource to humans. Long-term collection of adult pearl oysters from the wild for pearl production is not environmental sustainable. Sustainable pearl production is possible through collection of wild pearl oyster spat using spat collectors. Spat collection occurs when any material designed to attract spat settlement is placed in the water and tended. Properly designed spat collectors also protect the small spat while they grow.

These efforts support food security both directly and indirectly. Bivalve shellfish are an important source of protein and micronutrients for women and children. They are commonly the only source of protein that this group can access on a daily basis. Shellfish are also one of the main sources of income for women in Zanzibar, and the industries of producing shell jewelry and half pearls has begun to significantly increase women's incomes. It has been documented that Zanzibar women use income from these activities for children's school fees, food, and clothing and to improve their housing (Crawford et al., 2010; Haws et al., 2010; Lange and Jiddawi, 2009). Hence, stabilizing and scaling up bivalve culture is a feasible approach to improve food security and income for coastal women and children.

OBJECTIVES

The aim of this project was to develop a small-scale bivalve shellfish culture industry in Zanzibar to increase food security and family income with women as the primary participants. Specifically, this work addresses one of the primary obstacles to further development of the small shellfish farms: how to obtain stock in a sustainable manner for farms. Spat collection is one of the most sustainable and cost-effective methods to obtain stock for shellfish farms; hence, methods were tested to 1) determine the best materials and timing for spat collectors; 2) test nursery methods to rear the collected spat; and 3) provide training to women on other shellfish farming methods beyond the nursery stage.

METHODS

Pilot studies in 2009-2010 assisted in locating several sites near the villages of Bweleo and Nyamanzi on the Fumba Peninsula of Zanzibar, where spat settlement rates on artificial collectors were relatively high. Bweleo and Nyamanzi were among the eight villages participating in previous bivalve and pearl culture development work and their residents were among the most active in the participatory research. Approximately 200 women on the Fumba Peninsula have participated and/or benefitted from past aquaculture development efforts. Similar activities have been done in Mafia and

Mtwara on the Eastern Coast of Tanzania and showed promising results. Thus improvement of spat collection methods could be expanded to have regional benefits (Jiddawi, 1997).

Spat collection experiments were conducted by establishing submerged long lines in two areas and deploying 50 spat collectors every month over a one year period. Different spat collection materials (coconut and rubber tires; Figure 1a) and a new type of spat collection material (black mesh) (Figure 1b) were tested. This allowed researchers to determine the best time of year to deploy collectors and which material resulted in the highest level of spat settlement. The latter is more complex than it may appear because some materials may result in juveniles detaching themselves or being more vulnerable to predation (Haws, 2002). The long lines used to support the spat collectors were 10 m in length and were supported by buoys. The spat collectors were at a depth of at least 1 m depth from the surface during the lowest low tide because it is very important to make sure that the spat collectors do not touch the seabed during low tide.



Figure 1a. Spat collectors (from left: new spat collector, rubber tire and coconut shells)



Figure 1b. New Spat collectors

Collectors were inspected two months after deployment to obtain an estimate of the number of juvenile bivalves which attached and to identify these by species. Four months after deployment, the

collectors were removed from the water and all adhering bivalves counted and identified. The juveniles produced in this manner were then used in the nursery experiments. Data on water quality (temperature and salinity) were also collected at each experimental site. Women from the two communities participated in all aspects of this work and were trained in the technical details of spat collection and nursery rearing.

One trip per month was taken to each of the villages, Nyamanzi and Bweleo, involved in pearl farming. The aim was to monitor the pilot spat collectors. The spat seemed to be attaching quite well. Spat seem to attach more frequently in Nyamanzi than in Bweleo village. Researchers also checked to ensure that those involved in the project were cleaning off the antifouling organisms properly. One of the visits was taken to a previous workshop site to see if the area had some stakeholders still involved.

The work was conducted in Bweleo and Nyamanzi within Fumba Peninsula (Figure 2). Nyamanzi is located about 16 km South West of Zanzibar Island. Mean air temperatures range from 27 °C to 31 °C during the wet season and 25 °C to 28 °C in the dry season. Salinity ranges from 36 ppt in February to 41 ppt in September. Bweleo is located on the western side of Fumba Peninsula, on Unguja Island. The area is characterized by a rocky shore with mean surface water temperatures ranging from 30.5 °C in January to 26 °C in June. Salinity ranges from 36 ppt in January to 40 ppt in July. Near-shore waters are generally sheltered from strong waves because of its location on the leeward side of the peninsula.

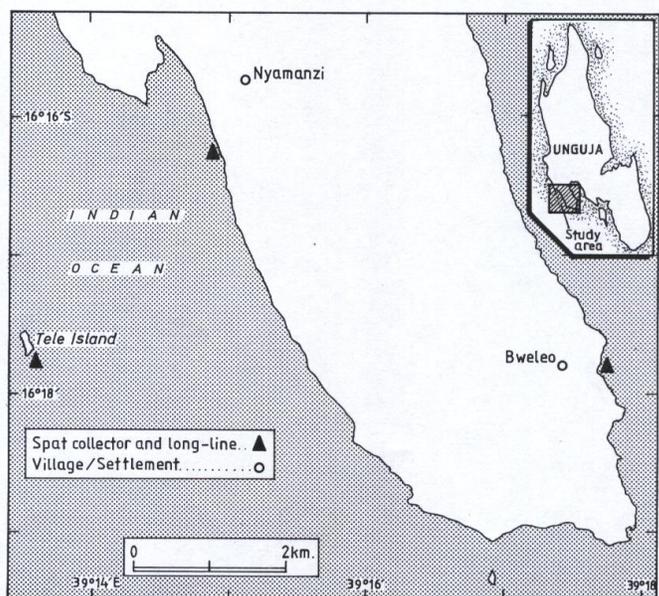


Figure 2. Study Area

RESULTS

The spat collection experiment involving women was conducted from August 2016 to June 2017 and produced a total of 3,354 *Pinctada margaritifera* spat and 3,861 *Pteria* spats at Bweleo and Nyamanzi respectively (Fig 3a and 3b). The spat collectors were hung in areas where there was the dense presence of adult pearl oysters in the surrounding waters to reliably produce high numbers of spat. The highest number of spat were observed from August to October 2016 and March to April 2017 for both sites. Previous results observed highest spat to be around the same periods of March to April as well as October to November (Jiddawi, 1995). Ishengoma (2011), however, observed highest catches in June. Based on the results of this short study, it is possible to obtain pearl oyster spat and

grow them. More spat were found on the new black mesh spat collectors compared to the other two collectors. Mean water temperature were 26.15 °C at Bweleo and 26.35 °C at Nyamanzi. The salinity recorded in the both sites was the same with an average of 32 ppt.

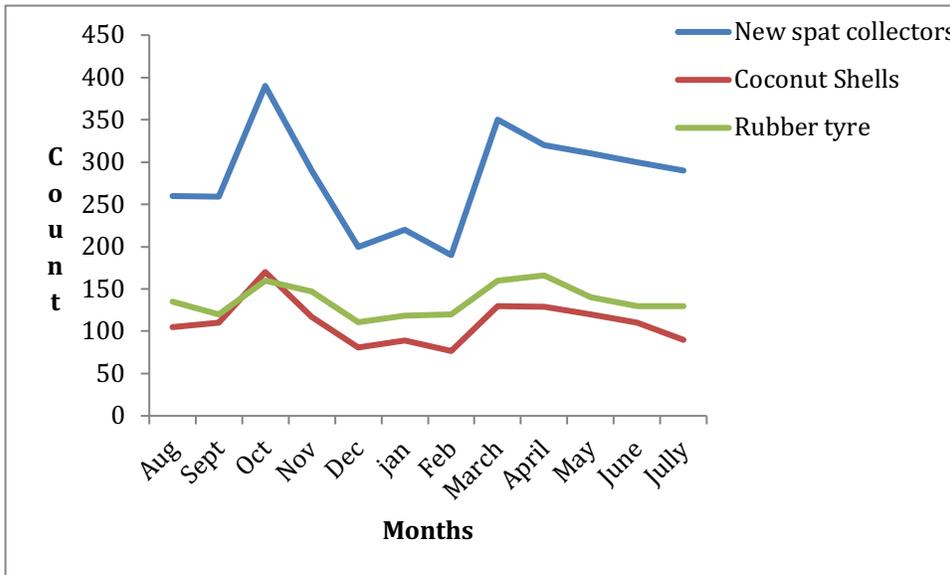


Figure 3a. Monthly number of *Pinctada* spat at Bweleo August 2016 to June 2017 on the various spat collectors.

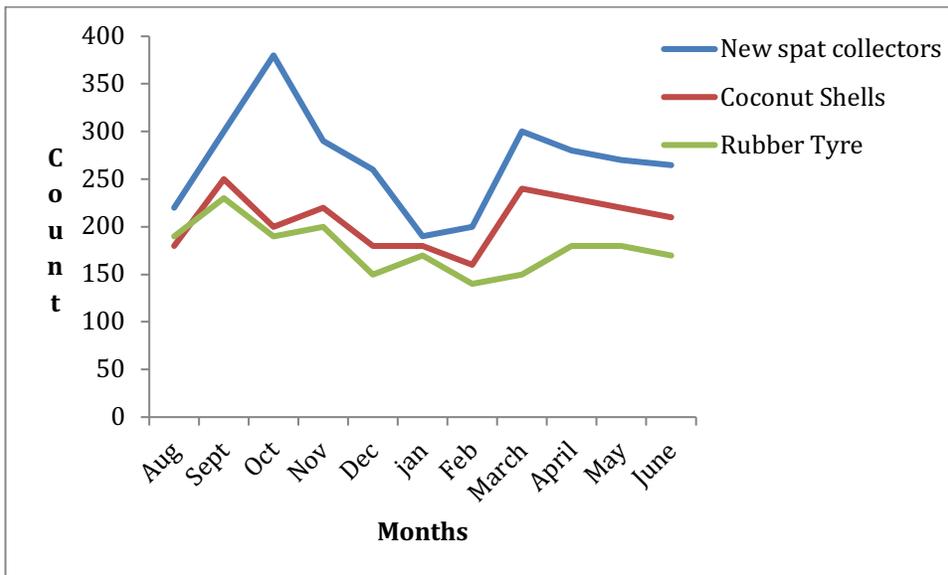


Figure 3b. Monthly number of *Pteria* spats at Nyamanzi August 2015 to March 2016 on the various spat collectors.

The women also participated in a one day training workshop on spat collection 20/11/2014 (Figure 4). This was done during the visit of Dr. Simon Elis, who visited Zanzibar in November 2014. He trained around 10 farmers from two Nyamanzi and Bweleo. The training focused on how to make spat collectors (Fig 4) and use them in an efficient manner. Swahili guidelines were printed and given to each participant. This will hopefully assist in improving oyster spat collection and pearl farming production techniques in Zanzibar. The manual elaborates on selection of collectors, when to install

them and how to maintain them. After the meeting the participants were given some of the supplies purchased to make spat collectors when they return to their villages.

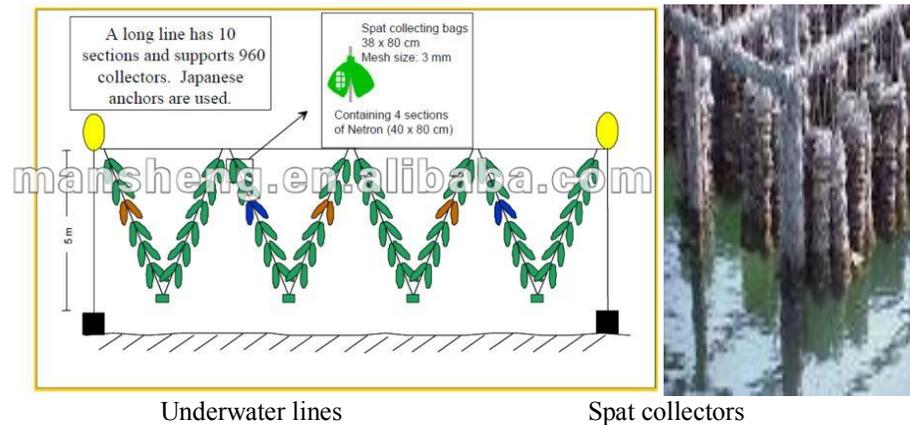


Figure 4. Spat collectors used during training

DISCUSSION

It is important to select the correct type of material for spat collectors, choose the right areas for spat collection, place the spat collectors into the water at the right time of the year, and provide proper maintenance of the spat collectors and the long lines. In this experiment, the new black mesh collectors were found to be very efficient as they provided a greater number of areas for the oyster larvae to settle, grow, and avoid predation.

Also the local materials available like coconut shells, rubber tires can still be used although settlement on these materials is less than on the black mesh collectors.

From the follow-up trainings which were done with the communities on how to maintain, handle, and grow the spat to a size that they can use to seed the pearls using methods indicated by Haws (2002), the communities have welcomed this information because it relieves them from going out into deeper waters to collect the large shells and depending on men. These communities are also ready to train others to make this activity more sustainable and feasible by having enough shells to seed.

Overall at least eight community members who have been trained on using this new technique are very active and are ready to train others. Those involved in the training were also beach recorders of the Department of Fisheries, members from local NGOs and local communities. Also a training manual was produced of which there was one section in Kiswahili (local language), which can be used efficiently.

Some problems were encountered:

- Fouling organisms, such as sponges and algae, can reduce the water circulation within a cage by blocking the nets' pores, which can then cause low supply of food and oxygen (hypoxia).
- High spat mortality during first month which continued to settle with high concentrations between October and November 2017.
- Some predators such as juvenile crabs, polychaetes, fishes and other marine organisms such as snails were observed.

CONCLUSIONS

Overall the project was very useful as the community learned a lot and it gave them a new insight on how to collect and handle spat and increased their overall aquaculture and marketing skills.

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