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incorporating molluscs and other shellfish

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Editorial

This is the second issue of the *Trochus Information Bulletin* that incorporates news on other molluscs and shellfish. I have tried to further broaden the scope of the bulletin by inviting more readers from Asia and the Asia-Pacific region to contribute articles.

Another change to the bulletin is the inclusion of many pictures on activities and contributions from the Asia-Pacific region. As an information bulletin, I believe pictures are in many ways much better for conveying activities and ideas to readers.

In this issue I have highlighted indigenous involvement in trochus and other aquaculture activities. The Kimberley Aquaculture Aboriginal Corporation is a success story that I would like to see happen in Pacific Island countries.

Also described in this issue is ACIAR funding for another three-year project on trochus in the Pacific involving Australia, Samoa and Vanuatu. This phase of the project involves communities, customary marine tenure, and the establishment of marine protected areas. The outcomes of the project will be of particular interest to Pacific Island nations.

Finally, in this issue, I have included an article each from the Philippines, Malaysia and Israel. I welcome more contributions from the Asia region.

Chan L. Lee

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Integration of broodstock replenishment with community-based management to restore trochus fisheries: A new ACIAR-funded project for Australia and the Pacific

Chan L. Lee¹

Introduction

The Australian Centre for International Agricultural Research (ACIAR) has agreed to fund a new trochus research project to establish and enhance trochus fisheries in Australia, Vanuatu and Samoa. The project (ACIAR project FIS/2001/085) is based on the successful outcomes of the previous trochus project, and involves broodstock replenishment and community-based management to restore trochus fisheries in selected communities in the three countries involved. The three-year project commenced in July 2002 and is due for completion in June 2005. This article provides a brief overview of the project, its objectives and projected outcomes.

The project is managed by the Kimberley Aquaculture Aboriginal Corporation (KAAC) as the Commissioned Organisation, and Dr Chan L. Lee as the Project Coordinator. The country coordinators for Vanuatu and Samoa are Moses Amos and Dan Sua, respectively. The scientists responsible for running the research nodes in Australia, Samoa and Vanuatu are Justin Bellanger, Robert Jimmy and Ms Malwine Lober, respectively.

This is the first ACIAR project where a community-based Australian indigenous organisation, KAAC, has been appointed the Commissioned Organisation. It is a big step for ACIAR and a bigger step for KAAC to be involved in the management of an international project. The experience gained will be invaluable to both ACIAR and KAAC, and to the Pacific partners.

Project objectives

The project's aim is to use broodstock seeding, in tandem with community-based management strategies, in partner countries to facilitate the establishment of effective breeding populations of trochus on depleted reefs in Australia, Samoa and Vanuatu. The ultimate goal is to: provide a simple

framework that allows responsible agencies to implement a nationally coordinated and strategic stock management plan for establishing sustainable trochus fisheries through broodstock reseeding; apply customary marine tenure (CMT) and/or the establishment of marine protected areas (MPAs).

The project involves three broad development and research activities and associated means of achievement.

1. The development of a framework for community consultation and participation in the project.
 - Hold meetings in respective partner countries to consult and negotiate with selected communities about reefs to be involved in the broodstock enhancement work, and the development of community-based CMT schemes in the project areas.
 - Establish marine protected areas (MPAs), where appropriate, after full consultation with the communities.
 - Appoint community coordinators to oversee the activities of the CMT and MPAs.
2. Stock enhancement on selected reefs.
 - Conduct well planned experiments, with adequate monitoring and sufficient scientific rigor to ensure the outcomes of the enhancement process are conclusively documented.
 - Provide opportunities for capacity building among participating national staff and communities involved in the activities.
3. Disseminate the results of the project nationally in partner countries and regionally.
 - Enhance the capacity of agency staff and communities to continue and extend the seeding programme.
 - Encourage and assist the development and/or further refinement of sustainable management practices for the trochus fish-

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ery and discuss the need for the establishment of permanent MPAs in selected reefs where enhancement is successful.

- Ensure linkages to SPC’s Regional Aquaculture Project.

In this and the next bulletin, researchers from Australia, Samoa and Vanuatu will provide more articles and news on the progress of the project.

Expected outcomes

The success of the project will result in the application of country-specific CMT and/or the establishment of MPAs for ensuring sustainable trochus fisheries in Pacific Island nations. It will allow the application of broodstock seeding to go hand-in-hand with community-based management and to bring about enhancement and/or establishment of sustainable trochus fisheries in all partner countries.



Figure 1. Consultation with elders, traditional owners and members of the Bardi Aborigines Association Council, One Arm Point, Kimberley, Australia



Figure 2. First annual general meeting held in the Department of Fisheries, Port Vila, Vanuatu – June 2003 (L to R: C. Lee, R. Jimmy, A. Solofa, M. Lober, M. Amos, C. Clements, K. Pakoa, T. Taleo and J. Bellanger)



Figure 3. Project staff visiting the trochus and giant clam hatchery in the Department of Fisheries, Port Vila, Vanuatu. (L to R: M. Amos, T. Taleo, J. Bellanger, A. Solofa, M. Lober and C. Clements)



ACIAR Regional Trochus Project (FIS/2001/085): Samoa node

Malwine Lober¹, Anama Solofa¹ and Autalatoa Taua¹

Introduction

Establishing *Trochus niloticus* stocks on Samoa's reefs has been one of the Fisheries Division's goals to further enhancing the availability of marine resources for utilisation. Trochus were first introduced into Samoa in 1990 with assistance from the FAO-funded South Pacific Aquaculture Development Programme (SPADP). A few shells were brought in from Fiji's Makuluva and Suva reefs and distributed at Namu'a Island off the Aleipata coast on Upolu, Samoa. The status of these shells was not known, especially after the havoc created by two cyclones to the reefs of Samoa in 1990 and 1991.

The first regional trochus project, of which Samoa is one of three participating countries, commenced in July 2002. The Samoa node is being implemented with funding provided by the Australian Centre for International Agricultural Research (ACIAR).

The objectives of the project in Samoa are three-fold. First, to establish trochus in Samoa, using broodstock and juvenile seeding. The latter will be produced extensively at the Fisheries Division's hatchery at Toloa. The second objective of the project is to utilise customary marine tenure (CMT) and the establishment of marine protected areas (MPAs) for the protection and establishment of trochus populations. The third objective is to encourage community participation in the management of the resource.

Project Co-coordinator Dr Chan Lee, and Mr Justin Bellanger of the Western Australian Fisheries Department, conducted the official launching of the Samoa node of the project during a workshop held in Apia in February 2003. The workshop was attended by the staff from the various sections of Fisheries Division that are involved in the implementation of the project: the Aquaculture, Extension and Inshore Sections

(Fig. 1). Site assessment, evaluation of the Toloa hatchery (Fig. 2), and survey method training were also undertaken by staff during their visit.

Site selection

In a previous habitat assessment conducted by Mr Moses Amos of the Vanuatu Fisheries Department in 1996, five sites were recommended for seeding. Some of these sites were re-visited, along with new sites, during the site assessment conducted by Mr Bellanger and Fisheries Division staff. As a result, six sites were recommended based on the availability of adult and juvenile habitats. Another important aspect that was taken into consideration was community participation in the Fisheries Division's Community-based Fisheries Resource Management Program. Most of the assessed communities had already established fish reserves, which were legally binding with the enforcement of village bylaws by the Village Fisheries Management Advisory Committee (VF-MAC).

Given the criteria for selection, the three sites that were eventually decided upon for broodstock and juvenile seeding were Saleapaga and Saoluafata on Upolu Island, and Papa-i-Puleia on Savai'i Island.

Broodstock

Obtaining broodstock for seeding and for spawning was a challenging task and a new experience for the Samoa node. After negotiations with the Fiji Fisheries Department, 428 shells arrived in Samoa in two separate shipments. These shells were collected from Makogai Island and transported to Viti Levu for onward passage to Samoa. The Fiji Fisheries Department arranged preparations for shipment and a Samoa Fisheries staff member, Mr Etuati Ropeti, travelled to Fiji to accompany the shipment to Samoa. This arrangement was successful and resulted in two shipments in March and May 2003. A third shipment

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was expected in May but bad weather prevented transport of trochus shells from Makogai Island to Viti Levu, resulting in cancellation of the shipment to Samoa. The trochus broodstock from Fiji was used for seeding at Saleapaga where 360 shells were stocked.

Delayed stocking of sites was a concern, and other sources of broodstock had to be considered. Mr Moses Amos and Mr Robert Jimmy from the Vanuatu Fisheries Department were aware of the Samoa node's dilemma and offered to assist in supplying trochus broodstock for seeding selected sites.

As this was the first time trochus were to be shipped from Vanuatu to Samoa, several arrangements had to be made prior to shipment. In Samoa, a quarantine import permit from the Quarantine Division was obtained, and the Customs Department was notified of the expected shipment. In Vanuatu, shells were inspected and several checks were made before they were shipped to Fiji to await the next flight to Samoa.



Figure 1. First trochus project meeting between Samoan and Australian project staff, January 2003, Apia, Samoa.

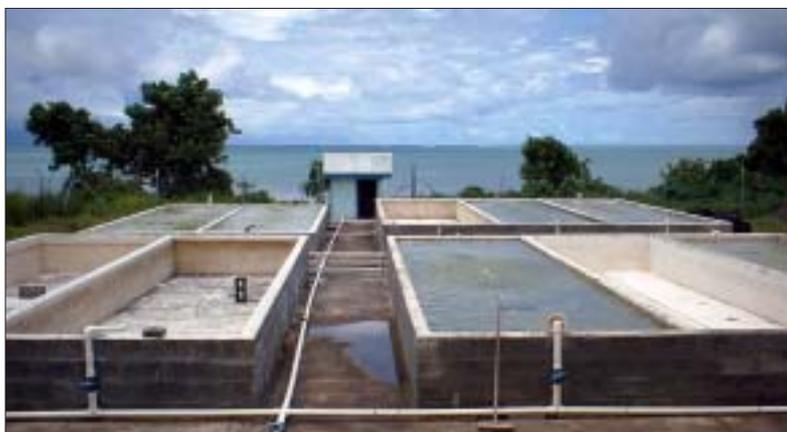


Figure 2. AusAID-funded hatchery at Toloa, Samoa.

The checks included inspections by the Customs and Quarantine departments, and certificates from these agencies, as well as the local Fisheries Department. The trochus shipment was to be held over for a maximum 24-hour transit period in Fiji so that it coincided with the flight to Samoa the following day.

The shipment, however, was delayed four times for various reasons. The first problem was that the source community of the broodstock withdrew approval to collect because of a dispute over the selling price of their shells. In the meantime, a Samoa Fisheries staff member had travelled to Fiji to arrange for clearance from Fiji's Fisheries, Quarantine, and Customs departments, and the freight forwarding company for the transshipment from Port Vila via Nadi, to Apia. Arrangements for storage while the shells would be in transit had also been made with Ocean 2000, a company exporting marine products out of Nadi. After the first delay, the staff member returned to Samoa, while the Vanuatu Fisheries staff sought alternative sources of broodstock.

A second attempt at shipping the broodstock which, by then, had been collected, took place several weeks later. However, this was also marred by another delay (closure of Vanuatu Customs Department for public holidays), and was followed by two more delays (cancellation of the flight by the airline and lack of available cargo space). A shipment of 900 shells finally arrived in Nadi on 3 August 2003 and, after clearance by customs officials, was stored at the Ocean 2000 facility located near Nadi International Airport.

Shells were re-packed and transported to Nadi International Airport in preparation for the flight to Samoa, after a final inspection and clearance by the Fiji Quarantine Department. Only two shells died during the 36-hour transit period.

On 4 August 2003, 898 shells arrived in Samoa accompanied by Anama Solofa from the Samoa Department of Fisheries. After clearance from Customs and Quarantine officials, the shells were transported to the Fisheries Division hatchery for quarantine. The shells were stocked into fiberglass tanks that were provided with vigorous aeration and continuous water exchange for a minimum of two hours. No shells died upon arrival. After the quarantine and health check, 800 healthy broodstock were seeded in the final two research sites.

Obtaining broodstock has been a challenging and useful learning experience for the

Samoa Fisheries staff as well as the Vanuatu node. It highlights the potential gain that could be obtained if Pacific Island researchers worked collaboratively. The experience gained by Samoa Fisheries staff will be extremely useful in future stock enhancement work.

Community-based Fisheries Management Plan

The three seeding sites selected for the trochus project are managed under the country Community-based Fisheries Management Plan. Management of the trochus project has been incorporated into the daily activities of the three communities currently participating in the Community-based Fisheries Management Program. Some of these communities outlined in their management plans the need for alternative developments in their coastal areas. Such developments included the introduction of potential

species for culture and stock enhancement to alleviate fishing on the already heavily fished reefs. An article providing details of the Community-based Fisheries Management Plan for trochus in Samoa will be published in the next issue of this bulletin.

Conclusion

Participation of the Samoa Fisheries staff in the ACIAR-funded trochus project has been extremely beneficial to the research staff involved. It provides opportunities to interact with regional and Australian researchers, and allows capacity building in the area of stock enhancement and hatchery production. We will be providing further reports on the progress of our work in future editions of this bulletin, including news of the first successful trochus spawning that occurred at the Toloa hatchery in August 2003.



The Kimberley Aquaculture Aboriginal Corporation (KAAC) story: A snapshot of development of the Manbana Hatchery and Discovery Centre

Charla Clements¹ and Chan L. Lee²

The indigenous communities in the Broome region of Australia became involved in trochus research in 1993 when Dr Chan Lee, a senior lecturer at the Northern Territory University commenced work in One Arm Point (OAP), Broome. At that time, indigenous communities in OAP expressed considerable interest in being involved in trochus and other aquaculture activities as a means of achieving economic independence. In 1995, ACIAR supported Chan's work with the communities by funding a three-year trochus project involving Australia, Indonesia and Vanuatu; this was subsequently expanded to include Samoa in the 2002 phase of the project. Over the past eight years, ACIAR has continued to be a strong and highly supportive partner in the trochus work in Kimberley and the Pacific. This commitment has provided the impetus to efforts of the Western Australia Department of Fisheries, the Australian Torres Straits Islander Commission (ATSIC), ATSIC Regional Councils, Department of Commerce and Trade and other agencies in Western Australia to expedite the involvement of indigenous communities in aquaculture development in the Kimberley.

As a result of the collaborative efforts by these agencies, significant research and community outcomes were achieved, including:

- Standardising spawning and hatchery production techniques for trochus
- Supporting hatchery development in communities in Australia, Indonesian, Vanuatu and Samoa
- Studies examining the nutritional requirements of hatchery reared juveniles
- Rigorous stock enhancement work using hatchery produced juveniles and seeding with broodstock
- Incorporation of the Kimberley Aquaculture Aboriginal Corporation (KAAC) in 1996
- Establishment of the OAP community-based hatchery
- Supported funding and construction of the \$3.5 million multi-species hatchery (Manbana Hatchery and Discovery Centre) in Broome
- Funding nine trainees and a community aquaculture project officer to work with KAAC and the communities

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- Securing 21 aquaculture licenses for indigenous communities in the Kimberley to participate in trochus, giant clams and tropical abalone farming.

This snapshot report on the development of the Manbana Hatchery and Discovery Centre provides some pictorial views of the construction and completion of the project. It clearly highlights that

consistent support and taking a long-term view in working with indigenous people can deliver significant outcomes and benefits to the people.

We hope this snapshot report will provide and encourage other funding bodies and researchers to take up the challenges of working with and developing aquaculture projects in indigenous communities in Australia and in Pacific Island nations.



At the beginning, there was nothing.



The Chair of KAAC (2nd from left) and the WA Minister of Fisheries (3rd from left) visited the hatchery site.



Hatchery and Discovery Centre taking shape.



Manbana Hatchery and Discovery Centre completed.



Entrance to Manbana Hatchery and Discovery Centre.



Staff and a trochus shell display in Manbana.



The three hatchery production tunnels. Each tunnel occupies an area of 400 m².



View of water storage tanks and facilities supporting the hatchery tunnels.



Inside view of hatchery tunnel.



Close-up view of spawning tanks.



Inside view of spawning room.



Inside view of the microalgae laboratory.



Trochus niloticus on the beach of Tel Aviv-Yafo: A reminder of the pearl button industry in Israel

Henk K. Mienis¹

I examined a collection of molluscs that were gathered along the Mediterranean coast of Israel by the late Arieh Hadar. This collection is now part of the National Mollusc Collection of the Tel Aviv University. This review revealed, to my surprise, two specimens of the commercial top shell *Trochus niloticus* Linnaeus, 1767. Hadar found these specimens on the beach of Tel Aviv-Yafo from 1948–1968. The two shells are medium sized and measure respectively, 67 x 60 mm and 86 x 76 mm. The latter shell is missing its top whorls.

How should the presence of these shells be explained? As another Lessepsian migrant²? As hitchhikers on the hulls of vessel? As discarded souvenirs? Or yet another possibility? Although the name *niloticus* brings to mind the Nile or Egypt, this Trochid does not live in the Red Sea (Dekker and Orlin 2000), therefore it can not be considered as another Lessepsian migrant. *Trochus niloticus* as a hitchhiker may also be ruled out although several other Indo-Pacific species managed to reach the Mediterranean Sea and even settle there in this way. Well-known examples of successful mollusc hitchhikers in the eastern Mediterranean are: *Conomurex persicus* (Swainson 1821), *Palmadusta lentiginosa* (Gray 1825), *Thais lacera* (von Born 1778) and most recently *Diodora funiculata* (Reeve 1850) (Mienis 1994, 1999, 2002a, b). It is unlikely that these top shells were discarded souvenirs because when Hadar collected both specimens (most probably in the early 1950s), such shells were still considered luxury items in the newly formed State of Israel, and it is rather unlikely that such expensive items were thrown back into the sea.

It is more likely that the two shells found on the beach of Tel Aviv-Yafo are left over from the pearl button industry. Both in Yafo and later in Bené Beraq, a township belonging to the greater Dan-district, of which Tel Aviv-Yafo forms the main

component, nacreous shells, including top shells, mother-of-pearl shells (*Pinctada margaritifera*) and various thick-shelled freshwater mussels, were imported for the manufacture of pearl buttons. Such a factory, called “dar”³, was still active in Bené Beraq in the 1960s until slowly but steadily there was a change to synthetic materials (Bergman 1975). Even in the early 1970s it was possible to collect shell scraps in the backyard of that factory. The shell material, imported among other goods from Japan and Australia, arrived via the harbour of Yafo and at a later stage via Tel Aviv. Usually the merchandise was unloaded and brought ashore by hand. Often, items fell into the water. This most likely occurred with the two top shells found by Hadar on the beach of Tel Aviv-Yafo.

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 2. A species extending its natural range of distribution in the Red Sea to the Eastern Mediterranean by means of the Suez Canal.
 3. “Dar” is the Hebrew word for the raw pearl material produced by certain mussels and snails.



Status of giant clams in Malaysia

Aileen Tan Shau-Hwai^{1,2} and Zulfigar Yasin¹

The largest bivalve molluscs in the world are the giant clams (Tridacnidae). Of the eight species found worldwide, six can be found in Malaysian waters: *Tridacna crocea*, *T. derasa*, *T. maxima*, *T. squamosa*, *Hippopus hippopus* and *H. porcellanus*. *T. crocea* is the only species in Malaysia that has a stable population, while the others are considered to be endangered. *T. gigas* is already extinct in Peninsular Malaysia and *H. porcellanus* and *T. derasa* are restricted to Sabah, Eastern Malaysia. Because of this, the Malaysian Department of Fisheries has listed giant clams as a protected species.

Giant clams are mainly found in the shallow seas around the islands off the east coast of Peninsular Malaysia — Pulau Redang, Pulau Pemanggil, Pulau Besar, Pulau Tinggi and Pulau Aur — and also in Sabah. Underwater surveys reveal that the distribution of giant clams is widespread but their numbers are very low. For some species, only shells have been found, for many other species, small-sized individuals are absent, indicating low or no recruitment of juveniles. Local inhabitants of the islands remember an abundance of some of these clam species. For the remaining species (e.g. *T. gigas*), they noted, only the dead shells had ever been seen.

Several possibilities may explain the disappearance of giant clams from Malaysian waters. One possibility is that there was a relatively sudden geological uplift of the islands. Areas that were formerly submerged became dry land. If the clams had previously been surviving in the shallow coral areas they would have then become uplifted to elevations beyond their limit of tolerance. This could explain why large empty shells are found only in the shallows, never on the deeper edges of the reef even though the clams, if they are alive, now could survive here.

Another likely explanation is poaching. The clams may have been transported to shallow reef areas

where a fisherman could work with ease removing the meat during low tide. In some areas of Malaysia, clam meat is still sold openly in the market (Fig. 1), and in other areas the empty shells are piled up high, and they have been used to construct walls and fences (Fig. 2).

Homemade bombs, similar to Molotov cocktails and poisons, were once used on Malaysia's reefs as late as the 1960s for capturing of reef fish. These



Figure 1. The quest for food: giant clams are harvested for food, but the large clams are too tough to eat. Even though endangered, clams are still poached and the meat sold openly in the market.

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bombs could easily kill many of the reef organisms including giant clams.

We may never know what caused these great giants to disappear, but it is not too late to save the remainder from going extinct. The clean waters of the islands on the east coast of Peninsular Malaysia, as well as East Malaysia, are still conducive for the survival, growth and propagation of giant clams.

Ecotourism is becoming more important as the public realises the importance of conservation and a clean environment. Many of the coral reef islands in Malaysia are pristine and healthy. Research on giant clams has been conducted to improve the status of these islands and at the same time return a lost heritage to its natural home. In doing so, the public was educated on the



Figure 2. Giant clams were once so abundant that the shells were used as construction material.

value of conservation and ecotourism. The local language is interspersed with words describing giant clams. Conservation and tourism can co-exist and bring mutual benefit to both.



SEAFDEC's stock enhancement programme

Wenresti G. Gallardo¹

Background

The Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) has four regular programmes that focus on urgent aquaculture issues in Southeast Asia. One of the programmes, which began in September 2000, addresses stock enhancement. SEAFDEC/AQD first became involved in stock enhancement in 1991 through the Community Fishery-Management Project, undertaken in Malalison Island, Culasi, Antique (west central Philippines). The importance of stock enhancement was articulated as early as 1969 in the Kyoto Declaration on Aquaculture (Sections 17 and 18) and later affirmed in 2000 in the Bangkok Declaration and Strategy for Aquaculture Development (Sections 3.9 and 3.10), and then again in 2001 during the ASEAN-SEAFDEC Conference on Sustainable Fisheries for the New Millennium. One of the 10-

point recommendations in the Millennium Conference is to: *Promote re-stocking activities (seed release programmes) from hatchery-produced stocks and/or wild collected sources in areas where they are considered to be feasible, particularly in localities operating within a regime of rights-based fisheries.*

Programme components

The stock enhancement programme of SEAFDEC/AQD has two research components:

1. Adaptation and refinement of breeding and hatchery production techniques of appropriate species for stock enhancement.

The breeding component brings together previous works on the propagation of the abalone (*Haliotis asinina*), top shell (*Trochus niloticus*),

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window-pane oyster (*Placuna placenta*), and seahorses (*Hippocampus barbouri* and *H. kuda*). Other species such as grouper and siganid, for which hatchery technologies have been developed, are being evaluated for their suitability for stock enhancement.

2. Development of strategies for release and stock enhancement of appropriate species.

Research studies are aimed at determining the optimum release method, animal size, season, habitat and density that will result in high survival, growth and reproduction of the released animal.

The stock enhancement programme also has training and information components such as:

1. Seminars and training on stock enhancement for fishers, local government units and non-governmental organisations.
2. Production of information materials, such as flyers to enhance people's awareness of stock enhancement efforts.

Abalone

Abalone is a high value species of gastropod mollusc that inhabits rocky and coral reefs. Its large "foot" is one big muscle that is sold either frozen or canned and is highly prized in Chinese cuisine. Due to its high market demand, overharvesting from the wild could result in its depletion, thus, stock enhancement in protected areas is necessary.

SEAFDEC/AQD started its research on abalone in 1993 with the aim of developing and refining hatchery and grow-out culture techniques. With the development of hatchery technology, abalone juveniles can now be mass-produced. For stock enhancement purposes, juveniles are "diet-tagged" by feeding them with artificial diet for three to four weeks followed by seaweed feeding. The bluish-green shell band produced through artificial diet feeding serves as a permanent marker of hatchery-produced abalone when released to the wild. Efforts are also being made to produce and release first generation offspring of wild spawners from the release sites to maintain genetic integrity of natural stocks.

SEAFDEC/AQD researchers have evaluated potential stock enhancement sites in Panay and Negros Islands and have selected Sagay Marine Reserve in Negros Occidental as a pilot stock enhancement site. Preliminary releases of hatchery-produced abalone in Sagay Marine Reserve have produced encouraging results. This research

aimed at determining the optimum release size, habitat, season and density, will continue with funding support from the International Foundation for Science (IFS).

Top shell

The top shell, *Trochus niloticus*, is another highly valuable gastropod mollusc. Its mother-of-pearl shell is used in the manufacture of buttons and other shell craft. The uncontrolled harvesting of top shell from the wild has resulted in the decline of natural stocks.

SEAFDEC/AQD started its research on top shell in 2000 with some broodstock obtained from Iris Marine Development Corporation, which operates a trochus hatchery in Palawan. SEAFDEC/AQD reared some broodstock and was successful in inducing it to spawn (see *SPC Trochus Information Bulletin #9*, p. 14). Thousands of juveniles have been produced and diet-tagged in preparation for release. In February 2003, more than 3000 top shell juveniles were brought to Palawan for release in a marine sanctuary in Binduyan, Puerto Princesa. The initial release was carried out by participants of the training course on Fish Sanctuary and Trochus Shell Resources Management conducted by the BFAR-Fisheries Resource Management Project (FRMP) in Palawan. SEAFDEC continues its efforts to refine seed production techniques to enable mass production of seeds for stock enhancement.

Window-pane shell

The window-pane shell, *Placuna placenta*, is a bivalve mollusc whose shells are used as lampshades and other shell craft marketed locally and internationally. The reported decline in natural stocks prompted SEAFDEC/AQD to resume its research on the species in 1990. SEAFDEC/AQD researchers have succeeded in propagating the species in the hatchery. Juveniles can be reared to larger sizes in tanks so that their survival rates in nature are increased once they are released. Initial attempts have also been made to restock the depleted beds along the Gulf of Panay by releasing both immature and breeding stocks collected from a neighbouring island. Close collaboration with the concerned local government has also resulted in the closure of the stock enhanced area to all forms of gathering so that a viable breeding population can be established. However, with the discovery of juveniles by fisherfolk, gathering was difficult to control. Closer cooperation of the fisherfolk and local government and the establishment of a permanent protected area are necessary so that a breeding population will always be available to repopulate the area.

Giant clams

SEAFDEC/AQD is collaborating with the Marine Science Institute of the University of the Philippines (UP MSI) in the restocking of giant clams *Tridacna* spp. UP MSI is distributing hatchery-produced giant clam juveniles to various parts of the Philippines in efforts to save and enhance the stocks of this endangered species. SEAFDEC/AQD received *Tridacna gigas* juveniles from UP MSI in October 2001 and these were reared in tank and ocean nurseries and then restocked in coral reefs in SEAFDEC/AQD's Igang Marine Substation in Guimaras Island. Restocked giant clams are growing well and the remaining giant clams in cages will be restocked in other protected areas such as Sagay Marine Reserve in Negros Occidental.

Seahorse

Commanding a good price either in live form for the aquarium trade or in dried form for traditional Chinese medicine, seahorse collecting in the Philippines and other parts of Southeast Asia is a good supplemental livelihood activity. However, because uncontrolled fishing will deplete natural stocks, seed production and stock enhancement techniques should be developed, coupled with other conservation measures.

Seahorse research at SEAFDEC/AQD started in 1996. Seahorse juveniles have been produced so that SEAFDEC/AQD now has at least second-generation, hatchery-bred animals in captivity. Sites are now being assessed where seahorse juveniles may eventually be stocked.



Commercial trochus button production in Hong Kong

Note from the Editor:

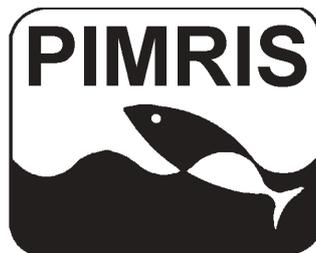
Head Crown Trading Limited is a Hong Kong-based company dealing in buttons and related trade, and is a key supplier of trochus buttons in Asia. Through the kind permission of Derek Put, we are able to reproduce a set of trochus button pictures produced by the company. Readers can get an e-copy of these button pictures by looking on the company website. Company details are given here for those who are interested.

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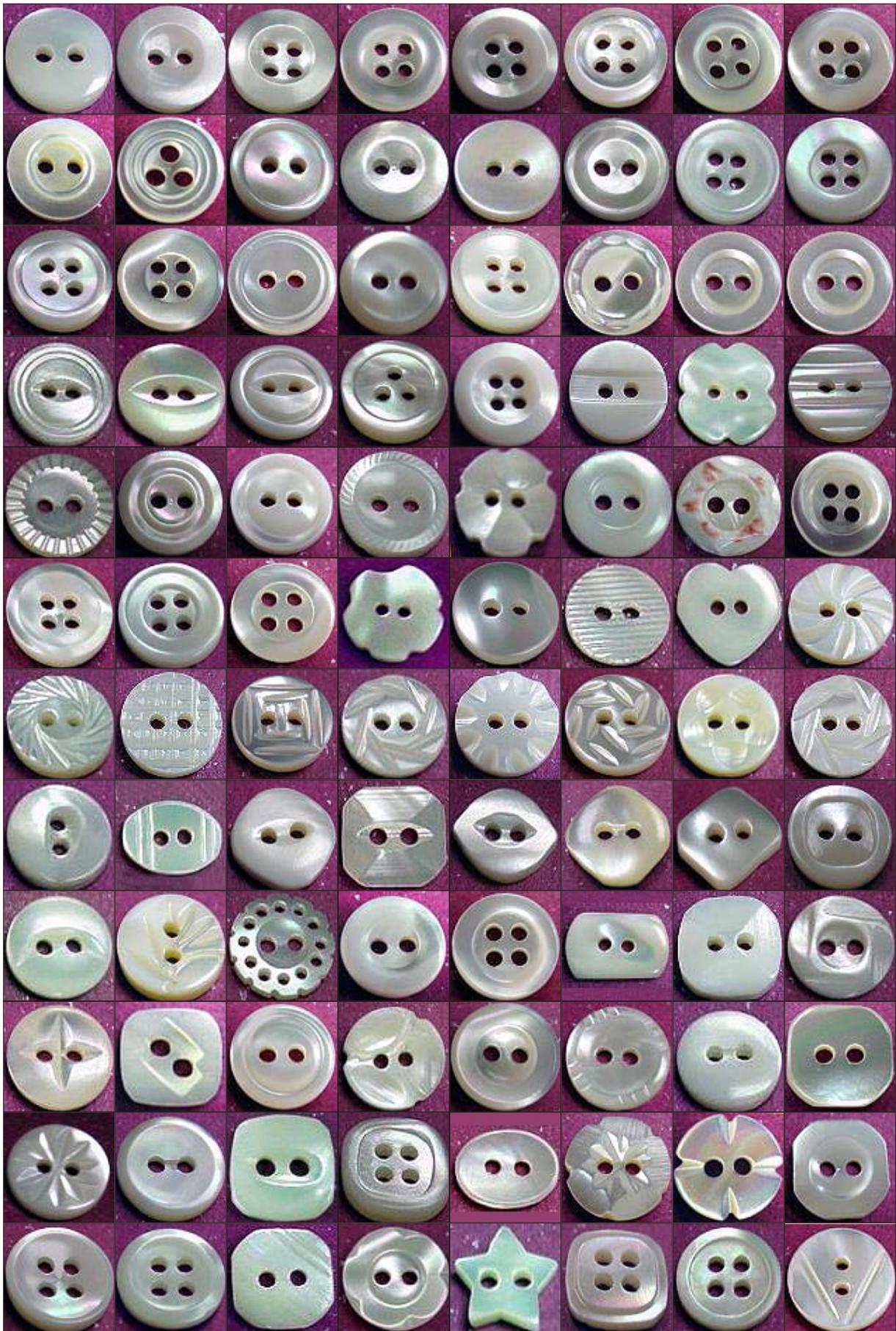


PIMRIS is a joint project of five international organisations concerned with fisheries and marine resource development in the Pacific Islands region. The project is executed by the Secretariat of the Pacific Community (SPC), the South Pacific Forum Fisheries Agency (FFA), the University of the South Pacific (USP), the South Pacific Applied Geoscience Commission (SOPAC), and the South Pacific Regional Environment Programme (SPREP). This bulletin is produced by SPC as part of its commitment to PIMRIS. The aim of PIMRIS is to improve



Pacific Islands Marine Resources
Information System

the availability of information on marine resources to users in the region, so as to support their rational development and management. PIMRIS activities include: the active collection, cataloguing and archiving of technical documents, especially ephemera ('grey literature'); evaluation, repackaging and dissemination of information; provision of literature searches, question-and-answer services and bibliographic support; and assistance with the development of in-country reference collections and databases on marine resources.



Publications and conferences on trochus and other molluscs

Proceedings of the 11th International Congress and Workshop of the Tropical Marine Mollusc Programme (TMMP)

Note from Chan L. Lee

Some *SPC Trochus Bulletin* readers may be familiar with the publications from the Tropical Marine Mollusc Programme (TMMP) funded by the office of Enhancement of Research Capacity (ENRECA) in the Danish International Development Agency (DANIDA), the Danish Ministry of Foreign Affairs. TMMP, based at the Phuket Marine Biological Center, Thailand, has been operating since 1990 and has produced 11 excellent and highly informative proceedings on tropical marine molluscs. Unfortunately, TMMP ended on 1 January 2002 due to cessation of funding by DANIDA. This is indeed a very sad development for mollusc researchers in the Asia-Pacific region.

I was lucky to get in touch with Professor Jorgen Hylleberg, programme director of TMMP and the editor of the final TMMP proceedings. Professor Hylleberg has kindly given me permission to reproduce some articles of interest from the final TMMP proceedings: Proceedings of the 11th International Congress and Workshop of the Tropical Marine Mollusc Programme (TMMP), 28 September to 8 October 2000, held in Kodaikanal, Rameswaram and Tuticorin, Tamilnadu, India. These articles and details of the final TMMP proceedings are given below.

Hyllebert, J. (ed). 2001. Proceedings of the 11th International Congress and Workshop of the Tropical Marine Mollusc Programme (TMMP), 28 September to 8 October 2000. Phuket Marine Biological Center Special Publication 25:vii-x, 599 p.

Some articles of interest in the 11th TMMP Proceedings:

Victor, A.C.C. 2001. Key note address: Recent development in pearl culture research in India. Phuket Marine Biological Center Special Publication 25(1):23–26.

Summary: This is a short article that provides a brief overview of the pearl industry in India. Six species of pearl oysters are found in the country, *Pinctada fucata*, *P. margaritifera*, *P. chemnitzii*, *P. sugillata*, *P. anomiooides* and *P. atropurpurea*. Among them *P. fucata* is the dominant and most valuable species for commercial pearl production in India.

Paongan, Y., Winanto T. and Soekendarsi E. 2001. Biometrics of male and female top shell *Trochus niloticus* Linne. Phuket Marine Biological Center Special Publication 25(1):87–88.

Summary: Regression analysis showed a linear correlation between shell diameter and weight of male *Trochus niloticus* ($r^2 = 0.893$), shell height ($r^2 = 0.899$), and diameter of operculum ($r^2 = 0.848$). In females the coefficients of correlation for the same relationships were 0.929, 0.965 and 0.614 respectively.

Paongan, Y., Winanto T. and Soekendarsi E. 2001. Size distribution of male and female top shell *Trochus niloticus* Linne in relation to depth and substrate. Phuket Marine Biological Center Special Publication 25(1):89–90.

Summary: The study was conducted at Baki Island Water, Pangkep Regency, South Sulawesi. Baki Island has both sandy shore and coral reef flats. *Trochus niloticus* is rare on the island. The distribution of 49 males (34.5–81.4 mm shell diameter) and 46 females (54.3–105.3 mm shell diameter) was studied in relation to depth and dead coral substrate. Regression analysis showed that both male and female distribution had a positive correlation to depth and substrate.

Soekendarsi, E., Djawad M. I. and Paongan Y. 2001. Growth rate of *Trochus niloticus* L. fed on four species of benthic marine macroalgae. Phuket Marine Biological Center Special Publication 25(1):135–137.

Summary: *T. niloticus* were fed dry and fresh algae: *Caulerpa sertularoides* (Vahl) C. Agardh, *Ulva reticulata* Forsskal, *Padina australis* Hauck, and *Gracilaria salicornia* (C. Agardh) Dawson. Green macroalgae resulted in the best growth of trochus. Brown macroalgae also contributed to an increase of shell size, but were inferior to green macroalgae.

Husin, N.M., Yasin Z. and Tan A.S.H. 2001. Shell morphology and culture of *Tridacna squamosa* larvae (Bivalvia:Tridacnidae). Phuket Marine Biological Center Special Publication 25(1):169–172.

Summary: The shell morphology of *Tridacna squamosa* larvae is described and illustrated based on SEM pictures. The increase in total shell length and shell width was more distinct compared to the length of hinge teeth. Prodissoconch 1 and prodissoconch 2 could clearly be differentiated. Other important morphological characteristics are discussed.

Granmo, A., Hernroth B. and Lindahl O. 2001. Marine bivalve farming: A sustainable food production. Phuket Marine Biological Center Special Publication 25(1):179–188.

Summary: Increased supply of nutrients to the sea is a serious environmental problem nearly worldwide and many coastal areas suffer from eutrophication. This has led to raised phytoplankton production and increased growth of filamentous algae followed by increased oxygen consumption in bottom waters as well as decreased penetration of light through the watercolumn. One possibility to counteract this problem is to recycle nutrients from sea to land by the cultivation of filter-feeding organisms, such as bivalves. The paper points out that bivalve farming is a sustainable way to produce food of high nutritional value. At the same time, the cultivation will result in advantageous environmental effects in areas where eutrophication is a problem. However, in many coastal areas humans also introduce pollutants (heavy metals, hydrocarbons, pesticides, and detergents) into the aquatic ecosystem. The occurrence of toxic algae is another serious threat to bivalve farming. Furthermore, high densities of pathogenic bacteria and viruses are often present in coastal waters. Increased knowledge of the capacity of molluscs to deal with pollutants, pathogens and toxic algae and how to optimise the location of farms is necessary in order to give important guidance to future management strategies.

Le, D.M. 2001. Reproductive characteristics of *Haliotis ovina* Gmelin, 1791 in South Central Vietnam. Phuket Marine Biological Center Special Publication 25(1):197–201.

Summary: The reproductive cycle, initial size at sexual maturity, sex ratio and fecundity of *Haliotis ovina* Gmelin, 1791 were studied in Cam Ranh Bay, Khanh, Hoa Province. *H. ovina* spawned year round, but intensively from April to August. Sexual maturity was first attained at size 44.4 mm for male and 48.0 mm for female. The sex ratio of wild *H. ovina* was 1:0.9 (M:F). Fecundity of females varied from 142,000 to 751,000 eggs with a mean of 392,760 eggs.

Le, D.M. 2001. Preliminary results on the artificial breeding of the abalone *Haliotis asinina* Linne, 1758 in Vietnam. Phuket Marine Biological Center Special Publication 25(1):203–205.

Summary: Wild-caught broodstock of the abalone *Haliotis asinina* were placed in a 600-L capacity composite tank and conditioned to photoperiods of 12 h light and 12 h darkness. Spawning occurred after 17–22 days. More than 400,000 newly hatched larvae were cultured. On average, 1.29 per cent of them reached the juvenile stage, which occurred after 35–40 days of rearing.

Conference

The triennial conference of the Malacological Society of Australasia will be holding the 15th World Congress of Malacology, 11–16 July 2004 in Perth, Western Australia. A major symposium on molluscan fisheries and aquaculture will be held as the key component of the World Congress.

For more information on the conference, visit www.amonline.net.au/malsoc or www.inter.nl.net/users/Meijer.T/UM/um.html or write to Dr Fred E. Wells, Western Australian Museum, 1 Francis Street, Perth, WA, Australia 6000, email: fred.wells@museum.wa.gov.au; Fax 61-8-9472 2882.

Consultancy, training and eco-tour

Dr Richard Braley from the Aquasearch Lab, Aquarium and Consultancy provides training in the following activities:

- Tropical marine biology and aquaculture consultancies;
- Marine display viewing for public and educational groups featuring cultured 17-year old giant clams (*Tridacna gigas*), fish and corals;
- Selected fresh- and saltwater fish and aquarium supplies for sale; and

- Assistance to educational groups for low-tide reef walks.

More information is available from their website: www.aquasearch.net.au/aqua/consultancies.htm

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In preparation for the next issue of the *SPC Trochus Bulletin*

In the next issue of this bulletin Dr Chan Lee will be featuring the achievement of a community-based hatchery located at One Arm Point (OAP), Kimberley, Australia. The Bardi Aborigines Association based at OAP has collected and traded trochus shells for many decades. As the price for trochus shells dropped from AUD 9.50/kg to AUD 8.50 in 2000 and to AUD 7.00 last year, the community has decided to go into the

aquarium trade, selling hatchery-produced juvenile trochus. Prices of AUD 2.00 to AUD 3.50 have been obtained for juvenile trochus ranging in size from a basal diameter of 10–25 mm.

Below are two photos of the OAP hatchery. More information and photos will be provided in *SPC Trochus Bulletin #11*.

Looks like a hatchery.
Find out more in *SPC Trochus Bulletin #11*



Power from solar panels for a hatchery?
Find out more in *SPC Trochus Bulletin #11*