



## THE KINGDOM OF TONGA



**Aquaculture Research and Development Project  
Japan International Co-operation Agency (JICA)**

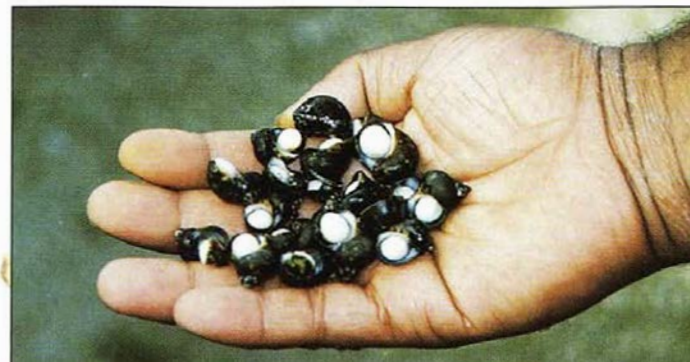


## HISTORY

Aquaculture (farming in the water) development has been one of the key roles of the Ministry of Fisheries in Tonga from as early as the 1970's when local oyster culture was initiated. Since then, aquaculture and related research activities have been continuously tested to increase the supply of high value marine fishery species for export, and more recently, for stock enhancement purposes to re-establish overexploited species such as giant clams and mullet.

In order to facilitate the demanding aquacultural activities, the Mariculture Centre was established in Sopa with the assistance of the Japanese government in 1978. However, cyclone Isaac in 1982 caused major damage to the facilities resulting in a set back to aquaculture development in the Kingdom.

The Ministry of Fisheries requested the Japanese government to initiate the Aquaculture Research and Development Project (ARDP) to rehabilitate and upgrade the facilities, as well as provide technical assistance to further develop aquaculture research and development. Current activities include fin-fish culture and research, shellfish culture and research, and fisheries stock survey and management. The results of the research are published in the Fisheries Research Bulletin of Tonga as well as the Inshore Fisheries Statistics Report.



GREEN SNAIL JUVENILES

## FIN-FISH CULTURE AND RESEARCH

- Study on the life cycle and availability of natural fry of Mullet
- Collection of Mullet fry for culture
- Construction of pen (fence net) in Fanga'uta lagoon
- Experiments on Mullet pen culture
- Study on supplemental feed for Mullet pen culture
- Study on mullet stocked in Lake Ano in Vava'u

## SHELLFISH CULTURE AND RESEARCH

- Biological and ecological survey on important shellfish in Tonga
- Seed production and intermediate culture of Gi Clam
- Giant Clam culture in ocean nursery
- Survey on Giant Clam resource
- Economic feasibility of giant clam culture
- Experimental transplantation of trochus and green snail (including seed production)

## STOCK SURVEY AND MANAGEMENT

- Stock survey on Giant Clam
- Preparatory survey for transplantation of Trochus and Green Snail
- Follow up survey on released Giant Clam, Trochus, and Green Snail
- Lobster survey (biology and ecology)
- Inshore fisheries landing site survey
- Marine resource conservation awareness campaign
- Production of videos, photos, and T-shirt for education activities

## FACILITIES AND EQUIPMENT

### Tanks

Concrete raceway tanks (8 ton capacity) × 8

Concrete circular tanks (15 ton) × 2

Concrete circular tanks (7 ton) × 6

Fibreglass raceway tanks

(3.75 ton × 8, 1.4 ton × 2, 0.5 ton × 2)

Fibreglass circular tanks

(1 ton × 6, 0.5 ton × 6)

### Facilities

Lecture hall

Museum

Wet laboratory

Audio visual editing room

Microscope room

### Vessels and vehicles

Research vessel 26 feet diesel 45 HP engine

Research vessel 26 feet outboard 55 HP engine

Research vessel 18 feet outboard 30 HP engine

Pickup truck

Van

Motor cycles

### Laboratory and Field Research Equipment

Profile projector, Microscopes, Photomicrography, Video

cameras, Video editing system, Computers, Cameras,

Under-water cameras, Under-water video housing, Scuba

diving equipment, Ultraviolet irradiation apparatus, and

other minor equipment.



## GIANT CLAMS AND THEIR CULTURE

There are 4 species of Giant Clams naturally occurring in Tonga. They are:

Smooth Giant Clam (*Tridacna derasa*, Tokanoa),

Fluted Giant Clam (*T. squamosa*, Matahele),

Elongated Giant Clam (*T. maxima*, Kukukuku) and

Tevolo Clam (*T. tevoloa*, Toki)

One species of Giant Clam, the Horse's Hoof Clam (*Hippopus hippopus*, no Tongan name), has become extinct from Tongan waters.

There are 3 more Giant Clam species existing in the world. They are:

True Giant Clam (*T. gigas*),

Boring Clam (*T. crocea*), and

Porcelain Clam (*H. porcellanus*).

Because of their slow growth and ever increasing fishing pressure, some of the species are facing a danger of extinction.

The smooth Giant Clam (Tokanoa) is one of the species whose population is declining rapidly in Tonga. This has prompted the Ministry of Fisheries to start its giant clam hatchery and ocean nursery.

In the early summer months of October- November, the Ministry conducts artificial breeding of Giant Clams at the hatchery. Brood stock (parent clams) are collected from nature or from an ocean nursery. Millions of eggs are fertilised, but only 100,000 clam seeds are kept in the land tanks. After 10 months, they reach the size of 3cm and are relatively safe from predators in the open water. They are then transferred to ocean nurseries, however, it will be 5 to 7 years before they sexually mature.

The Ministry is re-seeding the ocean with these small

## CHARACTERISTICS OF GIANT CLAMS

Giant clams are hermaphrodites (male and female simultaneously). They first have spermatozoa, then in later years also produce eggs.

Micro-algae (zooxanthellae) grow and reproduce inside the giant clam giving the clam its own food production mechanism (symbiosis). Because of this symbiotic relationship, giant clams need to live in shallow, clear waters where the micro-algae can utilise the sun's rays for photosynthesis.



## MULLET

Mullet is one of the most esteemed fish in the Tongan diet and its processed roe is a highly valued delicacy in China and Japan. As mullet is caught in large numbers during spawning season, mature fish with ripe gonads are often observed at the fish market.

The overfishing of mature mullet, before they spawn, has led to declining numbers of mullet being landed over the past 2-3 decades. Improvements in material and intensification of set net (paa) operations in and around Fanga'uta lagoon are believed to be a main factor for this decline. Surveys conducted in the past 3 years revealed that fry (very young stage of fish, 1-3cm) are the main species of mullet (grey mullet) is hard to find. In order to curb the decline of mullet resources, efforts are made to supply enough mullet for the people of Tonga. The Ministry of Fisheries has started its experimental study on mullet culture. Natural fry (which is otherwise consumed by predators) is collected and kept inside the surrounding net fence erected in Fanga'uta Lagoon. This is called pen culture. This culture method is believed to be one of the most cost effective methods for mullet farming in Tonga, and the Ministry of Fisheries is studying its economic feasibility. If proven economically feasible, the Ministry will pass on the skills and techniques to the fish farmers for future development.

There are 8 species of mullet confirmed to occur in Tongan waters. They are:

- Grey mullet (*Mugil cephalus cephalus*),
- Big-belly mullet (*Liza macrolepis*),
- Giant scale mullet (*L. melinotera*),
- Yellow tail mullet (*L. vaigiensis*),
- Bluespot mullet (*Valamugil seheri*),
- Engel's mullet (*V. enqeli*),
- Fringelip mullet (*Crenimugil crenilabis*),
- and *Neomyxus leusiscus*.

Most of the local fishermen classify mullet by their size. Small mullet are called "unomoa", larger ones are called "fua", and the largest mullet are called "kanahe", however, some experienced fishermen identify at least 7 species of mullet using local names.

### Characteristics of Mullet

Mullet always make shoals and they migrate during spawning season (spawning migration). Most of the species can tolerate a wide range of salinity.

Shoals of mullet migrate between coastal water and Fanga'uta lagoon where the salinity drops from 35ppt to 20ppt.

Mullets are detritus feeders meaning they eat from bottom sediment.



MULLET *MUGIL CEPHALUS CEPHALUS*



MULLET PEN CULTURE

## GREEN SNAIL (TURBO MARMORATUS)

This is an exotic species in Tonga and the shell as well as the flesh is highly valued in Asia. The shell is used as a material for decoration especially for inlay work.

The green snail grows to over 3kg and is one of the largest turban shells in the world.

The juveniles and sub-adults inhabit the reef crest zone, whereas, the adults move to the reef slope where the depth may be up to 25m.

The shell shape resembles the Crass turban, however, the operculum (lid) is white and does not have bumps. The shell height can be over 20cm.

Introduction of this lucrative species was conducted in 1993 and 1994 by ARDP who are hoping to establish the resource for the future. In order to realise this hope the snails need to remain untouched for 10 or more years.

As there are 4 turban shell species commonly sold at the fish market, here is a guide for identification of each species to help avoid the harvest of young green snails by mistake.

### Rough turban (*Turbo setosus*: 'Elii)

The most commonly harvested species in Tongatapu.

This species lives in the reef crest zone and at the outer edge of coral reef. The shape of the shell is roundish and the spiral line is evenly spaced.

Operculum colour is white or brown and the centre has fine bumps or no bumps. Shell height is 6cm.

### Silver mouth (*Turbo argyrostom*: 'Elii)

Along with the Rough turban this species makes up the majority of 'Elii sold at the fish market. Silver mouth can be found from the inter-tidal zone to outer reef slopes where the depth is up to 20m. The shoulder of the shell is well developed and the spiral line on the shoulder is