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**BIOLOGICAL SURVEY AND RESOURCE MANAGEMENT  
OF MULLET IN TONGA**

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# BIOLOGICAL SURVEY AND MANAGEMENT OF MULLET RESOURCE IN TONGA

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## ABSTRACT

The resource of *Mugil cephalus* has been declined by overfishing for last few decades in Tonga. To meet the local demand for mullet, mullet pen culture has been examined in Fanga'uta Lagoon to evaluate its feasibility on a five-year project of the Ministry of Fisheries. The pen culture system will be possible in small scale in the lagoon and could be one partial solution to counter the declining of mullet resource in Tonga, however, the project is still continuing.

## Introduction

In spite of concerns on mullet resource condition, no management program has been effective in Tonga so far. To solve a part of this problem, feasibility study of pen culture system started on a Aquaculture Research and Development Project in 1991 by the Ministry of Fisheries with a cooperation of Japan International Cooperation Agency (JICA). Mullet culture has been examined to meet local demand and biological survey of this resource has been also conducted for management purpose. Present paper introduces the progress of these studies and discusses the possible resource management plan for mullet in Tonga.

## Peculiarity of Mullet in Tonga

Mullet is one of the most esteemed fish in Tongan diet (Uwate et. al., 1983, Zann et. al., 1984, Hephher 1987, Langi et. al., 1992). Large and fresh mullets are sold quickly at the fish market and its price is quite high comparing with other species because of high demand of the local people. Many consumer prefer mullet (Udagawa, pers.comm.) and it is also highly regarded by fishermen according to the interview survey in 1992 (Udagawa et.al., 1993). The reason of preference is its oily and strong taste (Hephher, 1987, Zann et. al., 1984), and roe of the fish is also important to local people. As mullet is caught in large number during their spawning season, mature fish with ripe gonads is often observed at the fish market. People are fond of oily meat and roe of mullet which are the valuable protein source for them.

The average price of mullet which sampled at fish market in 1994 was TOP\$4.23 per kilogram and the highest price was TOP\$7.58 per kilogram, while the price of other species ranged TOP\$1.44 to TOP\$3.69 per kilogram (estimated from Inshore Fisheries Statistics Annual Report 1993). This high price reflects a great demand of the people.

## Decline of Mullet Resource

Decline of mullet resource has been people's concern since early 1970's in Tonga (Wilkinson, 1977, Ludwig, 1979, Zann et. al., 1984). After the introduction of wire netting as a material for fish fence in early 1950's, it experienced a boom in the mid 1960's and all the strategic location were covered by the fence (Zann et. al., 1984, Udagawa et. al., 1994). These fish fences had trapped schools of mullet when they migrated during the spawning season, which caused overfishing.

The mullet catch decreased rapidly between 1980's and early 1990's. According to Wilkinson, mullet catch often comprised 40% of the fish marketed at Nuku'alofa during the 1960's (Zann et. al., 1984). The landing of mullet was estimated to be 110 mt which was 5% of total fish consumption in 1982 (Kunatuba and Uwate, 1983). The landing had been dropped further and it became only 3.65 mt in 1993, which was 0.76% of annual fish landing (estimated from Inshore Fisheries Statistics Annual Report 1993).

Caused by the lack of mullet catch, the number of fish fence rapidly decreased at the same time. In 1975, a total of 105-km fish fence was observed at the main entrance of the Fanga'uta Lagoon (Zann et. al., 1984). Only 2.4 km of fish fence was remained along the northern coastal area in 1990 (estimated from aerial photograph, Commonwealth of Australia, Crown Copyright Reserved, 1990). As the fish fence material is quite expensive to the local people, many owners might have relinquished their fences because of the economical inefficiency.

The over-exploitation of mullet occurred mainly on the species *Mugil cephalus*, which was one of the main target species of fishing for fish fence until 1980's (Fa'anunu et. al., 1993). Although almost 75% of mullet sampled from fishermen was *M. cephalus* on the biological survey in 1987 (Langi et. al., 1992), the catch of *M. cephalus* had declined dramatically to 5.4% in 1994.

The appearance of mullet fry along the coast also showed similar declining trend. High appearance of *M. cephalus* fry, which was 54.8% of fry catch in 1988 (Kimura, 1989), dropped to less than 1.3% of the total fry collection between 1992 and 1993 (Fa'anunu et. al., 1994). It is a indicator that broodstock of *M. cephalus* had been dwindling.

## Biological Survey on Mullet

### Spawning Migration of Mullet

In 1994, fry of *M. cephalus* was observed from August to November and *L. macrolepis* fry appeared throughout the year. This appearance of mullet fry indicated that *M. cephalus* has shorter spawning period than *L. macrolepis*.

According to experienced fishermen, mullet makes a large schools during the spawning period (Langi et. al., 1992). A large school of adult mullets were observed in Fanga'uta Lagoon and along the northern coastal area. These migrated mullets are trapped by fish fence and fished by net fishermen.

### Nursery and Feeding Ground of Mullet

Fanga'uta Lagoon, which is situated in the center of Tongatapu Island, is approximately 2,800 ha (Ludwig, 1979) and has high productivity. Algal and seagrass biomass is very high and phytoplankton levels are approximately 10 times as high as most tropical waters (Zann, 1994). Therefore, the lagoon could be a suitable feeding site for many fish species. By the information from experienced local fishermen, schools of adult mullet are feeding on the sea bed when fishermen surround the schools with gillnet (Langi et. al., 1992).

The lagoon is also important as nursery for juvenile mullet (Wilkinson, 1977). Fry of *M. cephalus* was collected at the eastern entrance of the lagoon between August and November and a large number of *L. macrolepis* and other species fry were observed in the center of the lagoon throughout the year of 1994. Juvenile mullet is distributed in the shallow and protected water in the lagoon.

For both nursery and feeding ground, Fanga'uta Lagoon plays a key role in the mullet life cycle (Ludwig, 1979).

### Trial of Mullet Pen Culture

To counter the declining of mullet catch, pen culture system has been examined in Fanga'uta Lagoon since 1991. Four of 20m x 20m were constructed in the western area of the lagoon and feasibility study has been conducted.

Fry collection of mullet for the early years of the project concluded that the fry of *Liza macrolepis* could be collected in large number for mullet culture (Fa'anunu et., al., 1994). Fingeling of *Liza* species, which was approximately 15g in body weight was collected in May 1994 for the pen culture experiment in the lagoon. After 7 to 10 months, they grew up to marketable size which was approximately 100g of body weight. These cultured mullet was accepted by the local customers during the test selling (Fale et. al., 1994).

Another experiment showed that *L. macrolepis* could be cultured in the lagoon without feeding when the density of fish is lower than 7.5 fish/m<sup>2</sup>. Both mullet with feeding and without feeding showed the same growth in the pen. Therefore, the pen culture of *L. macrolepis* in the lagoon will be possible on a small scale and extensive way, however, the trial is continued for further experiment.

### Plan For Management of Mullet Resource

To conserve the remaining mullet resource, especially *M. cephalus*, four main programs are recommended. They are;

- i) conservation of broodstock of mullet,
- ii) conservation of nursery and feeding ground of mullet,
- iii) monitor of mullet fry appearance that indicate their resource, and
- iv) mullet culture to meet high local demand on mullet meat.

Firstly, the remaining mullet should be protected as broodstock. Most of the *M. cephalus* are caught in large number between June and September. To prevent the catch of mullet migrating for spawning, this period should be closed for fishing. During this period, fish fence and net fishing for mullet have to be prohibited and any mullet marketed should be inspected.

Secondary, Fanga'uta Lagoon should be protected from fishing and any commercial activities. This lagoon plays an important role as a nursery and feeding ground for mullet. Local villagers around the lagoon often reported mullet fishing during the closed season designated in Fisheries Act 1989, which is between June and July. The prohibition have to be enforced rigorously, however the period is not effective enough.

Dynamite fishing is another problem in the lagoon. Some fishermen still use dynamite for fishing against the law. The dynamite could damage the fish irrespective of the size and would be lethal for the fisherman himself. The more strict enforcement of the prohibition must be needed.

A 1975 ban of commercial fishing and activity in the lagoon, which was repealed by parliament in 1981 (Zann et. al., 1984), should be revived for protecting the area. With the demand for development, many commercial activities will be proposed in the unused area. Those commercial activities, such as dredging, reclamation, mining, will damage the ecology of the lagoon as well as fishing. The lagoon should be prevented from the destruction.

To monitor the recovery of protected mullet resource, fry collection will be continued. The occurrence of mullet fry could indicate the recovery of the broodstock.

Aquaculture of mullet will be important to supply to the market during the prohibition period. Mullet pen culture is a possible solution to meet the local demand for mullet and will bring several biological information which is necessary for the management of mullet resource. Culture of mullet will also be encouraged as an alternative for fishermen instead of fish fence.

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