Giant Freshwater Prawn Culture in Indonesia[1]

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Introduction

Indonesia is one of the countries in Asia with rich biodiversity, particularly in terms of the number of endemic freshwater aquatic organisms. Numerous indigenous freshwater fish species are found in Sumatera (30 spp.), Kalimantan (149 spp.), Java (12 spp.), and in Sulawesi (52 spp.) (Anonymous, 1994; Kottelat *et al.*,1993). These fauna are distributed in a total of 55 million hectares of freshwater resources consisting of lakes, dams, swamps, etc. The potential area for freshwater fish pond culture is estimated at 233,124 ha with a production of 334,085 mt/year (DGF, Indonesia. 2001), of which about 5,140 metric tons come from giant freshwater prawn culture.

Freshwater prawns are farmed in West Java, i.e., in Ciamis (Tambaksari, Pamarican and Kalipucang) and Tasikrnalaya. Government- and privately-owned commercial hatcheries are mostly found in Jogjakarta. In East Java, *Macrobrachium* culture is done in brackishwater ponds. Freshwater prawn culture has also spread to Bali Island, e.g., Gianyar, Klungkung, Buleleng and Tabanan.

Indonesia is recognized as the center of origin of freshwater prawns and to date, there are about 19 species found in its natural waters (Holthuis, 1980). Despite the advanced development of freshwater prawn culture and the availability of natural prawn populations in Indonesia, slow prawn growth rate, diseases and small edible portion remain unsolved. In recent years, the Indonesian Government through its fisheries research agency, has focused on improving the commercial production of the freshwater prawn through genetic means. Thus in 2001, a genetically improved stock of freshwater prawn has been developed and released for culture to local prawn farmers. This stock or strain has been referred to as the GI Macro or the Genetically Improved *Macrobrachium rosenbergii.*

Present Status of Freshwater Prawn Culture in Indonesia

The potential areas for giant freshwater prawn culture in Indonesia consist of paddy-ponds, freshwater- and brackishwater ponds. About 10,000 ha of the potential areas are found in Bali, 2,500 ha in West Java, 2,200 ha in Central Java, and 21,000 ha in East Java. Since 1990 there has been an indication of a decreasing production of giant freshwater prawn from the natural waters, specifically in some areas in West Java and Sumatera. This situation led to the promotion of freshwater prawn culture in Jogjakarta (Central Java) and Lamongan (East Java).

In Bali, freshwater prawn culture has been well developed since 1997 because of high market demand. Here, the estimated consumption of freshwater prawns is about 700 kg/day at US$ 4.00 to US$ 10.00/kg (before the Bali blast, 2002).

Freshwater prawns are farmed using traditional and semi-intensive systems in mono- or polyculture with common carp, tilapia, milkfish and *Puntius*. Small ponds (200 m^2) are used where postlarval fry (PL 25-40) are reared for two months. At two months, uniform-sized prawns are selected and then prawns are reared separately by size at a stocking density of 10 fry/m^2. Production using this scheme is about 300 kg/ year (polyculture) and 600 kg/year (from monoculture) with an average size of 30 g/pc. In order to meet the

[1]*consolidated information based on presentation made during the 1st and 2nd Roundtable Discussion on the Development of Genitically Improved Strain of* Macrobrachium

demand for freshwater prawn fry, hatcheries have been developed in Jogjakarta, West Java and in Bali. The fry requirement of Gianyar-Bali farmers estimated at about 24 million/year, is partly supplied by hatcheries in Jogjakarta and East Java. Each PL 25-40 fry costs US$ 0.60-0.70. The production capacity of hatcheries in Bali is about 7 million fry/year, about 300,000 fry/year in West Java, and 11 million fry/year in Jogjakarta.

Freshwater prawn culture in Indonesia has spawned interest especially among farmers with idle tiger shrimp ponds. While efforts to solve disease problems in tiger shrimp culture are being pursued, tiger shrimp production has declined, hence, freshwater prawn culture has become a viable alternative. For this purpose, a strain/stock of giant freshwater prawns with high salinity tolerance is being developed. Apart from the development of salt-tolerant prawns, efforts to formulate seed quality standards have been given due attention. Good quality prawn seedstock means fast growing, salt-tolerant postlarvae with relatively bigger edible portions.

The Freshwater Prawn Genetic Improvement Program

It is recognized that the quality of the country's freshwater prawn is genetically deteriorating. It has become difficult to produce export size (50g/pc) female prawns as the survival rate has become very low as well. To produce 50g average size male prawns, a batch's survival rate is only less than 40% in 9-11 months of culture. Since 1996, the Research Institute for Freshwater Aquaculture (RIFA formerly RIFF) implemented research programs with the main objective of improving the growth rate and increasing the edible portion of the prawn. The improvement program includes the following activities:

Breeding Program

A selective breeding program to improve the quality of the farmed freshwater prawns by developing a synthetic prawn population using breeders from the natural populations in Tanjung Air (Bekasi), Kalipucang (Ciamis) and Musi (Palembang), has been implemented. The Tanjung Air stock (average individual body weight = 70g) was collected in February 1995. Individual selection was applied on this sub-population to improve the edible portion trait. The Kalipucang sub-population (ABW=72g) was collected in June 1996. Index selection was used in this population to improve growth rate and size of the edible portion. After a two- step selection, a synthetic population was constructed from these two sub-populations and subsequently used in crosses with the Musi sub-population (ABW=75g) collected in May 1997. Family selection (based on growth and increased edible portion) was applied to the synthetic population using 24 families. Results obtained from the fourth generation freshwater prawns are shown in Table 1.

Table 1. **Characteristics of the GI Macro after the fourth generation**

Number	Character	Value
1	Heritability of edible portion (h^2_{ep})	0.56 *(SE: 0.07)*
2	Heritability of body weight (h^2_{bw})	0.84 *(0.02)*
3	Inbreeding rate (F)	0.0091
4	Total length of male (cm)	21.53 *(5.45)*
	Total length of female (cm)	15.02 *(3.19)*
5	Percentage of carapace (male)	30.45 *(5.86)*
	Percentage of carapace (female)	32.68 *(8.05)*
6	Hatching rate (%)	65.27-80.0
7	Survival rate (% per 4 months)	46.3-53.1

Distribution of GI Macro Seed

GI Macro seedstock have been distributed to three hatcheries in Probolinggo, East Java; Samas, Jogjakarta; and Pamarican, West Java on 24th July 2001 (Nugroho *et al.*, 2005). The seedstock were grown to broodstock and once mature, were subsequently set for production of the next generation seedstock.

Generally, the GI Macro did well initially but problems were encountered after two years. The average body size of GI Macro varied in different locations, e.g. 130g average weight for males and 51g for females in Samas, 30g (males) and 25g (females) in Probolinggo, and 40g (males) and 34.5g (females) in Pamarican. There indications of environmental influence (e.g. culture management) on the growth rate. Apart from this, the size of the edible portion gradually declined. The farmers can visually distinguish the GI Macro from unselected stock based on the proportion of the body to the carapace. The GI Macro mixing with other stocks and mating among themselves resulted to reduced response to selective breeding.

This year, RIFA obtained the second generation of GI Macro that can tolerate salinities of up to 15 ppt but the field performance of this stock has yet to be evaluated. The GI Macro developed at RIFA are shown in Figures 1 and 2.

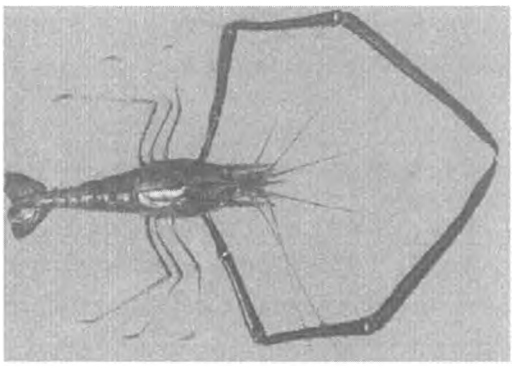

Figure 1. **Grand parent stock of fresh water prawn, GI Macro; total length: 38.0 cm and body weight: 480g**

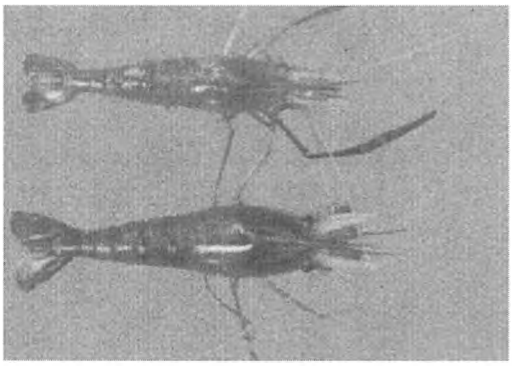

Figure 2. **Improve prawn (below) and control farmer strain (above) after five months rearing period**

Other Research Activities on the Freshwater Prawn

Application of molecular markers

DNA markers have been used to characterize a number of natural stocks of freshwater prawn collected since 2002. The genetic variability of freshwater prawns from Musi, Barito and GI Macro were examined using mitochondrial DNA cytochrome oxidase I restriction fragment length polymorphism (mtDNA CO-I RFLP) markers. Six composite haplotypes were detected following digestion of CO-I sequences with four endonucleases: Rsa I, Hae III, Mbo I and MspI. The average haplotype diversity was 0.603 (Table 2). Significant genetic differences were observed among the aforementioned freshwater prawn populations. The biggest proportion of the major composite haplotype was in the GI Macro, which came from Citatum and Citanduy. While Musi freshwater prawns contributed about 25% to the composite haplotype of GI Macro. The Barito stock is a potentially good genetic resource for future freshwater prawn breeding programs.

Application of hormone for sex reversal

Male freshwater prawns are bigger than their female counterparts. Large-scale production of all-male prawns can be done by obtaining female stocks that are can become genetically males or homogametic females. When homogametic females mate with normal males, the result is a 100% male phenotype. This research is still ongoing with initial results expected to come out before the end of 2003.

Table 2. **Frequency of composite haplotype mtDNA CO-I among freshwater prawn populations with four endonucleases, Rsa I, Hae III, Mbo I and Msp I**

Number	Type Composite Haplotype	Population		
		GI Macro	Musi	Barito
1	AAAA	0.375	0.071	0.647
2	ABAA	0.188	0.142	-
3	ACAA	0.250	0.642	0.353
4	ABAB	0.125	0.071	-
5	ACAB	0.062	-	-
6	ACBA	-	0.071	-
	Number of samples	16	14	17
	Number of haplotypes	5	5	2
	Haplotype diversity	0.766	0.573	0.471

Culture technology: closed recirculation system for larval rearing and nursery

The larval rearing system used is re-circulation with biofilter, ozone addition and UV radiation. This system is intended to supply good quality of water for larval rearing and nursery. The PL 25-40 produced using this system, are now being cultured in ponds.

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