Collection and Evaluation of Wild and Farmed Stocks of Giant Freshwater Prawn in Indonesia[3]

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Introduction

Giant freshwater prawn is an important commodity that has been cultured successfully in Indonesia. Freshwater prawn farming has been adopted in several areas of West Java, i.e. Ciamis (Tambaksari, Parigi, Rancah and Pasir Nagara) and Tasikmalaya. Some commercial hatcheries are found in Jogjakarta, a local government hatchery, and seven private hatcheries. In East Java, freshwater prawns are farmed in brackishwater ponds. Freshwater prawn culture has also spread to some areas in Bali, e.g. Gianyar, Klungkung, Buleleng and Tabanan, as well as in Riau, South Sulawesi and South Sumatera.

Inspite the development of freshwater prawn culture in Indonesia, some problems like slow growth rate, diseases and low carcass yield (small edible portion) remain unsolved. To address these problems, the Research Institute for Freshwater Aquaculture (formerly RIFF) started numerous genetic improvement programs since 1996 to improve growth rate and increase the animal's edible portion.

The genetically improved giant freshwater prawn stock named GI Macro (or Genetically Improved *Macrobrachium*), has been distributed to farmers particularly in Java. As reported in Nugroho and Emmawati (2004) and Nugroho *et al.* (2005), the performance of this stock in the different culture sites varied hence the development of a more suitable genetic base population with the use of other wild-sourced stocks in the continuous selection program was deemed necessary. An assessment of the genetic background of the wild stocks showed genetic divergence between giant freshwater prawns from western and eastern part of Indonesia (Nugroho *et al.*, 2007). A performance evaluation of giant fresh water prawn stocks will be conducted to complement the above results in order to produce high quality giant freshwater prawn seedstock.

Materials and Methods

Sample Collection

Broodstock of giant freshwater prawn were collected from Sulawesi (Makasar), Kalimantan (Pangkalanbun), Sumatera (Jambi) and Java (GI Macro-Sukabumi). Twenty eight prawns (12 males and 20 females) from Sulawesi, 45 prawns from Kalimantan (20 males and 25 females), 59 prawns from Sumatera (18 males and 41 females) and 22 prawns from Java (GI Macro, 12 males and 20 females) were brought to the Research Institute for Freshwater Aquaculture in Bogor.

Broodstock Evaluation

Broodstock of giant freshwater prawns were reared in 12 x 4 m concrete ponds and supported by paddle wheels made from fiberglass (Figure 1).The pond bottom has a substrate of gravel sand (10 cm) which serves as a medium for culturing bacteria or decomposer organisms. Water current in the pond is constant at 9-12 liter/sec.

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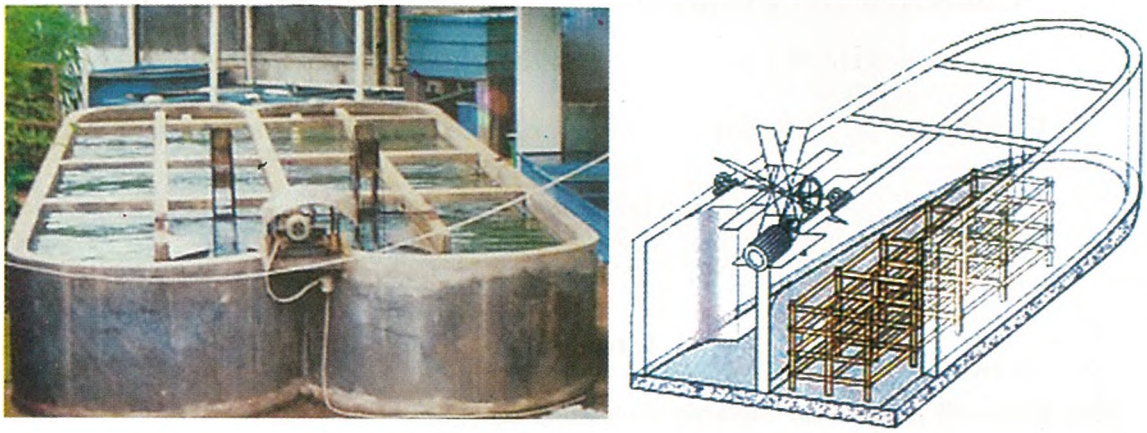

Figure 1. **A broodstock pond**

Commercial shrimp feed pellets were administered to the broodstock for two months. Breeders with fertilized eggs were taken and kept in 60 x 40 x 20 cm aquaria for hatching. The parameters recorded during this experimental period are growth rate, survival rate, fecundity and number of post larvae obtained.

The post larvae were reared in concrete ponds following standard operational procedures (SOP) for giant freshwater prawn culture at RIFA. Growth and survival rate were noted as the post larvae grew to marketable size.

Heterosis

Evaluation of heterosis was done by setting up individual mating pairs (1 female and 1 male) among giant freshwater prawn stocks tested. Breeders were taken and kept in concrete tanks for spawning. Larvae and post larvae were reared in aquaria (Figure 2), while juveniles were on-grown in concrete or earthen ponds. The rearing protocols are according to the RIFA's SOP. The parameters monitored are time of metamorphosis, survival and growth rate of larvae, post larvae and juveniles. The testing scheme to determine heterosis in intraspecific crosses is listed in Table 1.

Table 1. **Scheme for testing heterosis**

Male / Female	Sulawesi	Kalimantan	Sumatera	Java
Sulawesi	3 replicates	3 replicates	3 replicates	3 replicates
Kalimantan	3 replicates	3 replicates	3 replicates	3 replicates
Sumatera	3 replicates	3 replicates	3 replicates	3 replicates
Java	3 replicates	3 replicates	3 replicates	3 replicates

Figure 2. **A set aquarium for individual pair mating**

Selection

A base population was formed based on the result of heterosis-testing. Breeders that have good performance traits (fast growth and high survival) will be used to produce postlarvae for the selection activity. Selective breeding based on between and within family selection (selecting the upper 25% of the normal growth curve distribution) shall be undertaken.

Results and Discussion

Broodstock performance

Growth rate variation has been observed among the giant freshwater prawn stocks examined. The Kalimantan stock has the highest specific growth rate at 3.24%, followed by GI Macro (1.91%), Sulawesi (0.68%), and Sumatera (0.43%). The highest average weight was noted in the Sumatera stock at 83.6g, and followed by Sulawesi, Kalimantan and Java, at 80.2g, 48.6g and 40.2g respectively. In terms of reproductive traits, the giant freshwater prawn from Java (GI Macro) produced the highest number of eggs, i.e. 1,263 eggs/g body weight, followed by Sumatera (1258 eggs/g), Kalimantan (1,100 eggs/g) and Sulawesi (743 eggs/g). These results show that wild freshwater prawns are well-adapted and can be domesticated in hatcheries especially using modified concrete ponds.

The number of larvae produced varied from 48,000 to 55,000, while postlarval production ranged from 7,000-8,000 with a survival rate of 13.8%-16.9%. Giant freshwater prawn from Java produced the highest number of postlarvae, followed by Sulawesi, Sumatera and Kalimantan. The number of PL from each population is listed in table 2.

Table 2. **Number of larvae, postlarvae (PL), and survival rate of PL in the different populations**

Population	Number of Larvae	Number of PL	Survival Rate (%)
Sumatera	48,745 ± 11,950	7,160 ± 999	14.9 ± 0,02
Java/GI Macro	51,909 ± 6,285	8,667 ± 764	16.9 ± 0,02
Kalimantan	48,352 ± 2,590	6,591 ± 1,723	13.8 ± 0,04
Sulawesi	55,319 ± 2,311	8,179 ± 2,896	14.9 ± 0,06

D'Abramo and Brunson (1996) showed that the required time for development of larvae is about 15-40 days depending on the quality and quantity of feed, water quality and size of breeder. Giant freshwater prawn from Kalimantan and Java needed 27-28 days, while those from Sumatera and Sulawesi required 34-35 days for larval development. Furthermore, the survival rate of juveniles reared for one month was noted at 61.34% (Sumatera) to 89.30% (Java) (see Figure 3).

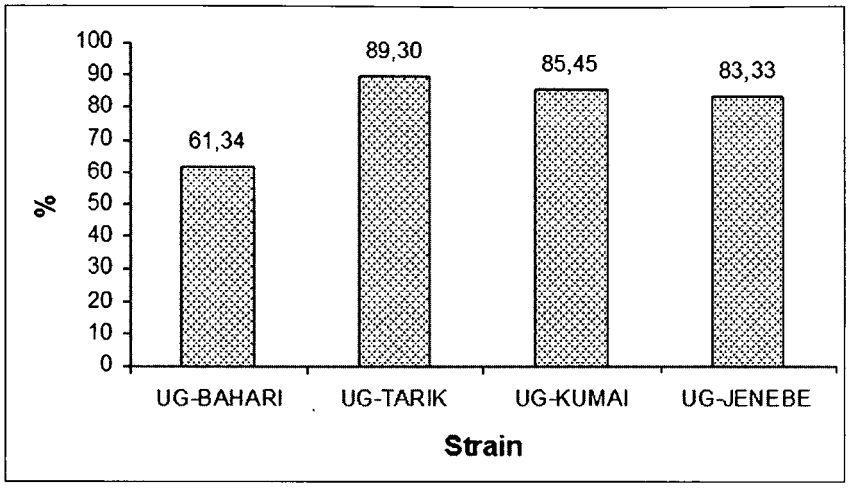

Figure 3. **Survival rate of the different freshwater prawn stocks**

Size variation is a problem in prawn culture. This variation influences the total harvest. Therefore the farmer cannot conduct total harvest, and can only sell from partial harvests because of the constraints posed by size variation. Relative size variation was also monitored. Offsprings of giant freshwater prawn from Kalimantan and Java have more homogenous sizes compared to those from Sulawesi and Sumatera. This indicates that a selection program will be more useful when breeders from Sulawesi and Sumatera stocks will be used. A comparison on the growth of juveniles reared for one month showed that the giant freshwater prawns from Kalimantan grew faster than other stocks (Figure 4).

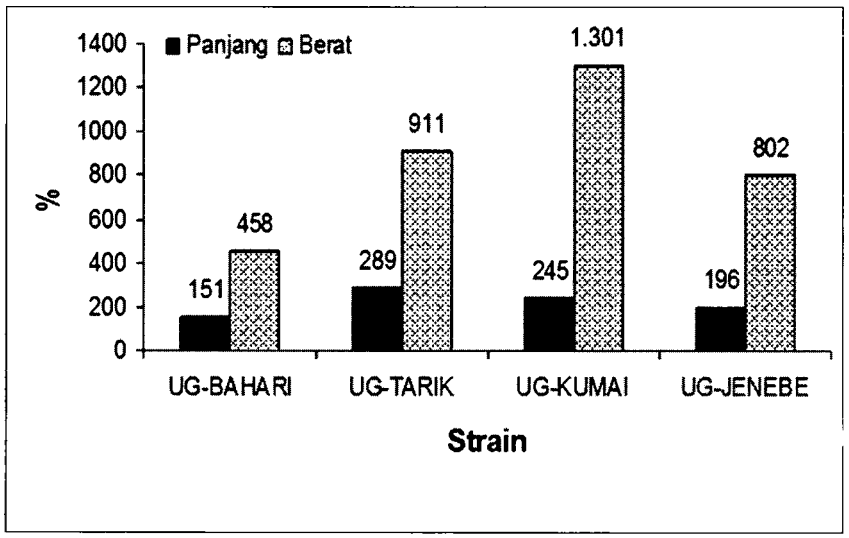

Figure 4. **Body weight (left) and body length (right) of giant freshwater stocks**

Heterosis

The effect of heterosis among giant freshwater prawn populations was measured using individual mating pairs between populations. Several pairs were mated and the larvae reared in aquaria. The number of larvae produced is listed in Table 3.

In general, the capability of male breeders to fertilize eggs from one female varies according to the source of the stock. Male freshwater prawn breeders from Sulawesi can fertilize eggs of females from all of the other test stocks, this is followed by male broodstock from Kalimantan and Sumatera which are able to fertilize eggs of females from 1-2 other populations. Meanwhile, male breeders from Java can successfully fertilize eggs of females from the Java stock only. On the other hand, the capability of females to spawn eggs

is not influenced by the source of the stock. Female broodstock from Kalimantan and Java can be mated to male broodstock from the two other populations, then followed by female breeders from Sulawesi while Sumatera female broodstock can be mated to one population. This capability to fertilize eggs depends on the size of the breeders used. Generally, male Sulawesi breeders are big therefore these have no problem when mated to female breeders from any population. Meanwhile male breeders from the Java stocks are relatively smaller than their female counterparts from the other populations therefore problems in individual pair mating occurs.

Table 3. **Body weight, body length and number of larvae produced from the intraspecific crosses**

Male / Female	Sulawesi	Kalimantan	Sumatera	Java/GI Macro
Sulawesi	WF= 50.9g LF= 17.3cm WM= LM = PL 18= 51,467 pcs PL 27= *	WF= 32.64g LF= 13.8 cm WM= LM = PL 18= 30,103 pcs PL 27= 4,170 pcs	WF= 67.24g LF= 16.0 cm WM= 193.38g LM = 22.2cm PL 18= 25,721 pcs PL 27= 7,674 pcs	WF= 30.16g LF= 13.9 cm WM= LM = PL 18= 25,721 pcs PL 27= 7,674 pcs
Kalimantan	WF= 45.33g LF= 14.2 cm WM= 34.0g LM = 16.4 cm PL 18= 20,500 pcs PL 27= 3,500 pcs	WF= 28.2g LF=14.5 cm WM= LM = PL 18= 23,726 pcs PL 27= *	NH	WF= 36.78g LF= 15.5 cm WM= 146.33g LM = 22.7 cm PL 18= 29.136 pcs PL 27=*
Sumatera	NH	WF= 33.37g LF= 14.2 cm WM= LM = PL 18= 23,421 pcs PL 27= 3,500 pcs	WF= 88.5g LF= 21.4 cm WM= LM = PL 18= 31,687 pcs PL 27= *	NH
Java/ GI Macro	NH	NH	NH	WF= 19.7g LF= 12.8 cm WM= LM = PL 18= 24,887 pcs PL 27= *

* Data unavailable to date

NH - no hatching, WF-weight of female, LF- length of female, WM - weight of male, LM - length of male

When a female breeder is bigger than the male, oftentimes mating does not ensue. This has become a limitation in freshwater prawn pair-mating therefore another option such as mating one male to 2-4 females will be tested in the next research.

The number of larvae produced varied from 20,500 pcs (♀ Sulawesi x ♂ Kalimantan cross) to 51,467 pcs (♀ Sulawesi x ♂ Sulawesi cross). Based on the preliminary data, the heterosis value based on larvae production is about -7.170. This shows that the productivity of the pure breed is better than the hybrid progenies. The pure breed Sulawesi stock gave the highest value. If data on the larval production from the pure Sulawesi was not included in analysis, then the value of heterosis will change to -2.404 or about 66% of the total heterosis value. Heterosis value of postlarval production and growth has yet to be estimated. It will require four months for the postlarvae to reach marketable size. Selection will be continued using a base population from the best performing pair from among the stocks.

Acknowledgements

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