Project Highlights

Genetic Characterization, Domestication and Improvement of *Macrobrachium rosenbergii* in the Philippines

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Introduction

Extensive studies in the Philippines and in adjacent countries revealed that 528 caridean prawn species are found in this region alone (Chan, 1998). Of all the known species, the giant freshwater prawn is considered the most commercially important. Except for the Philippines, culture of the giant freshwater prawn, *Macrobrachium rosenbergii,* has already made substantial contributions to the local aquaculture production in Southeast Asia, i.e. in Thailand, Malaysia and Indonesia. However, efforts are now being made to improve the aquaculture production of *Macrobrachium rosenbergii* in the Philippines, thus, optimal methods for the culture and propagation of this high value freshwater aquaculture species are being developed by the Philippine Government fishery agencies as well as other research and academic institutions.

The Integrated Rural Aquaculture Program under the ASEAN-SEAFDEC Special Five-Year Program or what is presently known as the Program on the Promotion of Sustainable Aquaculture in the ASEAN Region enabled the Bureau of Fisheries and Aquatic Resources, the Mindanao State University and the Aquaculture Department of SEAFDEC to jointly conduct studies on the genetic characterization, domestication and improvement of *Macrobrachium rosenbergii* stocks in the Philippines in order to improve the aquaculture production of the giant freshwater prawn. Under the collaborative project which started in late 2004, specific research activities under were conducted, and an update on their results are summarized as follows:

A. Collection, domestication and propagation of wild *Macrobrachium rosenbergii* stocks

Proponents: Westly Rosario and Editha C. Roxas, BFAR-NIFTDC

During the first RoundTable Discussion held at the Freshwater Aquaculture Development Center in Sukabumi, West Java, Indonesia in November 2003, the delegates from Thailand reported that the Philippine wild stocks of *Macrobrachium*, *Macrobrachium rosenbergii rosenbergii* Philippine strain could be a better variety and therefore must be protected from contamination by non-indigenous strains. This report supports and confirms the importance of the activity of the National Integrated Fisheries and Development Center (NIFTDC) to collect live specimens of various strains of *Macrobrachium* in the country and review their performance in terms of growth and fecundity.

In the Philippines, wild catch is available from the river tributaries and lakes in the provinces of Pangasinan, La Union, Ilocos Sur, Ilocos Norte, Cagayan, Pangasinan, Pampanga, Bulacan, Laguna, Palawan, Sorsogon, Leyte, Samar, Cotabato, Lanao, Maguindanao, Agusan and other parts of Mindanao. A survey by Agasen (2001, unpublished) reported 12 species in Luzon with *Macrobrachium rosenbergii* as dominant species.

Collection and Domestication

BFAR-NIFTDC collected live wild stocks of the species from Bulacan, Palawan, Bicol and two provinces in Mindanao from year 2002 and domesticated them at the Center. Due to limited space and manpower, the strains found to be inferior in growth performance were discarded. Recently however, a Gene Bank facility for *Macrobrachium* was established by the National Integrated Fisheries Development Center (NIFTDC) in Dagupan City, Pangasinan (Rosario, 2007). This gene bank aims to conserve the country's giant freshwater prawn resource hence live specimens of the various commercially important freshwater prawn species collected in several provinces in the Philippines are being maintained in this facility.

Testing of Local Strains

One local strain of *Macrobrachium* (BFAR 1) collected by BFAR-NIFTDC from Mindanao was tested to have better performance than the old strain used by the Center (BFAR 0). With the BFAR 0 as benchmark, the larval rearing period of BFAR 1 is shorter by 8 to 13 days. The normal rearing period of BFAR 0 is 45 to 50 days, whereas BFAR 1 only requires 37 to 40 days. The larval rearing period is much shorter during hot months. The size of BFAR 1 larvae are bigger by 25%. The survival rate of the larvae during rearing has improved by about 12%. Results of field trials on growth performance are still being evaluated.

There were more than 200,000 postlarvae produced and distributed to the farmers for culture by BFAR-NIFTDC from October 2003 to September 2004. From 100 breeders collected from the wild, the Center is now using 500 F_2 and F_3 breeders.

One problem encountered in the use of another local strain (BFAR 2) is the early release or detaching of eggs from the female breeders.

The basic problem encountered by BFAR-NIFTDC in the collection and use of local strains is the proper identification of species.

B. Morphometric characterization, identification and validation of *Macrobrachium* samples

Proponents: Maria Rowena R. Romana-Eguia, SEAFDEC/AQD
Henry Dejarme, MSU
Westly Rosario, BFAR-NFRDI
Edith Roxas, BFAR-NFRDI

Macrobrachium rosenbergii and other species that closely resemble the giant freshwater prawn can be caught in some of the 25 commercial fishing grounds in the Philippines (Rosario and Tayamen, 2004). Agasen (2001) identified about twelve species of freshwater prawns in a survey of river tributaries and lakes in Luzon, Philippines. An assessment of freshwater prawns in Visayan and Mindanao provinces where even larger *Macrobrachium rosenbergii* samples have been observed, has yet to be undertaken. Although studies that characterize caridean prawns have already been conducted, the exact identities of local species are often difficult to ascertain (Chan, 1998). In the Philippines, the need to validate the identity of freshwater prawn stocks, specifically *Macrobrachium rosenbergii* being collected and used by the various local research and government fishery agencies has been emphasized.

Confusion over the exact identity of both wild and hatchery-bred *M. rosenbergii* stocks stems from the fact that many of the existing hatchery stocks of the giantfreshwater prawn originated from an imported stock from Thailand which was brought in and later promoted by the Philippine Bureau of Fisheries and Aquatic Resources.

It has been shown that the Malaysian, Indonesian and Thai stocks of *Macrobrachium rosenbergii* basically of the western subspecies (*M. rosenbergii dacqueti* Sunier 1925), are different from the eastern subspecies (*M. rosenbergii rosenbergii* de Man 1895) found mainly in the Philippines (New, 2002; De Bruyn *et al.*, 2004; Chand *et al.,* 2005). This study was conducted to: (a) taxonomically validate the identity of the existing hatchery-bred and wild *Macrobrachium rosenbergii* stocks used in commercial aquaculture and *Macrobrachium* research in the Philippines; (b) identify possible sources of good quality *Macrobrachium rosenbergii rosenbergii* in the Philippines (particularly in Visayas and/or Mindanao) which can be used for domestication and selective breeding programs; and (c) characterize other indigenous *Macrobrachium* species that may have some aquaculture potential.

During the implementation of the project in September 2004, arrangements were made for Dr. Daisy Wowor and Prof. Peter Ng (noted crustacean taxonomists from the National University of Singapore and the Museum Bogoriense in Indonesia) to help validate the identity of the freshwater prawn samples collected from selected localities in the Philippines. The samples collected from each of the various sources comprised of at least three adult males, three adult females (preferably berried) and four juveniles. Individual morphometric measurements (rostral teeth, carapace length, body length, total length) were recorded and individual samples were photographed. The collected samples were initially kept for two weeks in 80% ethanol. After two weeks, the samples were individually wrapped in cheesecloth, placed in labeled plastic bags and sealed before these were sent off for validation at NUS.

Table 1 shows the number and identity of the samples collected from hatchery and wild sources in several locations in the Philippines. The Mindanao samples were procured by Prof. Henry Dejarme of the Mindanao State University.

Table 1. **Freshwater prawn samples collected for taxonomic identification**

Source	Number of samples	Identity
A. WILD		
REGION I		
Vigan, Ilocos Sur	3	*Macrobrachium lepidactyloides*
REGION II		
Buguey, Cagayan	13	*Macrobrachium latidactylus*
	4	*Macrobrachium australe*
	2	*Macrobrachium esculentum*
	8	*Macrobrachium lar*
Gonzaga, Cagayan	5	*Macrobrachium lar*
Pamplona, Cagayan	2	*Macrobrachium lar*
REGION III		
Calumpit, Bulacan	21	*Macrobrachium rosenbergii rosenbergii*
	11	*Macrobrachium rosenbergii dacqueti*
Baler, Quezon	5	*Macrobrachium lar*
Tarlac	1	*Macrobrachium idae*
	1	*Macrobrachium lanceifrons*
REGION IV		
Laguna de Bay (Binangonan, Rizal)	9	*Macrobrachium lanceifrons*
	2	*Caridina gracilirostris*
	8	*Caridina blancoi*
REGION V		
Lake Bato, Camarines Sur	10	For identification
Sorsogon	4	For identification
REGION VI		
Tangyan River (Igbaras, Iloilo)	8	*Macrobrachium australe*
	1	*Macrobrachium latidactylus*

	7	*Macrobrachium jaroense*
Leganes, Iloilo	27	*Macrobrachium rosenbergii rosenbergii*
Cairawan River (Laua-an, Antique)	4	*Macrobrachium esculentum*
	10	*Macrobrachium latidactylus*
	6	*Macrobrachium jaroense*
	2	*Macrobrachium horstii*
	1	*Macrobrachium lar*
	2	*Macrobrachium australe*
	2	*Macrobrachium lepidactyloides*
REGION VII	-	Samples yet to be collected
REGION VIII		
Divisoria, Leyte	13	*Macrobrachium latidactylus*
REGION IX		
Dapitan	1	*Macrobrachium rosenbergii*
Tambulig/ Aurora, Zamboanga del Sur	15	*Macrobrachium mamillodactylus*
(Panguil Bay)	12	*Macrobrachium equidens*
	2	*Macrobrachium rosenbergii dacqueti*
	8	*Macrobrachium rosenbergii rosenbergii*
Dinas, Zamboanga del Sur	5	*Macrobrachium rosenbergii dacqueti*
(Illana Bay)	5	*Macrobrachium rosenbergii rosenbergii*
Siay, Zamboanga Sibugay	4	*Macrobrachium rosenbergii dacqueti*
	6	*Macrobrachium rosenbergii rosenbergii*
REGION X		
Layawan, Oroquieta	5	*Macrobrachium lar*
	4	*Macrobrachium jaroense*
	1	*Macrobrachium latidactylus*
	1	*Macrobrachium equidens*
REGION XI		
Lake Apo Bukidnon	7	*Macrobrachium rosenbergii rosenbergii*
REGION XII		
Liguasan Marsh (Pikit side)	11	*Macrobrachium mamillodactylus*
	2	*Macrobrachium weberi*
	1	*Macrobrachium australe*
Pikit, North Cotabato	4	*Macrobrachium rosenbergii*
REGION XIII	3	*Macrobrachium jaroense*
Mangagoy, Surigao del Sur (Bislig Bay)	12	*Macrobrachium mamillodactylus*
	1	*Macrobrachium latidactylus*
Lake Mainit	10	*Macrobrachium lanceifrons*
Agusan River, Agusan del Sur	8	*Macrobrachium mamillodactylus*
	2	*Macrobrachium esculentum*
Bislig River	4	*Macrobrachium mamillodactylus*
ARMM		
Lake Lanao, Lanao del Sur	10	*Macrobrachium latidactylus*
B. HATCHERY		
SEAFDEC/AQD-1 (BFAR stock)	10	*Macrobrachium rosenbergii dacqueti*
SEAFDEC/AQD-2 (Leganes F_1)	60	*Macrobrachium rosenbergii rosenbergii*
SEAFDEC/AQD-3 (Zambales; orig. Calumpit)	30	Morphologically *M. r. dacqueti* but possibly mixed stock from *M. r. dacqueti* and *M.r.rosenbergii* cross
BFAR 0	5	*Macrobrachium rosenbergii dacqueti*
BFAR 1	10	*Macrobrachium rosenbergii rosenbergii*

The distinguishing characteristics of five major species which were identified from the samples are briefly described below :

1) *Macrobrachium rosenbergii* (giant river prawn)

Eastern form: *M. rosenbergii rosenbergii* (de Man, 1879)
Western form: *M rosenbergii dacqueti* (Sunier, 1925)

There are several subtle differences between these two forms or subspecies of *Macrobrachium rosenbergii.* However the main difference between them is the basal crest of the rostrum. The basal crest of the *M. rosenbergii dacqueti* is higher than that of the endemic *M. rosenbergii rosenbergii.* Apart from this feature, the body of the *M. rosenbergii dacqueti* is dark green to grayish blue with longitudinal streaks of darker and lighter color while that of the *M. rosenbergii rosenbergii* has some pattern as shown below. The giant prawn's long rostrum extends beyond the antennal scale and has 11-14 upper teeth and 8-14 lower teeth. The *M. rosenbergii's* second legs are very large, robust and of same size. In adult males, the entire second leg is densely covered with spines and sharp tubercles. The giant river prawn is the largest known *Macrobrachium* species. From the samples that were analysed, the largest adult individuals were obtained from Dinas and Tambulig, with total lengths of 23.6 cm and 23.5 cm, respectively. In *M. rosenbergii rosenbergii* all antenna are blue while in *M. rosenbergii dacqueti,* only the second antennae are blue, the rest are brown.

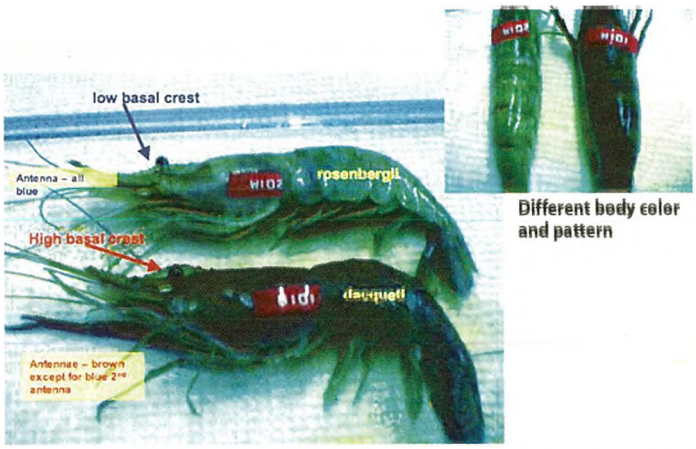

Figure 1. **Sample of *Macrobrachium rosenbergii rosenbergii* and *Macrobrachium rosenbergii daqueti***

This prawn is rarely found in pure freshwater. They normally thrive in lower parts of streams, river mouths, estuaries where the water has a higher salinity (brackishwater) as it breeds in brackish and seawater (Chan, 1998). From the samples analysed, 13 individuals from Tambulig were *M. equidens* (2.2 cm average carapace length, 9 cm total length, 7.2 cm body length, and 9 upper and 5 lower rostral teeth). The rostrum of the *M. equidens* almost always exceeds the distal end of the antennal scale. The large second legs are marbled like tortoise shell.

3) *Macrobrachium mamillodactylus* (knobtooth prawn)

The distinct feature of this species is the shape of the rostrum. The tip of the rostrum does not reach the distal end of antennal scale. The large second legs are longitudinally striped. The fingers of the second legs are not covered by soft short hair, but instead have rows of tubercles along the cutting edges. Samples of *M. mamillodactylus* were obtained from Tambulig and Mangagoy in Mindanao. The average measurements of the samples were: 3.6 cm carapace length, 12.1 cm total length and 10 cm body length. The rostrum has 11-13 upper teeth and 3-5 lower teeth.

4) *Macrobrachium latidactylus* (scissor river prawn)

This species is found mainly in estuarine and inshore marine waters. Adults are commonly found in tidal freshwater but larval development is in sea or brackishwater. One of the distinguishing features of this species is the unequal size of the large second leg even in young specimens. *M. latidactylus* samples were obtained from Mangagoy and Lake Lanao. The largest sample was obtained from Mangagoy (2.8 cm carapace length, 7.1 cm body length and 8.1cm total length).

5) *Macrobrachium lanceifrons* (Philippine river prawn)

This species is locally known as *hipon tagunton*. It is one of the commercially important prawn species in Laguna de Bay as it is used for human consumption and for duck food. The tip of the rostrum of *M. lanceifrons* is slightly curved upwards in full grown individuals but straight in the young. The second pair of walking legs or chelipeds is equal in length in young specimens but unequal in fully grown individuals. Fully grown males are best distinguished from fully grown females by the length and shape of the second leg or cheliped. In the male, this is longer and is provided with felted hairs on the mobile finger. Samples of *M. lanceifrons* were identified from the collection obtained in Lake Mainit. The Lake Mainit samples had a 1.5 cm average carapace length, 4.3 cm. body length and 5.3cm total length.

Thus far, we have identified and taxonomically validated 14 *Macrobrachium* species (*M. australe*, *M. equidens*, *M. esculentum*, *M. horstii*, *M. idae*, *M. jaroense*, *M. lanceifrons*, *M. lar*, *M. latidactylus*, *M. lepidactyloides*, *M. mamillodactylus*, *M. rosenbergii rosenbergii*, *M. rosenbergii dacqueti*, *M. weberi*) found mostly in Visayas and Mindanao. To complete the list, samples of four species confirmed in earlier reports as found in the following sites: Cebu, Mindoro, Camarines Sur, Surigao del Norte and Samar. These species are *Macrobrachium nipponense* (non-indigenous species brought into the Philippines and stocked in Camarines Sur), *Macrobrachium placidulum*, *Macrobrachium scabriculum* and *Macrobrachium latimanus* shall be collected. Once completed, we soon hope to finish the draft of the scientific manuscript and field identification guide based on the data generated from this study.

From some of the collected samples, observations on the breeding behavior and distribution in specific habitats/microhabitats will be noted in order to determine their exact nature (that is whether they are found naturally in the collection areas as wild stocks or as accidental/intentional introductions from hatchery populations).

Samples especially of *M. rosenbergii dacqueti* and *M. rosenbergii rosenbergii* are being processed for genetic marker analysis (mtDNA sequence and hopefully msDNA analysis) at the SEAFDEC-based Aquaculture Biotechnology Laboratory. Samples of these two subspecies will be analysed to determine the level of intraspecific variation among the populations and their phylogenetic relationships as many of these stocks are now found mixed in several commercial fishing grounds in the Philippines.

C. Genetic characterization of commercially important Philippine stocks of freshwater prawn, *Macrobrachium* sp., using DNA markers

Proponents: Maria Rowena R. Eguia, SEAFDEC/AQD
Henry Dejarme, Mindanao State University

The main objectives of this study are: a) to genetically characterize existing hatchery-bred and wild *Macrobrachium rosenbergii* stocks using mtDNA-RFLP markers; and b) to determine and compare the genetic diversity of the various prawn stocks that could serve as baseline data for biodiversity conservation or for a genetic program that will enhance growth and other economically important traits in the *Macrobrachium* sp.

Pleopod and muscle tissue samples were taken from several freshwater prawn stocks obtained from various locations. Methods to extract DNA and PCR-amplify mitochondrial DNA cytochrome oxidase I (CO-I) from wild and hatchery samples of *M. rosenbergii* have been optimized. mtDNA CO-I has been successfully PCR-amplified using Carini and Hughes (2004) protocol as follows: 5 min at 94°C; 35 cycles of – 30 sec denaturation at 94°C, 30 sec annealing at 55°C, 45 sec extension at 72°C; 7 min at 72°C. Processing of samples for genetic variability analysis is 70% completed. Preliminary results show distinct genetic differences between hatchery and wild stocks based on restriction morphs obtained after digestion with restriction enzymes: *Hae III, Rsa I, Msp I, EcoRI and Mbo*. However parameters estimating genetic variation can only be computed after all the samples have been analysed.

Conditions for mtDNA sequencing using primers flanking the mtDNA CO-I region are now developed and have been optimized. Thus far mtDNA CO-I from one hatchery stock (n=3 individuals, all *M. rosenbergii dacqueti* from Thailand) and three wild stocks: Leganes (n=5 individuals), Pampanga (n=3 individuals) and Zambales (n=5 individuals) have been sequenced. The wild stocks Leganes and Pampanga are taxonomically *M. rosenbergii rosenbergii* while the Zambales stock's identity has yet to be confirmed as either *M. rosenbergii dacqueti* or an interspecific hybrid based on the comparison of the sequence analysis. Work on mtDNA sequencing using representative samples from each stock shall be continued with the sequencing of *M. rosenbergii rosenbergii and M. mamillodactylus* (the outgroup) samples from Mindanao.

D. Evaluation of growth performance of two strains of *M. rosenbergii* in cages in Laguna de Bay

Proponent: Maria Lourdes C. Aralar, SEAFDEC/AQD

Macrobrachium rosenbergii from two separate stocks (CAL-progenies of the native strain from Calumpit, Bulacan; and BFAR-progenies of the strain from BFAR, originally from Thailand) were reared in net cages in Laguna de Bay at 15 prawns m^2. Two runs have been conducted for five months, the first run was from October 2004 to March 2005 and the second run was from April to September 2005. In the first run, CAL showed significantly better specific growth rate (SGR) than BFAR (4.6 vs 3.9%) but no differences in final weight, yield, and feed conversion ratio (FCR). Although CAL showed slightly better survival than BFAR, the difference was not significant (74.3 vs 69.1%). For the second run, survival (80.4 vs 61.1%), SGR (2.9 vs 2.6%), and FCR (2.1 vs 2.7) were significantly better in CAL than BFAR. Like the first run, there were no significant differences in the final weight of the two strains (24.0 vs 24.3g). Figures 1, 2 and 3 show the weight, SGR and survival trends in both BFAR and CAL stocks during the two runs.

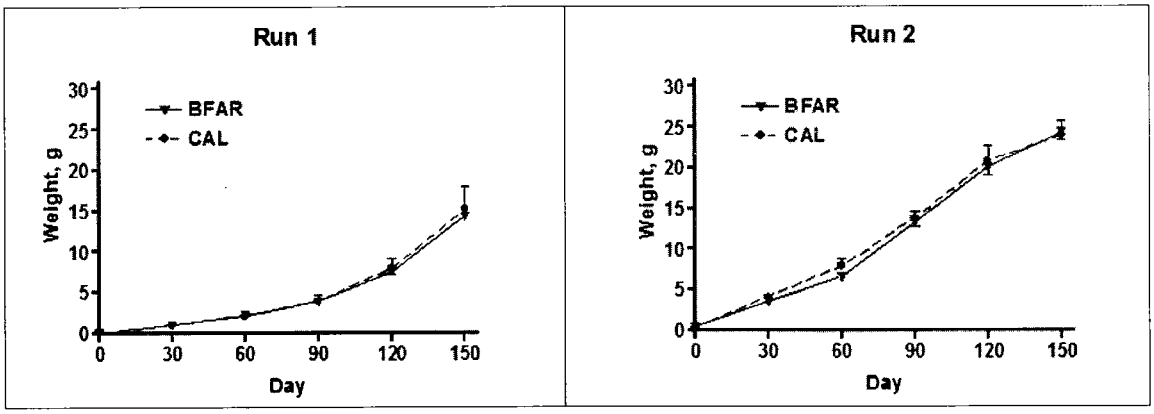

Figure 2. **Graphs showing the increase in weight of the stocks, BFAR and CAL during the two experimental runs**

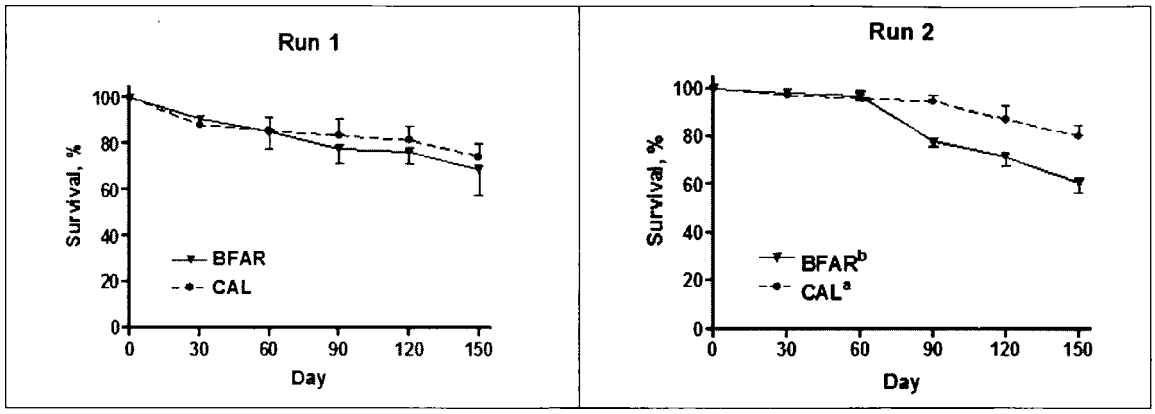

Figure 3. **Graphs showing the percentage survival of the stocks, BFAR and CAL during the two experimental runs**

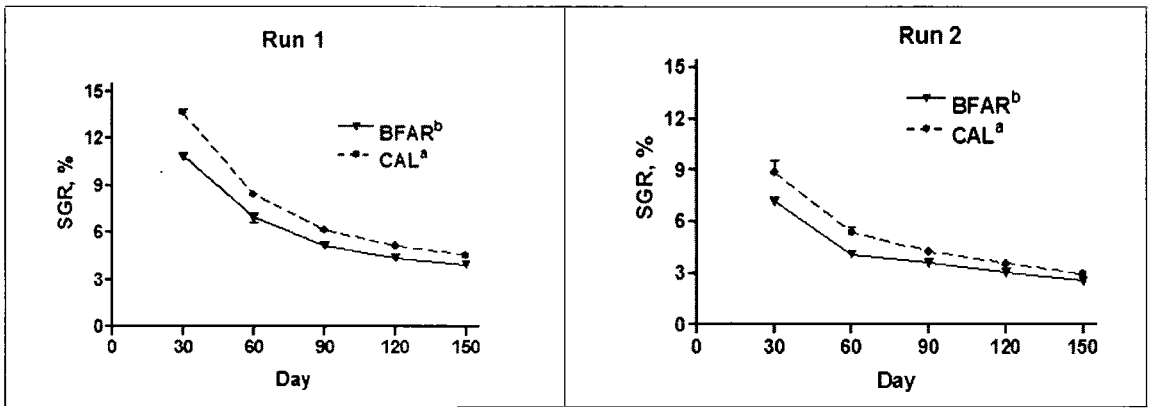

Figure 4. **Graphs showing the specific growth rate (SGR %) of the stocks, BFAR and CAL during the two experimental runs**

Meanwhile, post larvae of *M. rosenbergii* obtained from broodstock from Calumpit (in Bulacan) were stocked in commercial sized (7 x 7 x 1 m) cages in the lake in February of this year. Treatments included various feed types (shrimp feed, tilapia feed, catfish feed); mesh size of cages (*hapa* vs. b-net); and shelter (with or without). After two months of culture in the net cages, results show that feed type, and presence or absence of net shelters had no significant effect on growth and survival of *M. rosenbergii*. Mesh size affected survival, with higher rates observed in those reared in *hapa* net (91%) compared with those in b-net cages (78%). Larger prawns were observed in the *hapa* cages (3.4g) compared to those in b-net cages (2.7g), although the difference was not statistically significant.

E. Performance of juvenile *Macrobrachium rosenbergii rosenbergii* and *Macrobrachium rosenbergii dacqueti* cultured in *hapa* net cages at three stocking densities

Proponent: Henry Dejarme, Mindanao State University

This study aims to determine the suitable densities for *M. rosenbergii rosenbergii* and *M. rosenbergii dacqueti* in *hapa* nets in a nursery facility. The juveniles used were progenies of wild *M. rosenbergii rosenbergii* from Leyte and that of the domesticated *M. rosenbergii dacqueti* stock. The stocking densities used in the rearing trials were 25, 35 and 50 juveniles per square meter and the trial lasted for three months. The prawns were fed commercial shrimp pellets at 10% body weight from

August 24 to November 5, 2005 or 73 days. Every two weeks, prawn samples were taken for growth measurements (weight) and survival rates were noted.

Results showed that *M. rosenbergii dacqueti* is a fast-growing sub-species than *M. rosenbergii rosenbergii* (Figure 4). Discrepancies in size between the two subspecies were more prominent in the final weight measurements on the 73rd day of culture. The final result is consistent with the sluggish weight increases recorded every two weeks for the native subspecies. On survival however, *M. rosenbergii dacqueti* had a lower survival rate. This is attributed to the mass mortality observed on the 47th day of culture. Barring the occurrence of mass mortality which could have been prevented, it can be stated although inconclusively, that while the type of subspecies significantly influenced survival and growth rates in this study, the densities did not. However confirmatory trials must be conducted to verify the results of this study.

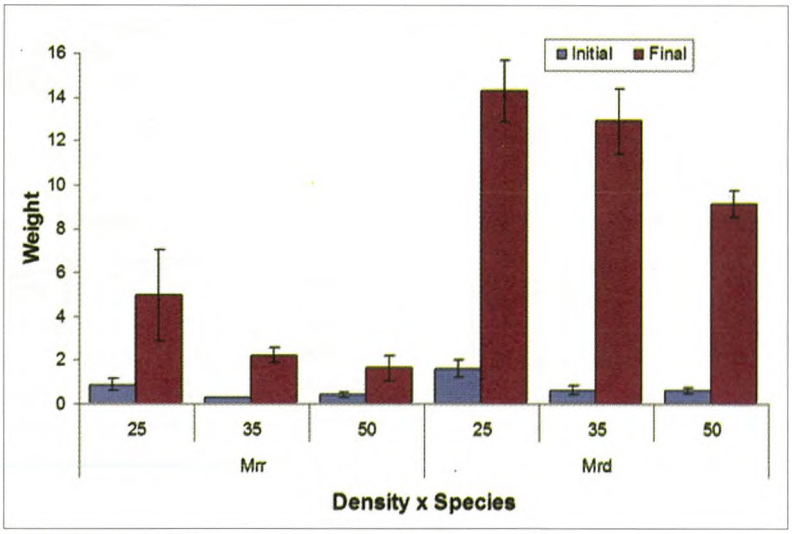

Figure 5. **Initial and final weight of *Macrobrachium rosenbergii dacqueti* and *M. r. rosenbergii***

F. Culture of juvenile *Macrobrachium rosenbergii dacqueti* in *hapa* net cages at four stocking densities

Proponent: Henry E. Dejarme, Mindanao State University

The traditional practice in places where *M. rosenbergii* are grown to marketable size in earthen ponds is direct seeding with hatchery-reared post larvae (PL). However, an increasing number of grow-out farmers prefer to stock larger juveniles (average weight = 2.0g) that have been reared from PL for two months in nursery facilities because, among others reasons, early mortalities will have already occurred before the seed stocks are transferred to grow-out facilities. Nurseries can be stocked at much higher densities than grow-out enclosures but optimum density has not been clearly ascertained. This study was conducted to determine the suitable densities for the production of large juvenile prawns of *M. rosenbergii dacqueti* Sunier 1925 in 1 x 1 x 1 m *hapa* nets. The densities 50 juveniles, 100, 200, and 300 per sq. m were tested in RCBD experiment at the concrete reflecting pool at MSU-Naawan. Two batches of hatchery-produced juveniles were used and cultured separately in Modules 1 and 2. The juveniles were fed commercial shrimp pellets for two months (64 days) and sampled for survival and growth in terms of weight, length every two weeks. The highest average weight gain and body length were obtained from stocking density of 50 pieces per sq. m. both for Module 1 (2.07g, 2.07 mm) and Module 2 (2.4g, 2.4 mm) (Figure 5). Survival was highest at stocking density of 200 juveniles per sq. m (Figure 6).

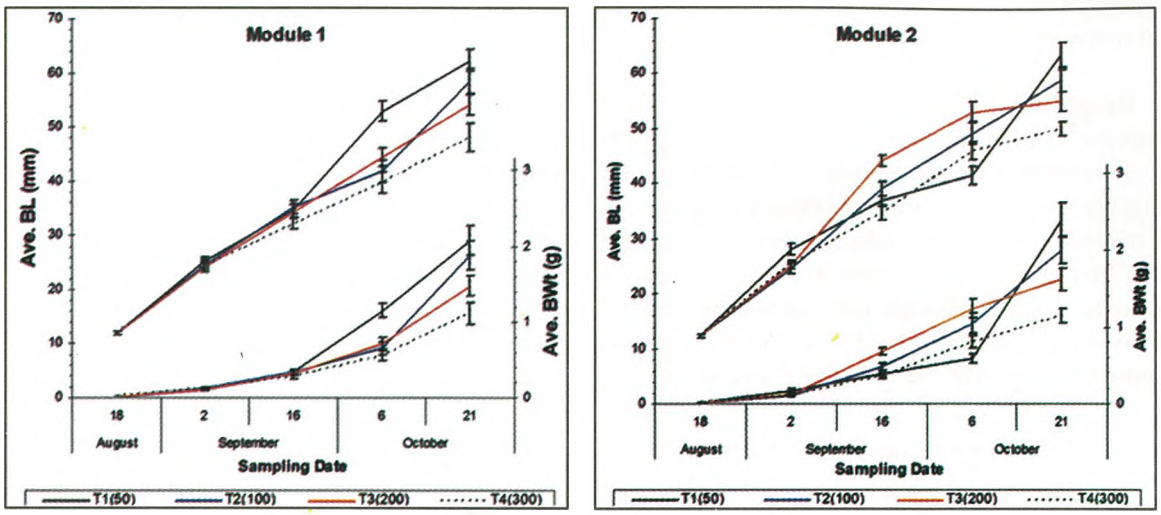

Figure 6. **Prawn juveniles in Modules 1 and 2**

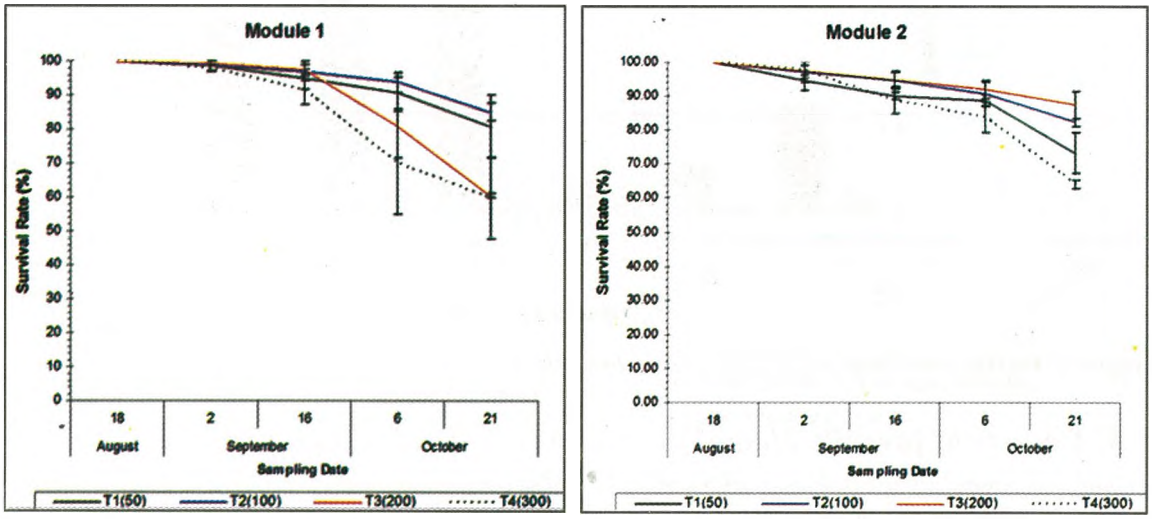

Figure 7. **Survival curves of experimental prawn juveniles in Modules 1 and 2**

A well recognized characteristic of *Macrobrachium* species is that individual prawns grow distinctly at different rates. Such growth feature was observed in the present nursery study. This phenomenon is also known as heterogeneous individual growth (HIG). Studies have demonstrated that some exceptionally fast-growing individuals may become up to 15 times larger than the population mode within 60 days after metamorphosis. Jumpers became obvious within two weeks after metamorphosis. Slow-growing prawns (laggards) only become apparent later, about five weeks following metamorphosis.

In a nursery study, however, survival is more important than growth because the interest is to produce the most number of larger juveniles per sq. m for subsequent stocking in grow-out ponds. In the present study, the results suggest 200 prawn juveniles per sq. m is a suitable initial stocking density in nursery culture. Yet the results are not definitive because the survival at lower densities (50 and 100 pieces per sq. m) was unexpectedly lower. No matter the reasons for this least outcome, the results still suggest that high survival can be attained at 200 prawn juveniles per sq. m stocking rate. If 200 is the most desirable initial stocking density in the nursery, then a big nursery cage or a number of smaller cages with a total of 570 sq. m area is needed to stock a hectare of grow-out prawn pond at the usual stocking rate of 10 juvenile prawns per sq. m.

F. Reproductive efficiency of two *M. rosenbergii* stocks at different protein levels

Proponent: Maria Rowena R. Eguia, SEAFDEC/AQD

Spawning sets (1 male : 5 females) of four-month old *Macrobrachium rosenbergii* from a hatchery stock (BFAR strain, *M. rosenbergii rosenbergii*) and a wild stock (Calumpit strain, possibly *M. rosenbergii rosenbergii x M. r. dacqueti* F_1s) were placed in replicate 2 x 2 x 1 m outdoor concrete tanks in April 2005. Stocks were fed using the following treatments: Treatment A: low protein (commercial fish feed pellets) at 2% of the prawn biomass; Treatment B: high protein (prawn feed pellets) at 2% of the prawn biomass and Treatment C: low protein (commercial fish feed pellets), given *ad libitum*. The reproductive efficiencies of the stocks were compared. Six months after stocking, preliminary observation showed that the BFAR stock fed low protein diet (fish feed pellets) *ad libitum* spawned more frequently (average number of spawning episodes=15.7) than prawns given fixed amounts of fish feed (10.7) and prawn feed (6.3). Calumpit stocks spawned less frequently at 9 (Treatment C), 8.7 (Treatment A) and 6 (Treatment B) spawning episodes. The average number of hatchlings produced per gram body weight of the female prawn broodstock was highest in the BFAR stocks at 669.7 (for treatment C), 665.28 (for treatment B) and 567.2 (for treatment A). The same ranking was observed in the Calumpit stock at 598.4, 532.7 and 438.7, respectively.

A similar experiment was also set up in lake-based netcages using five-month old prawns to determine if the reproductive efficiency of the two strains is influenced by the type of spawning system. Results showed differences in the reproductive efficiency of the two stocks especially in terms of the average number of hatchlings per gram female body weight. BFAR stocks fed low protein fish feed *ad libitum* had the highest number of hatchlings at 648/g body weight followed by those fed fish feed at 2% prawn biomass (583/g) and the high protein prawn feed pellets (578/g). On the other hand, Calumpit stocks fed low protein fish feed at 2% prawn biomass had the most number of hatchlings per gram female body weight (823/g), followed by low protein fishfeed administered *ad libitum* (741/g) and finally high protein prawn feed (609/g).

H. Promotion of freshwater prawn farming technology

Proponent: Melchor Tayamen, BFAR NFFTC

The Philippine Bureau of Fisheries and Aquatic Resources (BFAR) continues to pursue the aquaculture of *ulang* at the NFFTC in Munoz, Nueva Ecija (Central Luzon) as well as disseminate the potential and opportunities that freshwater prawn farming can offer. In 2004, BFAR established a Task Force with NFFTC as homebase for the promotion of the freshwater prawn aquaculture program.

Various interventions have been programmed by the Task Force for *ulang* aquaculture in the Philippines. These are: (1) establishment of *ulang* hatcheries in existing EXCEL tilapia central and satellite hatcheries throughout the Philippines to produce the required prawn postlarvae; (2) establishment of hatcheries in coastal areas near the EXCEL tilapia hatcheries to increase the number of freshwater prawn hatcheries; (3) lease, improvement or conversion of unproductive shrimp hatcheries into multi-species hatcheries that will include freshwater prawn hatchery production; (4) promotion and/or dispersal of *ulang* postlarvae throughout the country; (5) establishment of pilot techno-demo farms in collaboration with private cooperators, local government units and the academe; (6) awareness creation on the part of the fisherfolk and/or entrepreneurs on the potential of *ulang* culture; (7) development of a code of conduct for sustainable *ulang* production; (8) refinement of the rice-prawn technology and promotion of the technology throughout the country; and (9) intensive nationwide information dissemination campaign on the economics of *ulang* aquaculture.

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