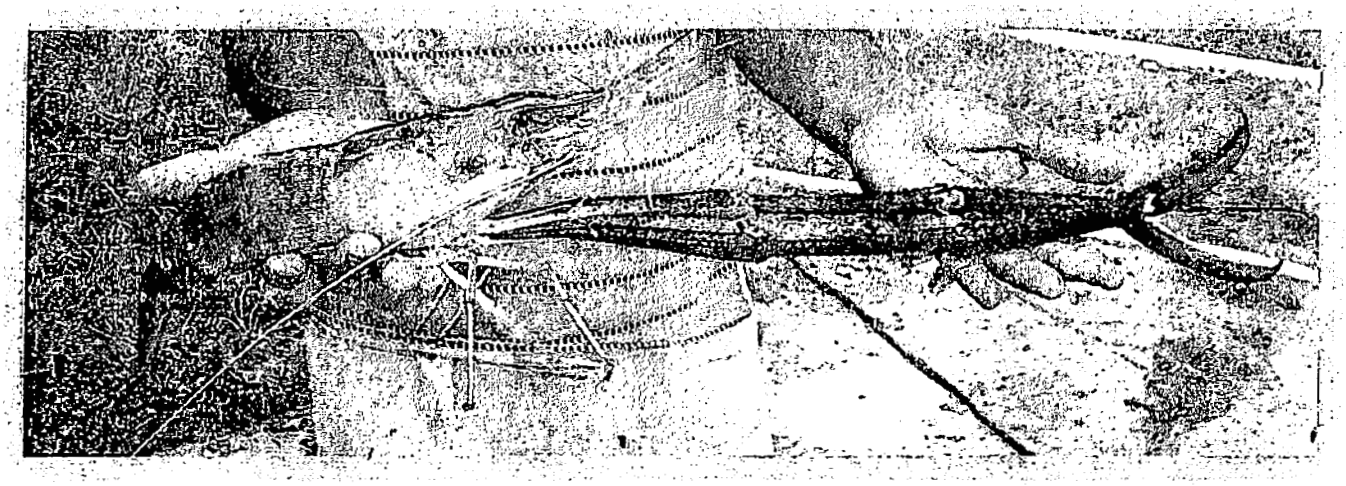
FINAL REPORT

CIFA–WORLDFISH CENTER BILATERAL PROJECT

ON

"GENETIC IMPROVEMENT OF FRESHWATER PRAWN *MACROBRACHIUM ROSENBERGII* (DE MAN) IN INDIA"



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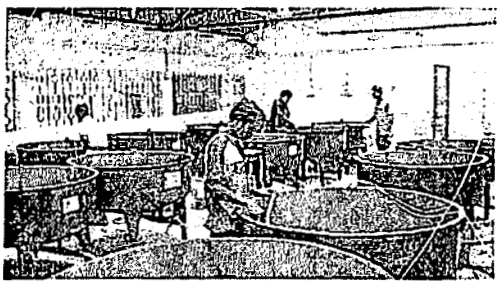

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and

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1. PROJECT TITLE: Genetic improvement of freshwater prawn, *Macrobrachium rosenbergii* (de Man) in India.

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3. PROJECT TEAM

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- Dr. S. C. Rath, Senior Scientist : Co-investigator II
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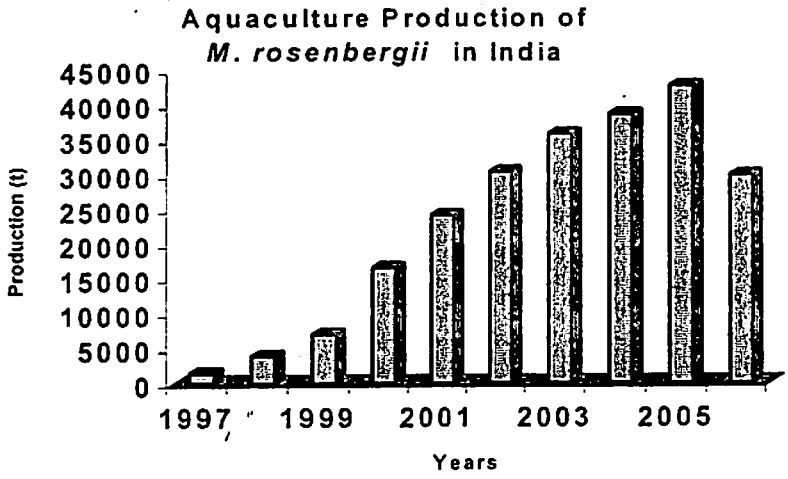
- Dr. Raul W. Ponzoni, Principal Scientist : Principal Investigator
- Dr. Nguyen Hong Nguyen, Scientist : Investigator I
- Ms. Khaw Hooi Ling, Research Assistant : Investigator II

4. Location of Research Project with Address (Division/Section) Prawn Unit, Aquaculture Production & Environnent Div., CIFA

5. Date of start: 07.07.2007

6. BACKGROUND AND OBJECTIVES

The giant freshwater prawn (*Macrobrachium rosenbergii)* is one of the most important crustacean species in the inland aquaculture sector of many tropical and subtropical countries. India is a major producer of farmed freshwater prawns and produced 42,820 tonnes in 2005. Despite the potential for increased production, the sustainability of freshwater prawn farming is currently threatened by low production efficiency and vulnerability of farmed stocks to disease as in the case of marine shrimp. Recently, there have been reports indicating productivity decreases due to low growth rate in Nellore, Andhra Pradesh, where major culture sites are located. Similar productivity declines have also been reported in other countries such as Taiwan and Thailand. In the early 1990's commercial stocks in Taiwan experienced a productivity decline from 16,000 t to just 7665 t, which was attributed to inbreeding depression effects. Sourcing brood stock from grow-out ponds rather than from the wild and the resulting high levels of inbreeding over time was believed to be the reason for growth decline in Thailand (De Bruan and Mather, 2007).



This rapid decline in production showed the necessity of a systematic selective breeding program aimed at improving the economically important traits of this species. In farmed terrestrial animals and plants it has been demonstrated that systematic selection is an efficient way of improving productivity. Today the high yields of land animal production are totally dependent on genetically improved domesticated breeds. By contrast, there is a paucity of selection work being carried out aquatic animal species. At present less than 10% of the world's total aquaculture production is based on genetically improved stocks. Much of the work has concentrated on salmon in Norway. In recent years there has been an increase in the application of quantitative genetics theory to the enhancement production traits in aquaculture species.

No scientific literature was available on selection work to improve growth rate or any other production trait in *M. rosenbergii*. Given the economic importance of this species, the initiation of genetic improvement work with it seemed totally justified. A research project was therefore proposed to undertake selective breeding on *M. rosenbergii*. So far

the focus of selection has been on growth rate. The long-term aim of the project is the development of a genetically high yielding freshwater prawn strain. More specifically, the project has the following objectives:

- To sample and evaluate the productivity of three Indian stocks of *Macrobrachium rosenbergii* viz., Gujarat (north west),Kerala (south west) and Orissa (east) to form a base population with abundant genetic variation
- To develop protocols for family production
- To develop protocols for tagging of juveniles and adults
- To estimate phenotypic and genetic variation in traits of economic importance
- To estimate the magnitude of heterosis effect based on crossing of stocks
- To establish the synthetic base population for genetic selection
- To conduct selective breeding program to improve growth performance of *Macrobrachium rosenbergii*
- To measure direct and correlated genetic responses in traits of economic importance in *Macrobrachium rosenbergii*

7. PRACTICAL UTILITY

The present project addresses problems such as low efficiency in existing freshwater prawn production systems, lack of high quality brood stock of freshwater prawn, and paucity of scientific knowledge in quantitative genetics for freshwater prawn species. Freshwater prawn is a species that fits well within the farming system followed by small farmers. Furthermore, it fetches a very high price compared with freshwater fish. In several countries there is a high demand from both domestic and export markets, the latter being an important source of foreign exchange in all developing countries. The project is expected to improve the growth rate of *Macrobrachium rosenbergii* through selective breeding and thereby help in increasing productivity and production of this important species. Generation of data that will enable the estimation of genetic parameters will help in developing a long-term strategy for the increase in productivity.

8. TECHNICAL PROGRAMME

2007-08

- Literature review, recruitment of staff.
- Upgrading the hatchery, nursery and grow-out facilities.
- Collection, transportation and maintenance of three populations of *Macrobrachium rosenbergii* from Kerala, Gujarat and Orissa.
- Develop tagging protocols for individual identification of *M.rosenbergii*.
- Diallel crossing trial of the three stocks.
- Rearing of larvae, post larvae as full sib families up to tagging
- Annual workshop and group discussion

2008-09

- Tagging of juveniles from different full sib families (Batch 1 and 2 of G0).
- Grow-out evaluation (Communal rearing) of tagged juveniles (Batch 1 and 2 of G0).
- Final data collection of grow-out evaluation (Batch 1 and 2 of G0)
- Data entry and statistical analysis of data.
- Forming the base population.
- Production of the 1st generation (mating, rearing of larvae, post larvae as full sib families up to tagging).
- Annual workshop and group discussion

2009-10

- Tagging of juveniles from different full sib families (Batch 1 and 2 of G1).
- Grow-out evaluation (Communal rearing) of tagged juveniles (Batch 1 and 2 of G1).
- Final data collection of grow-out evaluation (Batch 1 and 2 of G1)
- Data entry and statistical analysis of data.
- Selection of brood stock
- Production of the 2nd generation (mating, rearing of larvae, post larvae as full sib families up to tagging).
- Meeting and group discussion
- Estimation of genetic parameters& responses
- Final report and workshop

8. DETAILED REPORT:

Research methods:

A systematic genetic improvement program in *M. rosenbergii* involves the following steps: First, of crucial importance is strain comparison, it is the selection of the freshwater prawn populations which represents a species. Populations would be sampled at random in locations that are geographically isolated. The populations should preferably represent each of agro-ecological regions suitable for normal culture practices. The collection sites are indicated in figure 1. Due to the large distance between North-West, South-West and East in India, juvenile prawns will be collected from each location and reared separately in the same station (at CIFA) for 6 months until they attain sexual maturity, and will then be used for breeding. A complete diallel cross design involving the three strains, whereby one male is mated to 4 females will be carried out. The mating of brood stocks will be carried out in two batches per year.

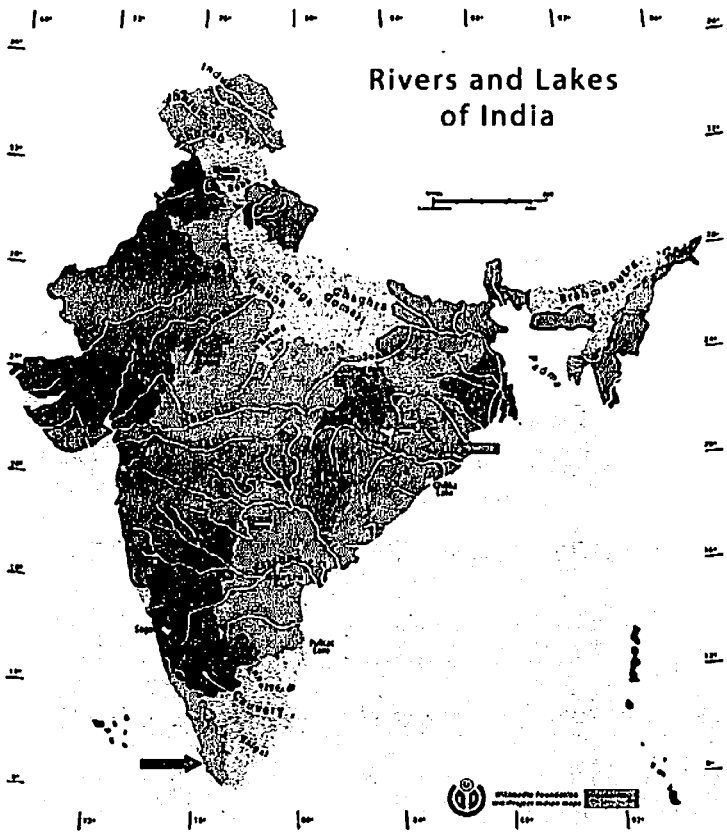
The second important step in the development of a genetic improvement program is the establishment of the base population. The performance of pure strains and crosses resulting from the complete diallel design will be ranked after communal testing. The

base population will be formed from the best performing individuals, irrespective of the origin of the individuals. Offspring of each of the families will be hatched and grown in separate tanks until they are large enough to be individually tagged.

Thirdly, selection will be practiced mainly for body weight. Individuals with the greatest estimated breeding value (EBV) for harvest weight (or highest EBV) in each family will be selected to become parents of the next generation. A limited number of individuals will be selected from each family with the aim of having representatives of as many families as possible in the next generation. The procedure will be repeated throughout the duration of the project.

Measurements will be made of several traits of economic importance. Statistical analyses using average information algorithm-restricted maximum (REML) likelihood and best linear unbiased prediction (BLUP) methodologies applied to a multi-trait mixed model. The REML and BLUP methods can account for environmental effects and changes in additive genetic variance due to inbreeding, assortative mating and gametic disequilibrium via the numerator relationship matrix. Thus, unbiased parameter estimates and breeding values will be obtained. As a consequence, the method increases the accuracy of selection, and hence the rate of genetic gain made in the population.

Figure 1 Collection sites of wild *M. rosenbergii*



Strain collection and Evaluation

I.1 Collection and Rearing of *M. rosenbergii* from River Narmada, Gujarat (north west)

Initially around 220 juvenile prawns (4.2g) were collected from River Narmada, near Bharuch, Gujarat and were transported to the farm facility of CIFA by road, rail and air covering a distance of nearly 2000 km within 24 h. Nearly 150 juveniles survived and were released in the indoor rearing facility at CIFA. After a fortnight of acclimation the juveniles were transferred to outdoor cement tanks and were reared for one month. Prawns were then screened for the presence of noda virus using an RT-PCR diagnostic kit developed at CIFA. The prawns were found virus free and tagged with green visible implant elastomer tags (NMT, USA) and stocked in one 0.04 ha earthen pond for growth and maturation. Subsequently to increase the population size, further collections were made and nearly 2100 early juveniles (~0.3g) were collected from River Narmada, and brought to the CIFA farm in November 2007. These juveniles after virus screening were stocked in another 0.04 ha earthen pond for growth and maturation. The prawns were fed with pellet diet twice daily at10% of the biomass per day. Prawns were sampled on a monthly basis to study the growth and health of the stock.

I. 2 Collection and Rearing of *M. rosenbergii* Stock from Kerala

Approximately 2000 *M. rosenbergii* post-larvae (0.01g) each from two different commercial hatcheries in Kerala (Alleppy and Trichur) and 200 early juveniles (0.1g) from the hatchery of fisheries college, Kerala Agricultural University were collected in September 2007 and transported to CIFA farm by road, rail and air covering a distance of nearly 1900 km within 24 h. The prawns were stocked in separate cement tanks and were screened for the presence of noda virus. The prawns were found virus free and were then mixed together and stocked in a 14 m^2 out door cement tank and reared for two months. The juveniles were then harvested and 2316 juveniles were stocked in one 0.04 ha earthen pond and reared to maturity following the husbandry practices described above for Gujarat stock.

I. 3. Collection and rearing of *M. rosenbergii* Stock from River Mahanadi, Orissa

Nearly 900 juveniles of *M. rosenbergii* (6.5g) were collected from river Brahmani near Rajkanika, Kendrapada, Orissa) in October 2007 and transported to CIFA farm. The prawns after virus screening were stocked in a 0.04 ha pond and reared to maturity following the husbandry practices described above.

2. Experiments to Synchronize ovarian maturation in *M. rosenbergii*

2.1. Evaluation of eyestalk ablation

One experiment was conducted in six out-door cement tanks (7.5x1.75x1m) to evaluate unilateral eyestalk ablation as a means for synchronization of ovarian maturation in adult *M. rosenbergii* (28±4.1g). Experimental group of 18 females was subjected to unilateral eyestalk ablation and was released to three tanks (six each). Another 18 females were kept as control. One male was released to each of the six tanks for breeding purpose. Experiment was conducted for a period of 45 days. The specific growth rate of unilaterally eye-ablated prawns (0.965±0.525) was significantly higher ($p<0.05$) than that of control prawns (0.869±0.474). Survival rate was higher in control prawns (83.3%) than

that of ablated prawns (77.7%). Percentage of maturing females and berried females were marginally higher in ablated group, but there was no statistically significant difference ($p>0.05$). We may conclude that unilateral eyestalk ablation only marginally accelerated the pace of ovarian maturation, and that the effect was not strong enough to synchronize ovarian maturation in *M. rosenbergii*.

2.2 Evaluation of vertebrate steroids (Estradiol, E_2)

One experiment was conducted in 15 numbers of 500 litre fibre glass tanks to study the effect of 17 beta -estradiol on ovarian maturation of adult *M. rosenbergii*. A total of 30 adult immature female prawns were selected for the experiment. They were divided into three groups of 10 prawns. One group was injected (intramuscularly) with 1 µg E_2/g body weight and released to five tanks. Another group was injected with 2 µg E_2/g body weight and released to another five tanks. A third group of 10 prawns served as sham operated control and were injected with 50 µl of coconut oil. The prawns were observed daily for moulting and ovarian maturation. The experiment was terminated after 20 days. All surviving prawns were measured to the nearest millimeters and weighed individually to the nearest milligram. Ovary was isolated from all surviving prawns to determine the gonadosomatic index and ova diameter. Results revealed that estradiol at the tested levels did not have any significant effect on ovarian maturation in *M. rosenbergii*.

2.3 Studies on the effect of serotonin on ovarian maturation in *M. rosenbergii*

Effect of serotonin (5-hydroxytryptamine) on ovarian maturation of adult *M. rosenbergii* was evaluated in a laboratory experiment. Two doses (20 and 40 µg serotonin/g body weight) were used in the experiment. Experiment was carried out in triplicate in 500 L FRP tanks for a period of two weeks. Results revealed that serotonin at the tested levels did not induce ovarian maturation in *M. rosenbergii*.

3. Development and standardization of individual tagging technique for *M. rosenbergii*

The retention and readability of an internal tag - visible implant alphanumeric tag (VI alpha) (Northwest Marine Technology Inc., Shaw Island, Washington, U.S.A) was evaluated in giant river prawn *Macrobrachium rosenbergii* under laboratory conditions. VI alpha is a small fluorescent tag with an alphanumeric code designed to identify individual specimens. Two tag formats (standard 1.0 x 2.5 and large1.5 x 3.5 mm) were tested during 10 weeks of rearing under laboratory conditions on juveniles (standard format), sub adult(standard format) and adult (large format) *M. rosenbergii*. The effect of tagging on growth and survival of the prawns was also evaluated.

Average daily growth rate (mg/day) and SGR of tagged juvenile prawns (22.4±0.23, 0.81±0.02) did not vary significantly ($p>0.05$) from that of untagged control (20.5±1.47, 0.83±0.04) (Table1). Similar results were observed in sub-adult and adult *M. rosenbergii*. Mean final survival (%) also did not show any significant difference ($p>0.05$) between tagged and untagged prawns (table 1).

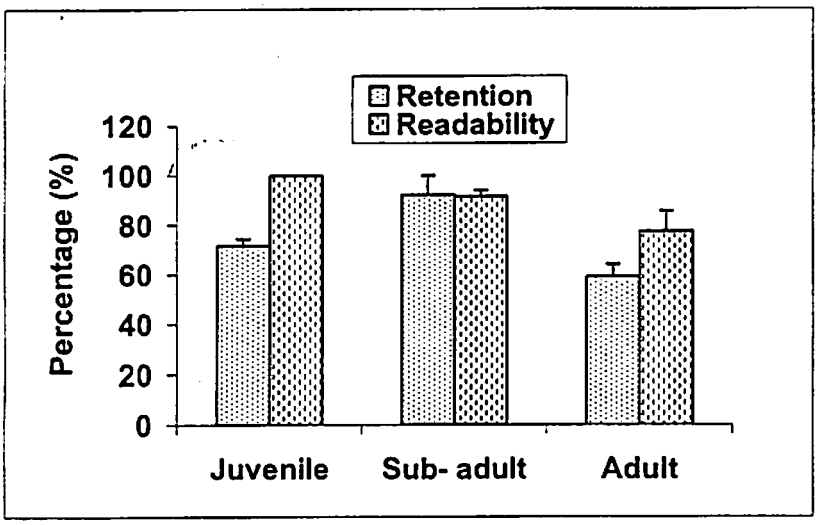
Final mean tag retention (%) was highest in sub-adult prawns (92.3±7.69) and lowest in adult prawns (59.0±5) (Figure 3). Tag retention in juvenile prawns was 71.7±2.9. Final tag readability (%) was highest in juveniles (100.0) followed by sub-adults (91.6±0.7) and adults (77.37±1.19) in that order. The results indicated that tagging with VIA tag had no adverse effect on survival or growth of these prawns. Tag retention and readability were also high especially for juvenile and sub-adult prawns indicating that *M. rosenbergii*

can be effectively tagged with VIA tags and it can be used as individual tag to identify individuals in a selective breeding programme.

Table 1 Initial and final weight, average daily growth, specific growth rate and survival of control and VI alpha tagged juvenile, sub-adult and adult *M. rosenbergii* under laboratory conditions

	Juveniles		Sub-Adults		Adults	
	Control	**Tagged**	**Control**	**Tagged**	**Control**	**Tagged**
Initial mean weight (g)	1.7±0.11	2.1±0.35	12.9±0.40	14.9±2.69	26.7±3.24	27.4±1.37
Final mean weight (g)	3.2±0.22	3.8±0.31	15.1±0.36	17.8±3.21	29.5±3.19	30.2±0.59
Duration (d)	76	76	70	70	70	70
Survival (%)	95.8±5.9	92.8±12.8	93.4±2.5	95.2±4.1	92.8±9.5	90±17.3
Growth ($mg.d^{-1}$)	20.5±1.47	22.4±0.23	31.4±0.88	41.5±1.9	40.6±1.4	40.0±0.92
SGR	0.83±0.04	0.81±0.02	0.22±0.02	0.25±0.03	0.14±0.02	0.14±0.03

Figure 2 Final retention (%) and readability (%) of VI alpha tag in juvenile, sub-adult and adult *M rosenbergii* under laboratory conditions



4. Determination of optimum stocking density to obtain taggable size juvenile prawns

An experiment was conducted in 6 outdoor cement tanks (7.5x1.75x1m) to find out the optimum stocking density to obtain taggable size juvenile prawns. Three stocking densities were evaluated 10, 20 and 40/m^2. Prawn post larvae (0.09g) were stocked in October last week. The post larvae were fed twice daily with formulated pellet diet (in crumble form) @ 25% of biomass. Twice every week water exchange was done @50% to maintain the water quality. Among the water quality parameters temperature was monitored twice daily. Approximately 15% of the surface area was covered with floating weeds (*Eichhornia* sp.) to provide shade and shelter to the post larvae.

The average final size after 45 days of rearing was 0.48g, 0.43g and 0.54g respectively in 10, 20 and 40 /m^2 stocking density. Contrary to the expectation highest growth was found when post larvae were stocked at a relatively higher density (40/m^2) density. The highest final mean size attained was also not taggable indicating the necessity of extended rearing to achieve desired size juveniles.

In another experiment net hapas (2.0x1.0x1.0x1m) were used for nursery rearing. Four stocking densities were evaluated 20, 40, 80, and 120/m^2. The average final size after 45 days of rearing was 0.28g, 0.18g, 0.23g and 0.18g respectively in 20, 40, 80, and 120/m^2 stocking density. Growth rate was significantly higher at the lowest stocking density tested. The relatively low growth rate recorded was due to the low ambient water temperature (20-23°C). Mean survival rates (%) obtained in different treatments were 69.0%, 75.4%, 75.0% and 74.5% respectively in 20, 40, 80, and 120/m^2 stocking density. Statistical analysis did not show any significant effect of density on survival of post larvae.

5. Establishment of the synthetic base population (Generation 0, G0) of giant fresh water prawn *Macrobrachium rosenbergii* for selective breeding.

A synthetic base population was established using a complete diallel cross design involving the three populations of giant freshwater prawn *Macrobrachium rosenbergii* collected from three locations in India (Gujarat, Kerala and Orissa) that represent different agro-ecological regions and are geographically distant from each other. Due to the difference in the size of the prawns groups of the three stocks they did not respond simultaneously in terms of their readiness to reproduce. Hence, the crossing was undertaken in a stepwise manner. The mating of brood stocks was carried out in three batches. The mating of the first batch started in the second week of April 2008 and the mating for the second batch was carried out in June 2008. More details are provided below.

5. 1 Mating

In the initial mating trial maturing males and females of the three stocks were collected and kept for mating in nylon hapas (2 x 1 x 1 m) placed in a concrete nursery tank. One male and 3-4 females with maturing ovary were stocked in one mating hapa. Prawns were provided with pellet diet at 10% of the biomass daily. Hapas were observed after every 3-4 day interval. Mating was observed in hapas and orange-berried females were collected. Gujarat females did not respond initially as the females were in early maturing condition. In subsequent mating trials Gujarat females also mated and produced viable offspring.

Initially egg loss was observed in berried females due to handling stress while collecting from nylon hapas. Subsequently ferro-cement tanks (3 x1.2x1.0m) were used for mating. In these tanks breeding took place and the berried females could be collected using hand nets without any egg losses.

5. 2 Rearing of egg bearing Females

Egg bearing females (berried females) from the different crosses were reared individually in freshwater in fiberglass reinforced plastic (FRP) tanks for 14-16 days until the orange eggs turned to light gray. Floating weeds were provided in the tanks as shelter for the berried females. During rearing prawns were provided with pellet diet at 10% of the biomass daily. Tanks were cleaned daily and water was exchanged at a rate of 50% twice every week to maintain water quality. After 14-16 days of rearing the berried females were transferred to hatching tanks (500 l FRP tanks) containing 5 ppt saline media until egg hatching occurred.

5. 3 Rearing of larvae (FRP tanks)

Hatching tanks were observed daily for the appearance of the larvae. Once the larvae were hatched out they were released to the same tank or transferred to another tank for further rearing. Larvae were then reared in brackish water (10-12 ppt) for 30-40 days (4-6 weeks) until they metamorphosed to post- larvae. Larvae were fed 4-5 times a day with *Artemia nauplii* and egg custard. Tanks were cleaned daily and water was exchanged once every alternate day to maintain water quality. Once approximately 90% of the larvae were metamorphosed to post-larvae, they were collected and acclimatized to fresh water and reared in hatchery for 10-12 days.

Larval rearing is the most critical phase due to the longer duration of rearing and the delicate nature of the early larvae. In spite of the careful daily monitoring we have lost some larval batches due to bacterial diseases. In the first phase of diallel crossing 35 larval batches out of the 43 were completed and in the second batch 33 out of 38 batches were successfully completed.

5.4 Juvenile raising (nylon hapas)

Post larvae (~600) from each of the families were collected and divided into two groups, one group was transferred to nylon hapas (2.5x1.0x1.0 m) kept in one 0.10 ha earthen pond and another was stocked in nylon hapas placed in a concrete nursery (20 m x5 m x 1.2 m). Post larvae were fed twice daily with commercial pellet diet (crumbles) at 20% of the biomass per day.

Hapas were clogged by silt materials and algae, which necessitated regular cleaning. Some of the hapas fixed in the pond lost the juveniles due to holes made by crabs. Once every month juvenile prawns were sampled to determine the growth and survival. Post-larvae were reared in nylon hapas until they attained taggable size (>0.6g). Due to the high stocking density of the prawn juveniles the growth rate of juveniles in hapas was very slow and hence the first and second batch of juveniles could be tagged after nearly 90-100 days of rearing.

5. 5 Tagging

For diallel crossing two tagging techniques were employed. Visible implant alpha numeric tag VIA (standard size format 1.0 x 2.5 mm) with alpha numeric codes was used

as individual tag and visible implant elastomer (VIE) tag was used as a batch tag (nine codes for the nine crosses). VIA was inserted on the lateral side of the second abdominal segment and the tagging location for VIE tag was ventral side of the sixth abdominal segment. A total of 2233 prawn juveniles from 30 full sib families representing all the nine cross of the three stocks *M. rosenbergii* were tagged in the first phase and in the second batch 2537 juveniles from another 30 families were tagged.

5. 6. Grow-out evaluation of tagged juveniles (Communal Rearing)

Earthen ponds (0.04 ha) were selected for communal rearing of juveniles. After tagging the juveniles of first batch were stocked in the two well-prepared ponds at 3 prawn juveniles /m^2 stocking density. The prawns were fed with commercial pellet diet at 10% of the biomass per day. Second batch juveniles after tagging were stocked in another two well-prepared 400 m^2 (0.04 ha) earthen ponds. Communal rearing of first batch juveniles were carried out during September 2008 to February 2009 and communal rearing of second batch juveniles were carried out in another two (0.04 ha) earthen ponds during January to April 2009. Prawns were fed twice daily with commercial pellet feed at 10% of the biomass per day in the first month. Feed rate was modified every month based on the body weight obtained during sampling. Water quality was maintained by frequent addition of water from a near by reservoir. Pond water temperature was measured twice daily. Dissolved oxygen, pH and ammonia levels were measured once every week using standard procedures. Ponds were provided with continuous aeration from an air blower.

5. 7 Harvest and data Collection

The first batch of juveniles was harvested for final data collection during the first week of February 2009. All the surviving prawns were collected, sexed, and measured individually (total length, carapace length, standard length, wet weight). Males were categorised according to their morphological appearance into Blue Claw males (BC), Orange Claw males (OC) and Small males(SM). Females were grouped into immature, maturing, fully mature, berried females (those carrying eggs), and spent females (those with an enlarged brood chamber). Presence and absence of VIA and VIE tags were also noted. Prawns with readable VIA tags were retagged with large format VIA tag. After measurements the prawns were released to another well prepared 0.04 ha pond for further grow out. The second batch of juveniles was harvested during the second week of April 2009 and the above-mentioned measurements were taken from all the surviving prawns.

5.8 Survival and Tag readability

In the first batch of communal rearing survival rate of tagged juveniles ranged from 81.4 to 85.1% after 120-135 days of rearing. Retention of VIA tag ranged from 69.8 to 71.4% and that of VIE tag ranged from 91.7 to 96%. Readability of VIA tag ranged from 81.5 to 82.9%. In the second batch of communal rearing survival rate of tagged juveniles ranged from 84.3 to 86.7% after 120-125 days of rearing. Retention of VIA tag ranged from 89.4 to 90.4% and that of VIE tag ranged from 95.2 to 97.4%. Readability of VIA tag ranged from 87.6 to 89.2%.

5. 9 Data Analysis and Cross Performance

Data were analysed using SAS and ASREML software. Data were analysed separately for first and second batch for selection of breeders for forming base population. For

estimation of genetic parameters the data from batch 1 and 2 were combined and analysis was done. Basic statistics of growth traits are presented in table 2. Least squares means of harvest body weight of all the nine crosses of stocks are given in figure 3 and final survival of the different crosses of the stocks are provided in figure 4. Table 3 provides sex wise least squares means of final body weight. Data analysis revealed a significant sex effect and non-significant pond effect in harvest weight (Table 4). A significant difference in harvest weight was observed between crosses. Kerala (K) stock was found to be significantly different from Orissa (O) and Gujarat (G) stock. Among the pure breeds, the growth performance of Kerala stock was best and that of Gujarat was the poorest. Kerala stock was significantly different ($p<0.001$) from both Gujarat and Orissa stock, however the growth performance of Orissa stock was not significantly different ($p>0.05$) from that of Gujarat stock.

Among the cross combinations KO grew best. Growth performance of KO was not significantly different ($p>0.001$) from that of GK, OK, and KG. Poorest growth performance was that of OG. Growth rate of GO was higher than OG but significantly lower than other cross breeds. Negative or not significantly different from zero heterosis effect was observed for different variables. Results of the genetic analysis of the diallel cross experiment is presented in table 5-7. After correction for age, sex and pond effect breeding value estimation was done individually. From the higher ranked individuals breeders for the first generation were selected.

Table 2: Diallel crossing experiment: Basic statistics for growth traits

Traits	Units	N	Mean	Min	Max	SD	CV
Harvest body weight	g	2545	21.5	1.6	94.9	14.4	67.2
Carapace length	mm	2545	29.5	11	66	8.0	27.0
Standard length	mm	2545	76.8	23	141	16.7	21.7

Table 3: Diallel crossing experiment: Least squares means (LSMs) for female and male

	Body traits	
	Body weight (g)	**Carapace length (mm)**
Male	19.6 ± 1.042	31.7 ± 0.444
Female	15.2 ± 1.037	28.1 ± 0.389

Figure 3 : Diallel crossing experiment: Least squares means (LSMs) of cross combinations for harvest body weight (g)

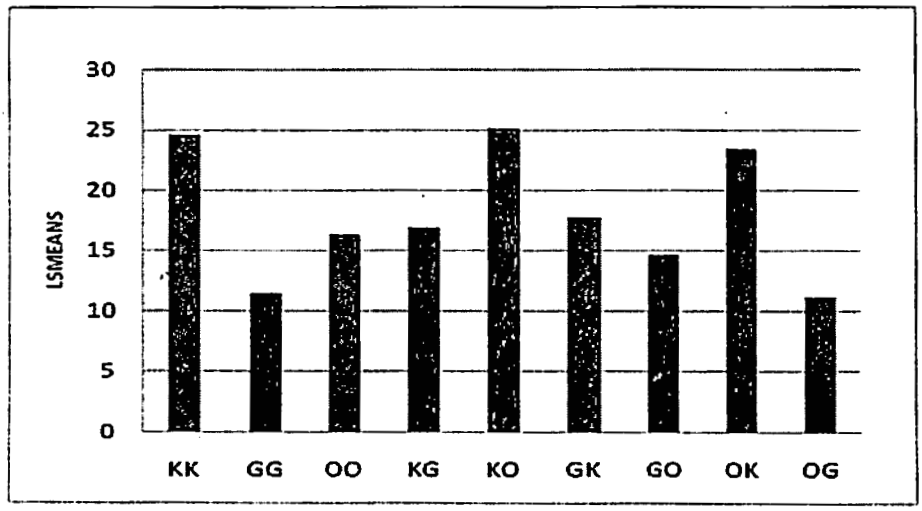


Figure 4 Diallel crossing experiment: Final survival of cross combinations

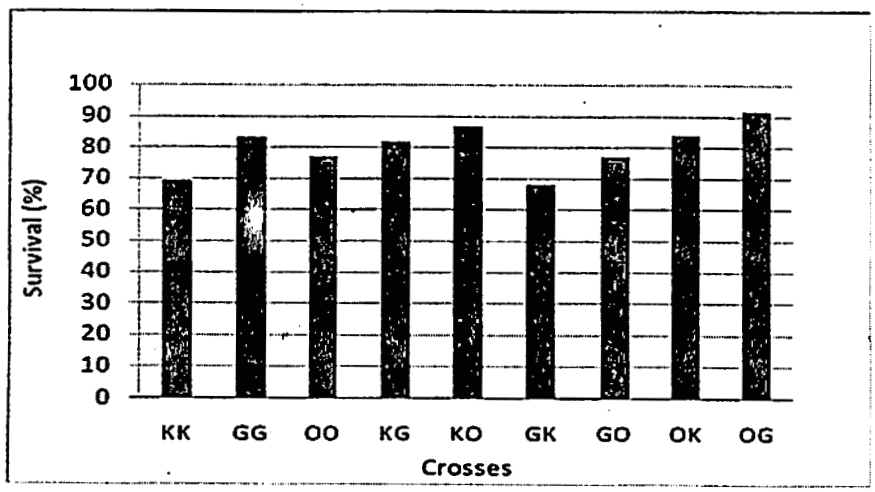


Table 4: Diallel crossing experiment: Significance of fixed effects verified by mixed model for final body weight

Effect	Num DF	Den F	F Value	Pr > F
cross	8	50	7.75	<.0001
batch	1	50	33.72	<.0001
pond	1	2473	4.81	0.028
batch*pond	1	2473	0.33	0.567
sex	1	2473	71.29	<.0001
cross*sex	8	2473	5.56	<.0001
age	1	2473	0.04	0.851

Table 5: Diallel crossing experiment: Estimates of strain additive genetic effects for body traits in logarithmic scale and as percentage of the pure strain mean.

Traits	BW		CL		SL	
	Estimate ±se	%	Estimate ±se	%	Estimate ±se	%
Means of pure strains	2.80 ± 0.05		3.341±0.02		4.308±0.02	
Pure strains						
G	-0.36±0.07	-12.86	-0.13±0.02	-3.89	-0.11±0.02	-2.55
K	0.40±0.07	14.28	0.141±0.03	4.22	0.11±0.02	2.55
O	-0.04±0.09	-1.43	-0.012±0.03	-0.36	-0.007±0.02	-0.16
Crosses						
GK	0.018±0.04	0.62	0.006±0.02	0.18	0.003±0.01	0.07
GO	-0.20±0.04	-6.9	-0.071±0.01	-2.10	-0.05±0.01	-1.2
KO	0.18±0.04	6.22	0.065±0.01	1.92	0.05±0.01	1.2

Table 6: Diallel crossing experiment: Heterosis components for body traits in logarithmic scale and as percentage of the pure strain mean

Traits	BW		CL		SL	
	Estimate ±se	**%**	**Estimate ±se**	**%**	**Estimate ±se**	**%**
Means of pure strains	2.80 ± 0.05		3.341±0.02		4.31±0.02	
General strain heterosis						
G	0.018±0.08	0.64	0.008±0.03	0.24	0.0004±0.02	0.009
K	0.138±0.08	4.93	0.056±0.03	1.68	0.050±0.03	1.16
O	0.107±0.08	3.82	0.048±0.03	1.44	0.036±0.03	0.84
Heterosis of particular strain crosses						
GK	-0.038±0.04	-1.31	0.017±0.03	0.50	0.014±0.03	0.32
GO	0.002±0.04	0.07	0.001±0.04	0.03	-0.013±0.03	-0.3
KO	0.237±0.04	8.2	0.096±0.04	2.84	0.086±0.04	1.98
Average heterosis for all strains	0.09±0.07	3.2	0.038±0.03	1.1	0.027±0.02	0.65

Table 7: Diallel crossing experiment: Estimates of strain maternal (reciprocal) effects for body traits in logarithmic scale and as percentage of the pure strain mean

Traits	BW		CL		SL	
	Estimate ±se	**%**	**Estimate ±se**	**%**	**Estimate ±se**	**%**
Means of pure strains	2.80 ± 0.05		3.341±0.02		4.31±0.02	
Maternal effects of pure strains						
G	-0.079±0.06	-2.82	-0.031±0.02	-0.93	-0.029±0.02	.0.67
K	-0.028±0.07	-1.0	-0.013±0.03	-0.39	-0.012±0.02	-0.28
O	0.107±0.07	3.82	0.043±0.03	1.29	0.041±0.02	0.95
Maternal effects for reciprocal crosses						
GK	0.026±0.06	0.90	0.009±0.02	0.27	0.009±0.02	0.21
GO	0.093±0.06	3.22	0.037±0.02	1.09	-0.035±0.02	-8.07
KO	0.068±0.07	2.35	0.028±0.03	0.83	0.026±0.02	0.6

6. Production of Generation 1

6.1 Mating, Larval rearing and juvenile raising

In the first batch a total of 28 males and 95 females were selected for mating in June 2009 and stocked in mating hapas at 1:3 or 1:4 sex ratio. Fifty-three full sib larval families were produced out of which 8 were lost due to bacterial diseases. Larval rearing of forty five families was successfully completed and post larvae were collected from these for further growth. Post larvae from all the forty five full sib families were reared to taggable size in nylon hapas. Rearing protocols of full sib larvae up to post larvae and post larvae up to taggable size juveniles were same as that explained earlier.

In the second batch 34 males and 99 females were selected for mating in September 2009. Fifty-five berried females were collected and out of which only 39 completed the embryonic development and released larvae. Larval rearing of 39 full sib families was carried out during November–December 2009. Larval rearing of 32 families was successfully completed and post larvae were collected from these for further rearing. Post larvae from 32 full sib families were reared to taggable size in nylon hapas. The low water temperature during October–December adversely affected embryonic development, larval rearing and juvenile rearing.

6.2 Tagging and Grow out of Generation 1

Three 400 m^2 (0.04 ha) earthen ponds were prepared for stocking by complete dewatering, liming and manuring. All the ponds were provided with aeration connection from an air blower. A total 3844 juveniles from 45 full sib families of Generation 1 (batch 1) were tagged individually with VIA tag and stocked in three communal grow-out ponds at 3/m^2 density in November 2009. The prawns were fed with commercial prawn pellet feed at 10% of the biomass per day. The water level was maintained at 1 m with frequent water addition to compensate the loss due to evaporation and seepage. Important water quality parameters such as pH, dissolved oxygen, ammonia nitrogen were monitored at weekly intervals to maintain the water quality.
Prawn juveniles (1893) from 32 full sib families of Generation 1 (batch 2) were individually identified with VIA tags and stocked for communal rearing in two 0.04 ha earthen ponds in March 2010. The prawns were reared for 150-160 days following the management practice described above for batch 1.

6.3 Data collection

The first batch of Generation 1 was harvested for final data collection during April 2010 and the second batch was harvested in August-September 2010. All the surviving prawns were collected, sexed, and measured individually (total length, carapace length, standard length, wet weight). Males were categorised according to their morphological appearance into Blue Claw males (BC), Orange Claw males (OC) and Small males(SM). Females were grouped into immature, maturing, fully mature, berried females (those carrying eggs), and spent females (those with an enlarged brood chamber). Presence and absence of VIA tags were also noted. After measurements the prawns were released to another well prepared 0.04 ha pond for further growth.

6.4 Survival and tag readability

In the first batch of communal rearing survival rate of tagged juveniles ranged from 71 to 81 %. Retention of VIA tags ranged from 89 to 91 % after 145-150 days of rearing. Readability of VIA tags ranged from 86 to 90 %. In the second batch of communal rearing survival rate of tagged juveniles ranged from 51.6 to 54.6%. Retention of VIA tags ranged from 50.5 to 56.3 % after 150-160 days of rearing. Readability of VIA tag ranged from 96 to 100 %.

6. 5 Data Analysis

The genetic evaluation of batch 1and 2 of the first generation was conducted. This first batch data set consisted of 2300 progeny that were the offspring of 44 dams and 25 sires. A mating list was designed to be used in the production of the second generation.

7. Mating cycle among selected G1 individuals, resulting in G2

The mating cycle among selected G1 individuals was conducted in the last week of June 2010. In the first batch a total of 40 males and 80 females were selected for mating based on breeding value and stocked in mating tanks at 1:2 sex ratio. The selected prawns were observed on a daily basis to record spawning. Larval rearing of 47 full sib families were successfully completed and post larvae were collected from these for further growth. Post larvae from all the 47 full sib families were reared up to taggable size in nylon hapas following the protocols developed and standardized for earlier generations.

As the genetic improvement programme is a long term work a second phase of the project was proposed and has now been approved to continue the work to achieve the desired goals.

II. Organization of workshops

The project has organized annual workshops at CIFA to review the progress of the project and to bring together researchers working on the biology and culture aspects of freshwater prawn and quantitative geneticists working on shrimp selection programs. Project leader and investigators from the collaborating institute have participated in all the workshops and detailed discussions were held regarding the progress of work and future work plan. Details of the annual workshops are presented below.

First Workshop

The first workshop of the bilateral project was held at CIFA on 17th March, 2008. Dr. Nguyen Hong Nguyen, scientist from the collaborating institution WorldFish Center, Malaysia, researchers working on the biology and culture aspects of freshwater prawn from different research institutions in India as well as quantitative geneticists working on shrimp selection programme attended the workshop. Principal investigator of the project from CIFA gave a presentation on the project progress so far and sought suggestions and advice from the participants of the workshop. Dr. Nguyen gave a presentation on the selective breeding projects being carried out by WorldFish Center, Malaysia. The Project team from CIFA had detailed discussions with the visiting scientist from the collaborating institution regarding the progress of the project.

Second workshop

The second workshop of the Bilateral Project was held at CIFA on 22nd June 2009. Dr. Raul Ponzoni, Project leader from WorldFish Center attended the workshop and gave two presentations. His first talk was on the ongoing selective breeding programme of freshwater prawn *Macrobrachium rosenbergii* in China, Vietnam and Malaysia. He also talked about the "Social interactions and selective breeding programme" an emerging concept that is very pertinent for *Macrobrachium rosenbergii* as this species shows size variation related to social interactions. Principal investigator of the project from CIFA gave a presentation on the "Global status of freshwater prawn culture" and also gave an update of the research progress of the project. Dr. Kanta Das Mahapatra, Principal Scientist spoke about the data analysis conducted on 3x3 diallel cross and discussed the results obtained. Dr. Gopikrishna, Sr. Scientist, CIBA gave a presentation of the "Selective breeding programme of shrimp *Penaeus monodon*". Dr. Ravindranath, Dean, College of Fisheries, SVVU, Tirupati gave a presentation on the "Prospects and Problems of Scampi farming in Nellore, India". Ms. Lopamudra Sahoo, Scientis gave a talk on "Tagging techniques of Freshwater prawns". Dr. A Gopalakrishnan, Principal scientist, NBFGR gave a talk on 'Genetic Cataloging and Conservation'. The formal workshop was followed by two days of project discussions involving Dr. Raul Ponzoni and the team of researchers working in the project in India.

Final workshop

The final workshop of the project was held at CIFA during 2-3 July 2010 with the following objectives a) To review the progress of the project, and b) To present the project results to stake holders including prawn farmers, hatchery owners, state fisheries departments, researchers working on the biology and culture aspects of freshwater prawn and quantitative geneticists working on shrimp selection. In addition to researchers from different parts of the country, representatives from national developmental agencies such as National Fisheries Development Board, Marine Product Export Development Authority, state fisheries department, prawn farmers and hatchery operators participated in the two day workshop. The technical session started at 11.00 am on 2 July under the chairmanship of Dr. Ambekar E. Eknath, Director.

The chairman made the first presentation and spoke about the "Genetic resources of freshwater prawns of India: potential for aquaculture". Dr. Bindu R. Pillai, Senior Scientist, CIFA and principal investigator of the project gave a presentation on the "Genetic Improvement of freshwater prawn *Macrobrachium rosenbergii* – status of research at CIFA". She gave a brief introduction to the global status of *M. rosenbergii* aquaculture with special reference to India. She also gave an update on the project's progress. Dr. Kanta Das Mahapatra, Principal Scientist and co-principal investigator gave a presentation on the "Establishment of base population and selective breeding of *Macrobrachium rosenbergii* at CIFA". She explained the data collection and data processing methods used in the genetic analysis of data. Dr. Raul Ponzoni, Project Leader from the WorldFish Center, Malaysia gave a presentation entitled "Update on genetic improvement work with freshwater prawn". In a second presentation Dr. Ponzoni addressed the issue of "Effective population size in our genetic improvement programs: conclusions from a case study". He observed that aquaculture production is currently based on unimproved strains, and that the very limited number of improved strains we have suffer from a relatively low effective population number. Dr. Haribabu, Associate Professor, Nellore Fisheries College, gave a presentation on the "Brood stock blocks: an

experience from Nellore region". Dr. Gopikrishna, Principal Scientist, CIBA, gave a presentation on "Genetic improvement in tiger shrimp: the way forward". He informed the house that the problem in the *P. monodon* breeding programme is the difficulty in closing the life cycle under captive conditions. Dr. S. Jahageerdar, Senior Scientist, CIFE, Mumbai, spoke about "Genetic evaluation of three stocks of *Macrobrachium rosenbergii* for economic traits". Dr. Gopinath Sai, Executive Director, National Fisheries Development Board, Hyderabad, spoke about the difficulties faced by the scampi farmers in Andhra Pradesh, who are the major producer of cultured scampi.

The second day of the workshop (3rd July) was dedicated to interaction with farmers, hatchery owners and researchers. Dr. Haribabu chaired the session and Dr. Gopinath Sai acted as the co-chairperson. Farmers from Guntur districts of Andhra Pradesh and hatchery owners from Orissa participated in the discussion. They shared their experience with the species and very informative dialogues were developed. They also spoke about the difficulties they face as farmers. All the farmers agreed that poor quality seed is the major problem facing the industry now.

III. Presentation of the research results in International Seminars

The Principal investigator and the co-PI of the project from India participated in the International Seminar on "Giant Malaysian Prawn 2008" organized by the Malaysian Fisheries Society during 28-29 March 2008 at Kuala Lumpur, Malaysia and presented a paper entitled "Genetic Improvement of giant freshwater prawn *Macrobrachium rosenbergii* in India".

Dr. Bindu R. Pillai, Senior Scientist, CIFA and Dr. Kanta Das Mahapatra, Principal Scientist, CIFA from India also participated in the International Seminar on "Asian-Pacific Aquaculture 2009" organized by World Aquaculture Society during 3-6 November 2009 at Kuala Lumpur, Malaysia and presented a paper entitled "Evaluation of the growth performance in a 3x3 diallel cross of giant river prawn *Macrobrachium rosenbergii* in India".

IV. Study visit to WorldFish Center

The Principal investigator and the co-investigators (Dr. Kanta Das Mahapatra, Sr. Scientist, and Dr. N. Sarangi, Director, CIFA) from India visited WorldFish Center, Penang, Malaysia during 31 March to 4th April 2008. Detailed discussions were held with Dr. Raul Ponzonii and his team regarding the project. On 4th April one interaction meeting was also held with Dr. S. Ayyappan, Deputy Director General, Indian Council of Agricultural Research, Dr. N. Sarangi, Director, CIFA and the project team. Subsequently they visited National Prawn Fry Production Centre, Pulau Sayak, Kedah state, Malaysia where the genetic improvement programme on *Macrobrachium rosenbergii* is being carried out in Malaysia.

During 13-18 December 2008 two project personnel from India Dr. S. C. Rath, Sr. scientist and Mr. Sovan Sahu, technical Officer visited WorldFish, Penang, Malaysia on a study visit. In August 2010 Mr. P. L. Lalrinsanga, scientist and project investigator from India also visited WorldFish Center on a study visit.

V. Infrastructure Development under the project:

- A concrete nursery of 100 m^2 (20 X 5 X 1.2m) for the common rearing of full sib groups of post larvae in nursery hapas until they attained taggable size was constructed.
- For the individual rearing of full sib larval families we have designed and fabricated cylindrico-conical fibre-glass reinforced plastic (FRP) tanks of 500 l capacity. A total of 56 such FRP tanks were procured under the project.
- Renovation of the existing hatchery and farm ponds were also carried out under the project for undertaking the project work in a more efficient manner. A 0.30 ha pond was partitioned into four 0.05 ha ponds by erecting earthen bunds. Water supply pipe connection was extended to three grow-out ponds. A Shade net covering was made for the concrete nursery tank (20 x 5 x 1.2 m). The existing hatchery complex was also renovated by providing a glass window system for providing adequate light and preventing the lowering of temperature during the winter season.

VI. Salient Achievements:

- Collected three stocks of giant freshwater prawn *Macrobrachium rosenbergii* from three geographically distant locations in India namely Gujarat, Kerala and Orissa to form a base population with wide genetic variation for initiating selective breeding programme for improving the growth performance.

- The above three stocks of *M. rosenbergii* were brought to CIFA farm, stocked in separate earthen ponds and reared to sexual maturity

- A complete diallel crossing(3 by 3) of the three stocks was carried out to evaluate the performance of all the nine possible crosses of these stocks.

- Results of diallel crossing revealed significant differences in harvest weight of different stocks and their combinations.

- Among the pure bred stocks, harvest weight of Kerala stock was highest and that of Gujarat was the lowest.

- Harvest body weight of Kerala stock was significantly higher than that of Gujarat and Orissa stock.

- Harvest body weight of Orissa stock was not significantly different from that of Gujarat stock.

- Sex showed significant effect on the harvest weight.

- Pond and age effect on harvest weight was not significant

- Estimated the magnitude of heterosis effect based on crossing of stocks and the total heterosis effect was not significant for different body traits measured.

- A synthetic population of giant freshwater prawn *Macrobrachium rosenbergii* was established for selective breeding

- Protocols for individual tagging of juveniles prawns were developed using soft visible implant alpha numeric tags (VI Alpha) manufactured by Northwest Marine Technologies, USA.

- Protocols for the reliable production of a reasonable number of full sib families of *M. rosenbergii* were also developed.

- Conducted selective breeding to improve growth performance and produced first and second generation of selectively bred *M. rosenbergii*.

- Heritability was estimated to be 0.298±0.008.

VII. Research Publications:

a) Research papers/ Astracts:

1. Bindu R Pillai, Lopamudra Sahoo, Kanta Das Mahapatra, Raul Ponzoni, Sovan Sahu, Swagatika Mohanty, Vijaykumar and Swagatika Sahu, 2009. Evaluation of a new Fluorescent Internal Tag (soft Visible Implant Alphanumeric Tag) in Freshwater Prawn *Macrobrachium rosenbergii*, *The Israeli Journal of Aquaculture-Bamidgeh*, 61 (4) 345-350.

2. Bindu R. Pillai, R. W. Ponzoni, K. D. Mahapatra, L. Sahu, S.C. Rath, N. Sarangi, N. H. Nguyen and S. Sahu. Genetic improvement of giant freshwater prawn *Macrobrachium rosenbergii* (de man) in India. In: International Seminar on "Giant Malaysian prawn 2008" held at Kuala Lumpur, Malaysia during 28-29 March 2008 (abstract)

3. Bindu R. Pillai, Lopamudra Sahoo, Sovan Sahu, S. Mohanty, Vijaykumar and S. Sahu. 2008. Evaluation of unilateral eyestalk ablation as a tool for synchronizing ovarian maturation in *Macrobrachium rosenbergii* (de man). "8th Indian Fisheries Forum" held at Kolkota, India during 20-24 November 2008. (abstract)

4. Bindu R. Pillai, K. D. Mahapatra, R. W. Ponzoni, L. Sahu, L. Sanga, N. H. Nguyen, S. C. Rath, Sovan Sahu, S. Mohanty, S. Sahu and G. Patra. Evaluation of growth performance in a 3x3 diallel cross of *Macrobrachium rosenbergii* in India. International Seminar "Asian Pacific Aquaculture 2009" held at Kuala Lumpur, Malaysia during 03-06 November 2009. (abstract)

5. Bindu R. Pillai, K. D. Mahapatra, R. W. Ponzoni, L. Sahoo, P.L. Lalrinsanga, N. H. Nguyen, Khaw, H.L., S. Mohanty, S. Sahu, G. Patra, s. Patnaik, and A.E. Eknath. Selective breeding of giant freshwater prawn *Macrobrachium rosenbergii* for improved harvest weight in India. (abstract) International Seminar "Asian Pacific Aquaculture 2011" Kochi, India 17-20 January, 2011 (abstract).

6. K. D. Mahapatra, Bindu R. Pillai, R. W. Ponzoni, L. Sahoo, P.L. Lalrinsanga, N. H. Nguyen, Khaw, H.L., S. Mohanty, S. Sahu, G. Patra, s. Patnaik, and A.E. Eknath. Estimation of heterosis effect on body traits in complete diallel cross involving three stocks of *Macrobrachium rosenbergii*. International Seminar "Asian Pacific Aquaculture 2011" Kochi, India 17-20 January, 2011 (abstract).

b) Seminars and Workshops in which the Scientists have participated:

- International Seminar on "Giant Malaysian Prawn 2008" organized by the Malaysian Fisheries Society in Kuala Lumpur, Malaysia, 27-28 March 2008 presented a paper entitled "Genetic Improvement of giant freshwater prawn *Macrobrachium rosenbergii* in India".
- "8th Indian Fisheries Forum" held at Kolkota, India during 20-24 November 2008.
- International Seminar "Asian Pacific Aquaculture 2009" at Kuala Lumpur, Malaysia, 03-06 November 2009.
- International Seminar "Asian Pacific Aquaculture 2011", Kochi, India, 17-20 January 2011.

VIII. Signature of Principal Investigator, CIFA, India

Dr. Bindu R. Pillai:

Signature of Principal Investigator, WorldFish Center, Malaysia

Dr. Raul Ponzoni:

IX. Signature (with comments, if any) of Head of Division:

X. Signature (with comments, if any) of Director, CIFA:

22/2/2011

Central Institute of
Freshwater Aquaculture
P.O.- Kausalyaganga
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PROJECT TEAM

Name	Designation
CIFA, India	
Dr. Bindu R. Pillai	Senior Scientist and Principal Investigator
Dr. Kanta Das Mahapatra	Principal Scientist, Co-Principal Investigator
Dr. N. Sarangi (Up to 30.06. 2008)	Former Director and Co-Investigator I
Dr. S. C. Rath	Senior Scientist and Co-Investigator II
Ms. Lopamudra Sahoo	Scientist and Co-Investigator III
Mr. P. L. Lalrinsanga (From 01.08.2008)	Scientist and Co-Investigator IV
Mr. Sovan Sahu	Technical Officer
Mr. Vijaykumar (07.07.2007 to 15.01.2009)	Senior Research Fellow
Ms. Swagathika Mohanty (09.07.2007 to 30.09.2010)	Senior Research Fellow
Mr. Siddhartha Biswal (09.07.2007 to 30.04.2008)	Senior Research Fellow
Ms. Swagathika Sahu (07.07.2008 to 31.12.2009)	Senior Research Fellow
Ms. Shivani Patnaik (30.01.2009 to 30.09.2010)	Senior Research Fellow
Ms. Swagathika Sahu (07.07.2007 to 30.04.2008)	Laboratory Attendant
Mr. Gunamaya Patra (21.07.2008 to 28.08.2009)	Laboratory Attendant
Mr.Gopal Krushna Jena (15.10.2009 to 14.01.2010)	Laboratory Attendant
Ms. Namita Naik (18.01.2010 to 30.09.2010)	Laboratory Attendant
The WorldFish Center, Malaysia	
Dr. Raul Ponzoni	Principal Scientist and Principal Investigator
Dr. Nguyen Hong Nguyen	Scientist, Investigator 1
Ms. Khaw Hooi Ling	Research Assistant, Investigator II

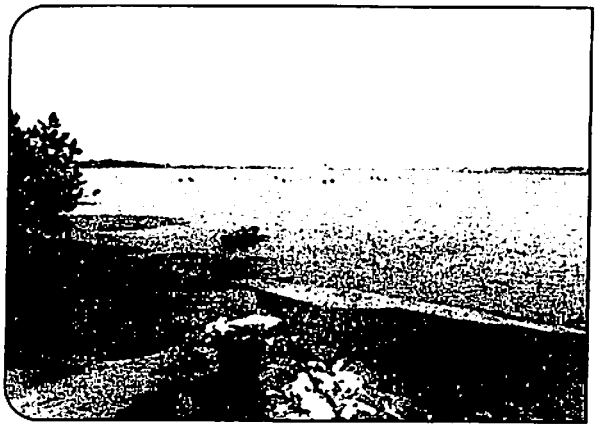
Executive Summary:

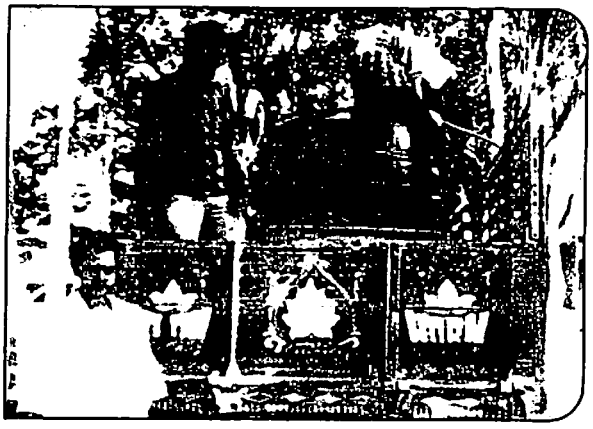
Macrobrachium rosenbergii is one of the widely cultured freshwater prawn species globally. India was the third largest producer of this species in 2007 and its aquaculture production rose to 43,000 metric tons (t) in 2005 from less than 500 t in 1995. However, since then production has been declining and in 2008-09 it was 12,856 t, a reduction of more than 70% compared to 2005. There are several contributing factors to this decline, such as slow growth rate, poor survival, disease outbreaks, increase in cost of production, and availability of low risk alternative fish species. However, there is a consensus that poor seed quality leading to unsatisfactory growth and survival rates in ponds is one of the major reasons. Hence, the development of a systematic selective breeding program aimed at improving growth rate and ensuring high survival rate of this species was deemed a high priority. The Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar, India in collaboration with the WorldFish Center, Malaysia initiated a selective breeding program for this species in 2007.

For the establishment of a base population with wide genetic variation, three populations from geographically distant locations (Gujarat, Kerala and Orissa) in India that represent different agro-ecological regions were brought to CIFA and reared to sexual maturity. These populations were then involved in a complete diallel cross (3 by 3) in two mating batches to evaluate the performance of all the nine possible crosses of these stocks. Juveniles (4770) from 60 full sib families from two batches were individually tagged with Visible Implant Alpha numeric tags (VIA) for grow-out evaluation in 400 m^2 earthen ponds. After a rearing period of 125-130 days all the surviving prawns were collected, sexed and measured individually (total length, carapace length, standard length, wet weight). Survival rate ranged from 81.4 to 85.1%. Data were analyzed using SAS and ASREML software. The results revealed significant sex and batch effects but non-significant pond effect in harvest weight. Harvest weight of Kerala stock was found to be significantly higher than that of Orissa and Gujarat stock. The total heterosis effect was not significant for the recorded traits. Significant differences in harvest weight were observed between crosses.

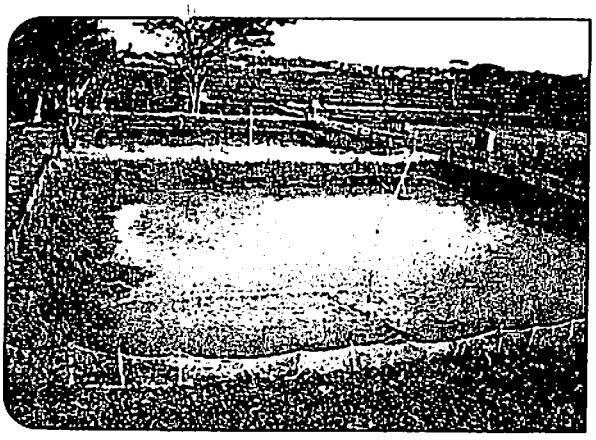
Breeding values for harvest weight were estimated fitting an animal model to the data. Mating of the selected individuals from the base population was carried out and 77 full sib families of generation 1 were raised. From these full sib families, 5381 juveniles were individually tagged and reared together for grow out evaluation in five 400 m^2 earthen ponds in two batches. Survival rate of tagged juveniles after 145-150 days of grow out ranged from 71 to 81%. Retention and readability of VIA tags ranged from 89 to 91% and from 86 to 90% respectively. The heritability estimate for harvest weight was 0.30± 0.088.

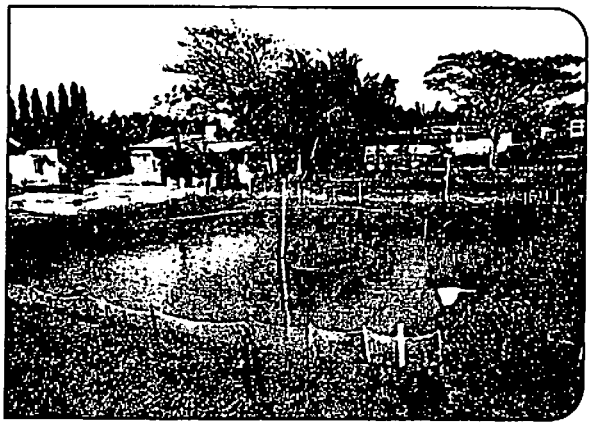
Project Activities





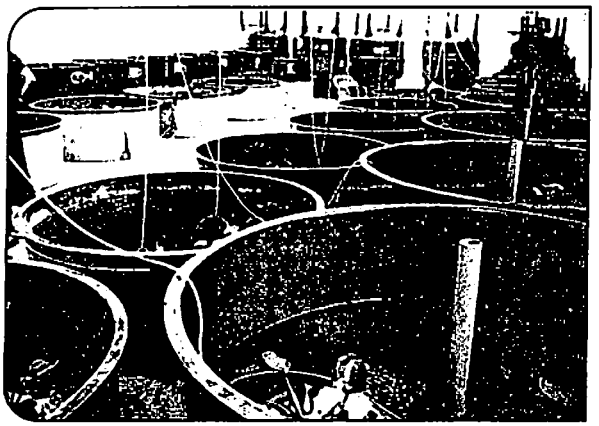
Collection of wild stocks of Macrobrachium rosenbergii and transportation to CIFA

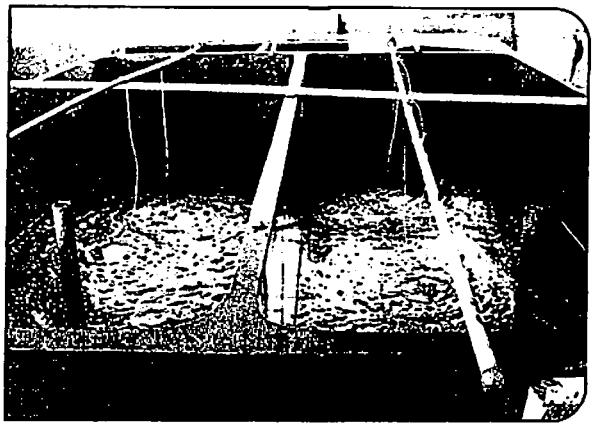




Rearing ponds of different stocks of Macrobrachium rosenbergii at CIFA

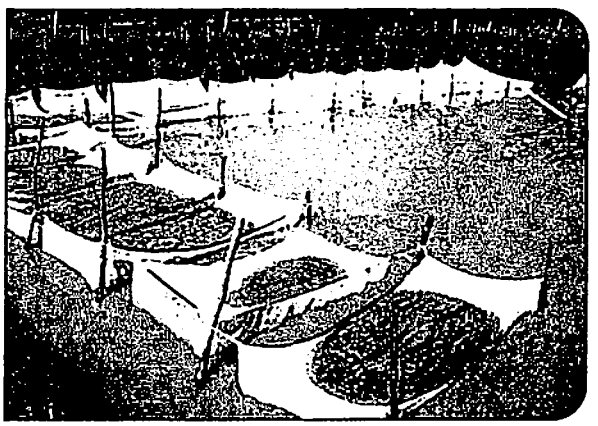
Project Activities





Mating set up

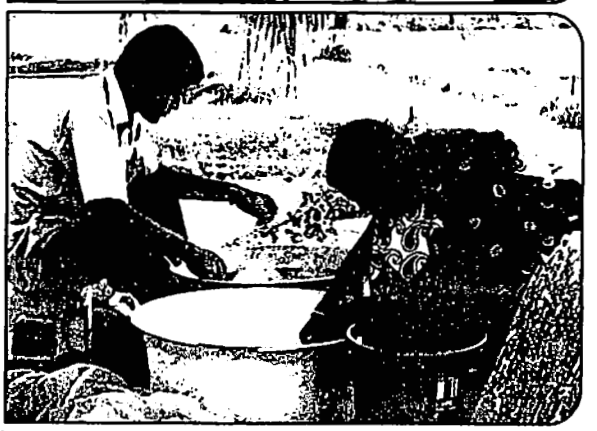
Full sib rearing of larvae



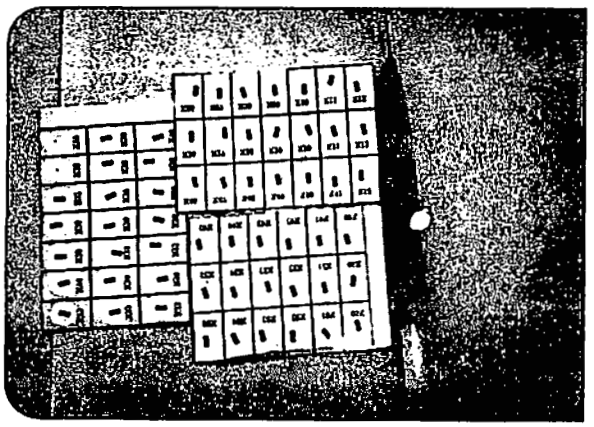
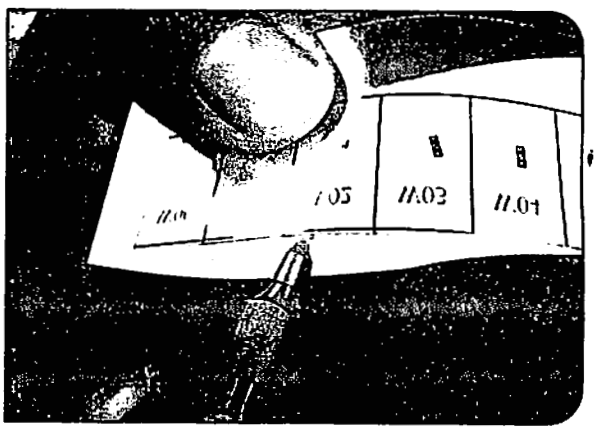
Full sib rearing of post larvae

Project Activities

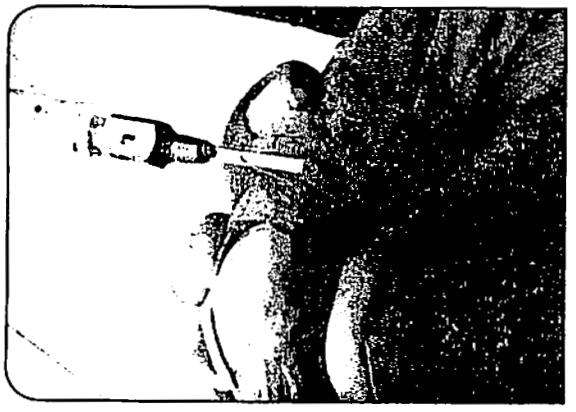
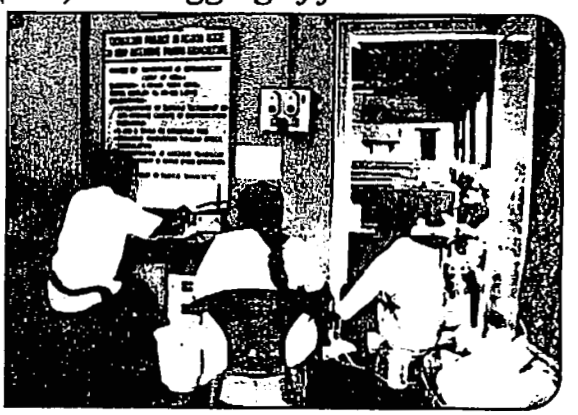


Sampling of juveniles for growth evaluation

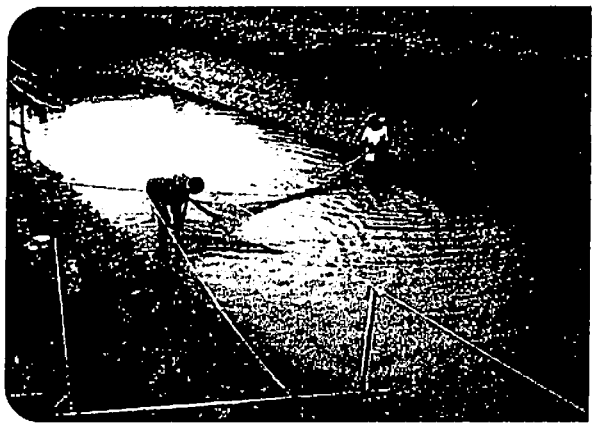



Visible implant alpha numeric tag (VIA) and tagging of juveniles.

First data collection at tagging

Project Activities

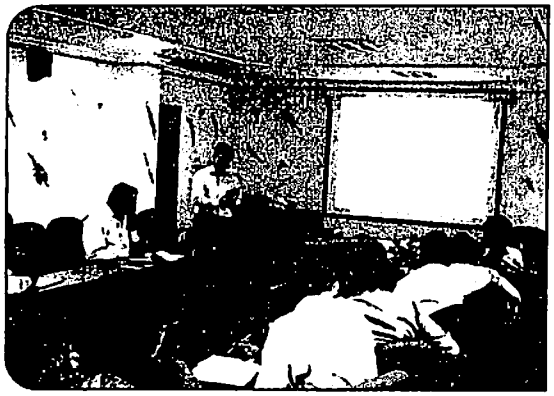


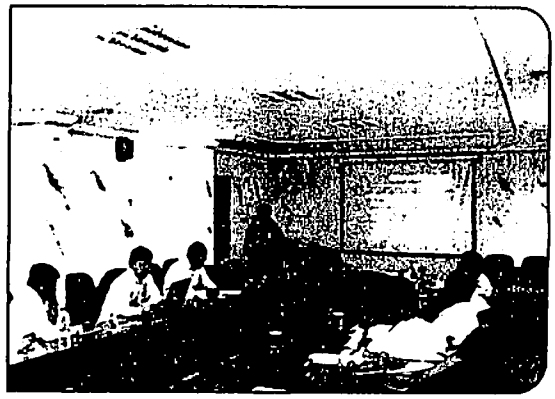
Dewatering of grow-out ponds for final data collection

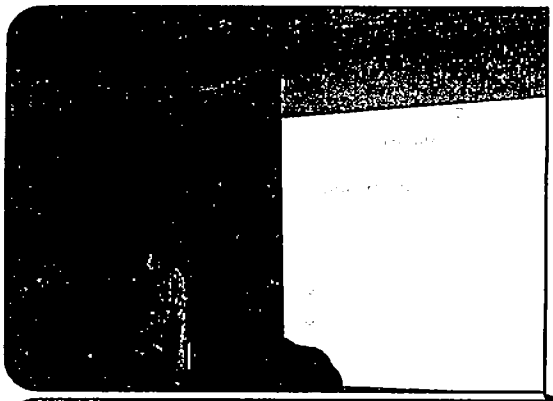
Mate allocation

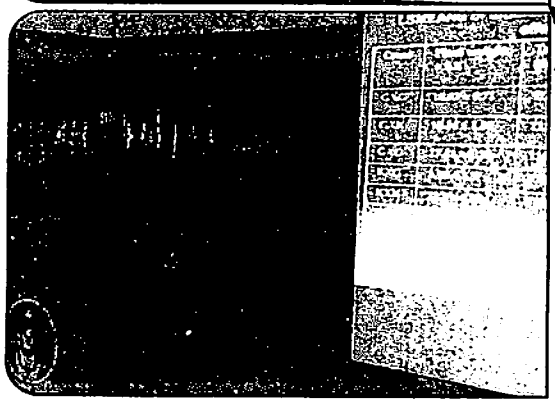
Workshops Organized

First Workshop 17 March 2008

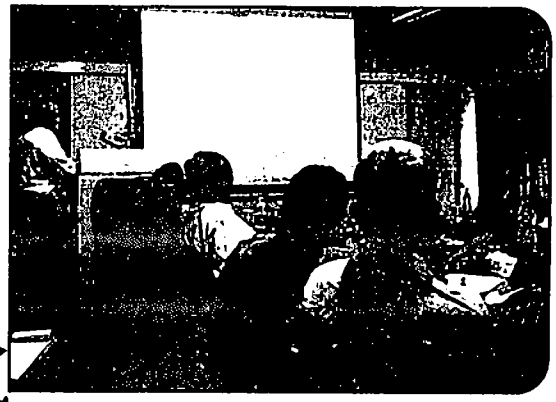








Second Workshop 22 June 2009



Final Workshop 2-3 July 2010