Fresh Water Prawn farming
Zoo-301, Unit-V

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Prawn vs Shrimp

- Prawns are larger variety, freshwater, brackish water inhabitants
- Shrimps are smaller marine forms
- These are Crustacean belonging to families Penaeidae & Palaemonidae

Penaeid	Non-Penaeid
(1) The pleurae of the second abdominal segment overlap the pleurae of the first segment only. (Fig. 8.1a).	The pleurae of the second abdominal segment overlap the pleurae of the first and third segments. (Fig. 8.1b)
(2) The first three thoracic legs are chelate.	The first two thoracic legs are chelate.
(3) Male has petasma* (Fig. 8.2a) for transferring sperms. Female has thelycum‡ (Fig. 8.2b).	Such organs are absent in males and females.
(4) The females lay eggs individually in water. Fertilisation and development take place outside.	The females carry eggs between their pleopods as a cluster.
(5) The penaeid catch along the Indian coast is a little over 50%, the bulk of which comes from the coast of Kerala.	The non-penaeid catch along the Indian coast is a little less than 50%, of which 90% are hauled from Maharashtra and Gujarat coasts.

* **Petasma** : The male endopodites contain hooks and the hooks of the two sides interlock to form a rod-like structure called petasma.

‡ **Thelycum** : It is a structure in the female into which sperms are transferred through petasma of males.

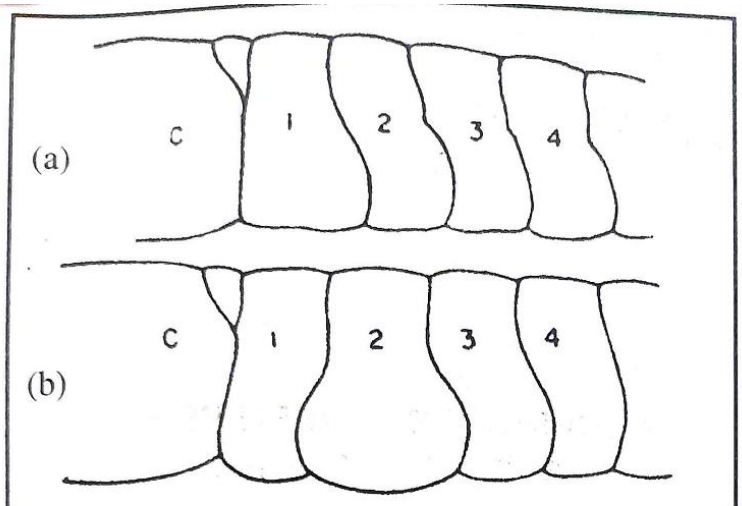


Fig. 8.1. Exoskeleton (sketch) of (a) Penaeid and (b) Non-Penaeid prawn (C, carapace; 1 to 4, first four abdominal exoskeleton)

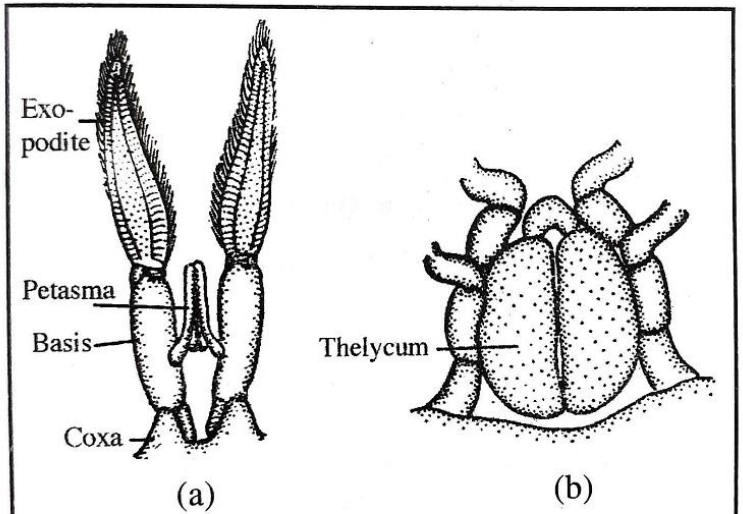


Fig. 8.2. (a) First pleopod of male penaeid showing petasma (b) Thelycum of *Penaeus indicus.*

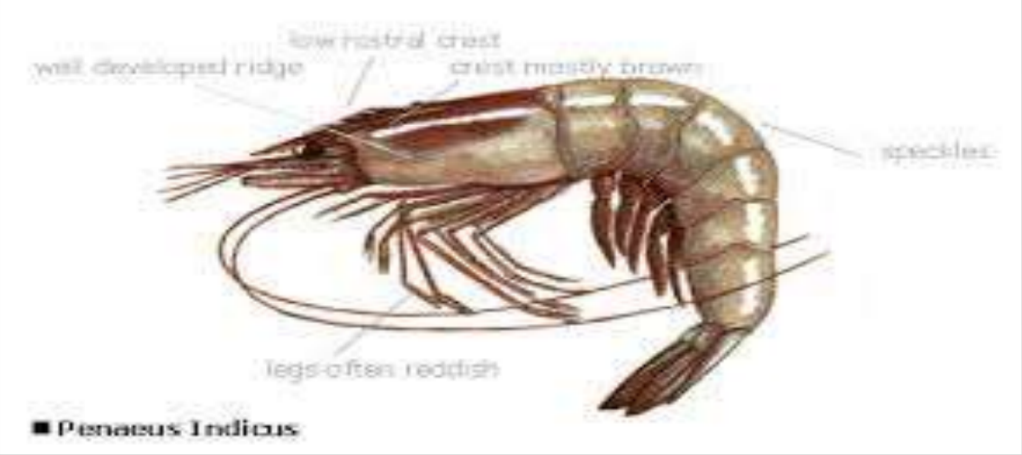
Species of Prawn in India

- In India mostly five genera of prawn are reported, are as follows :

1) ***Penaeus***
2) ***Metapenaeus***
3) ***Parapenaeopsis***
4) ***Palaemon***
5) ***Macrobrachium***

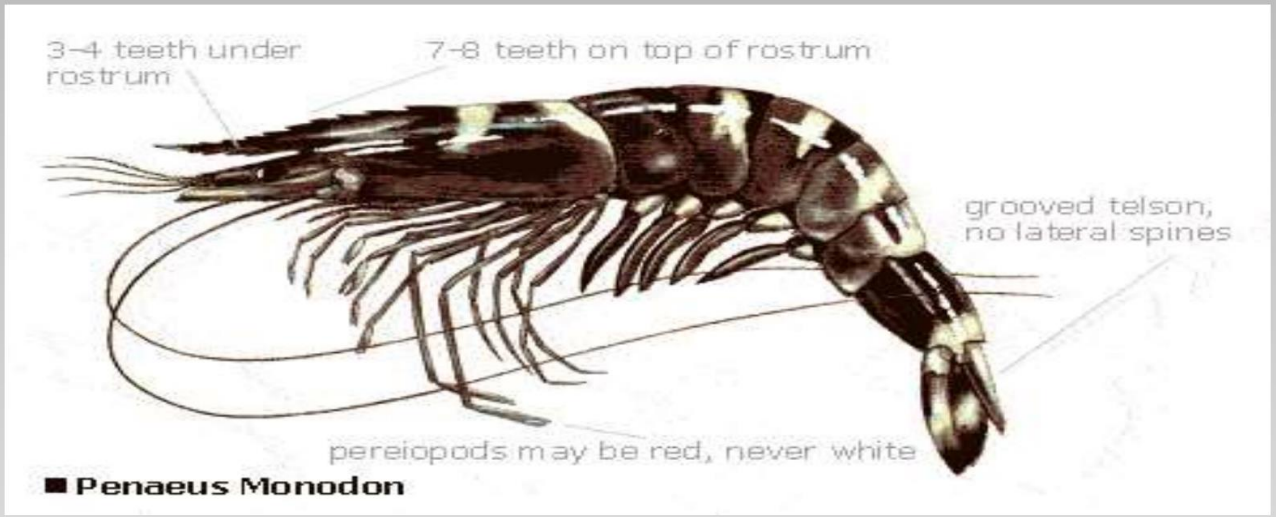
Penaeus indicus

- This is the most common commercial prawn species.
- This is found in both the coasts, occurring through coastal water and estuaries to coastal lakes.
- It can attain maximum length up to 20 cm.



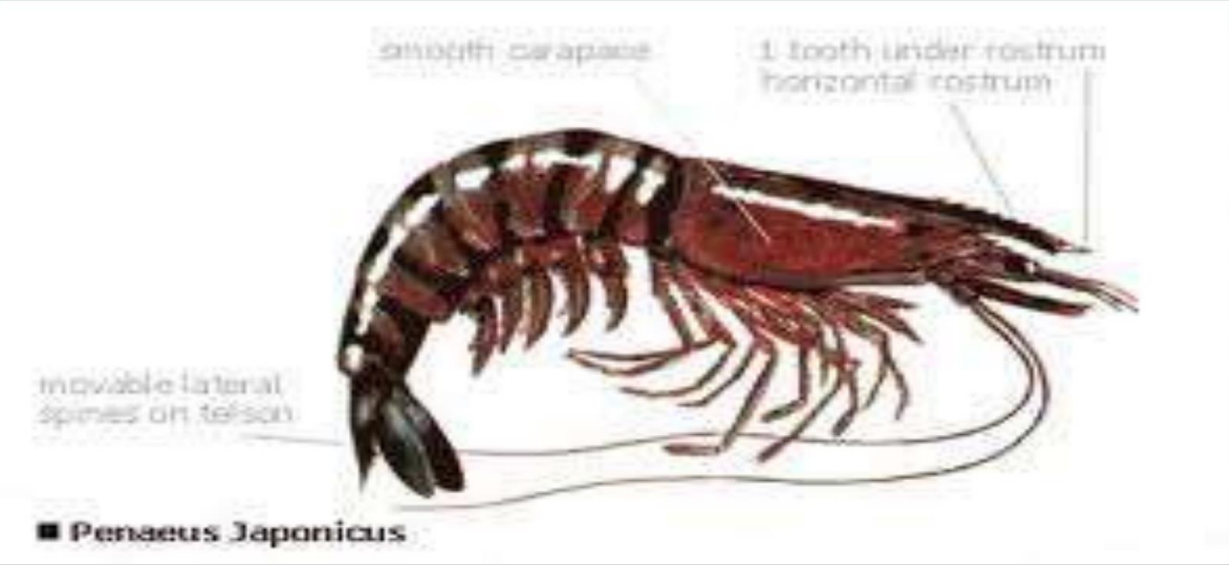
Penaeus monodon

- This is largest sea prawn.
- Found in Indian water of east and west coasts.
- It can attain maximum length up to 30 cm.



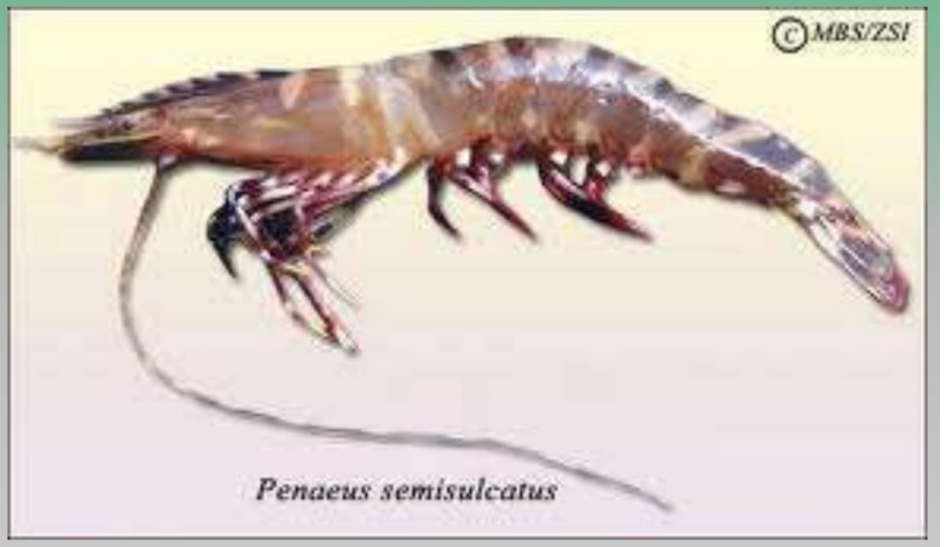
Penaeus japonicus

- It is mostly found in sea coast of east areas.
- It can attain maximum length up to 26 cm.



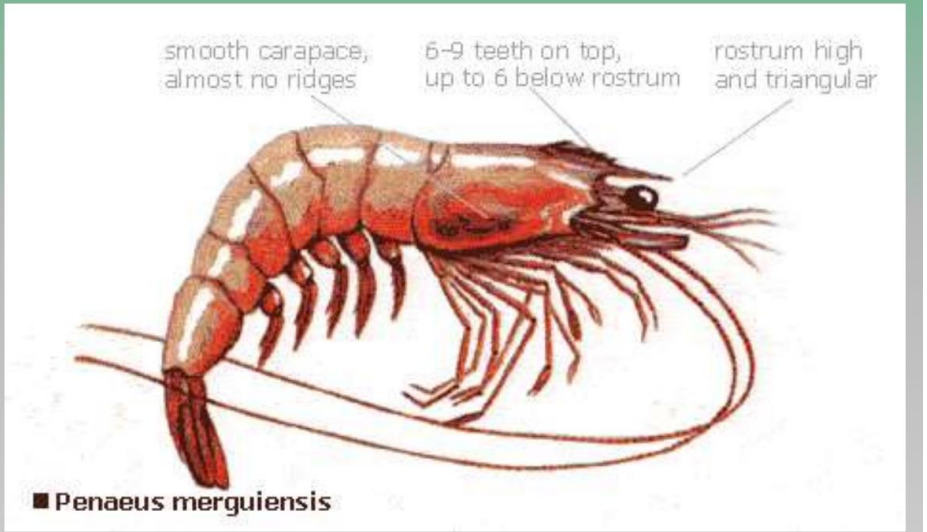
Penaeus semisulcatus

- This is mostly found in both West Bengal coast and Mumbai coast.
- This can be attain maximum length up to 20 cm.



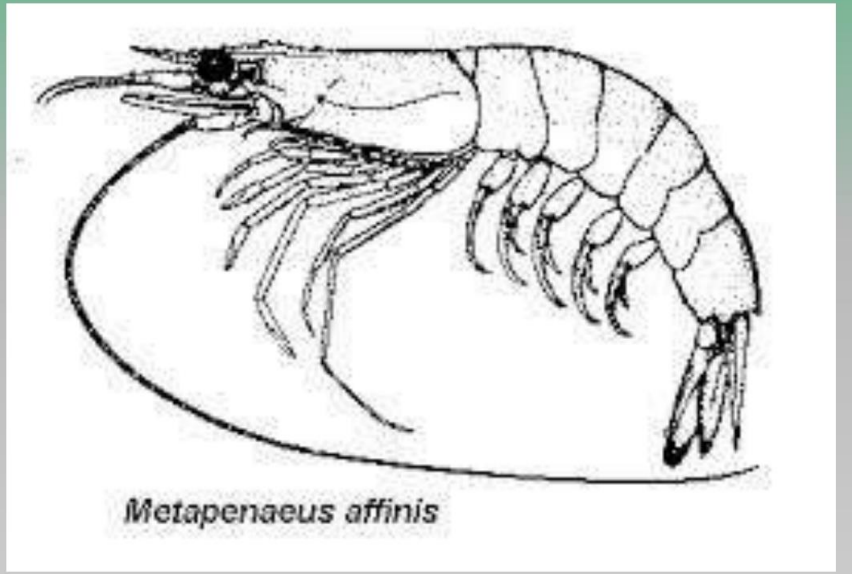
Penaeus merguiensis

- This is found both east and west coast in India.
- This is the main species for catching easily.
- This can be attain maximum length up to 18 cm.



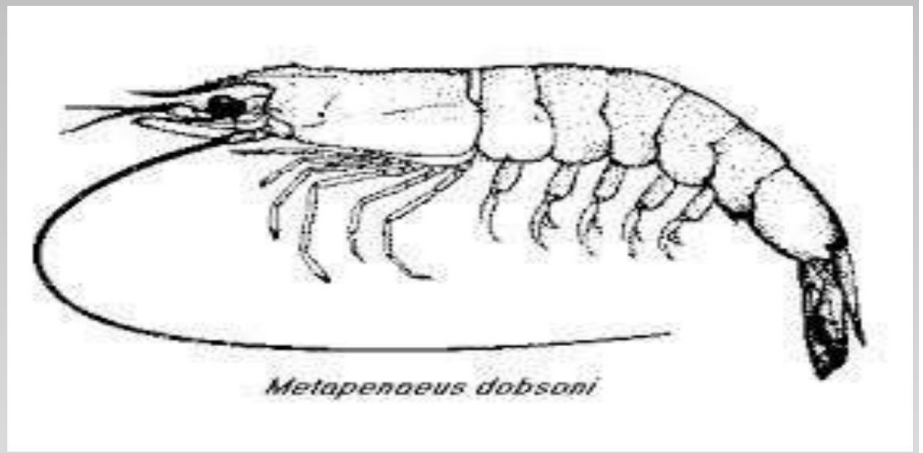
Metapenaeus affinis

- This is commonly found in paddy field of West Bengal.
- Some time it may be found on the Mumbai coast also.
- It can attain a length of 13 cm. when fully grown.



Metapenaeus dobsoni

- This is commonly found in brackish water and estuaries.
- It is dominant species on Kerala coast and fishing throughout the year.
- It can grow up to maximum length 11 cm. and its life span 3 years.

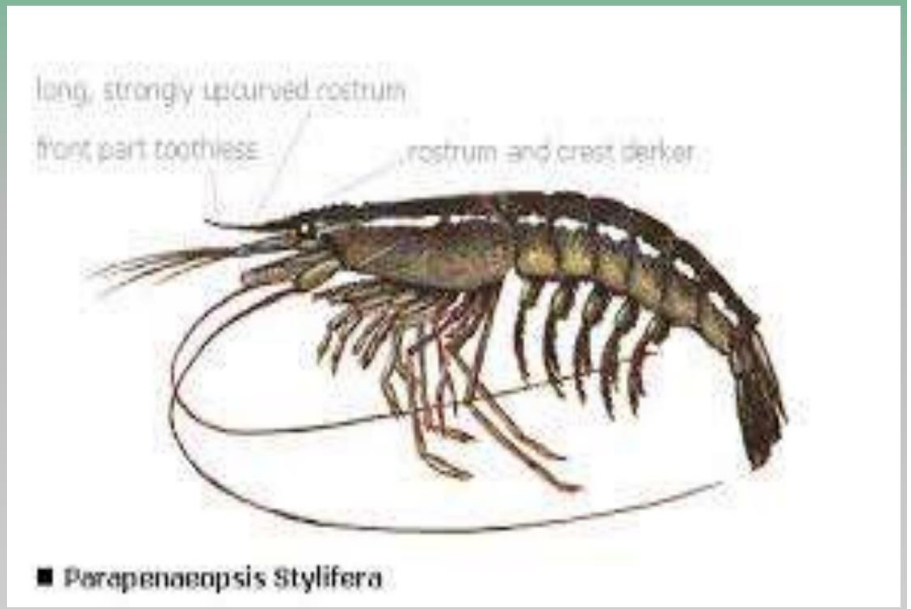


Metapenaeus monoceros

- **This is found the entire coast line.**
- **It is common for estuaries water.**
- **It can attain a maximum length up to 17 cm.**

Parapenaeopsis stylifera

- This is found on the west coast.
- It is maximum fished in Kerala State in the months of December to May.
- It can grow up to maximum length 11 cm.
- Life span of this prawn is of 2 years.



■ Parapenaeopsis Stylifera

Fresh Water Species

❖**Fresh water prawns of the genus *Macrobrachium* are very suitable for intensive culture.**

❖**The main species of *Macrobrachium* are as-:**

- ***Macrobrachium rosenbergii***
- ***Macrobrachium malcomsonii* (Rivers)**
- ***Macrobrachium birmanicum***
- ***Macrobrachium rude***
- ***Macrobrachium idae* (Ponds)**

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(Rivers)

- *Macrobrachium rude*
- *Macrobrachium idae*

(Ponds)

Palaemon fluminicola

- This prefers to inhabit fresh of brackish water.
- This is reported to ascend the river Ganga to a distance of 1127 Km.
- This can be attain maximum length up to 22 cm.

Palaemon styliferus

- This is found brackish and marine waters.
- This is contributes good catch of the Gangetic delta and Mumbai coast.
- This can attain maximum length up to 18 cm.

Macrobrachium carcinus

- This is fresh water prawn and migrate to brackish water for breeding.
- This can attain maximum 30 cm.
- This prawn is highly demanded species for freezing and export.


Macrobrachium carcinus

Macrobrachium idae

- This is commonly found in Kerala coast water.
- During the months of September to December.
- This can be attain maximum length 26 cm.

Macrobrachium malcomsoni

- This is migratory species generally found in Chilka lake.
- This is fishing in large number in monsoon season.
- This attain maximum length up to 15 cm.

Macrobrachium mirabilis

- This is an important prawn catch in the upper reaches.
- This is found in West Bengal estuaries.
- This become up to length 23 cm.

Classification of fresh water prawn *Macrobrachium rosenbergii*

- **Kingdom : Animalia**
- **Phylum : Arthropoda**
- **Subphylum : Crustacea**
- **Class : Malacostraca**
- **Order : Decapoda**
- **Sub-order : Pleocyemata**
- **Infraorder : Caridea (Natantia)**
- **Superfamily : Palaemonoidea**
- **Family : Palaemonidae**
- **Subfamily : Palaemoninae**
- **Genus : *Macrobrachium***
- **Species : *rosenbergii* (giant river prawn)**

Fresh water prawn Breeding and Culture

Why *Macrobranchium rosenbergii*?

- 150 species freshwater prawns in world of which 40 species found in India
- *M. rosenbergii* most suitable because of its faster growth rate, higher tolerance to wider range of salinity & tempt. & less cannibalistic tendency

Introduction

- Giant freshwater prawn *Macrobrachium rosenbergii* is commonly known as **"SCAMPI"**.
- It is widely distributed in Southeast Asia and found in most river systems in India.
- It is highly valued due to its high price, large size, rapid growth, good taste and high export demand.
- These prawns inhabit rivers, canals, estuaries and coastal waters in nature.
- It can also be cultured in freshwater as well as slightly brackish water.
- ICAR-CIFA has developed a package of practices for the scientific culture of *Macrobrachium rosenbergii.*
- It involves a nursery phase and grow out phase.

Body composition of *M. rosenbergii*

Moisture 78.29	Fat 0.27	Calcium 0.074	Sodium 0.182	Iron 0.0012
Protein 21.17	Ash 0.37	Phosphorus 0.1799	Potassium 0.2986	Dry matter 21.71

Identification characteristics of mature male & female giant freshwater prawn *M. rosenbergii*

Table 8.2 : Identification characteristics of mature male and female giant freshwater prawn (*M. rosenbergii*)

Mature male	Mature female
1. Mature male prawns are larger in size.	1. Mature female prawns are comparatively smaller, of some age group.
2. Abdominal region is narrower.	2. Abdominal region is broader than that of male.
3. The second walking legs are considerably larger and thicker (Fig. 8.6c)	3. The second walking legs are thinner and narrower (Fig. 8.6f).
4. The cephalothorax is proportionately larger.	4. Cephalothorax is comparatively smaller.
5. At the base of each fifth leg is present male genital opening (male gonopore) guarded by lid.	5. At the base of each third leg is present female genital opening (female gonopore) without lid.
6. Gonad is a narrow greyish-coloured mass.	6. A ripe 'berried' female possesses large orange coloured masses of eggs.
7. A limb-like structure of the copulatory organ (Appendix masculina) present at the base of the endopodite of the second pleopod (Fig. 8.6b).	7. Absent in females (Fig. 8.6e).
8. There is presence of a lump or hard point in the centre on the ventral side of the first segment of the abdomen (Fig. 8.6a).	8. No such structure present in female (Fig. 8.6d).
9. No modifications present in abdominal pleura.	9. The abdominal pleura become distended outwards to make space for holding eggs (popularly known as "brood-pouch").

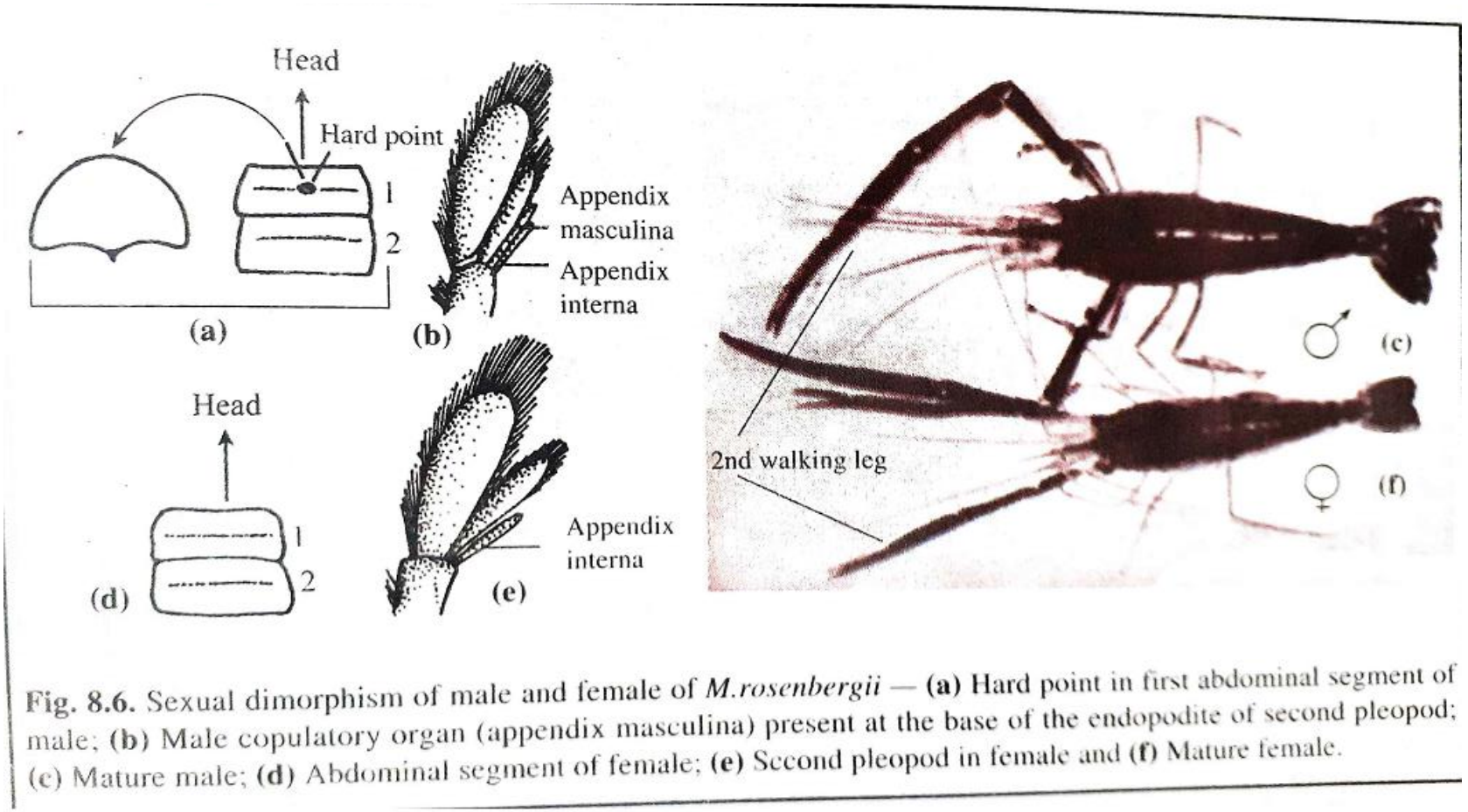


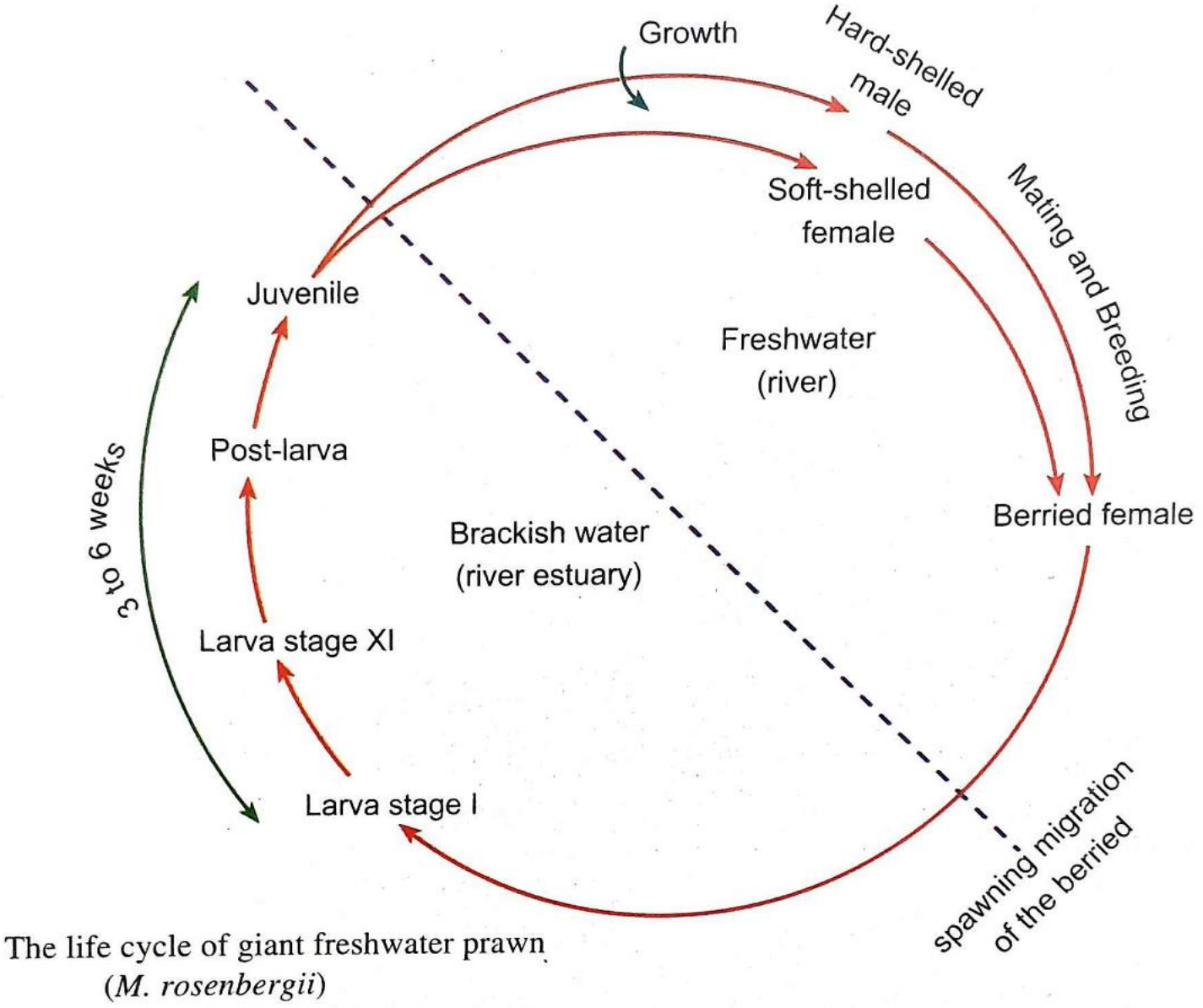
Fig. 8.6. Sexual dimorphism of male and female of *M.rosenbergii* — **(a)** Hard point in first abdominal segment of male; **(b)** Male copulatory organ (appendix masculina) present at the base of the endopodite of second pleopod; (c) Mature male; **(d)** Abdominal segment of female; **(e)** Second pleopod in female and **(f)** Mature female.

Biology & life history of *M. rosenbergii*

- Attains first maturity when 136-150mm length, weight 35 to 40 gm within 4 to 6 months under captivity.
- Moulting frequency irregular. Interval of moulting 20 to 40 days. (moulting required for growth)
- Female shows moulting before mating (pre-spawning or pre-mating moulting
- Six to twenty hours after mating female lays eggs & whole batch of eggs laid in 20 mnts.
- egg size 0.6 to 0.7mm diameter, wt. 0.1mg
- Medim sized prawn of 180 cm length & 80 gm weight lays 60,000 eggs. Large sized females lays 1 lakh to 1.7lakhs eggs

Biology & life history of *M. rosenbergii*

- *Embryonic development*:
- 3 to 4 spawning in a year
- Berried females migrate to estuarine regions for hatching their young
- Incubation period 18 to 21 days requiring tempt. 28^0 to 30^0 C
- Fertilized eggs bright orange color, color changes to pale grey, then slate grey prior to hatching
- On 19^{th} or 20th day after fertilization larvae hatches out.



The life cycle of giant freshwater prawn (*M. rosenbergii*)

Biology & life history of *M. rosenbergii*

- *Larval development*:
- Newly hatched larvae (Zoea) eat planktons requiring brackish water for survival.
- Larvae active swimmers , omnivorous
- Larvae passes through 11 moults & completes larval cycle in 30 days.
- Length of larvae ranges from 1.92mm (stage I) to 7.73mm (stage XI), while newly metamorphosed larvae measures 7.8mm

Table 8.3 : Characterisation of larval stages in *M. rosenbergii* (PL : Post-Larva)

Larval stages	Age (in days)	Recognisable characters
I	1	Sessile eyes
II	2	Stalked eyes
III	4	Appearance of uropod
IV	6	Two dorsal rostral teeth
V	8	Narrow and elongated telson
VI	9	Appearance of pleopod bud
VII	13	Pleopod bare and biramous
VIII	16	Pleopod with setae
IX	18	Endopods of pleopods with appendices internae
X	20	3-4 teeth on the anterior edge of the rostrum
XI	22	Many teeth on half of the dorsal margin of rostrum
PL	25	Teeth on both dorsal and ventral side of the rostrum. It resembles juvenile prawns.

Biology & life history of *M. rosenbergii*

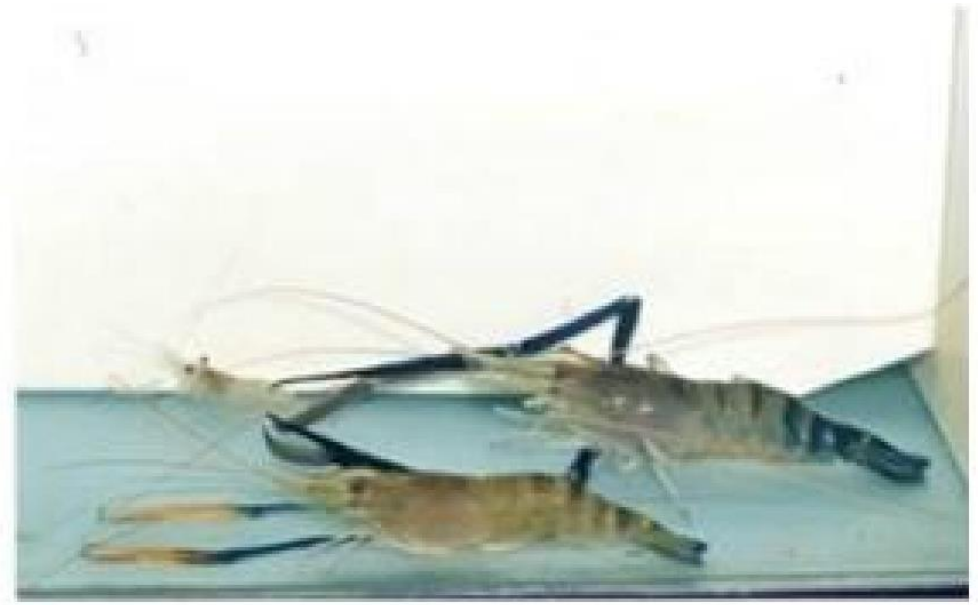
- *Post larvae, juveniles, adults*:
- Juveniles emerge when last stage larvae metamorphose & cease their pelagic life. They sink down & settle at the bottom as crawler & clings to vegetation. (see Fig.)
- Juveniles remain for 1 to 2 weeks in brackish water & gradually migrates upstream against the current into less saline water. Migrate to ponds, streams during rainy season.
- Juveniles become sexually matured in about nine months. The adult prawn's body gradually changes from transparency to bluish or brownish color.

Males and females have different growth rates and males exhibit heterogenous individual growth (HIG)

- Three distinct male morphotypes (and a number of intermediary types) exist: small male (SM),
- orange claw males (OC), and blue claw males (BC). The normal male developmental pathway is SM → OC → BC.
- BC males have extremely long second pereiopods; those of OC males are golden coloured; SM have small, slim, almost translucent claws.

Large male [Photo: Deborah Ismael]

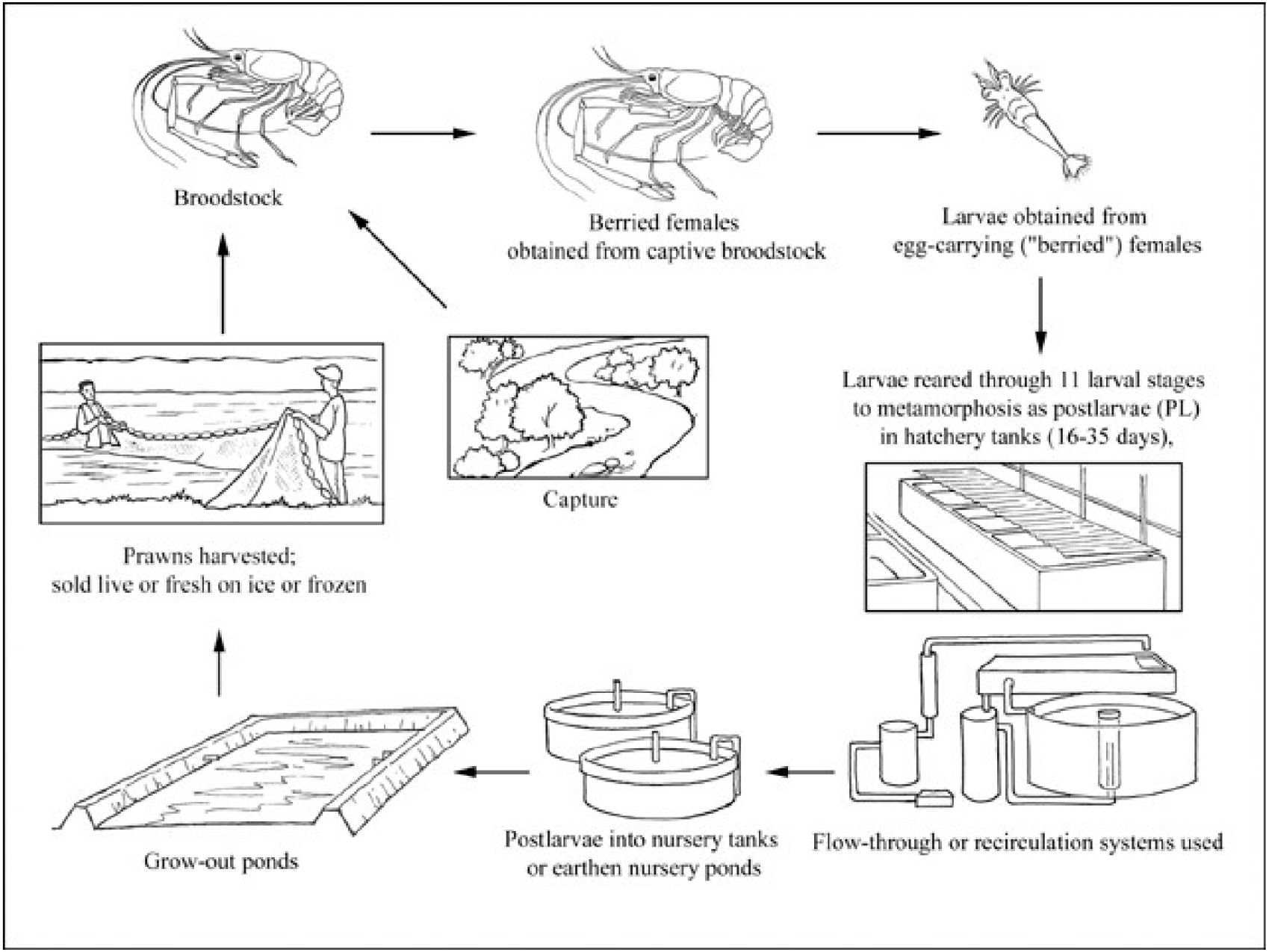
Berried females [Photo: Takuji Fujimura]



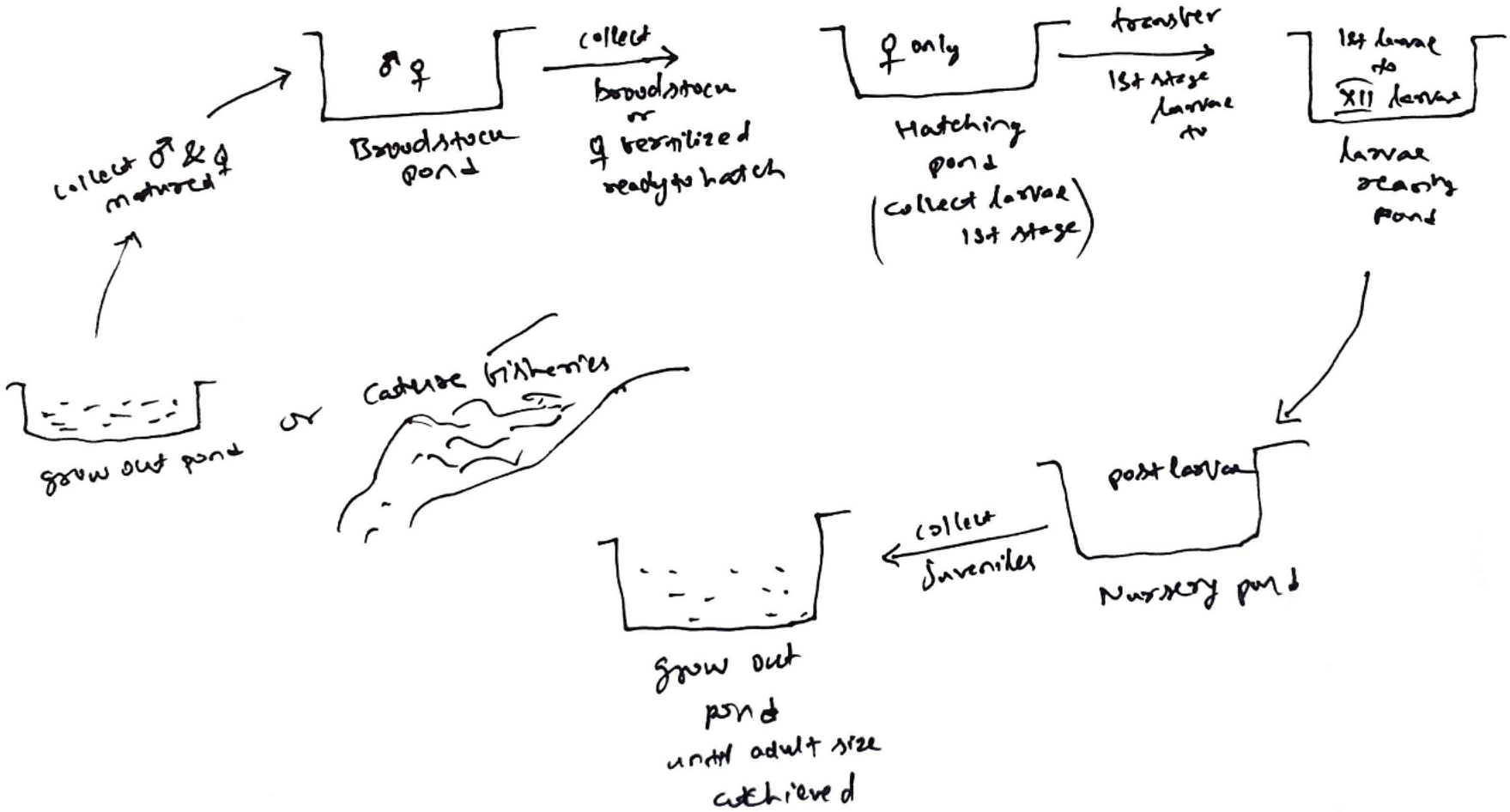
BC, OC and SM prawns [Photo: Assaf Barki]

Females with brown to grey eggs are usually selected, brought to the hatchery

Culture practices of *M. rosenbergii*



Production cycle of Macrobrachium rosenbergii



Culture practice of M. rosenbergii

Broodstock pond

- To start prawn farming collection of matured male & female prawns are done
- Female broodstock are usually obtained from grow-out ponds but can be sometimes from capture fisheries.
- broodstock usually refers only to the females that are kept in hatcheries until their eggs hatch, after which they are discarded or sold.
- The typical male to female ratio in broodstock holding systems is 1-2 BC males or 2-3 OC males per 20 females, at a total stocking density of 1 prawn per 40 litres.
- (Capture fishery refers to all kinds of harvesting of naturally occurring living resources in both marine and freshwater environments.)
- Management of broodstock normally encompasses those practices associated with typical pond production in grow-out ponds.
- One can start prawn culture with seeds which may be PL or post larvae; juveniles is obtained from the capture fishery instead of collecting broodstock females

Broodstock pond & management

- To produce batches of 500,000 larvae, approximately 11 egg-carrying female prawns averaging 45 g each would be needed
- at least 440 female prawns be stocked to provide 500,000 larvae in 5 to 6 months
- At least 110 males (44 BC and 66 OC males) would also be required to service (i.e. to fertilize) these females.
- Therefore broodstock system would support a continual supply of larvae from different batches of females (e.g. 5% of females available every few days or at least once weekly)
- Once the eggs have become grey they are ready to hatch within a few days during which time, the females may be transferred to a hatchery system

Broodstock pond & management

- For short-term holding, BC males and females can be held either individually or more often in communal tanks at a ratio of one BC male to ten females.
- For long-term holding a stocking density of one individual per 20 to 60 L and a ratio of 1 or 2 BC males per 20 females are recommended.
- After fertilization the females (broodstock) is transferred to hatching pond. The time of hatching can be known when eggs carried by females turn to grey brown from orange color.

Broodstock pond & management

- Methods to get broodstock throughout the year :-
- If broodstock are collected in early to late October (April in the southern hemisphere) and larval production is planned for December or January (June or July in the southern hemisphere), then OC males should be stocked at a ratio of 2 or 3 OC males per 20 females in addition to the BC males. The OC males should weigh >35 g when stocked.
- If newly hatched larvae are needed after March (September in the southern hemisphere), then OC males should be stocked at 3 to 4 per 20 females to offset increased mortality of males over a longer holding period
- Sureshkumar & Kurup (1998) suggested a ratio of 1 BC to 4 females was optimal for oviposition and hatching;

Broodstock pond & management

- temperatures ranging from 27 to 32°C are believed to be optimal for spawning.
- a photoperiod of 12L : 12D and a temperature of 32°C increased the frequency of reproductive moults, compared to a photoperiod of 15L : 9D.
- Females are typically not fed when being held simply for larval collection. But food may be given for broodstock held indoors for extended periods of time
- Larval hatching systems is used to collect larvae. **This Larval hatching systems may be attached to this broodstock pond or kept separately.**

Hatching pond (system) & management

- Females with grey to brown eggs attached are collected from broodstock pond and placed in a hatching system where eggs are allowed to hatch, and stage I larvae are collected with either a collecting device or simply netted from the system.
- Healthy mother prawns (bearing grey eggs on their pleopods >50 g) are selected from the broodstock pond/tank and disinfected with 0.3 ppm copper sulphate or 30 ppm formalin for 30 min. Mother prawns are then stocked @ 100-150 g/m^2 (2-3 nos of ~ 50 g female) in brackishwater (salinity of 5‰) and reared till hatching. Tanks are checked daily for appearance of larvae.

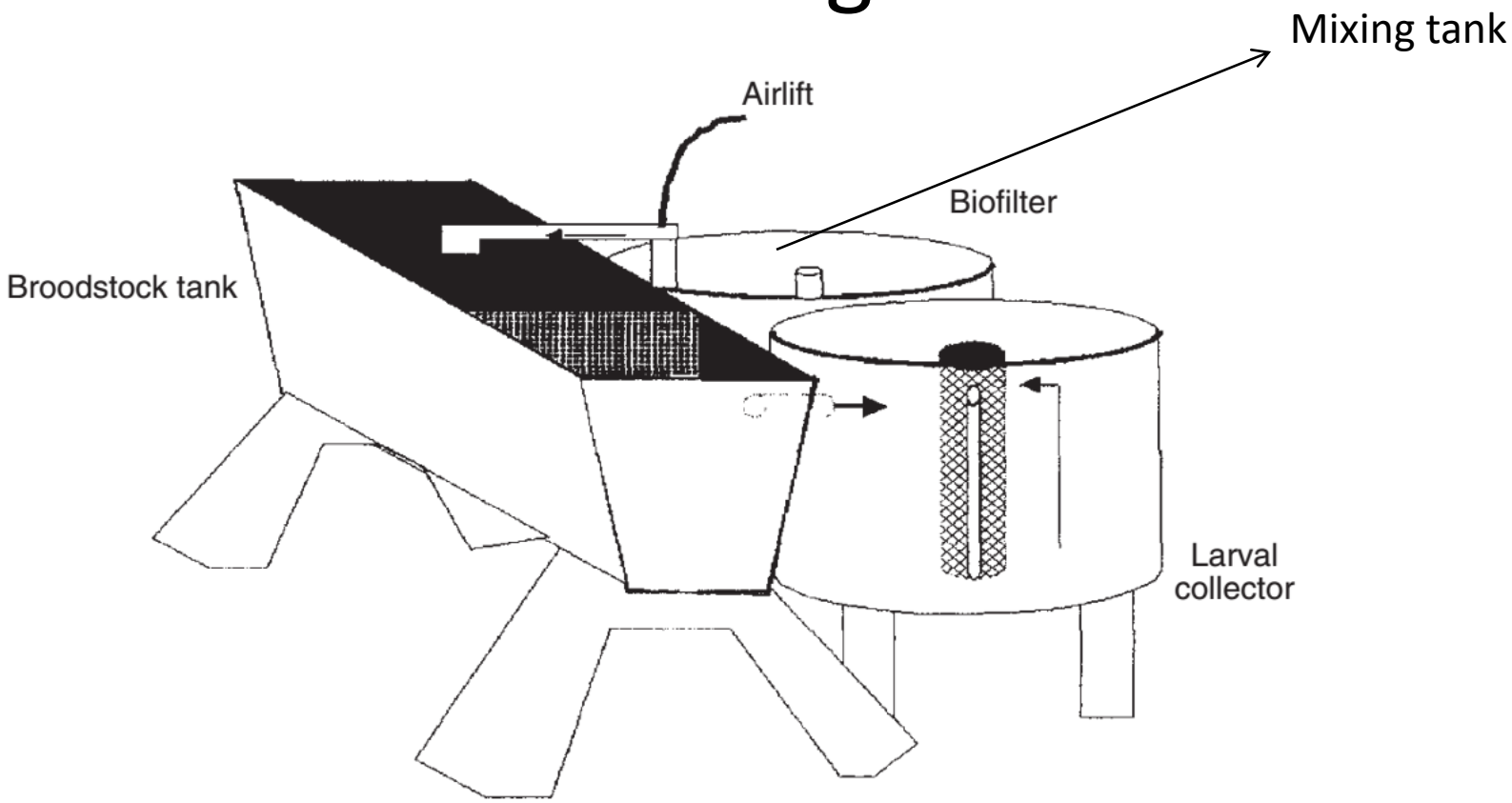
Hatching pond (system) & management

- Hatchability is higher when berried females are kept in brackishwater (5 p.p.t.).
- Larvae can be attracted away from the females using light to take advantage of their phototactic nature, and drawn towards a water flow to move them into another collection tank.
- Collection normally occurs at night when most hatching occurs.
- Each larval culture tank is then stocked with stage I larvae collected over a period of 1 to 3 days

Hatching pond (system) & management

- A typical hatching system (see Figure) consists of a hatching tank (300 L rectangular tank), larval collector (120 L circular tank), and a mixing tank or biofilter (120 L circular tank), and a mixing tank or biofilter (120 L circular tank).
- Forty to sixty females with brown to grey eggs are placed into the hatching tank supplied with adequate habitat structures
- The interior of the hatching tank is made black except around the area where the overflow pipe is located. This area is painted with a lighter colour.
- Black-painted grating (e.g. egg crating or louver material) divides the tank into two chambers with the chamber for holding the females occupying about 80% of the tank volume.

Hatching pond (system) & management



A hatching system consisting of a 300L broodstock tank and two 120L circular tanks (larval collector and biofilter). (Source: Daniels *et al*., 1992.)

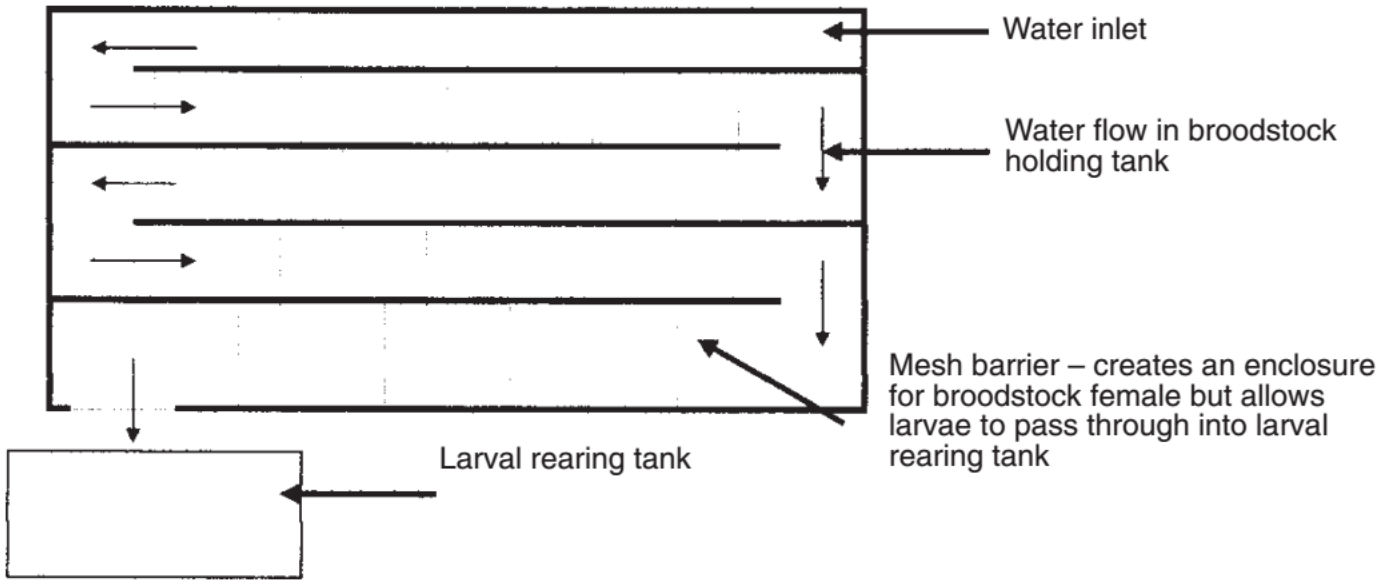
Hatching pond (system) & management

- Water overflows from the hatching tank into the collection tank, passes through a 180 µm mesh screen located around a centre standpipe, and then flows into the mixing tank. Water is returned to the hatching tank from the mixing tank by airlifts.

Hatching pond (system) & management

- Another version of hatching pond was made by Universiti Pertanian Malaysia, that allows for maintenance of individual broodstock and natural water flow to remove larvae into a separate tank upon hatching.
- It consists of a shallow raceway approximately 1 m x 0.5 m (H x W) and can either be constructed as a flow-through or recirculation system.
- Chambers are divided by screening with a mesh size large enough to allow the larvae to pass through, but small enough (10 mm) to prevent the female moving into an adjacent compartment.
- The water depth should be approximately 0.5m to allow sufficient covering of the adult female and provide a low flow rate.

Hatching pond (system) & management



hatching system developed by Universiti Pertanian Malaysia, which allows for maintenance of individual broodstock and natural water flow to remove larvae into larval tank

In vitro hatching

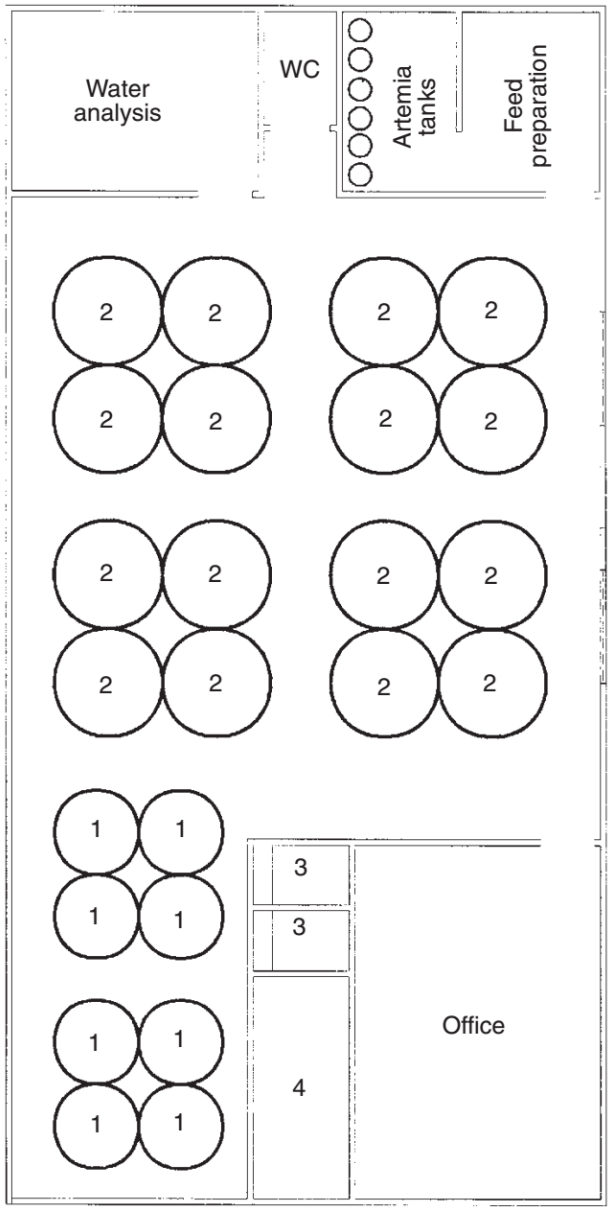
- The use of in vitro incubation is thought to increase the number of larvae released from a single egg clutch because berried females usually lose eggs as incubation proceeds.
- In vitro incubation increases not only the number of larvae released, but also the breeding frequency of females relieved from the task of incubation.
- A combination of 6 p.p.t. salinity with temperatures of 26 to 28°C is optimal for the incubation of *M. rosenbergii* eggs.

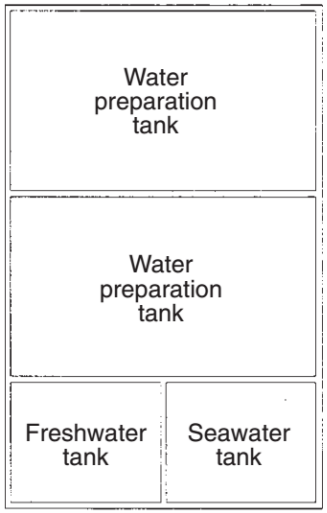
Larval Rearing Tank

- Larval rearing tanks may be round, rectangular, square or cylindrical-conical shape. However, cylindrical-conical tanks present easy handling.
- Larval rearing tanks may be constructed in fibreglass, polypropylene, cement-covered brick (see Figure) or asbestos. It is essential that the materials used are inert. In particular, the interior of cement or cement-lined tanks must be painted with epoxyresin to avoid toxic chemicals leaching into the larval rearing water.
- Tank colour, like many other facets of prawn hatchery technology, remains controversial. However Rodrigues et al. (1998) reported that greater numbers of PL were obtained with the use of black, as opposed to white tanks, irrespective of the incidence of sunlight.

Brick larval rearing tanks

Asbestos larval rearing tanks





1. Larval rearing tanks # 1
2. Larval rearing tanks # 2
3. Hatching tanks
4. Broodstock holding tank

NOT IN SCALE

Simplified layout of a prawn hatchery system

Larval Rearing Tank

- Furthermore, they reported that larger and heavier PL were produced when black tanks were used and sunlight was present.
- Larval rearing tank capacity typically ranges from 1 to 10 m^3. Small hatcheries use 1 to 3 m^3 tanks to minimise water consumption and facilitate maintenance. 3 to 10 m^3 tanks is used in large hatcheries.
- The depth should be approximately 1 m and the water column not more than 0.9 m.
- The bottom of larval tanks is sloped slightly towards the drain. Drainage is provided by means of a turn-down PVC pipe having a diameter varying from 38 to 76 mm, which is protected by a 150 to 1000 µm nylon screen.

Larval Rearing Tank

- Each tank requires an independent supply of brackishwater and air. A freshwater supply should be available close to the tanks, to reduce salinity when necessary for emergency use, and for tank cleaning operations between larval rearing cycles.
- Some flow-through hatcheries (notably in Brazil) use two types of tanks sequentially to optimise the use of water and food, and to enhance management. In these cases, larvae are stocked and maintained at higher densities (300–500/L) until they reach the fifth larval development stage. After stage V the larvae are transferred to the larger tanks, decreasing their stocking density to 60 to 100/L.

Larval Rearing Tank

- Pipework is required to distribute seawater and freshwater from storage tanks to mixing tanks, and from thence to supply brackish water to each larval rearing and Artemia nauplii hatching tank.
- prawn larvae are normally reared at 12 to 16 p.p.t.,
- Water treatment in larval tank is as follows. Before use, brackish water is allowed to stand, to allow any sediment to settle. It is then chlorinated for 1 day with 20 to 50 p.p.m. of sodium hypochlorite (10–12% of active chlorine).

Larval Rearing Tank

- The salinity of the larval rearing medium is then increased to 12‰ and the rearing is continued in the same tank. In the first phase the larvae (Zoea I) are stocked in cylindro-conical tanks at a high density (200-300 larvae/l). About 50% of the medium is usually exchanged every other day with fresh medium of identical salinity. The larvae are reared for about 10-12 days in this phase.
- In the second phase, the advanced larvae are stocked in larger tanks with a greater surface area at the rate of 50-80 per litre and reared till metamorphosis. About 50% of the medium is exchanged every alternate day.

Larval Rearing Tank

- The freshly hatched *Artemia* nauplii (obtained from specially made Brine shrimp hatching tanks where *Artemia* cysts hatch to produce nauplii) are given as live food to the prawn larvae, 4-5 times per day in the early stages (Stages II to V or VI) and later, once during late evening in combination with wet larval feed which is usually given during day time. The brine shrimp nauplii are fed to the prawn larvae at the rate of 5 to 50 nauplii per larva per day. About 2 kg of *Artemia* cysts are required to produce one-lakh post-larvae.

Larval Rearing Tank

- Wet larval feed (egg custard, minced fish/mollusc flesh; protein level> 50%) is fed @ 50-200 mg/larva/day depending on the larval stage. The wet feed is given from 8 am till 2 pm at one-hour interval. The larval rearing tanks are cleaned daily by siphoning off excess food particles and metabolic waste from the bottom of the tank.
- This is done after stopping aeration, preferably in the evening hours before exchange of water and introduction of live food (*Artemia* nauplii). Daily monitoring of temperature, salinity, pH and dissolved oxygen levels is essential to maintain the water quality at optimum levels. The optimum ranges of water quality parameters for successful seed production are given below.

Larval Rearing Tank

- The appearance of first post-larva is usually observed 20 days after hatching, normally between 22 and 26 days (at 28-32°C) and 90% larvae metamorphose within next 10 days. The seed production normally requires 35-40 per litre and the cycle lasts for 35-40 days. The post-larvae are gradually acclimatized to the freshwater and reared at high densities (2000-5000/m^2) for 10-15 days in hatchery. The post-larvae are fed with formulated diet @ 100% of the biomass per day. After a week post-larvae are suitable for stocking in grow-out ponds.

Larval Rearing Tank

- New post larvae (PL) are about 7-8 mm long. Although PL can withstand the physiological shock of sudden transfer from 12 ppt water into freshwater, it is not recommended to harvest them from the larval tanks and transfer them directly into holding tanks containing freshwater.
- The animals are best acclimatized to freshwater in the larval tank. Once the majority of larvae have metamorphosed (at least by day 32-35) water level in reduced in flow-through system tanks to about 35 cm.
- The PL can then be harvested and transferred, or the larval tanks refilled to 70 cm height with freshwater and the animals temporarily held in them. If the latter is done, the PL should only remain in the larval tanks for a few more days, with frequent water exchange, before transfer to a larger holding tank.
- The best way to harvest PL from the larval tanks is to reduce the water level and then remove them in dip nets. Most flow-through hatchery operators harvest their post larvae only once, at the end of the production cycle. Then the post larvae are transferred to nursery pond.

Larval Rearing Tank

- Water quality for larval pons should be as follows

Water tempt. 29-31^{0}C, pH: 7 to 8, salinity: 10-12 ppt, dissolved oxygen: at saturation level, nitrites: <0.1ppm, nitrate: <20ppm, ammonia <0.1ppm

- Feed for larvae is as follows

Fish feed:68%, Hen's egg:20%, Wheat flour: 5%, Skimmed milk powder: 5%, vitamin & mineral mix: 2%

Nursery pond & management

- Here newly metamorphosed post larvae are reared to juvenile stage (25mm)
- The preferred stocking density in the nursery pond is 50-100/m^2. Post-larvae (8-10 mg) may be fed with pellet diet (crude protein 35%; lipid 8%) in crumble form @ 100% of the biomass during the first fortnight and further reduced to 50% in subsequent period
- In the absence of pellet diet a mixture of groundnut oil cake (powdered) and rice bran may be given as feed. The feed should be broadcasted in the pond twice daily preferably in the morning and in the late evenings. In nursery ponds approximately 10% of the pond surface may be covered with floating weeds with dense root system such as *Eichhornia* sp. to improve the survival rate of post-larvae. The weeds should be kept inside a PVC or bamboo frame to avoid their spreading in the pond. Aeration is provided for ~8 h/day.

Nursery pond & management

- Quality of pond water should be Water tempt. 28-32^{0}C, pH: 7.0 to 8.5, total hardness:40-100 ppm, dissolved oxygen 4 to 6 ppm
- post larvae (PL) are reared for one to two months so that they attain a size of 0.5 to 1.0gm
- Feeds given are: small aquatic worms, insect larvae, small pieces of clams, snails, squids, shrimps (*Acetes* sp.), plant materials such as broken rice, sweet potato, peas, oil cakes.

Nursery pond & management

- During nursery rearing water temperature may be checked twice daily. pH, dissolved oxygen, transparency and depth may be checked once every week and to be maintained in optimum ranges. Loss of water due to seepage and evaporation should be compensated by water addition at least once every fortnight. Nursery rearing may be done for 45-60 days. At the end of rearing period the juveniles (>1.0 g) are collected by dewatering the pond and transferred to grow-out ponds
- Juvenile prawns can be harvested by seining your ponds two or three times with a 5 to 6 mm mesh seine, or by emptying them completely. Polypropylene boxes or tanks filled with water from the nursery pond and kept aerated, can be used to transport the juveniles to the grow-out ponds if they are close by.

Nursery phase of Prawns

- During nursery phase, delicate post-larvae **(PL) (15-20 mm)** procured from prawn hatcheries are **raised to juveniles (2-5g)** in the small earthen ponds/tanks.
- The size of nursery pond may range from 0.02-0.1 Ha, the recommended **stocking density of seed (post-larvae) range from 20-50/m²**.
- Provision of floating weeds inside a PVC frame covering 10% of pond surface is recommended to provide shade and shelter to PL. Commercially
- available prawn/shrimp feeds (starter feeds in crumble form) is recommended for good growth and survival.
- It should be **fed @ 100% of the biomass/ day for first two weeks** and **reduced to 20% of biomass towards the end**.
- If the farmer does not have access to commercial feed then powdered groundnut oil cake and rice bran can also be used.
- **Nursery period may range from 45-60 days** during which the **PL grow to juveniles of 2-5g size.**

Grow out pond & its management

- Prior to initiation of culture the grow out Ponds should be drained and the pond bottom should be exposed to sun for a week to kill all predatory fishes.
- Rectangular ponds are suitable mainly from the harvesting point of view. A convenient width is 30-50 m, whereas length of the pond depends on site, topography and farm layout. Normally a size of 0.5 to 1.5 ha is found suitable. The average depth of the ponds should be 0.9m with a minimum of 0.75m and a maximum of 1.2 m.
- Bund must have a freeboard of at least 60 cm above the highest water level in the pond. Designing and layout of the farms may be done keeping in view the water intake and water outlet facilities. The drainage system should be designed carefully to prevent mixing of outlet water with incoming water.

Grow out pond & its management

- Lime may be applied @ 200 kg/ha, if the soil pH is between 6.5-7.0. Higher dose will be required in case of soil with low pH values. Water should be let into the pond up to two feet using nylon mesh nets to prevent the entry of eggs and larvae of predatory fishes and competitors.
- Pond should be fertilized with raw cow dung/poultry manure and super phosphate as per the requirement. In general for a pond of medium nutrient contents the fertilizers may be applied at the rate of 5 tonnes raw cow dung, 200 kg urea and 300 kg/ha/crop super phosphate.
- After a week of fertilization the pond should be filled up to 4 feet water level. Transparency of pond water should be checked after 2-3 days using a secchi disc. Ponds can be stocked with post-larvae in case of nursery pond and with juveniles in case of grow-out ponds once the transparency is 30-35 cm during early morning or late evening hours.

Grow out pond & its management

- After liming & fertilization of pond, the 1 to 4 weeks old juveniles are stocked at rate of 5 to 8/m2 for a period of 5 to 6 months in case of monoculture.
- but in case of polyculture with carp culture the stocking density of prawn reduced by 50% where compatible carp fry (Indian major carps are stocked at rate of 300/ha.
- To keep ponds a continuous supplier of prawns at regular intervals 30 to 45 gm size of prawn are captured for marketing
- Feeds for prawns are aquatic worms, insects, small molluscs, crustaceans. They are given to prawns at rate of 20% of body weight
- Here prawns reach marketable size of 40 to 50 gm within 5 to 6 months of culture

Grow out pond & its management

- Water quality should be : tempt. 28 to 31^{0}C; pH: 7 to 8.5, total hardness: 40 -100 ppm, dissolved oxygen: above 3ppm before dawn, calcium: 50 to 100 ppm; transparency 30-35cm

(Source: Food and Agriculture Organisation, 2002)

Variables	Recommended range
Temperature (oC)	28-31
pH	7.0-8.5
Dissolved oxygen (ppm)	3-7
Salinity (ppt)	<10
Transparency (cm)	25-40
Alkalinity (ppm)	25-60
Total hardness (ppm)	30-150
Ammonia (ppm)	<0.3
Nitrite (ppm)	<2.0
Nitrate (ppm)	<10
Boron (ppm)	<0.75
Iron (ppm)	<1.0
Copper (ppm)	<0.02
Manganese (ppm)	<0.10
Zinc (ppm)	<0.20
Hydrogen sulfide (ppm)	Nil

Water quality requirements for prawn nursery and grow out

- Polyculture Culture for *M. rosenbergii*

- Farming *Macrobrachium* species in combination with single or multiple species of fish, including Tilapias, Common carp, Chinese carps, Indian carps, Ornamental fish etc are common. The inclusion of freshwater prawns in a polyculture system almost always has synergistic beneficial effects, which include:

- More stable dissolved oxygen levels;
- The reduction of predators;
- Coprophagy (the consumption of fish faeces by prawns), which increases the efficiency of feed;
- Greater total pond productivity (all species); and
- The potential to increase the total value of the crop by the inclusion of a high-value species.

- Prawn-fish polyculture systems are therefore normally batch-harvested. The addition of prawns to a fish polyculture system does not normally reduce the quantity of fish produced. On the other hand, the addition of fish to a prawn monoculture system markedly increases total pond yield but may reduce the amount of prawns below that achievable through monoculture.

Table 8.4 : Some important diseases with symptoms and stages of infestation, encountered by the giant freshwater prawn

Type of disease	Name of the disease, causative agent and symptoms	Infected stages of prawn
I. Bacterial infection	(1) Chitinolytic bacteria. Erodes the surface of the exoskeleton, causes loss of appendages and lesions. "Shell disease" or "black spots".	"Black-spots" is an obvious disease of post-larvae and harvest-sized prawn
	(2) Filamentous bacteria (*Leucothrix* sp.). Clogs gills and interferes with respiration.	Post-larva
II. Fungal infection	*Saprolegnia* sp., *Fusarium* sp., *Lagenidium* sp., *Sirolpidium* sp., etc.	Egg, nauplius, protozoea, juvenile to adult.
III. Protozoan infection	*Epistylis* sp. and *Zoothamnium* sp. are very common; *Vorticella* sp. is less common. It is attached to body surface and gills.	Common cause of larval disease. Also found in adult.
IV. Hydrozoan infection		Prey upon larvae
V. Soft-shell syndrome	*Vibrio alginolutium*. Carapace brownish in colour and septicaemia.	Juvenile and adult
VI. Other diseases	(1) 'Whiteness' disease of muscular tissue which starts from the tail region. It is caused from stress condition, overcrowding, low O_2 level, temperature, shock, etc.	Juvenile and adult
	(2) Dark areas in gill chamber, caused due to precipitation of chemicals and for high level of nitrogenous wastes, etc.	Juvenile and adult

(Source: Food and Agriculture Organisation, 2002)

Virus Diseases	Bacterial and Rickettsial Diseases	Fungal Diseases
Macrobrachium hepatopancreatic parvo-like virus(MHPV) None **,** Not associated with significant morbidity or mortality.	**Black spot (sometimes called brown spot or shell disease)** One or many melanized lesions on the cuticle; often caused by opportunistic bacteria which enter following physical damage; problem may disappear at the following moult but sometimes develops into deep spreading lesions; reduces marketable value of harvested prawns.	**Lagenidium infection** Affects larvae: an extensive mycelial network can be seen through the exoskeleton; can decimate hatchery populations within 24 hours.
Macrobrachium muscle virus (MMV) Muscle tissues become opaque, followed by necrosis; occurs within 10 days of stocking PL and may cause upto 50% mortality.	**Appendage necrosis** Larval appendages become necrotic and melanized; affected larvae do not eat and may become bluish in colour; may be associated with a heavy surface burden of the filamentous bacterium Leucothrix.	**Infections by Fusarium and Saprolegnia** Cause necrosis and melanization; follow physical damage.
White spot syndrome baculovirus (WSBV) Targets the cuticular epidermis, stomach, gills and hepatopancreas; important disease in marine shrimp; Macrobrachium is known to be a carrier but it is not yet certain whether WSBV causes mortalities in it.	**Internal infections** Caused by a variety of Gram negative bacteria such as Vibrio spp. and Aeromonas spp.; feeding discontinues; discolouration of the body (usually pale and white) occurs; animals listless; infections by luminous vibrios are usually serious.	**Yeast infections** Muscles appear yellowish, bluish or grey; causes heavy mortalities in grow-out ponds; particularly prevalent when temperatures are lower than optimal and organic matter is allowed to accumulate and eutrophication occurs.
Nodavirus (M R NV) Opaque whitish appearance of the abdomen, followed by severe mortalities.	**Bacterial infection caused by Enterococcus** Necrosis in muscles and hepatopancreas; begins in the head portion and proceeds to the tail; animal appears opaque; exacerbated in high temperature (33-34°C) and high pH (8.8-9.5) conditions. **Rickettsial disease** Larvae become white throughout their bodies and generally inactive before death; infected populations experience significant mortalities.	

(Source: Food and Agriculture Organisation, 2002)

Disease	Prevention and Treatment
Macrobrachium hepatopancreatic parvo-like virus (MHPV)	Obtain and maintain disease-free stock; good management. No treatment reported.
Macrobrachium muscle virus (MMV)	Obtain and maintain disease-free stock; good management. No treatment reported.
White spot syndrome baculovirus (WSBV)	Obtain and maintain disease-free stock; good management. No treatment reported.
Nodavirus (M R NV)	Obtain and maintain disease-free stock; good management. No treatment reported.
Black spot (sometimes called brown spot or shell disease)	Good management, especially maintaining good water quality and avoiding physical damage by handling (by transfer, sampling) or by other prawns (may be caused by overstocking, poor feeding, etc.). Treatment by immersion in 10 ppm oxolinic acid for 1 hour, or 2 ppm nifurpirinol for 96 hours reported.
Appendage necrosis	Good management, especially maintaining good water quality and avoiding physical damage by handling (by transfer, sampling) or by other prawns (may be caused by overstocking, poor feeding, etc.). Treatment by 0.65-1.0 ppm erythromycin or 2 ppm of a penicillin-streptomycin mixture, or 1.5 ppm chloramphenicol reported.
Internal infections	Good management, especially good filtration and/or treatment of incoming hatchery water. Treatment by 2 ppm chloramphenicol combined with 2 ppm furazolidone for 5-7 days reported.
Bacterial infection caused by Enterococcus	Good management, especially by avoiding constructing farms in areas where (or operating farms at times when) temperature and pH are too high. No treatment reported.
Rickettsial disease	Obtain and maintain disease-free stock; good management; treatment of tanks and equipment with lime (CaO) before stocking. Treatment by application of 10 ppm oxytetracycline combined with 10 ppm furazolidone reported.
Lagenidium infection	Good management. Treatment by maintaining 10-100 ppb trifluralin in hatchery tanks, or treatment with 20 ppm of Merthiolate ® has been reported.
Infections by Fusarium and Saprolegnia	Good management, especially maintaining good water quality and avoiding physical damage by handling (by transfer, sampling) or by other prawns (may be caused by overstocking, poor feeding, etc.). No treatment reported.
Yeast infections	Good management, especially the avoidance of lower than optimal water temperatures, the accumulation of organic matter and eutrophication; use better water exchange, aeration and circulation and lower feeding rates. No treatment reported.

Site selection for pond: for Prawns

- Proper site selection is an important factor for successful freshwater prawn culture.
- Culture sites where water temperature remains above 20° C for 6-8 months are suitable.
- The water pH should be above 7.
- The **pond bottom soil should be clayey-loam or sandy-loam**.

Pond construction:

- The pond should be preferably **rectangular in shape with a size of 0.2-1 ha**.
- Provision of inlet and out let and water control structures are recommended.
- Pond bottom should have suitable slope towards the outlet.
- **Depth of water should be 1.0-1.5 m**.

Pond Preparation

- For pond preparation pond is dried and pond bottom is exposed to sunlight for one week.
- If it is not possible to dry the pond then mahua oil cake or urea and bleaching powder are added for removal of predatory fishes.
- Liming is done @200 kg/ha or as per requirement based on soil pH.
- **Cow dung @200 kg/acre or urea @10 Kg and SSP @15 Kg is added in the pond for plankton development at weekly interval.**
- Then water is properly filtered and filled in the pond up to a level of 4ft.
- As prawns grow by moulting (shedding of outer shell) and are very soft and are easy prey to other prawns, earthen tiles, small tree branches and tyres are provided in the pond as hideouts to save them from predators during moulting.
- **The pond is covered with nylon net or threads to save them from predatory birds**.
- For **monoculture practice**, they **are stocked @3-4 juveniles/m²** and for **polyculture, 1-1.5 prawn juveniles/m² along with 3000-5000/ha Rohu and Catla fingerlings.**

Food and feeding for Prawns

- Prawns feeds on small animals like worms, crustaceans, bottom detritus, and plant material available on the pond bottom.
- If there is lack of feed they feed on the soft shelled weak prawns that result in low production.
- It is recommended to feed prawns twice daily with commercial prawn/shrimp feed (2-3mm,pellets)@10% of their biomass which is gradually reduced to 2% towards the end of the culture period.
- The **feed is broadcasted to the pond from the dykes**.
- **Feed can also be given in check trays placed 2-3 m away from the dyke for better feed management**.
- Feed management should be done properly to ensure better growth and environment management.

Water quality management

- Visibility and colour of the pond is an important indicator of the health of pond ecosystem.
- In unproductive ponds the visibility can be up to the bottom which will lead to growth of bottom algae that adversely affect the growth and survival of prawns.
- **Ideally, the visibility** should be maintained in the range of **30-40 cm** to avoid water quality deterioration.
- Provision of aerators (paddle wheel or any other such devices) is recommended especially during the final 2-3 months when the biomass in the pond is high.
- When the oxygen level in the pond is critically low, the prawns come to the surface along the periphery which indicates the need for taking immediate remedial actions such as water exchange or operation of aerators to avoid mortality of stock.

Harvesting of Prawn

- **Large prawns (>40 g) may be harvested using seine net of suitable mesh size** after four months of culture, which should continue **once every 3-4 weeks thereafter for the next 3-4 months**.
- The prawns may be finally harvested after 8 months of culture by complete dewatering.

Diseases Encountered by Tiger Shrimp:

Table 8.6 : Some important infectious and non-infectious diseases encountered by tiger shrimp

Type of disease	Name of the disease, causative agent and symptoms	Infected stages
IV. Protozoan	*Epistylis, Vorticella, Zoothamnium, Ephelota, Gemmipara* and *Acineta*-ciliate infestations from eyes, gills, appendages, shell or body surface.	Adult and larva
Gregarine	Gregarines	Larva
Microsporidiosis	Microsporidia	Female spawner
V. Copepods	*Caligus epidemicus* (a crustacean disease)	Adult mostly
VI. Other diseases	Chronic soft shell syndrome	Juvenile, adult
	Red disease	Juvenile, adult
	Fatty infiltration of hepatopancreas	Juvenile, adult
	Blue disease	Brood stock
	Cramped tail	Juvenile, adult
	Haemocytic enteritis (secondary bacterial infection of *Vibrio alginolyticus*)	Young, juvenile and sub-adult
	Blackgill disease (for *Zoothamnium* infestation)	Juvenile to adult
	Muscle necrosis	Juvenile to adult
	Gas-bubble disease	All stages