# Nursery Rearing of Indian pompano - Different Culture System Approach

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## Introduction

Cocastal marine aquaculture is one of the emerging areas for marine food fish production and is mainly performed in the seaand in coastal ponds. Mariculture and coastal aquaculture collectively produced 30.8 million tonnes (USD 106.5 billion) of aquatic animals in 2018, and they are mainly from marine cages, coastal cages and coastal earthen ponds. Increasing marine food fish production through innovative and intensive culture methods has increased demand for marine finfish seeds either from wild collection or hatchery based production. In this context, nursery raring plays an important role in supplying sufficient numbers of fingerlings at ready-to-stockable size in grow–outculture for better survival and faster growth. Larval rearing ends after the larvae achieve the full metamorphosis, and the metamorphosed early fry harvested from larval tanks is often not strong enough for direct stocking in grow-out farms. Thus, nursery rearing of fish larvaeis important for the production of the grow-out culture of stockable-size fish. It is evidenced that healthy seeds are key for a healthy grow-out culture with better economic returns. Thus, maintaining healthy and disease-free stock is of prime importance for achieving better production in the grow-out system. So, the nursery-rearing concept gives a better opportunity to maintain large numbers of fish fingerlings in small areas, which facilitates for effective management. Nursery rearing practices are majorly classified into two major categories; indoor and outdoor systems; where indoor-based culture is performed either by flow-through or recirculation based concept in FRP (Fibre Reinforced Plastic) /concrete/collapsible tanks. Outdoor-based system is performed either running or moving waters in hapa erected or installed in earthen ponds, coastal cages and marine cages. All these culture systems have their own merits and demerits concerning

management and advocating these systems are based on the size of stocking and method of grow-out systems will be implemented for the species.

## Nursery rearing of Indian pompano

The culture technology for the species has been standardised, disseminated and presently being practised in different coastal states inmarine cages, coastal cages, and coastal ponds. In order to perform for grow-out culture in these systems, the fry produced in hatchery should be nursery-reared till attaining the size at which the larvae tolerate different environmental conditions in the grow-out environments. Depending on the culture systems and locations, the nursery rearing is performed in different culture conditions with different suitable management practices. In general, 25-30 g size fingerlings are considered as an optimum size for stocking in grow-out culture systems, but stocking of bigger size fingerlings will help in reducing the grow-out culture period, and will enhance the culture performance of the stocked Indian pompano seeds. The nursery reared fingerlingsare to be transported to the culture site, and thus the size of the fingerlings depends on the distance between the nursery and grow-out site, and mode of transportation. This fish is sensible to transportation stress, and thus the establishment of nursery facilities in proximities of grow-out culture environment is highly recommended. Common nursery rearing systems recommended and adopted for the species includes indoor-based flow-through systems (FRP and concrete cement tanks), recirculating based indoor system (RAS); hapa in the coastal pond, coastal cage and marine cage based outdoor systems. More importantly, the growth rate for Indian pompano is <0.1 to 1.0g/day during early growth phase till attaining 100 g and then the growth rate increases up to 7.0 g /day in the later growth period. Therefore, maintaining nursery in small confined area for long time is recommended to save time, energy and expenditure in the grow-out culture operations.

## Indoor based nursery rearing systems

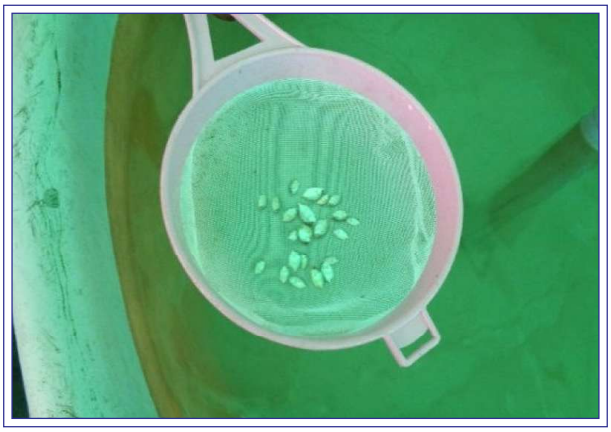
### *Flow-through based nursery system*

Flow-through-based nursery rearing is the low density based extensive rearing method, performed in FRP or concrete cement tanks. In this system water is filled once in the rearing tank and then same water is discharged along with faecal matter and unused feed after particular time period without treating. This system is suitable for the early fry stage, immediately after larval rearing. This system is mainly practiced in circular

or square-shaped tanks of 1-10 tonnes capacity with 1.0 meter water depth and central drainage system. Tank colour plays an important role in the smooth functioning of daily activities, where light blue colour is the preferred for clear visibility of the fish fingerlings and other faecal matters. The concrete tank should be coated with nontoxic epoxy paint for smooth tank surface. Indian pompano larvae attain an early fry (1.5-2.5 cm; ~0.2 g in size) stage after 35-45 days and at this stage, it can be shifted to indoor-based flow through nursery facilities. Fry of this size preferably should be stocked in indoor based flow through facilities for better survival. The early fry stocked in this facility reaches 2.5 to 3.5 g in size approximately after a month, then it can be shifted to outdoor nursery systems. While shifting, the early fry can be shifted to nursery facilities by small containers (plastic buckets) with or without oxygen if the nursery facilities are available within the proximities of hatchery complex. However, shifting with help of oxygen will help to keep the fry in better conditions without stress. The transported fry is directly released to nursery rearing tank at 1500-2000 nos/$m^3$ and maximum carrying capacity should be of less than 5.0 kg/$m^3$. After transfer, the stocked fry is fed with feed of 500 $\mu$ in size and 100% water exchange is recommended. While in daily operation, the central drain in the tank is covered with PVC pipes of small slits or drain covers. These pipes and drain covers should be wrapped with small mesh size nets according to size of stocked fry, which will avoid the escape of fry while in water exchange. Recommended feeding for the stocked fry is 4-6times per day at 5-6% of body weight or till satiation. As feeding frequencies is more at initial stage, thus it is recommended for 100% water exchange in two different spells in the morning and evening at 50% in each time. As water is exchanged every day, the dissolved oxygen is consider as critical point than any other water quality parameters and ideal salinity is 10-35 ppt. Concentration of oxygen should be maintained always above 4.0 ppm and 1.5 ppm is considered as critical oxygen limit. While rearing, one feet gap between water surface and rim of the tank is necessary as the Indian pompano respond to the light variation, thus the stocked fry jumps out of water if disturbed either by light variation or sound. Thus, enough gap is required to avoid the larvae jump out of water or the tank surface should be covered with small sized mesh. The advanced fry takes nearly one months to reach an average of 3.0 g and survival varies between 75-95%, depending on nursery management practices.

Feeding in FRP tanks

Feeding in concrete tanks



Fingerlings sampling

Fingerlings sampling

*Fig.1: Nursery rearing of Indian pompano in indoor culture systems*

## RAS-based nursery rearing

The major limitations in nursery rearing and other aquaculture operations are land and water availability, gradual deterioration of aquatic ecosystems, frequent disease outbreaks and difficulties with sediment and wastewater treatment. Therefore, it is very important to develop new culture methods to decrease the ecological impact in terms of waste production and water use. One important and effective method to solve these problems is the rearing of fish in re-circulating aquaculture systems (RAS). RAS is indoor tank-based water recirculation systems in which fish are grown at high density under controlled environmental conditions to maximize fish fingerlings growth year-round. The system has the flexibility to locate the production facilities near grow–out culture site, complete and convenient harvesting and quick and effective disease control. These systems can be used to maximize production where suitable land or

water is limited, or where environmental conditions are not ideal for the particular species to be cultured. It is a land-based aquatic system where the water is mostly re-used after mechanical and biological treatment processes to reduce the consumption of water and energy. The system offers advantages where temperature and other water quality parameters can be controlled and provide conducive environment in order to maximise the growth and maintain fish health. Most of the modern RAS systems are generally consisting of the components like solids collecting systems (drum filter/sand filter), foam fractionation unit (protein skimmer), bio-filter, carbon dioxide degasser, nitrate filter, sterilization point (usually UV sterilizer), temperature control, oxygen injection system and pH control and alkalinity dosing system. All these components together help to maintain good water quality parameters and create conducive environment for the stocked fingerlings to grow. Recommended seed stocking size is 1.0 to 3.0 g and stocking density can be increased up to the total biomass of ~15 to 20 kg/$m^3$, increasing and decreasing in stocking number is depending on the size of stocking. Since, the system is stocked with high stocking density and water is continuously recirculated and thus, maintaining proper water quality with saturated level of dissolved oxygen is highly essential to maintain high survival in the culture system. Feeding in the system in similar to tank based flow through system and survival varies between 80-95% depending on stocking size and management practices. The preferred tank size is 5.0 to 10.0 tonnes capacity with 1.5 m water depth.

Nursery rearing in RAS system

Feeding in RAS system

***Fig.2: Nursery rearing of Indian pompano in indoor RAS based culture systems***

## Outdoor culture system

Indian pompano grow-out culture is practised in coastal ponds, coastal cages and marine cages in the specified locations, and these locations are generally away from hatchery facilities. Thus, nursery reared fingerlings are to be shifted to the respective culture system by different mode of transportations. In this circumstances, outdoor based nursery rearing in the respective grow-out culture system is recommended to reduce transportation related stress and expenditure. Also, performing nursery rearing in the respective grow-out culture facility helps to grow the fingerlings to required bigger size to reduce length of the grow-out period.

### *Nursery rearing in hapa based coastal pond*

Coastal based pond farming is one of the important culture systems for Indian pompano culture. The optimum stocking size for the species in grow out coastal pond culture is 25 to 30 g, and if the available size is small (~1 inch), then nursing of the fry should be done before stocking in the grow-out pond. Pond based nursery culture in hapa is recommended to perform in the same grow-out pond or in separate nursery culture ponds. In general, less than 10% of the total grow-out culture area is recommended for nursery rearing in pond based culture. Rectangular hapas are installed in the pond and are supported with bamboo or casuarina poles. Customised hapa sizes are used, and the recommended sizes can vary from 2 x 2 x 1.5 m to 4 x 4 x 1.5 m with mesh sizes of 0.5 mm. However, the size can be still bigger, but requires more manpower to manage while net exchange and other management practices. The suitable seed size in this system is 1.0 to 2.0 g in size and immediately stocking in the hapa, the newly stocked fry fed with floating pellet feed after acclimatisation. The mesh size of the hapa can be increased at time interval depending on the growth of stocked fry/fingerlings. The installed hapa should be stitched with mosquito mesh of one feet height at water interface for avoiding feed wastage through hapa mesh. Nylon net is preferred material for hapa in nursery rearing since it is softer than HDPE net. The ideal stocking density varies from 250 to 450 nos/$m^3$ for the fingerlings of 3.0 to 20.0 g in size and grading of stocked fry based on size should be followed on a fortnight basis, to achieve uniform growth. Hapa change during nursery period is recommended preferably once in a month based on the waste/algae accumulations. If not exchanged at particular interval, it may affect water flow and dissolve oxygen deficiency for the stocked fingerlings. The fish accepts artificial feeds,

Seed stocking in hapa in pond

Feeding in hapa

Sampling of Indian pompano

KMno4 treatment for disease

***Fig.2: Nursery rearing of Indian pompano in hapa in coastal pond***

and the diet with high nutrient content (Crude Protein 45% and Crude Fat 10%) is suggested for the nursery rearing. Feeding frequency of 4-6 times/day at 5-8% of body weight is recommended during the initial phase. The commonly available supplier for nursery feeds are Skretting (Norway), Lucky star (Singapore), Uni-President Enterprises Corporation (Taiwan), Growel Feeds Pvt Ltd (India). The fry stocked at 2.0 to 3.0 g in size should be culture for 60 to 75 days till it reaches 30-40 g, which is an ideal size for stocking in grow-out pond. The expected survival for the fish during hapa based nursery rearing is around 80-95%, and depends on efficient management. Maintaining good water quality is paramount in nursery rearing and thus, adequate aeration should be provided in the nursery pond as the fish fry are stocked at high densities in the hapa. Maintaining dissolved oxygen level of 4 to 6.0 ppm is recommended through use of paddle wheel aerators in the pond. The recommended salinity for good growth is 15-35 ppt. Water pH can vary from 7.5 to 8.5, but high

fluctuations in daily pH due to algae in the pond increases the toxicity of ammonia, ultimately impacting the stocked fry, and therefore, has to be avoided. After attaining the stockable size, the nursery reared fingerlings are directly release into the grow-out systems.

## Hapa based nursery rearing in coastal cages

In India, huge estuarine resources are available bordering the coasts and this potentially available under-utilized high saline water bodies, could be efficiently utilized by culturing the different species of finfishes in cages installed thereof. Optimum size of initial stocking for the fish in coastal cage is 20 to 25g. The fish stocked at the optimum size takes nearly 10 months to attain the market size of 750 g. However, the culture duration could be further reduced if the fish stocked are of bigger sizes. Thus, nursery culture of Indian pompano is considered an important aspect in cage culture for reducing the culture duration in cage culture operation of the fish. If ambient culture conditions existing in backwater culture farm facilities, nursery rearing can be performed in a few cages itself by use of hapas. Hapa based backwater nursery is performed, especially where the distance between land-based culture and backwater cage is far away. Keeping the culture situation in consideration, backwater cage based nursery rearing is recommended for reducing seed transportation related issues and to stock bigger size fingerlings for initial stocking. Unlike, indoor tank based nursery facilities, the initial stocking size should be 3.0-5.0 g in size due to rough climatic conditions. In general 5x5x3m GI cages are used for grow-out culture, and therefore, a hapa of either 2x2x2.5 or 3x3x2.5 size are recommended for nursery in cages. The mesh size of the hapa should be 5 mm in size, and should be stitched with feed mesh of 1.0 feet height at water and air interface to avoid feed wastage through hapa mesh. Optimum stocking density is 350-500 nos/$m^3$and this stocking density can be maintained till 25.0g in size. Immediately after stocking, the fingerlings can be fed with floating pelleted feed of 0.8 to 1.0 mm in size, at 5-6% of body weight. Feeding frequency should be 4-6 times and minimum of 4 times /day is highly recommended at initial stage. As, backwater is prone for bacterial load due to domestic waste accumulation, the nursery reared fingerlings should be continuously monitored and necessary medications with feeding should incorporated based on requirements. The estimated survival in this system is varied from 75-80% and more mortality is encountered during initial stage of nursery rearing, and especially more at the time of net exchange.

Coastal backwater cages

Hapa installed in coastal backwater cages

Seed stocking in coastal backwater cages

Sampling of Indian pompano seed

***Fig.3: Nursery rearing of Indian pompano in hapa in coastal cages***

## Hapa based nursery rearing in marine cages

Cage farming technology is widely recognized as one of the most important culture technology in mariculture for increasing fish production. Different species of marine finfishes are cultured in marine cages and Indian pompano is considered as a suitable potential candidate species for marine cage culture system. Cage culture is operated in isolated locations at 1-5 km distance from the coast. Thus, seldom transportation of the bigger seed is problematic to transfer for long distance, and in this situation performing nursery rearing in marine cageitself using small hapa is preferred if conducive environmental conditions are existed in cage farm site. Similar to coastal cages, hapa of 2x2x2.5 or 3x3x2.5 or other optimum size is preferred for nursery rearing and hapa should be prepared by HDPE materials to withstand in rough weather in sea. Recommended initial seed stocking size should bigger (~ 5.0 g), as

wave action and water current are high in sea cage site. The recommended stocking density is less than 10 kg/$m^3$ (400-500 nos/$m^3$ till 20.0 g) and then slowly the stocking density is reduced as fingerling grow. Stocked fingerlings fed at 5-6% of body weight with minimum of 4 times/day, and floating feed is recommended. Feed mesh by mosquito mesh should be attached at water and air interface to avoid wastage of floating feed due to wave actions. While in culture, hapa should be exchanged once in a month in order to avoid blockage of water movement due to fouling in the net. Hapa installed in cage is prone for folding due to high wave action and thus use of ballast pipe in happa is preferred, which will avoid net folding due to wave action. The survival of nursery reared fingerling in this system is ranged between 70-80%.

Seed transport – Via polythene bag  Seed stocking in hapa in cage

***Fig.4: Nursery rearing of Indian pompano in hapa in marine cages***

## Impact of different nursery rearing environments on growth

Growth performance is one of the important traits which determine long-time existence of a species in commercial culture operations. Fish growth is a complex process in which the ingested energy is converted to biomass and is regulated by genetic growth potential of the fish and several other abiotic factors provided by culture systems. Indian pompano is nursery reared in different culture systems and growth in all these systems is influenced by the different environmental factors brought by the respective culture systems. In comparison with indoor culture environments, outdoor culture system exhibit better growth due to availability of natural feed in addition to merely pelleted feed. The natural water movement also found to enhance the growth. However, outdoor systems are more prone for bacterial and other kind of infections,

which seldom reduce survival. Growth rate and feeding details in nursery rearing of Indian pompano in different culture system is given below.

*Table.1: Growth performance of Indian pompano in different nursery systems*

| Days (DOC) | Pond | Cage | Tank | RAS | Feed Size | Frequency | Feed Weight |
|---|---|---|---|---|---|---|---|
| | Weight (g) | | | | (mm) | (Time/day) | % of BW |
| 0 | 3.5 | 3.5 | 3.5 | 3.5 | 0.8 to 1.2 | 4-6 | 5-6 |
| 30 | 19.35 | 27.7 | 10.55 | 18.8 | 1.2 – 1.8 | 4-5 | 4-5 |
| 60 | 48.05 | 48.4 | 21.35 | 35.55 | 1.8 to 2.0 | 4 | 4 |
| 90 | 73.3 | 90.5 | 39.8 | 73.6 | 2.0 to 3.00 | 4 | 4 |
| Survival (%) | 80-90 | 70-80 | 85-95 | 80-95 | | | |

## Seed transportation

It is preferred to establish the nursery raring unit near to grow-out culture site for ease of transportation. Advanced fingerlings to nursery rearing or nursery to grow-out culture system is transferred via polythene bags filled with oxygen or sintex / FRP tanks supported with oxygen. When fingerlings are to be shifted at more than 5.0g in size, preferably they should be transported via a container supported with pure oxygen for achieving maximum survival and smaller sized advanced fry of less than 1.0 gin size can be transported via polythene bags. Fingerlings transported in stressed condition (overcrowding and less dissolved oxygen) are more susceptible to bacterial infection after stocking. Thus, adequate care should be given to keep the animals under stress-free conditions. Based on the observations; the optimum fish size, stocking density and mode of transportation is given in the Table below.

*Table.2: Indian pompano seed transportation – Mode of transportation in different stages*

| Fish Size (g) | Duration (hr) | Stocking (nos/lit) | Mode of transportation |
|---|---|---|---|
| > 0.25 | 24-36 | 50-60 | Polythene bag filled with oxygen |
| 1.0 to 2.0 | 15-30 | 20-25 | Polythene bag filled with oxygen |
| 2.0 to 5.0 | 12-24 | 10-15 | Sintex tank supported with oxygen |
| 5.0 to 15.0 | 12-20 | 5-6 | Sintex tank supported with oxygen |
| 25.0 to 30.0 | 12-20 | 2-2.5 | Sintex tank supported with oxygen |

## Points to be considered of nursery rearing of Indian pompano

- Rearing fish larvae through the early life stages is performed in nursery, and this is the phase between hatchery and grow-out. Thus, before stocking for grow-out, cultures pecies needs to be nursed for attaining optimum stocking size.
- Nursery rearing of Indian pompano is essential in cage culture for reducing the culture duration during grow-out. Two major types of nursery systems are preferably used: Indoor and outdoor-based systems and the use of these systems depends on the nature of the grow-out culture.
- Feed used in nursery should have a high nutrient profile; 45% crude protein and 10% crude fat. Feeding frequency of 4-6 time/day at 5-8% body weight is recommended. The feeding rate varies with size of the fingerlings reared.
- Indian pompano, being a fast-moving pelagic fish, dissolved oxygen requirement is very high; therefore, during nursery, the dissolved oxygen concentration should always be above 4.5 ppm.
- With proper feeding and water quality management, expected survival in indoor tank-based cultures is 80-95%, whereas in hapa-based outdoor culture systems it is 70-85% and survival is mainly depending on the management practices.
- Fishes are very active during nursery rearing; therefore, they tend to jump to at-least 15.0 cm above the water level. Thus, water level should be at least 30.0 cm below the tank surface for avoiding fish fingerlings falling out of water. It is suggested to cover the tank surface with fish net to avoid fish jumping out of the tank.
- Vibriosis is the most common bacterial infection occurring during nursery, because of stress. Minimising stress in nursery will help to keep the fishes free from bacterial infection. Possible stressorsare: overcrowding, more waste accumulation in tank bottom, rough handling, higher water temperature and lower dissolved oxygen.

## Suggested readings

Ranjan, R., Megarajan, S., Xavier, B., Chinnibabu, B., Ghosh, S., Gopalakrishnan, A. 2022. Practical manual on seed production of orange spotted grouper and Indian pompano; CMFRI, special publication number. 144, pages 72

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