

## Techno Guide Series

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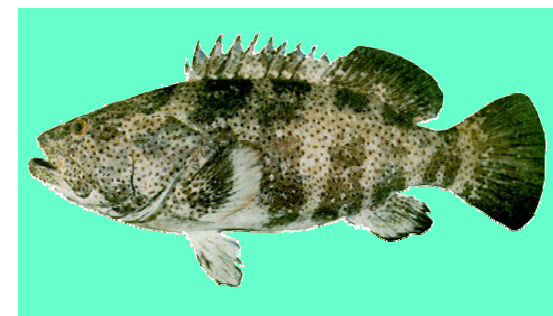
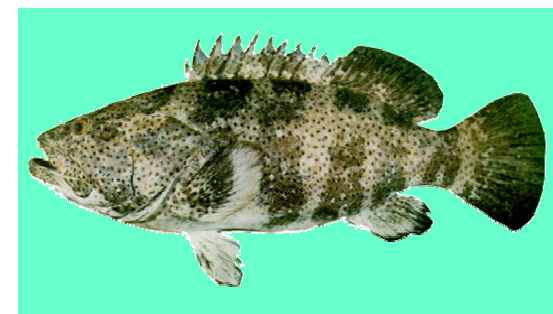
## Leaflets

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## *Techno Guide*

Department of Agriculture  
**BUREAU OF FISHERIES AND AQUATIC RESOURCES RFO 8**  
CRM Center Brgy. Diit, Tacloban City  
Tacloban City

## *Grouper in Cages*



## GROUPER CAGE CULTURE

Grouper, locally known as "lapu-lapu" are among the most commercially important marine food fish in the Philippines and Southeast Asia. They are one of the most expensive fish species and is valued for the excellent texture and flavor of its flesh, as well as its great potential in aquaculture. They are farmed commercially in brackishwater fishpond and net cages. The fish grow fast and attain marketable size of about 500-600 g body weight in 6-8 months of culture depending on the environmental conditions and farm management skills employed.

The grouper industry in the Philippines is developing rapidly mainly due to its export potential. However, its growth and development is constrained by the lack of seeds supply and trash fish feed. The domestic market is primarily the big hotels and seafood restaurants in cities particularly Metro Manila, which pay 3-5 times the normal price for any live grouper weighing between 400-1,000 g body weight. The buying price of live groupers in Metro Manila is between P300 to P500 per kg depending on size and season.

## COMMERCIALY CULTURED SPECIES

There are about 40 species of groupers distributed in tropical waters but only species are currently popularly cultured commercially. These are :



### ***Epinephelus coioides***

Common name : Orange-spotted, red-spotted, estuary or green grouper)

## REFERENCES

1. Baliao, Dan D., Santos, Miguela A. de los, Rodriguez, Eduard M., Ticar, Romulo B.; 1998. Grouper Culture in Brackishwater Ponds. AQD, SEAFDEC, Tigbauan, Iloilo, Phils.
2. Dieta, Romeo E; \_\_\_\_\_. Net Cage Culture of Grouper in Coastal Waters. (Training and Extension Material); National Brackishwater aquaculture Technology Research Center, Pagbilao, Quezon.
3. Yashiro, Remu, Vichai, Vatanakul, & Poonsin Panichsuke. 1999. present Status of Grouper Culture in Thailand. Network of Aquaculture Centers in Asia Pacific (NACA).
4. Lee, young Don. 1999. Brief on Grouper Culture in Korea. Network of Aquaculture Centers in Asia-Pacific (NACA).
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6. Boonvaratpalin, Mali, 1999. Nutritional Requirements of Grouper *Epinephelus sp.* APEC-NACA-NICA Workshop on Grouper Research and Development, 7th-9th April ,1999
7. Ali, A., M.T. Mohn Salleh & A.Z. Siti Noraziah, 1999. food Preference of Early Larvae of Brown-Marbled Grouper. NAPFRE, Kedah, Malaysia.

### **Production Staff:**

*Justerie M. Granali; Lea Tumabiene;  
Lita F. Villamor; Arnulfo Briones,  
Floredeliza Abrantes*

**COST AND RETURN ANALYSIS (8 - month period)**

**Technical Information**

<b>Nursery of tiny to XL size</b>		<b>Grow-out of XL to marketable size</b>	
Initial stocking: 4,500 pcs.		Size at stocking: 10-12 cm	
Size at stocking: 2-3 cm tiny		Stocking rate: 250/cage	
Size of cage: m x 3 m x 2 m		Survival rate: 95% (2,565 pcs. x 430)	
Culture period: 4 months		Culture period: 4 months	
Survival rate: 60%, 2,700 pcs.		Size at harvest: 450 g. up (10-12 cm)	

**Investment requirement**

Cages and hut		28,000.00
Work area		129,300.00
<b>Sales</b>	<b>1154 kg @ P280/kg</b>	<b>323,120.00</b>
<b>Costs</b>	<b>4,500 x P10</b>	<b>45,000.00</b>
Feeds P40 worth of trash fish to produce a 500 g fish		91,314.00
Wages 1 Laborer (feeder) @ P2,000/mo.		16,000.00
Depreciation		31,460.00
Maintenance and Repairs		3,000.00
Contingencies @ P500/month		4,000.00
Marketing expenses 5% of sales		16,156.00
	<b>Total Costs</b>	<b>206,930.00</b>
<b>Net Income</b>		<b>P 116,190.00</b>
<b>Return of Investment</b>		<b>0.74</b>
<b>Payback period</b>		<b>16.25 months</b>

**COST AND RETURN ANALYSIS: (Family-Based project)**

**Technical Information:**

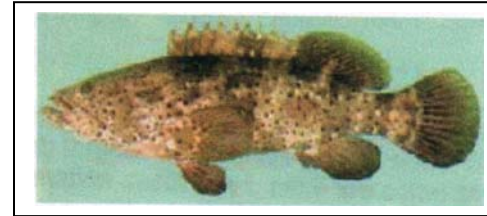
Initial Stocking: 800 pcs.		
Size at stocking: 100 g		Size at harvest: 600 g
Size of cage: 3m x 3m x 2m		Survival rate 90%
Culture period: 20 weeks		

<b>Sales</b>	<b>468 kgs@ P 250/kg</b>	<b>117,000.00</b>
Cage materials (40 pcs. bamboo, 10 kg Nylon #150, 1,000 pcs. plastic drums 20 pcs. sinkers, 4 pcs. anchorage, 1.5 rolls GG net, 1 roll envelope rope, 200 pcs. nipa Shingles, 2 kgs. nails		21,580.00
Other materials:(weighing scale, petromax, styrofoam Boxes, scoop nets)		2,160.00
Operating Materials:(800 pcs. fgs, 1116 kgs. Tateh feeds, ice gass)		44,500.00
	<b>Total Cost</b>	<b>68,240.00</b>
<b>Net Income</b>		<b>48,760.00</b>
<b>Return on Investment(ROI)</b>		<b>0.71 or 71%</b>

**Cont'n. Commercially cultured species**



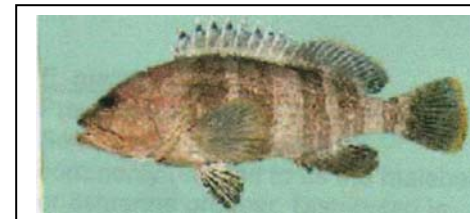
***Epinephelus malabaricus***  
Common Name : Black-spotted grouper)



***Epinephelus fuscoguttatus***  
Common Name : Brown marbled grouper or flowery cod

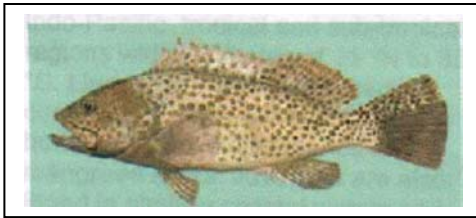


***Epinephelus amblycephalus***  
Common Name : Banded or black spotted grouper



***Epinephelus areolatus***  
Common Name:Areolate grouper

Cont'n. Commercially cultured species



***Epinephelus awoara***  
Common Name : Yellow grouper



***Epinephelus bleekeri***  
Common Name : duskytail or yellow spotted grouper



***Epinephelus tauvina***  
Common Name : greasy or green grouper



***Epinephelus lanceolatus***  
Common Name : giant grouper)

**RECIPES**

**Seaweed-Topped Lapu-Lapu**

Ingredients:

- ½ lapu-lapu fillet
- 1 cup pickled *Eucheuma* (see recipe below)
- ½ cup sliced carrots
- 1 piece onion, sliced, separated into rings
- 1 tbsp, cornstarch
- 1 clove garlic, minced
- ¼ tsp. dried oregano, crushed
- 1 cup chicken broth
- 2 pcs. sliced tomatoes
- red & green pepper sliced
- dash of hot sauce
- salt

In a saucepan, combine carrots, red & green pepper, onion, garlic, 1/8 tsp. salt and ¼ cup water. Bring to boil and reduce heat. Cover, simmer for 2 minutes. Drain. Mix tomatoes, cornstarch, oregano and hot sauce. Simmer and stir for 2 minutes more.

Meanwhile, in a large skillet, bring chicken broth just to a boil. Carefully add fillets. Return just to a boil; reduce heat. Cover and simmer heat. Cover and simmer till fish flakes easily with a fork. Remove fish from broth. Arrange in a serving dish. Mix the pickled *Eucheuma* with the prepared sauce. Pour sauce over fish.

**Pickled Seaweed Relish**

Ingredients:

- Cleaned seaweeds
- 1 cup vinegar
- 1 cup sugar
- onions
- carrots
- black pepper
- bell pepper

Mix together, sugar and pepper in a casserole. Boil the mixture for 10 minutes and cool. Blanch previously cleaned seaweeds for about a minute. Place the blanched seaweeds inside the sterilize bottles. Pour the cool mixture into bottles containing the blanched seaweed.

## HARVESTING

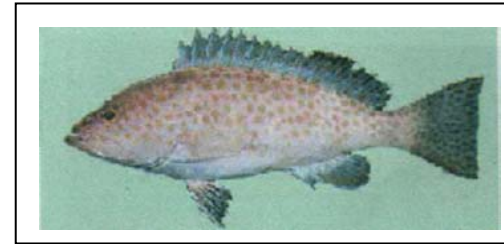
Starve the fish 24 hours before harvesting. Harvest depends on the demand of the local and export market.

## POSTHARVEST

Scoop live marketable size grouper (400 g and up) from the cages. Hold grouper temporarily inside the conditioning tank and provide aeration for about 1-2 hours. Adjust water temperature gradually to 18° C by adding packed ice. Place 3-5 fish in an oxygenated double sheet plastic bag, with water at 3-5 cm or at least covering the nostrils of the fish. Place crushed ice on top of the plastic bags to maintain the water coolness during the transport.

Place 3-5 fish in oxygenated double sheet plastic bag, with water at 3-5 cm or at least covering the nostrils of the fish. Place crushed ice on top of the plastic bag to maintain the water coolness during the transport.

Place plastic bags inside the square Styrofoam box (30 cm x 30 cm x 20 cm) with a cartoon cover having a tag "live fish" and then ready for transport.



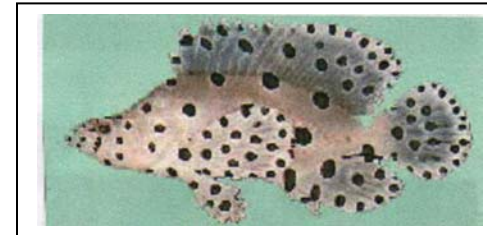
### ***Epinephelus akaara***

Common name: Hongkong  
Red spotted or red grouper



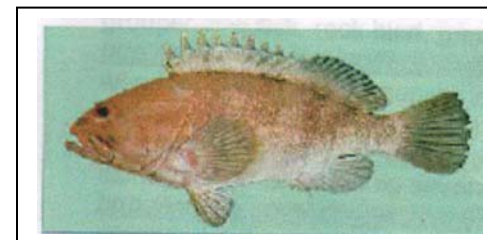
### ***Epinephelus akaara***

Common Name : Hongkong, red  
spotted or red grouper



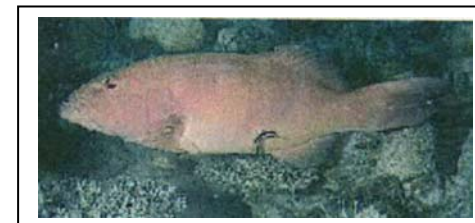
### ***Cromileptes altivelis***

Common Name : humpback or  
polka dot grouper



### ***Epinephelus rivulatus***

Common Name : Half-moon  
grouper



### ***Plectropomus maculatus***

Name : Spotted coral grouper)

## SOURCE OF STOCK

At present, the supply of grouper fry for commercial cage/pond production still depends on the wild. However, institutes like SEAFDEC/AQD and other progressive finfish hatchery operators are refining their broodstock and seed production techniques. In due time, these hatcheries will be able to supply fry and fingerlings.

Grouper fry are collected from tidal rivers, estuaries and coastal bays. Their availability is seasonal although in some areas, grouper juveniles are available all year round, with a peak in November to June. Tiny groupers measuring 2-3 cm body length abound in estuarine areas particularly near mouth of tidal rivers during spawning season. The fry can be collected by a fish trap net set at the mouth of the river as they are carried by tidal currents toward the shore. Grouper fingerlings measuring 5-12 cm length can be caught by baited hook and line, bamboo trap and dip net. They are also gathered in nominal quantities using various devices, e.g. scare-lines or brush piles. In Eastern Visayas, the major sources of grouper fry are in Ormoc City, Guiuan, Eastern Samar and Palompon, Leyte.

## SITE SELECTION

The site should :

- be in calm water, e.g. sheltered lagoons, coves, inlets, bay, behind an island or a river mouth. This is to avoid damage caused by strong winds, waves and currents.
- Have salinity ranging between 20-30 pt for juveniles and 25-35 ppt for adults
- Have a temperature should be between 26-32°C and dissolved oxygen (DO) above 4 ppm
- Have a pH of 7-9 or slightly alkaline and water transparency higher than 3 m
- Have water depth not less than 3 m during lowest low tide
- Have good water exchange to maintain good water quality and ensure effective removal of wastes and adequate supply of dissolved oxygen
- Allow at least 1-2 meter distance between the bottom net cage and the sea bed during the lowest tide water level

## Blister Disease :

The outbreak of Blister disease has been observed in fingerling groupers since 1988. Infected fish exhibit an initial loss of appetite, followed by blisters appearing on the body surface and a complete refusal to feed towards the end.

Even the blister disease cause a small daily mortality. Natural infection may cause mortality of 60-80% within a month.

Treatment : Kongpradit et al. (1997) reported that this disease is caused by an icosahedral shaped iridovirus, 140-160nm (in diameter). Isolation of the virus in GF (grouper fin) and EPC cells was possible. Pathogenicity was successful through waterborne transmission of cultured virus. Infected fish showed signs within 5 days after infection and the onset of mortality occurred. Mortality rates of experimental transmission as high as 100% were reached within 10 days.

## Health management

It is generally recognized that many diseases in fish culture are often associated with stress. Stressed fish can easily be infected with disease-causing agents and this affects growth. The following tips may minimize stress on fish and prevent disease outbreaks:

1. Observe any unusual swimming behavior of the fish, especially during dawn and late afternoon. Fish gasping for air usually indicates low levels of dissolved oxygen. Should this happen, thin out stocks by transferring some of them into another compartment.
2. Weak fish, i.e. individuals refusing to "school" with other fish and those observed as losing balance while swimming, should be separated from healthy stocks immediately. Stocks found to have sudden loss of appetite and with red "spot-like" wounds on the skin and fish are likely to have a bacterial infection. Use Povidone-iodine, commercially known as "Betadine solution" at 15 parts per million for 5-10 minutes for 3 alternative days, as an effective treatment for bacterial infection. Methylene blue can be used for swabbing. Transfer treated fish to a new compartment.
3. Maintain a distance of 1m between compartments to ensure easy and continuous water flow and maintain ideal water quality for the fish.

fish always swim near the water surface with their body in a curved position. Larvae and juveniles are generally more susceptible to the disease than fingerlings and adult fish. Mortality of up to 90% was reported in larvae and juveniles within a week of infection but was much lower (2%) in fingerlings and adult fish (Danayadol et al. 1995).

VNN is caused by the Nodavirus which infects the optic nerves and brain of victims (Danayadol et al. 1995). Infected organs usually vacuolated due to constant lesion. Homogenated filtrate of their brain or eye can bring about pathogenicity after intr-muscularly injection.

Occurrence of the VNN was indicated in grouper fry collection from natural waters along the southern coast of Thailand. High mortality of >80% occurred through the VNN during the nursing stages from juvenile to fingerling.

**\*Iridovirus disease :** In 1993 a serious outbreak of the disease caused by iridovirus occurred in grow-out net cages holding 20g-5kg groupers overall the cultured area of southern part of Thailand. About 90% of total production (one million individual fish) were lost from this disease in that year. Disease fish showed no lesions but evidenced a pale body color before they suddenly died (Danayadol et al. 1997). This disease turned up again just only in the year 1994.

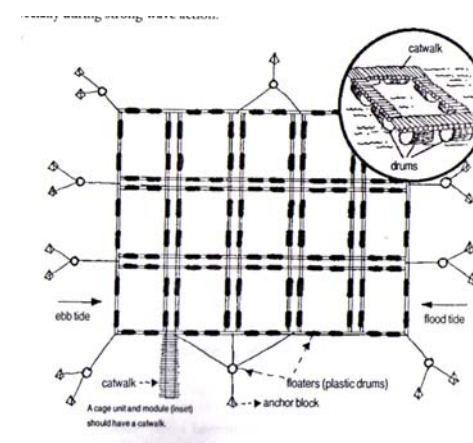
Virus particles were found in enlarged macrophage cells in the spleen and head kidney of infected fish. It caused necrosis in hematopoietic tissues, including the appearance of enlarged macrophage cells. Hexagonal shape viruses, 120-135 nm (in diameter), were detected. This virus was thereafter shown to have the same DNA sequences as a virus known to have infected several species in Japan (Miyata et al. 1996).

In 1997, a new species of iridovirus was reported in infected small grouper larvae (1.0-1.5cm) (Kasornchandra and Kongpradit, 1997). Infected fish were observed to have darkened pectoral fins and caused lower mortality (20-30%) than the earlier one. Isolation in EPC (epithelioma papulosum cyprini) and GF (grouper fin) cells was successful, this virus had a bigger diameter (220-240nm). Transmission of the disease can be accomplished by intra-peritoneal injection and cohabitation of viral cells.

- Be relatively free from any source of pollution (industrial, agricultural and domestic) and protected from any environmental hazards such as typhoons, floods, erosions, etc. It must be accessible and preferably secured from vandals and poachers.

## LAY-OUT DESIGN OF CAGE STRUCTURE

Net cages used for grouper culture can be either floating or fixed type. A floating cage module is usually composed of 4-12 compartments supported by a framework.



## Cage Dimension

The net cages vary in sizes depending on the financial capability of the fish farmer, but the most manageable and economical sizes are 2m x 2m x 1 m, 3m x 3m x 1.5m and 5m x 5m x 2m.

## Cage Shape

Since the shape of net cages does not affect the mobility and growth of the cultured groupers, the square or rectangular shape is mostly preferred than the circular shape because its easier to assemble and managed.

### Cage Frame

Made of bamboo or wooden planks. They must be durable enough to withstand stress caused by wave action and increased weight during culture operation.

### Catwalks

Attach lumber measuring 1 in by 6 in (cross section) and 6 m in length to the framework.

### Sinkers

Use small concrete blocks as sinkers suspended by ropes, placed at the bottom of the 4 corners of the cage or cage module for rigging.

### Floaters

Use plastic drums as floaters on each side of the cage between the bamboo pipes. Tie the drum to the cage frame using a rope 5 mm in diameter to stop the drum from drifting, especially during strong wave action.

### Cage netting

Fish net requirement for grouper cage culture

Growing Stage	Fish body length	Mesh Size	Net type
Fry	2-3 cm	2-5 mm	B-net
Fingerling	8-12 cm	1-2 cm	B or G net
Under Size	15-20 cm	2-3 cm	Super G net/PE knotted net
Good Size	25-30 cm	3 cm	PE knotted net

Nets are fabricated like an inverted mosquito net (hapa). Each cage is supported with polyethylene rope (5mm diameter) inserted along the sewed borders of the net and held using a clove hitch with overhand knot.

Each cage should have double-layered nets to avoid loss of stock due to tearing and other mechanical damages.

quality is inferior. This frequently takes place during the dry season when the salinity is high (33-35 ppt). Darkened skin was observed in ill fish at the initial stages and external lesions at the end. Mortality of <30% was reported. The *Dacrylogyrus* spp. were mainly identified from damaged fish (Ruangpan and tubkeaw, 1993)

Treatment -Formalin treatment of 250-ppm at 30 min/day for three days or a continuous bath in 0.3- ppm dipterex for three days are the most effective treatments for this parasite.

### Bacterial Diseases:

- **Flexibacteriosis** : This is a common disease found in both freshwater and marine fishes, is caused by a gliding bacteria, *Flexibacter sp.*; specifically *F. maritimus*
- A serious outbreak of this disease in groupers, known as the red boil disease, was reported in 1996 ( Danayadol et al. 1996). It was named after the clinical signs of reduced scales and severe hemorrhage on the body surface, casing it to resemble boiled skin. A high mortality rate of > 80% can be seen within a week. It was felt that stress from grading was the most significant cause of the disease, making the fish susceptible to invasion from bacteria.

*F. maritimus* shows yellowish colonies on cytophaga agar containing 50-100% seawater. It is long and gram negative. This bacteria grows well at 10-37°C, at pH 4 -7, exhibits positive reactions to oxidase and catalase and shows a negative reaction on gelatin and arginine.

Treatment : Potassium permanganate and oxytetracycline are actively used against the disease in ill fish, especially at the early stages.

### Viral Diseases:

\* *Viral Nervous necrosis* (VNN) : The VNN or whirling disease was formerly known as the encephalomyelitis in several species, such as in barramundi (*Lates calcarifer*, Glazebrook et al. 1990) , seabass (*Dicentrarchus labrax*, Breuil et al. 1991) and in some Japanese fishes (Muroga 1997). VNN has been detected in culture grouper since 1983. An important clinical sign is whirl-swimming of infected fish whose swimbladder is generally hyperflattened. There are no lesions on the body surface - the only indication of the disease is darkened skin. The infected



During the grow-out operation, the stocking rate is reduced when the fish reach the given body weight. Give trash fish at a rate of 5 % of the average body weight every 2 days.

### Monitoring

- Take a few samples of the stock every 15 days to determine feed requirement and growth rate of grouper stock. Scoop out 10-15 samples and measure the weight of each sample. The average body weight will be used in determining the feed requirement bimonthly.
- Inspect nets for tears or breaks.
- Clean/remove dirt, debris and fouling organism attached to the nets
- Repair or replace damaged nets

### Fish Diseases

Occurrence of diseases are common in intensive culture systems which generally change various parameters in the environment. Nutritional deficiency and environmental stress indirectly lead to diseases.

The causative agents of diseases are parasitic organisms, bacteria and viruses. The diseases that they cause are as follows:

#### Parasitic Diseases:

- **White Spot** - It is a skin parasite commonly occurring at every stage of the grouper's life. The fish is especially prone to this disease when regularly exposed to highly turbid water, which usually occurs during the monsoon months or during heavy rains. In the initial stages, affected fish scrape their bodies on the sides on the pond or tanks. Later stages show fish having opaque eyes and white spots on the body surface and gills. Mortality up to 100% can occur in all stages within three days in every size of fish. *Cryptocaryon irritans* is the parasite known to infest white spot in grouper (Ruangpan & Tubkaew, 1993 cited by Yaowanit Danayadol, 1999).

**Treatment** - At early stage, treat with 0.10-0.15 ppm malachite green mixed with 25 ppm formalin (Danayadol & Direckbusarakom, 1987).

**Monogenetic trematodes:** These parasitic worms usually infect grouper fingerlings cultured in net cages especially when the water

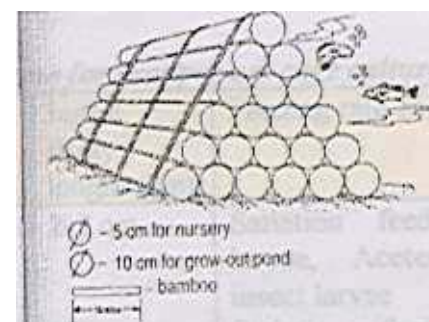
### Anchor

The rope length from the floater to the anchor should be the same as the water depth at high spring tide. The raft structure needs 14 concrete blocks (0.5-1 ton each) with 8 plated at the ebb end ( ebb tide being stronger than flood tide), 4 at the flood end and 2 in the mid-section.

Generally, the weight of the anchor should be twice the weight of the entire floating cage module.

### Shelter

Groupers need a place to hide, unlike other fish. To provide a place for groupers to hide, use sawed-off bamboos, 5 cm in diameter and 15 cm in length (for nursery cages) and 10 cm in diameter and 30 cm in length (for grow-out cages) tied in triangular bundles and suspended in strategic areas inside the net cage.



Shelters for groupers

## PRODUCTION STRATEGY

The culture technique involves 3 major stages : fry conditioning, nursery rearing and grow-out management.

### Fry Conditioning

Tiny grouper fry which are newly caught from the wild are very delicate and sensitive to changes in water conditions (e.g. water salinity, turbidity, temperature, DO), hence, stocking them directly into the nursery ponds or net cages will result to high mortalities. Therefore, it is necessary for tiny groupers (2-3 cm body length) to first be conditioned in plastic or concrete tanks for a month under controlled environmental conditions. Upon arrival to the site, newly caught wild grouper fry are first sterilized in 10-20% formalin solution for about 15-20 minutes to free the fry of any bacterial or parasite infection. After sterilization, the fry are stocked in aerated tanks filled with live small fish and crustaceans (e.g. fish larvae, Acetes, Artemia) and insect larvae at least three times a day of 0600, 1200 and 1800h respectively (Table 2). Before feeding the fish, tanks are changed with new sea water and cleaned of dirt, fish faeces and uneaten food. The fry must be sorted every 2 weeks by separating the big ones (shooters) from the small ones to avoid cannibalism. After a month, the surviving grouper juveniles can now be transferred to the nursery net cages.

### Nursery Rearing

Sort healthy and conditioned grouper juveniles (3-5 body length) and stock in nursery net cages at a stocking rate of 60-100 fish per cu.m. The nursery net cages should have a 2-5mm mesh size and measure 2m x 2m x 1m, submerged about 80 cm below the waterline. For safety reasons, it is advisable to cover the net cages with nets. Feed the juvenile groupers to satiation three times daily at 0600, 1200 and 1800 h respectively. During the first month, the fish are fed with live small fish, crustaceans and insect larvae. In the second month, the fish are weaned with finely chopped trash fish and small shrimp ( Table 2). To prevent cannibalism, the fish are sorted every 2 weeks by manually separating the smaller ones in another net cage.

Install a 50-watt incandescent lamp (hover type) inside the cages, about 0.5 m above the water line, at night to attract live food such as mysids, copepods and other smaller fishes.

After 2 months in the nursery net cages, the fingerlings (8-10 cm body length) are transferred into the grow-out net cages.

**Table 2. Feeding scheme for grouper net cage culture in coastal waters**

CP (Days)	Growing Stage (g)	Initial Body length (cm)	Feeding rate and feed type	Feeding frequency
1-30	Tiny	2-3 cm	Satiation feeding; live fish larvae, Acetes, Artemia & insect larvae	3x daily 0600/1200/ 1800 hr
	Fry	3-5 cm	Satiation feeding, live fish larvae, Acetes, chopped anchovies and shrimps	2x daily 0700/1700
91-150	Fingerling	8-12 cm	Satiation feeding, live tilapia fingerlings or trash fish	Once every 2 days
151-240	Under size	15-20 cm	-do-	-do-
241-300	Good Size	25-30 cm	-do-	-do-

### Grow-out Management

The grow-out stage can be undertaken in net cages measuring 2m x 2m x 1m, 3m x 3m x 1.5 m and 5m x 5m x 2m using a G net or PE knotted net with a 2-3 cm mesh size (Table 1). The stocking rate in the grow-out net cage is varied depending on the size of grouper (Table 3).

**Table 3. Recommended Stocking rate of grouper in grow-out net cages**

Initial body weight	Fish body length	Stocking rate
20-30 g	8-12 cm	50-60 m <sup>-3</sup>
200-250 g	17-22 cm	30-40 m <sup>-3</sup>
400 g above	25-30 cm	20- 30 m <sup>-3</sup>