

## 40

## Review of knowledge on Grouper aquaculture in South East Asia

S. TOOKWINAS

Brackishwater Fisheries Division, Kasetsart University Campus  
Bangkhen, BANGKOK 10900, Thailand

**Abstract** — The grouper is a popular marine food fish of high market value in Southeast Asia. Groupers have been farmed in netcages in coastal water for a longtime. The species which have been reared in tropical countries are estuarine grouper, *Epinephelus malabaricus*, black spotted grouper, *E. salmoides* and brown spotted grouper, *E. tauvina*. Some countries, like Indonesia and Singapore have attempted to rear leopard grouper, *Plectropomus leopardus*. In southern part of China and Japan the red spotted grouper, *Epinephelus akaara*, have been cultured in floating netcage.

Induced breeding trials for *E. tauvina* have been conducted since 1977 in Singapore. The induced spawning by hormone injection have been reported successful in Singapore, Kuwait and Thailand. However, the nursing of fry up to fingerlings are still under experiment. Therefore, uncertain supply of fingerlings from the wild has been the main problem for fish culture through out the region.

### INTRODUCTION

The grouper is a popular marine good fish in many parts of the world such as in Kuwait, Indonesia, Malaysia, Thailand, the Philippines, Hong Kong, Taiwan, Republic of China, Japan and Mexico. Their habitat are coral reefs and stony environment. Majority of groupers belong to the genus *Epinephelus* (Brais, 1987).

The grouper is characterized by an oblong body usually with spots and blotches and having a very large mouth (Brais, 1987). A highly carnivorous organism, it feeds on fish, crustaceans and cephalopods.

Some species of grouper such as estuarine grouper, *E. malabaricus*, black spotted grouper, *E. salmoides*, brown spotted grouper *E. tauvina*, red grouper *E. morio* and red spotted grouper *E. tauvina*, red grouper *E. morio* and red spotted grouper *E. akaara* have been found to be suitable for intensive cage culture in coastal water (Chen et al., 1977, Kohno et al., 1988, Brais, 1977 and Tookwinas et al., 1988). The culture of grouper

can be conducted both in cages and pond. However, cage culture is more popular than pond culture in many countries. The major constraints to its large-scale development are, however, the shortage and uncertain supply of fingerlings from the wild.

Artificial breeding has been done in many countries, such as in Singapore, Thailand, Kuwait and Japan. The hatchery techniques are still under experiment. However, the research efforts have therefore been directed at larval rearing techniques aimed at achieving self-sufficiency and independent supply of fingerlings.

## CULTURE SPECIES AND CULTURE METHODS

### Culture species

Grouper have been cultured in Southeast Asia for more than 10 years. *Epinephelus tauvina* was the first recorded species for culturing in Kuwait, Singapore and Thailand, while, *E. salmoides* have been cultured in Penang, Malaysia (Chua, 1978). At present, many species of grouper have been cultured in some Asian countries (Table 1). However, only *E. tauvina*, *E. salmoides* and *E. malabaricus* have been cultured in commercial scale in Southeast Asia and middle east. *E. akaara* have been cultured in Japan and China (Tseng and Foon, 1983).

Tab. 1. — Species of groupers cultured in some countries in Asia

SPECIES	COMMON NAMES	COUNTRIES	REFERENCES
1. - <i>Epinephelus</i> <i>E. malabaricus</i>	Black spotted grouper	Thailand Philippines	Tookwinas et al., 1988
<i>E. salmoides</i>	Estuarine grouper	Malaysia Thailand	Chua and Teng (1978)
<i>E. tauvina</i>	Brown spotted grouper	Singapore Kuwait	Chen et al., 1977
<i>E. akaara</i>	Red spotted grouper	Japan Hong Kong China	Tseng and Poon (1981)
<i>E. amblycephalus</i>	White-spotted green grouper	Hong Kong Philippines	Tseng and Poon (1983) Kohno et al., 1988
<i>E. bleekeri</i>	Yellow-spotted grouper	Philippines Hong Kong, Thailand	Kohno et al., 1988 Personel information
2. - <i>Plectropomus</i> <i>leopardus</i>	Leopard grouper	Indonesia, Singapore	/
3. - <i>Cromileptes</i> <i>altivelis</i>	Hump-backed Grouper	Thailand	Pakdi et al., 1985

### Culture methods

Cage culture has been practised in many countries such as Thailand, Malaysia, Singapore, Philippines, Indonesia and Hong Kong, while the

pond culture has been reported to be practised in Philippines (Kohno *et al.*, 1989). Cage culture has some advantages (Tookwinas and Charearnrid, 1988) which include following :

- cage culture are usually set in sites with better aquatic environmental condition. Therefore, cages can be stocked with more fish than ponds,
- the cost of cage preparation is much more cheaper than the cost of pond construction,
- cage culture would not need water changing and elaborate preparation, which makes the cage culture operation less costly than pond culture.

## SEED PRODUCTION TECHNIQUES

### Broodstock development

Grouper broodstock would be ready to spawn at an age of approximately 3 years (3.0-4.0 kg in body weight) (Ruangpanit *et al.*, 1988). Grouper is a protogynous hermaphrodite i.e. it matures as a female but transforms into a male when it grows bigger and older (Chen *et al.*, 1977). Therefore, male grouper can be obtained by accelerating the process of sex-reversal of 3 years old female through oral application of methyltestosterone at the dosage of 1 mg/kg for a period of about 2 months (Rungpanit *et al.*, 1988 and Ratanachot and Pakdee, 1986).

Tab. 2. — Summary of hormonal treatments for induced spawning of grouper

SPECIES	FIRST DOSES	FINAL DOSES	INTER-VAL PERIOD (HRS)	REFERENCES
<i>E. tauvina</i>	500 IU HCG + 3 mg P.G. (female)	1000 IU GCG + 3mg P.G.	24	Kungvankij <i>et al.</i> , 1986
	500-1000 IU HCG + 50-150 mg P.G.*	—	12-24	Chen <i>et al.</i> , 1977
<i>E. malabaricus</i>	400-500 IU HCG + 2 mg P.G. (female)	800-1000 IU HCG + 4 mg P.G.	24	Chulavitayanuko <i>et al.</i> , 1985
		500 IU HCG + 2mg P.G. (male)	—	Chulavitayanuko <i>et al.</i> , 1985
<i>E. salmoides</i>	1 IU HCG (female)	—	—	Huang <i>et al.</i> , (1986)

- \* 1. The number of injections and timing of the final injection depended on the response of the fish to initial treatment.  
 2. Pituitary gland extracts were usually given with HCG in the final injection.

### Induction of spawning

Induced spawning by environmental manipulation is now mostly employed. The technique includes controlling the feeding at 1-2 percent of

total body weight; the feeding is done once a day in the afternoon. The sea water is daily changed approx. 30-50 percent (Ruangpanit *et al.*, 1988). In the past, induced spawning by hormonal injection and artificial fertilization were conducted (Table 2).

The parent fish can spawn naturally in captivity for several days continuously during both lunar phases, full and new moon, a month, and every month from November to April of the following year. The hatching rate obtained at the National Institute of Coastal Aquaculture (NICA) was 57.16 % in 1988 (Rungpanit *et al.*, 1988).

#### Embryonic development and larval rearing

The hatching mechanism, embryonic development and larval rearing have not been studied in detail. The techniques for larval rearing of seabass have been applied, however, larval rearing techniques are under experiment. Only one crop of fry survived in the NICA hatchery in 1988. The average survival rate of 50-day old grouper fry was only 2.2 % (Rungpanit *et al.*, 1988).

### FLOATING CAGE CULTURE OF GROUPEL

#### Site selection

Floating cage should be set up in clam water, e.g. in a bay, behind an island or at a river mouth. This is to avoid damage caused by strong waves and current. The criteria for selecting a suitable site for cage culture of grouper (Tookwinas *et al.*, 1988 and Kohno *et al.*, 1988) are the following :

- salinity. This should be of range, 20-32 ppt. However, a site salinity of more than 10 ppt can be suitable for culture in the Philippines (Kohno *et al.*, 1988),
- tide and water depth. Water depth should be more than 2-3 metres. This is due to the usual size of culture cage which is 5 m x 2 m and 2 m deep. The tidal fluctuation should allow the water depth to be at least 2 meters at the low water of spring tide,
- current and waves. Area should be protected from strong winds, waves and current. An ideal area would be a protected bay, sheltered cove or inland sea,
- water quality. The site should be relatively free from domestic, industrial and agricultural wastes and other environmental hazards,
- water circulation. The site should have enough water circulation to improve on poor water quality that could occur at some period in the culture due to the decomposition of waste material which often accumulate beneath the net cage.

The water quality parameters which are considered of minimum range for cage culture are shown in Table 3.

Tab. 3. — The suitable water quality for cage culture of grouper  
(Tookwinas et al., 1988)

PARAMETERS	RANGES
pH	7.5-8.3
Dissolved Oxygen	4.0-8.0 mg/l
Water salinity	20-32 ppt
Water temperature	26-32°C
Ammonia - nitrogen	less than 0.02 mg/l
Hydrogen sulfide	none
Current	normal

### Material for cage preparation

Galvanized iron (GI) or wooden parts are used for the cage frame in Thailand, Singapore and Malaysia. The cage is kept afloat by styrofoam drum, plastic carbuoy or bamboo. In Philippines, wooden parts are used for the frame. Styrofoam drum, plastic carbuoy or bamboo are also used for supporting the cage frame (Kohno et al., 1988).

Cage is usually 5 × 5 × 2 m in Thailand (Tookwinas et al., 1988). However 3 × 3 × 3 m are also used in the Philippines (Kohno et al., 1988).

### Stocking density

At present, grouper fry are collected from the wild for culturing. The fry at size of 7.5-10 cm are usually collected by fish trap from coastal water near magrove aeras. The fry should be stocked in nursery cage. Stocking must be done separately for each size group. This is to avoid the cannibalistic behaviour of the species.

The stock density up to the marketable size varies from 10 to 100 fish per m<sup>3</sup> (Tookwinas et al., 1988; Sakaras and Kumpang, 1988 and Tanomkiat et al., 1987). However, the actual stocking density varies. This is due to insufficient supply of the fry.

### Feeding

Grouper is a carnivorous and voracious fish taking live fish and crustaceans as food (Kohno et al., 1988). However, it is not difficult to train the grouper to feed on trash fish. For first two months of culture, feeding rate is 10 percent of body weight. After that, it can be reduced to about 5 percent of body weight (Kungvankit et al., 1986).

Supply of trashfish is always insufficient and expensive in some seasons and areas. The artificial diets can be recommended for feeding. It is easy to train the grouper to feed on artificial diet (Tanomkiat et al., 1987). The growth rate is similar to the fish fed on trashfish (Table 4).

**Tab. 4.** — Growth of grouper at different stocking densities in cages (Sakaras and Kumpang, 1988 and Tanomkiat *et al.*, 1987)

CULTURE PERIOD (Days)	STOCKING DENSITY	
	58/m <sup>3</sup> <sup>a</sup>	100/m <sup>3</sup> <sup>b</sup>
0	83.7	26.9
30	158.7	45.6
60	186.5	65.9
90	243.9	98.7
120	283.7	137.0
150	296.8	217.1
180	355.8	312.4
210	433.9	387.6
250	/	586.6

\* a : fed with trashfish

\* b : fed with artificial diets.

#### Marketable size and rearing period

Marketable size fish varies from 0.5 to 1.3 kg. In the Philippines, marketable size fish of high demand ranges from 0.5 to 1.0 kg. In Thailand, 1.3 kg fish are usually exported live by air to Hong Kong.

Fish cultured in net-cage can reach 586.6 g in 8 months of culture period (Table 4).

#### POLY CULTURE OF GROUPEr AND OTHER FISH

Polyculture of grouper and tilapia have been reported in Philippines (Manzano, 1985 and 1986). A ratio of 1 grouper to 20 tilapia proved to be the most effective in earthen pond. Grouper yield is greater since they fed on tilapia fingerlings.

The basic construction of the polyculture pond is similar to milkfish or prawn ponds. A suitable site with salinity higher than 10 ppt is preferred. However, feeding techniques, water changing management, growth rate and food conversion ratio (FCR) should be studied in more detail.

#### MARKETING

Grouper is more expensive than most other fish species in Thailand. The local demand is rather limited. At present, production from cage culture in Thailand is exported live by air to Hong Kong. The demand is year round. Therefore, the income from grouper could be more than from other species (Tookwinas, 1988). In Singapore, the production from cage culture is only sold live in the local market (Teo and Wah, 1988).

- Brais, 1987.** Grouper abstracts, SEAFDEC Aquaculture Dept. Tigbauan, Iloilo, Philippines, 95 p.
- Chen F.Y. et al., 1977.** Artificial spawning and larval rearing of the grouper, *Epinephelus tauvina* (Forsk.) in Singapore, Singapore. *J. Pri. Ind.*, **5** (1) : 1 - 21.
- Chua T.E. and S.K. Teng, 1978.** Relative growth and production of the estuary grouper, *Epinephelus salmoides* (Maxwell) reared in floating net-cages. Penang, School of Biological Sciences, University Sains Malaysia, 23 pp.
- Chulavitayarukool P., C. Puthinuawarat and N. Sutemechaikul, 1985.** Study on the artificial propagation of grouper, *Epinephelus malabaricus* (Bloch and Schineder). In : Proceedings of the 3rd seminar on coastal aquaculture, 22-24 May 1985, Brackishwater Fisheries Div., Dept. of Fish, p. 9-21.
- Huang T.S. et al., 1986.** Experiments on the artificial propagation (Sic) of black spotted grouper, *Epinephelus salmoides* (Lacapedea) I hormone treatment, ovulation of spawners and embryonic development. *Bull. Taiwan Fish. Res. Inst.*, **40** : 241 - 258.
- Kohno H.M., Duray and J. Juario, 1988.** State of grouper *Lapu-Lapu* culture in the Philippines, SEAFDEC Asian Aquaculture (10) 2 : 4-8.
- Kungvankij P. et al., 1986.** Induced spawning and larval rearing of grouper. In : the First Asian Fisheries Forum, Manila, 26-31 May 1986. Ed. by J.L. McClean, L.B. Dizon, L.V. Hosillos. Manila, the Asian Fisheries Society., p. 663-666.
- Kungpanit N. et al., 1988.** Propagation of grouper *Epinephelus malabaricus* at National Institute of Coastal Aquaculture, Tec. paper (in press) : 15 pp.
- Manzano V.B., 1985.** Polyculture system using grouper *Epinephelus tauvina* and tilapia *T. mosambica* in brackishwater ponds. *RSDJ*, **2** (1) : 43 - 50.
- Manzano V.B., 1986.** Polyculture systems using groupers *Epinephelus tauvina* and tilapia *T. mosambica* in brackishwater ponds, 13 pp. (unpublished).
- Pakdi K. et al., 1987.** Cross breeding of *Epinephelus tauvina* (Forsk.) and *Cromiplites altivelis* (C & V). In : Conclusion on research reviews on grouper aquaculture, Dept. of Fisheries, p 82-92.
- Ratanachot A. and Pakdi K., 1987.** Experiments on propagation of brown spotted grouper *Epinephelus tauvina*. In : Conclusion on research reviews on grouper aquaculture, Dept. of Fisheries, p. 93-109.
- Sakaras W. and Kumpang P., 1988.** Growth and production of brown spotted grouper, *Epinephelus tauvina* (Forsk.) cultured in cages, Tec. paper N° 2/1988, Rayong Brackishwater Fisheries Station, Dept. of Fish., p. 17.
- Tanomkiat T. et al., 1987.** Culture of grouper in floating net-cages with artificial diets, Tec. paper N° 26/1987, Phuket Brackishwater Fisheries Station, Dept. of Fisheries, p. 17.
- Teo K.L. and Wah C.F., 1988.** The status of marine finfish culture in Singapore. In : Seminar report on the status of finfish culture in China, DPRK, Indonesia, ROK, Malaysia and Singapore, reviews presented during the finfish training course in Thailand, 1-21 August 1988, NACA-SF/WP/88/6, p. 41-46.
- Tookwinas S. and Charearnrid B., 1988.** Cage culture of sea bass *Lates calcarifer* in Thailand. In : Culture of Sea bass *Lates calcarifer* in Thailand, p. 50-58.
- Tookwinas S. et al., 1988.** Cage culture of estuarine fish in Satul Province, Tec., review N° 36/1987, Satul Brackishwater Fisheries Station, Dept. of Fisheries, 28 p.
- Tseng W.Y. and Poon C.T., 1983.** Hybridization of *Epinephelus* sp., *Aquaculture*, **34** (1983) : 177 - 182.