Fingerling Production of Orange-Spotted Grouper on Abu Al Abayad Island, United Arab Emirates

Omer M. Yousif, Krishn Akumar, M. Balamurugan, V. Hozifa and A. Sagir

The orange-spotted grouper *Epinephelus coioides*, locally known as *hamour*, is the food fish in greatest demand and correspondingly fetches the highest price in the local market. However, there has been a significant decline in natural stocks from severe over-exploitation in UAE waters over the last few years, as indicated by decreased landings. The high market demand and reduced natural supplies of the orange-spotted grouper make this species the top potential candidate for aquaculture in UAE.

The orange-spotted grouper *Epinephelus coioides*, locally known as *hamour*, is a member of the family Serranidae and is distributed throughout the Indo-West Pacific from the Red Sea and Arabian Gulf to South Africa, eastward to Palau and Fiji, north to the Ryuku Islands and south to the east coast of Australia and southern Japan. In the United Arab Emirates (UAE) the species is widespread throughout the entire coast line occurring in shallow waters down to 100-m depth. It is a carnivorous fish that feeds on fish and crustaceans. Like other serranid species, it is a protogynous hermaphrodite, maturing first as females at around 3-4 kg body weight, corresponding to 2-3 years of age. Some of the fastest growing females later transform into males when they reach a body weight of more than 6 kg (Abdessalaam 2002, Yousif *et al*. 2016).

In the UAE, *hamour* is the food fish in greatest demand and correspondingly fetches the highest price in the local market. However, there has been a significant decline in natural stocks from severe over-exploitation in UAE waters over the last few years, as indicated by decreased landings. It is estimated that this species is being exploited at a level of up to six times the sustainable limit (Grandcourt *et al*. 2005, Choat *et al*. 2015). The high market demand and reduced natural supplies of the orange-spotted grouper make this species the top potential candidate for aquaculture in UAE.

To support the development of *hamour* aquaculture in Abu Dhabi, the Aquaculture and Marine Studies Center (AMSC), located on Abu Al Abyad Island, made a trial to produce fingerlings of this species, which is the major bottleneck hindering development of commercial grouper aquaculture in the area (Ma *et al*. 2013). The results of broodstock management, spawning, larval rearing and nursing of this species are presented in this article.

TABLE 1. Spawning performance of orange-spotted grouper in 40-t indoor concrete spawning tanks at the AMSC.

	BATCH 1	*BATCH 2*
No. of females	6	14
Water temperature (C)		
Minimum	23.5	25.3
Maximum	26.5	27.5
Collected eggs (x10^6)		
Total	7.28	15.05
Fertilized	3.02	8.99
% fertilized	41.9	59.7
Collected larvae (x10^6)	0.84	2.76
Hatching rate (%)	27.9	30.7

Broodstock Management and Spawning

Fifty-two adult broodfish from 3.5 to 14.0 kg were collected from the channels surrounding Abu Al Abyad Island and were stocked in 5 × 5 × 2.5 m net cages located in one of these channels near the AMSC. Broodfish were given a freshwater bath for about 3 min before stocking in the net cage. During two years in net cages, broodfish were fed daily with fresh sardines, squid and crabs to satiation. Beginning January 2016, fresh feeds were fortified with vitamin E and fish oil every other day.

On 15 March 2016, fish were checked by cannulation and only ripe females with oocytes ≥ 490 μm in diameter and ripe males with running milt were selected and transferred to 40-t, indoor, oval spawning tanks at 8 fish/tank (4♀:4♂). Broodfish were gradually acclimated to 35 ppt seawater over four days by adding fresh water to the natural seawater of the island (50 ppt). During this acclimation period and throughout the spawning period, broodfish were fed fresh squid and crabs daily to satiation. No hormone injection was applied and all fish were allowed to spawn naturally. Buoyant eggs averaging 847 µm (824-864 µm) in diameter were skimmed from the water surface 12 h after spawning, rinsed, separated and counted as described by Yousif *et al*. (2012). Fertilized eggs were then directly transferred to 600-µm mesh cylindrical incubation baskets placed in larval rearing tanks at 20 eggs/L.

The first batch of fish spawned from 30 March to 8 April and the second batch from 12 April to 7 May. The total number of females spawned was 20 females yielding 22.33 million eggs, of which 12.01 million (54 percent) were fertilized. The average hatching rate was 30 percent, resulting in 3.60 million newly-hatched larvae (Table 1).

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FIGURE 1. *Tank for harvesting rotifers* (Brachionus rotundiformis).

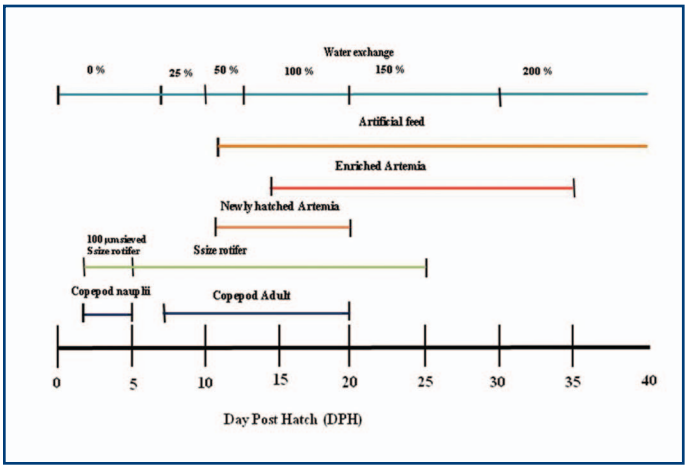

FIGURE 2. *Feeding and water exchange scheme for rearing orange-spotted grouper larvae.*

FIGURE 3. *Harvesting orange-spotted grouper fingerlings.*

Larval Rearing and Nursing

Of the hatched larvae, 2.175 million healthy larvae averaging 2.11 mm (2.03-2.15 mm) total body length were stocked in five 40-t circular concrete larval rearing tanks (LRTs) at 11 larvae/L. All LRTs were indoors with clear acrylic transparent sheets on the roof above the tanks. Each tank was provided with an aeration grid with air diffusers. The central standpipe was fixed in such a way that a diffuser placed inside the pipe created an upwelling current that provided gentle ripples on the water surface.

The green algae *Nannochloropsis* sp. was added to LRTs from 1 to 25 days post-hatch (dph) at a daily rate of 200 to 400 L/tank to maintain 1-3 x 10^4 cells/mL. After 50-52 hours from hatching, screened rotifers *Brachionus rotundiformis* (68-146 µm) were added twice daily at 0700 and 1600 h. A density of 2-3 rotifers/mL was maintained in the LRTs during 2 to 5 dph and 7-10 rotifers/mL between 6 to 25 dph. Prior to their introduction into LRTs, rotifers were cultured in yeast and Ori-One (Skretting, France; 56 percent protein, 17 percent lipids, 37 mg/g HUFA and >5 DHA/EPA), followed by 12 h of enrichment with Red Algamac[1] (2.59 percent EPA, 38.94 percent DHA) at 0.09 g/million rotifers. Rotifers were harvested using a specially designed harvest box with 60-μm mesh screens, which facilitated concentrating, rinsing and cleaning of rotifers before being fed to grouper larvae (Fig. 1). From 2-5 dph, copepod nauplii collected from shrimp ponds were fed to larvae at 0.03-0.06 individuals/mL and from 7-14 dph adult copepods were introduced at 0.2-0.5 individuals/mL. Newly hatched *Artemia* nauplii were provided from 11-17 dph and red Algamac-enriched *Artemia* from 14-35 dph. Harvested *Artemia* nauplii were stored at 4 to 6 C to maintain size and quality and fed in four rations per day. The feeding of formulated feeds started on 11 dph with Love Larva No. 1[3] (< 200 µm; 57.40 percent crude protein, 12.42 percent lipid) until day 20 dph. From 18-30 dph artificial Love Larva No. 2 (200-310 µm) and from 25-35 dph Love Larva No. 3 (310-480 µm) were provided.

Water was not renewed from 0-7 dph and water exchange started around 8-10 dph at 25 percent at night to maintain water quality and rotifer density, followed by 50 percent on 11-12 dph and 100 percent on 13-20 dph. Water exchange increased to 150 percent on 21 dph followed by 200 percent on 30 dph (Fig. 2). Photoperiod was maintained at 14 hours of light and 10 hours of dark during the rotifer feeding stage using florescent light (400-600 lux). After 30 dph, natural photoperiod was maintained.

Water quality during the larval rearing stage was: water temperature 26.0 ± 0.8 C, dissolved oxygen concentration 5.2 ± 0.8

FIGURE 4. *Size grading orange-spotted grouper fingerlings.*

FIGURE 5. *Orange-spotted grouper fingerlings at 95 dph.*

mg/L, ammonia concentration 0.18 ± 0.05 mg/L, nitrite concentration 0.021 ± 0.003 mg/L and pH 7.8 ± 0.4. All LRTs were harvested on day 40 by reducing water level in the tanks and scooping out post-larvae with hand nets (Fig. 3). The number of 40-d old post-larvae collected was 200,463 averaging 21.1 ± 4.3 mm total body length and 199 ± 92 mg body weight. The average survival rate of larvae was 9.3 ± 4.9 percent.

Harvested post-metamorphosis fish fry were transferred to 40-t circular concrete nursing tanks and stocked at 0.5-1.0 fish/L. Fry were further grown for 55 days and fed during this period with Love Larva No. 5 (680-1058 μm) and No. 6 (1100-1300 μm) plus 1.0- and 1.6-mm feeds[3]. To reduce cannibalism and size variation, grading was done every four days during this period (Fig. 4). The final harvest after 55 days (95 dph) yielded 177,462 fingerlings averaging 3.2 ± 0.3 g body weight (Fig. 5). Survival during this last phase was 88.5 percent with an FCR of < 1.0.

Conclusion

Although spawning was successful, the hatching rate was low, suggesting insufficient nutrition of broodfish, which in turn affected embryonic development. Future attempts should focus on the proper control of broodfish nutrition. Also, the considerable mortalities observed during the first two weeks after hatching were possibly because of the shortage of appropriate amounts of small-size prey such as copepods. The quantity of copepod nauplii provided to larvae in this trial (0.03-0.06 individuals/ml) during 2-5 dph and adult copepods (0.2-0.5 individiduals/mL) during 7-14 dph was insufficient to support good growth and survival rates. In future trials, special attention should be given to improve production efficiency of copepods from shrimp ponds.

In general, the survival rate achieved in this trial is encouraging and demonstrates the possibility of successful mass production of grouper fingerlings in captivity under the harsh environmental conditions of Abu Al Abyad Island (Yousif *et al*. 2011). Such success in orange-spotted grouper fingerling production is expected to give a boost to the emerging aquaculture sector in the UAE and also give impetus to current restocking programs aimed at natural resource conservation.

Notes

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[1] Aquafauna Bio-Marine, Inc, USA

[2] Hayashikane Sangyo Co. Ltd., Japan

[3] Skretting, Turkey

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