First breeding of the spangled emperor, *Lethrinus nebulosus* (Forsskäl, 1775), in the United Arab Emirates

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The spangled emperor *Lethrinus nebulosus*, locally known as Sheeri, is a top grade food fish in the United Arab Emirates (UAE) with a high market demand the year round. The fish, the largest representative of the family Lethrinidae, has a wide geographical distribution ranging from Indo-West Pacific, Red Sea, Arabian Gulf and East Africa to southern Japan and Samoa. The fish is a marine species occurring in a variety of habitats from coral reefs to seagrass beds and mangroves, from nearshore to at least 75 m. The adults are usually solitary but are sometimes found in small aggregations; juveniles form large schools in shallow, sheltered sandy areas. Like other members of the family Lethrinidae , *L. nebulosus* is a carnivorous bottom feeder that exists mainly on echinoderms, bivalve and gastropod molluscs, crustaceans and, to some extent, on polychaetes and fish (Brothers *et al.* 1983, Carpenter and Allen 1989, Randall1995, Kulmiye *et al.* 2002). The fish has an elongated to oval, pale yellowish brown body with dark brown edges on the scales and a light blue spot on many scales on the upper half of the body. Three blue streaks or series of blue spots radiate forward and ventrally from the eye.

The fish are protogyrous hermaphrodites, maturing first as females and then become males within a size range of 17 – 54 cm (Brothers *et al.* 1983, Carpenter and Allen 1989). They reach sexual maturity after 5-6 years (45 cm in length). Litherinidae is listed among a number of families of coral reef fishes that may aggregate to spawn (Domeier and Colin 1997, Claydon 2004). The fish spawns in open waters throughout the year with a peak in April. Spawning usually follows the lunar cycle, with increases in spawning frequency during the first and last quarters of the moon. Spawning events of marine finfish correlated with lunar cycles take advantage of maximum tidal flows to flush embryos and larvae offshore to a more predator-free environment and, ultimately, return them to recruitment sites along inner shelf areas (McFarland 1982). It has been shown that this species exhibits several traits desirable for aquaculture (Brothers *et al.* 1983, Carpenter and Allen 1989). This article reports the initial work carried out to evaluate the possibility of captive breeding of spangled emperor at Abu Al Abyad Island, United Arab Emirates.

Brood Stock Collection

Large numbers of ripe spangled emperor were observed to aggregate between the end of March and end of April each year along an artificially dredged channel associated with Abu Al Abyad Island. The channel was on the southeast part of the Island where a few small coral colonies occurred. It was 8 m deep with a silty bottom and good tidal water exchange. The salinity during the aggregation period was 52 ppt and the water temperature was 24-27°C. The fish aggregations were so dense that fish lay horizontally on top of each other and they were easy to approach and capture by hand. The same behavior has been reported for other *Lethrinus* species (Hamilton 2005).

A number of running ripe fish were selected from the aggregations on April 4 as spawners. Ten females with an average weight of 1.48 kg and 10 males averaging 1.38 kg were transferred to the hatchery where the females were injected with HCG at 500 IU/kg body weight and then randomly placed for spawning into two nets (5 x 5 x 2.5m, 30mm mesh nylon) hung in two indoor oval 40 t (30 t water volume) concrete spawning tanks at a density of 10 fish/net (5 ♀:5 ♂). Quinaldine was applied for general handling of broodfish during transportation to the spawning tanks. Filtered and disinfected seawater (52 ppt) was continuously supplied at 31.25 L/min, allowing a 150 percent daily water exchange. Fish in the spawning tanks were fed squid meat *ad libitum*. During the spawning season the water temperatures ranged from 24-25ºC and the photoperiod was kept at 12 L:12 D.

Spawning and Hatching

Spawning took place 48 hrs after hormone injection in the early morning hours. The eggs were small, spherical and buoyant (pelagic). They were non-adhesive and ranged in diameter from 784-838 µm. Each had a single oil globule that was150 µm in the diameter. Spawning was continuous at both the first and second quarters of the moon, suggesting that the fish did not exhibit lunar spawning rhythm in captivity. The floating eggs were collected twice daily (0800 and 1700 hrs) using fine meshed (220 µm) collection buckets placed at the overflow of the spawning tanks. To eliminate foreign material and milt, the

Table 1. Spawning and hatching performance of spangled emperor during 4 April -16 May 2005.

Spawning Period	4 April–15 April	16 April-30 May	1 May-15 May	16 May-29 May
Lunar cycle	2nd	1st	2nd	1st
Water Temp.(°C)				
Minimum	24	26	27.5	30
Maximum	25	27	28	31
Salinity (‰)	52	52	52	52
Collected eggs (x10^6)				
Total	2.76	2.44	0.92	0.30
Buoyant	1.80	2.36	0.76	0.28
Sinking	0.96	0.08	0.16	0.02
Incubation period (hrs)	20.0	17.5	17.5	19.0
No. larvae (x10^6)	0.125	1.411	0.507	0.107
Hatching rate (percent)	6.95	59.78	66.71	38.21

eggs were washed thoroughly fresh seawater and placed in a graduated cylinder for separation of buoyant fertilized eggs from those that sank and to obtain volumetric estimates. To remove the settling unfertilized eggs, the bottom water of the spawning tank bottom water was drained daily after the second egg collection in the afternoon and replaced with new seawater. The good fertilized (buoyant) eggs were incubated in cylindrical 400 µm hatching nets (0.7 m dia. x 0.65 m height). The nets were suspended in indoor 5-t rectangular fiberglass tanks with flowthrough filtered and sterilized seawater and all nets were provided with moderate aeration. The eggs were stocked at an average rate of 300 mL/net (approximately 600,000 eggs/ net). Dead eggs were siphoned out from the bottom of the net.

The total number of eggs collected from 10 females during the spawning season (4 April-16 May) was 6.42 million or an average of 435,000 eggs/kilogram of female. The total number of eggs produced decreased from 2.76 million during the first two weeks of April to 300,000 during the last two weeks of May. Buoyant eggs amounted to 81 percent of the total. The eggs hatched within an average of 18.5 hrs at an average minimum water temperature of 26.9°C. The average hatching rate was 42.9 percent of the total incubated eggs and the total number of larvae produced was 2.15 million.

Larval Rearing

Immediately after hatching the larvae, averaging 1.7-2.0 mm, were collected from the hatching nets by siphoning into 100 µm collection buckets and then transferred to the 5-t indoor fiberglass rearing tanks (LRTs) at a stocking density of 50 larvae/L. The LRTs were supplied with filtered/ sterilized seawater and continuous aeration. At day 1 after hatching, *Nannochloropsis* algae concentrate[2] was initially added to the LRTs at a concentration of 680,000 cells/mL to precondition the water in the tanks, to serve as rotifer food and to stimulate the digestive processes of the fish larvae (Reitan *et al.* 1997). The microalgae were added continuously until day 20 post-hatch at a density of 300,000 cells/day.

From day 2 to 20 days post-hatch, enriched rotifers were provided at a density of 10/mL and from day 21 to 30 post-hatch, at a density of five unenriched rotifers/mL. The rotifer density was monitored twice a day and adjusted to maintain the required density. The S-type rotifers, *Brachionus plicatilis*, (93.1-106.4 µm), were first grown on yeast (0.5-0.75 g/million individuals) and *Chaetoceros* and then harvested and placed in the enrichment tanks. Enrichment was done for 48 hrs; in the first 24 hrs, the rotifers were enriched with Packboost, 6 percent EPA, 8 percent DHA[3] and in the second 24 hrs with HUFA, ≥ 30 percent ω3 fatty acids, ≥ 12 percent EPA, ≥ 12 percent DHA, and ≥ 1.75 percent ARA[4].

Enriched *Artemia* nauplii[3] were offered from day 14 to 20 post-hatch at a rate of 0.05-0.1 nauplii/mL. Unenriched *Artemia* nauplii were provided from day 21 to day 30. Enrichment of *Artemia* was done with 300 ppm Packboost 3 hrs before feeding to the larvae. From day 4 to 20 surface skimmers were introduced in the LRTs. The skimmers were cleaned every six hours using soft paper sheets.

On day 11, the first prepared feed of <200 µm (Progression) was distributed hourly in quantities of 2-5 g. On day 15, prepared feed of 200-300 µm (Proton, INVE, Belgium) was introduced and on day 20, feed of 360-560 µm[5] was provided. On day 25 distribution of the smallest size feed was terminated and only feeds of latter two sizes were provided until the end of the 30-day rearing period.

The water exchange rate in the LRTs was dependent on feeding protocol. During the period of enriched rotifer feeding the water was replaced on days 8-13 at a rate of 10-20 percent daily. Beginning on day 14 when enriched *Artemia* were added, the daily

water exchange rate was increased to 50 percent until day 20. From days 21-30 when unenriched live food and prepared feed were provided, the daily volume of water change was increased to 100 percent. A photoperiod of 16L:8D was maintained throughout the rearing period. The pH and dissolved oxygen levels recorded were within the ranges of 7.5-8 and 4-4.5 mg/L.

The survival rate of the larvae in all LRTs was good during the first two weeks. Significant mortality began on day 15. On day 30 all LRTs were harvested and larvae were counted and measured. The average survival rate was only 1.5 percent. Variation in larval growth was distinct. Body lengths and weights at harvest ranged from 2-4.2 cm (averaging 2.87cm) and 0.2-1.1 g (averaging 0.50 g.

Summary and Conclusions

Spangled emperor broodfish were collected from the wild and successfully spawned in captivity, but larval survival was poor (1.5 percent). Nevertheless, the results of this trial suggest that captive spawning *Lethrinus nebulosus* through hormone manipulation in the hypersaline conditions of Abu Al Abyad Island is possible. The low survival rate of the larvae may have been a result of the following:

- The broodfish used in the trial were collected from the wild and were not given enough time to acclimate to captive conditions, so early capture and domestication of broodstock using the proper nutritional regime might improve egg quality and larval survival.
- Feeding of the larvae was carried out as recommended for marine finfish larvae, but the nutritional quality of the *Artemia*, artificial feed and enrichments used to boost the levels of HUFA in the rotifers and *Artemia* may have been inadequate, so future trials should evaluate that theory.
- The size variation among the larvae my have triggered cannibalism in the rearing tanks and contributed to low survival rate, so periodic grading of the larvae should be considered in future trials.

Notes

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[3]Golden Prawn Inc., Taiwan.
[4]Salt Creek, Utah, USA.
[5]NRD, INVE, Belgium.

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References to commercials products does not constitute endorsement of those products and does not imply approval to the exclusion of other products that may be suitable.

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New Literature

Genten, F., E. Terwinghe and A. Danguy. 2009. **Atlas of Fish Histology.** Science Publishers, Enfield, New Hampshire USA. 215 p.

This book contains 450 color histological photomicrographs covering the various finfish tissues and systems. There is an introductory chapter on histological techniques and fish gross anatomy with photos of fish sections on which the various tissues, organs and other features are identified. The introduction is followed by 15 chapters that cover fish tissues in general; the skeletal tissues; muscles; heart, blood vessels and blood cells; immune system; integument; digestive system; gastrointestinal glands; swim bladder; respiratory system; kidney, chloride cells and rectal gland; nervous system; endocrine glands; reproductive system; and sensory systems. The photomicrographs are taken from 40 fish species. Each chapter contains a brief narrative, but is primarily comprised of high quality photographs. The book should be of particular interest to fish pathologists who want to compare their histological slides with normal histology.