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Present Culture Status of the Endangered Snakehead, *Channa striatus* (Bloch, 1793)

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ABSTRACT

Snakehead (*Channa striatus*) belonging to the Channidae family is an indigenous freshwater fish of Malaysia that has carnivorous behavior. *C. striatus* command high prices since it has a strong demand and are sold alive. It is a commercially important species in Thailand, Philippines, Cambodia and Vietnam. Increased human activities destroyed the feeding and breeding grounds of this species, leading to decline in wild catches. *C. striatus* is considered as an endangered fish in Bangladesh. The research of *C. striatus* provides an account of current knowledge, especially on reproduction, culture and nutritional requirement of snakehead. The problems encountered in snakehead culture are discussed and suggestions made to overcome the problems are highlighted.

Key words: *Channa striatus*, reproduction, culture status, carnivorous behaviour

INTRODUCTION

Snakehead, *C. striatus,* known as "Haruan" in Malaysia, is a native freshwater fish of tropical Africa and Asia (Ng and Lim, 1990). It belongs to the family Channidae and is also known as murrels or serpent-headed fish. It is carnivorous in nature and eats frogs, fish, insects, tadpole and earthworms. It is an air-breathing fish that can survive in harsh environments with low dissolved oxygen and high ammonia contents (Marimuthu and Haniffa, 2007). It can stay alive without water as long as its gills remain moist.

C. striatus is not a good swimmer. As an air-breathing fish, it prefers stagnant, slow running and shallow water not more than 2 m deep with dead log and aquatic plants so that it can easily hide and hunt for food (Mat Jais, 2007). However *C. striatus* can also be found in waters up to 12 meters deep. The fish has a unique habit of settling and boring itself into bottom mud of ponds during drought and going deeper and deeper into the mud during the dry process and only comes out when situation granted (Mat Jais, 1992; Rahman *et al.*, 2012).

In Malaysia, *C. striatus* is a well known remedy for wound healing and traditionally used among mid wives for decades. *C. striatus* is consumed to fasten healing especially for mothers who underwent caesarean operations and become supplementary among illnesses like diabetic gangrene and cancer (Mat Jais *et al.*, 1994; Mat Jais, 1997).

C. striatus comprises 13% of the marketable freshwater fishes in India (Chakrabarty, 2006; Aliyu-Paiko *et al.*, 2010a). It is commercially important in Philippines, Thailand, Cambodia and Vietnam (Wee, 1982). The natural population of this species decreases rapidly due to habitat degradation and now this species is acknowledged as an endangered fish in Bangladesh (IUCN, 1998).

REPRODUCTION OF SNAKEHEAD

The natural breeding time for *C. striatus* is during the onset of monsoon and usually takes place in ditches, ponds and flooded paddy fields. The fecundity of snakehead varies from 16330-56476 eggs in the size range of 34.2-51.50 cm (Rahman *et al.*, 2012). However, Ali (1999) found mean absolute fecundity ranged from 4326-9017 eggs whereas mean relative fecundity ranged from 10.5-36.3 eggs per g b.wt. *C. striatus* exhibits parental care. After eggs are hatched, the fry stay at the surface of the shoal. Their parents guarded them by hiding at the bottom of the water (Rahman *et al.*, 2012).

Ali (1999) has conducted an experiment about the reproductive biology of *C. striata* collected from irrigated rice agroecosystem in Malaysia for about one year. He found six developmental stages of oocytes. The frequent observation of different ovarian stages in samples showed that gonadal development occurs throughout the year. The result also confirmed spawning readiness of *C. striata* throughout the year.

There is insufficient knowledge about the breeding and feeding of early larval stages of snakehead (Marimuthu and Haniffa, 2007). Such knowledge is very important in culturing *C. striatus* since seed collection from the wild is limited due to monsoon failure (Haniffa *et al.*, 2000; Marimuthu *et al.*, 2001). Marimuthu and Haniffa (2007) conducted an experiment to breed *C. striatus* in laboratory conditions. They injected the snakehead with ovaprim hormone with a dosage of 0.5 mL kg^{-1} b.wt. and spawning occurred within 24-26 h after injection. The fertilized eggs were floating, non-adhesive, straw yellowish in color and have diameter that ranged from 1.20-1.40 mm. The incubation period took 23-24 h at temperature of 29±1°C with hatching rate of 80-85%. The newly hatched larvae were 3.4±0.2 mm in length and the yolk were completely absorbed within three days after hatching. The larvae metamorphosed into young juveniles within 20 days post-hatching.

IMPORTANCE OF SNAKEHEAD

The snakehead meat has good taste, high nutrient and also has high pharmaceutical values (Khanna, 1978). The white, boneless flesh of snakehead is believed to have recovery and strength giving substances so that it is usually given to the elderly women during recuperation after giving birth (Ling, 1977). The presence of fatty acids like prostaglandin and thromboxane contribute to hasten the recovery of wound and internal injuries (Yaakob and Ali, 1992). Polyunsaturated fatty acids can regulate prostaglandin synthesis and can influence the immune system (Bowman and Rand, 1980). Snakehead contains 17 amino acid including a high amount of Arachidonic Acid (AA), a polyunsaturated omega-6 fatty acid which is important for internal and external healing (Mat Jais *et al.*, 1994). Snakehead also has all the essential amino acids for wound healing, especially glycine, which is important for the formation of human skin collagen (Mat Jais *et al.*, 1994).

C. striatus contains Docosahexaenoic Acid (DHA) 22:6 ω3 (omega-3 fatty acid) which is very useful for the maintenance of healthy skin. This essential fatty acid has been identified as a nutraceutical with clinical value in the treatment of skin disease (Mat Jais *et al.*, 1998; Mori *et al.*, 1999). Other pharmacological activities include anti-microbial, anti-inflammatory, cell proliferation, induction of platelet aggregation and anti-nociceptive properties of the mucus (Mat Jais, 2007). Hence, snakehead is commonly consumed for medicinal purposes in Asian markets.

CULTURE OF SNAKEHEAD

Asian people take snakehead as a valuable fish. It is most common staple food fishes in Thailand, Indochina and Malaysia (Davidson, 1975). Snakehead is a valuable fish dish due to its firm, white and almost boneless tasty flesh and also easy to handle, which has made it commercially viable to culture (Qin and Fast, 1998). Since snakehead is an air-breathing fish, it can be sold alive in the market with higher price compared to dead fish because people like to consume fresh fish for better taste.

Snakehead is considered as a 'police' fish in polyculture and has been labelled as an undesirable intruder to other fish culture systems due to its piscivorous behaviour. It has however surprisingly developed into a major species in aquaculture nowadays (Chen, 1976; Qin and Fast, 2003). Besides, it is economically important in both culture and capture fisheries throughout southern and southeastern Asia (Vidthayanon, 2002). Once, farmer prefer to culture *Clarias* catfish (*Clarias batrachus* and *Clarias macrocephalus*) due to their shorter raising period (6 months) compared to the longer culture period (7-9 months) for *C. striatus*. The longer culture period as well as the higher capital out-put as feed cost can reach more than 70% of the total operating cost. However, there is some difficulties encountered in culturing *Clarias* species, include: diseases, management problems, husbandry and low price nowadays due to overproduction of this species in the market. Hence, farmer is now moving towards snakehead due to higher market price.

According to the survey made by Boonyaratpalin *et al.* (1985), there are few problems encountered during culturing snakehead. One of the major problem is the poor survival rate of *C. striatus* especially in the initial period due to cannibalism and the huge size variation during grow out culture (Wee, 1982; Diana *et al.*, 1985). *C. striatus* is highly predaceous that they can swallow their prey wholly (Diana *et al.*, 1985). Qin and Fast (1996) found that juvenile snakehead could eat siblings of less than two-third of their body length. Qin and Fast (1996) indicated that cannibalism cannot be avoided with this species. However it can be reduced by regular size grading and feeding the fish *ad libitum*. Besides this, *C. striatus* has slow growth rates and usually takes 8-11 months to reach table size (Boonyaratpalin *et al.*, 1985). Sometimes fish refused to eat, affecting growth and resulting in high cost of production (Boonyaratpalin *et al.*, 1985).

Qin and Fast (1998) mentioned that initial size differences can lead to cannibalism between individuals. Therefore size variation must be minimized at stocking to reduce cannibalism losses. They also suggested that the suitable stocking density for snakehead for grow out in tanks can be increased to more than 30 m^{-2} when food is not limited. Snakehead gained more weight but showed greater size disparity at high temperature. However, temperature could not affect the cannibalistic behavior among snakeheads (Qin and Fast, 1998).

Diana *et al.* (1985) cultured snakehead juveniles with a stocking density range from 40-80 m^{-2}. Survival rates were 13-15% after 9-11 months of culture in earthen pond. However, it was not clear whether the growth of snakehead was affected by stocking density. Rahman *et al.* (2012) has carried out an experiment using different stocking densities of snakehead fingerlings in earthen ponds. The stocking densities they used were 5000, 6250 and 7500 fingerlings ha^{-1} and they concluded that 5000 fingerlings ha^{-1} was the most suitable stocking density for culturing *C. striatus* in earthen pond for better production.

Yang *et al.* (2004) cultured mixed-sex Nile tilapia with predatory snakehead. The treatments they used were monoculture of sex-reserved all male tilapia, monoculture mixed-sex tilapia, polyculture of snakehead and mixed-sex tilapia at ratios of (1:80), (1:40), (1:20) and (1:10). Among the treatments evaluated, polyculture of snakehead and mixed-sex tilapia (1:80) gained the best performance by reducing the overcrowding in pond culture due to fast breeding of tilapia. The predatory snakehead not only acted as biological control of tilapia but also contributed to economic gain since it had high market value.

NUTRITIONAL REQUIREMENTS OF SNAKEHEAD

There is limited information about the nutrition of *C. striatus* (Qin and Fast, 1997). Usually, farmers fed the snakehead with trash fish and cattle blood mixed with wheat flour or spent grains and rice bran (Wee, 1982; Victor and Akpocha, 1992). In Thailand, they fed snakehead with trash fish mixed with rice bran, vitamins and minerals and sometimes added antibiotics during the first month (Boonyaratpalin *et al.*, 1985).

Abol-Munafi *et al.* (2004) stated that during the first month, *C. striatus* larvae should be fed with *Artemia* and *Moina* since formulated diet was much less acceptable and can cause low survival rate and growth rate. However, Qin and Fast (1997) concluded that *C. striatus* could be trained to eat formulated feeds using two methods. Method 1: feed the larvae with *Artemia* nauplii supplemented with formulated feed for 30 days and slowly stop giving live food over a 7-10 day period. Method 2: feed the larvae with *Artemia* nauplii only for 30 days and feed *Artemia* and formulated feed for following 7-10 days. After that they can be adapted to consume formulated feed. Kumar *et al.* (2008) reported that the best live feed for growth and survival of *C. striatus* larvae is mosquito larvae when compared to chironomus (bloodworm) larvae and plankton.

Sarowar *et al.* (2010) reported that *C. striatus* fry fed with live tubificid worms showed higher performance in terms of weight and length gain and survival rate compared to chopped silver carp fry and artificial feed. Artificial feed should contain the right protein or lipid/protein ratio in order to gain good growth. Fingerlings need 500 g kg^{-1} of protein (Wee and Tacon, 1982; Wee, 1986). Fry needs 550 g kg^{-1} of protein (Mohanty and Samantaray, 1996). According to Samantaray and Mohanty (1997) fingerling of *C. striatus* need 130/450 g kg^{-1} lipid/protein ratio. However, Aliyu-Paiko *et al.* (2010a) reported that 65/450 g kg^{-1} of lipid/protein is adequate for growth and survival of *C. striatus* fry. Seaweed meals as binding agents in formulated feed for *C. striatus* fry has been produced by Hashim and Mat Saat (1992). The result showed that *Ulva* spp. meal diets gave the best water stability and growth and feeding efficiency value for *C. striatus* fry.

C. striatus fingerlings can utilize carbohydrate better than lipids, however it can lower SGR if the diet contains high amount of carbohydrates (Arockiaraj *et al.*, 1999). They stated that 12% of carbohydrate level was optimal and effectively utilized by *C. striatus* fingerlings without adverse effect. Aliyu-Paiko *et al.* (2010b) indicated that to promote good feed efficiency and growth performance in *C. striatus* fingerlings, the diet should contain 65 g kg^{-1} lipid and 450 g kg^{-1} protein, with gross energy of 18.5 kJ g^{-1} and a dietary n3/n6 PUFA ratio for about 0.1.

CONCLUSION

C. striatus demand in the aquaculture market has been increased day by day for its good taste and white and boneless flesh. It has higher nutritional and pharmaceutical value to speed the healing of wound and commonly consumed among caesarean mothers, hence making it commercially viable to culture, especially in tropical Asia. Information on culture techniques, nutritional requirements and reproductive biology of *C. striatus* will assist farmers to develop suitable culture techniques for better production with minimum resources. Knowledge on reproductive biology can help the farmers to commercially breed *C. striatus* without depending on wild catches. It would be ideal if *C. striatus* could be spawned continuously throughout the year especially in the captive environment to ensure no shortage of fry production in the market.

This paper reviewed information that could contribute to the aquaculture industry for better production and conservation. The information generated from the present review could help towards a better understanding of snakehead biology, reproduction and culture which will ultimately contribute to the aquaculture industry for better production and conservation of this high valued but endangered fish species in the region.

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