



Original Article

Feeding behaviour of snake head fish, *Channa striatus* larvae

Thumronk Amornsakun^{1*}, Wasan Sriwatana² and Ponpanom Promkaew²

¹ *Fisheries Technology Program, Department of Technology and Industries, Faculty of Science and Technology, Prince of Songkla University, Pattani Campus, Mueang, Pattani, 94000 Thailand.*

² *Pattani Inland Fisheries Research and Development Center
Yarang, Pattani, Thailand.*

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Abstract

Feeding scheme experiments were done in a 15-liter glass aquarium (water volume 10 liters) containing 500 of two-day old larvae (stage at first feeding). It was found that larval snake head fish aged 3-11 days (average total length 6.08-10.86 mm) consumed *Moina*. Larvae aged 12-15 days (average total length 10.79-14.61 mm) consumed both *Moina* and commercial pellet (40 % crude protein). Larvae aged more than 16 days consumed only commercial pellet.

Determining the daily food uptake by the larvae and juveniles was done in a 15-liter glass aquarium (water volume 10 liters) containing 1,000 larvae. The larvae consumed *Moina*, provide of a density of *Moina* 10 individual/ml. The amount of food intake was calculated based on changes of food density in the aquarium with and without fish larvae at 2-hour intervals. It was found that larvae aged 3-15 days consumed *Moina*. The average uptake of *Moina* in digestive tract per day of larvae age 3, 6, 9, 12 and 15 days old was 28.7, 115.70, 162.27, 195.30 and 227.30 individual/larva, respectively at water temperatures ranging between 25 and 28°C.

A starvation experiment was carried out using a 15-liter glass aquarium (water volume 10 liters) with three replications. Two hundred newly hatched larvae were kept without feeding. Larvae started to die at 216 hr and totally died within 326 hr after hatching at water temperature ranging between 28.0 and 30.5°C.

Keywords: feeding scheme, daily food uptake, starvation, larviculture, snake head fish, *Channa striatus*

1. Introduction

The growth and survival rate of larval and juvenile fish are determined by various environmental factors, food supply etc. Mass mortality of larval and juvenile fish might occur if the food supply is inadequate (Houde, 1978). The food supply during larval stage is an important factor to achieve high growth and survival rates. The sequence of food in early larval stages differs among species. The freshwater fish are generally given rotifer, *Artemia* or *Moina*, as an initial

food. At a later stage the larvae or juveniles are fed minced fish, shellfish and shrimp or an artificial pellet (Hecht and Appelbaum, 1987; Hogendoorn, 1980). It is obvious that fish of different species require different feeding techniques. Commercial scale propagation of snake head fish in hatcheries is yet to be standardized. Larval feeding activity may be considered as the most important aspect and a critical factor in larval production of this fish in hatcheries. Few report on feeding of snake head fish feeding have been published so far. Growth and survival of larval snake head fish fed with *Artemia* nauplii and formulated feed has been reported (Qin and Fast, 1997; Qin *et al.*, 1997). Arul (1991) reported the larvae died when initial feeding was delayed after yolk absorption. The feed and feeding scheme in the snake head fish larvae feed with *Moina* have not been established.

* Corresponding author.

Email address: thumronk@bunga.pn.psu.ac.th

The purpose of this study was to investigate feeding scheme, daily food uptake and starvation in order to indicate the suitable time for feeding, and suitable food for larval and juvenile snake head fish.

2. Materials and Methods

2.1 Feed and feeding scheme experiment

The experiments of feed and feeding scheme were conducted in a 15-liter glass aquarium (water volume 10 liters) containing 500 of 2-day old larvae (stage at first feeding). *Moina* were given to 3 to 15-day old larvae at a density of 10 individual/ml, and commercial pellet (40 % crude protein) was given to 12 to 15-day old larvae (*Moina* and commercial pellet were given to 12 to 15-day old larvae) twice a day (Tarnchalanukit *et al.*, 1982; Kungvankij *et al.*, 1986; Eda *et al.*, 1993). Samples of 20 larvae were randomly collected every day about 1 hour after feeding, then preserved in 5% buffered formalin. Stomach content of preserved larval snake head fish was later determined.

2.2 Daily food uptake experiment

To determine the daily food uptake by the larvae and juveniles, three experiments were carried out. All experiments were done in a 15-liter glass aquarium (water volume 10 liters) containing 1,000 larvae. The larvae were fed with *Moina* at a density of 10 individual/ml. The amount of food intake was

calculated based on changes of food density in the aquarium with and without fish larvae, with 5 replications of water sampling at 2-hour intervals. Aquaria without larvae were set for a control of natural fluctuation in food density (Hassan, 1990). Known numbers of food were added when the density became low.

2.3 Starvation experiment

A starvation experiment was carried out using a 15-liter aquarium (water volume 10 liters). Two hundred newly hatched larvae were kept without feeding and mortalities of starved larvae were recorded at 2-hourly intervals until all had died (Fukuhara, 1987). The procedure was carried out in triplicate.

3. Results

It was found the feeding scheme by larvae of age 3-15 days (average total length 6.08-14.61 mm) consumed *Moina*. The average uptakes of *Moina* in the digestive tract per day of larvae age 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 days old were 7.17, 12.15, 22.55, 28.92, 31.45, 39.75, 40.56, 50.15, 52.40, 48.82, 25.36, 13.60 and 5.20 individual/larva, respectively, at water temperatures ranging between 25 and 28°C. The larvae of age 12-15 days (average total length 10.79-14.61 mm) consumed both *Moina* and commercial pellet. Larvae aged more than 16 days consumed only commercial pellet (Table 1 and Figure 1).

Table 1. Amount of food uptake in a day of snake head fish in each stage

Larval age (days)	Total length (mm)	<i>Moina</i> (ind)
	Mean \pm SD (Min-Max)	Mean \pm SD (Min-Max)
1	5.21 \pm 0.29 (4.74-5.58)	0
2	5.69 \pm 0.32 (5.24-6.18)	0
3	6.08 \pm 0.23 (5.61-6.36)	7.17 \pm 2.08 (5-9)
4	6.12 \pm 0.25 (5.76-6.70)	12.15 \pm 5.50 (8-26)
5	6.71 \pm 0.25 (6.29-7.09)	22.55 \pm 5.90 (16-40)
6	6.84 \pm 0.18 (6.47-7.11)	28.92 \pm 6.05 (20-39)
7	7.56 \pm 0.62 (6.79-8.50)	31.45 \pm 11.980 (22-56)
8	7.91 \pm 0.59 (7.07-8.83)	39.75 \pm 10.360 (21-55)
9	8.45 \pm 0.32 (7.81-8.85)	40.56 \pm 8.60 (28-64)
10	9.26 \pm 0.21 (8.72-9.43)	50.15 \pm 8.956 (37-65)
11	10.86 \pm 0.41 (10.33-11.42)	52.40 \pm 10.37 (32-70)
12	10.79 \pm 0.34 (9.98-11.12)	48.82 \pm 6.02 (32-65)
13	11.84 \pm 0.54 (11.13-12.61)	25.36 \pm 4.70 (15-48)
14	13.38 \pm 0.62 (12.28-14.13)	13.60 \pm 2.30 (5-20)
15	14.61 \pm 0.72 (13.47-16.03)	5.20 \pm 2.50 (2-9)
16	15.21 \pm 0.96 (13.50-16.20)	0
17	16.13 \pm 0.70 (14.90-17.00)	0
18	16.66 \pm 0.49 (15.80-17.20)	0
19	17.16 \pm 0.35 (16.50-17.60)	0
20	17.29 \pm 0.24 (16.90-17.60)	0

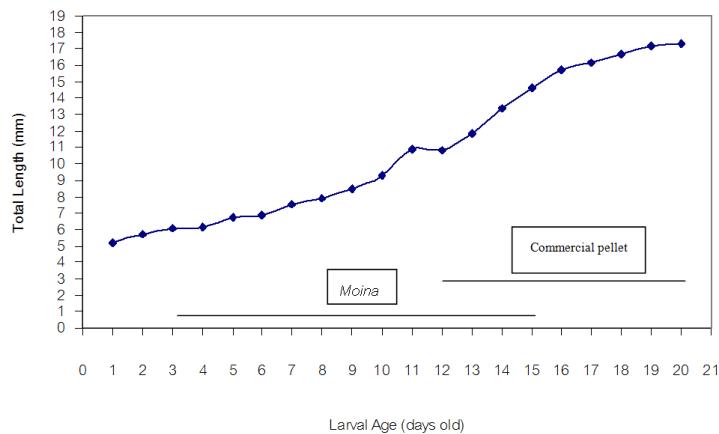


Figure 1. Mean total length of larval snake head fish according to age and feeding scheme

The daily food uptake by larvae of age 3-15 days (average total length 6.08-14.61 mm) indeed only *Moina*. The average uptakes of *Moina* in digestive tract per day of larvae age 3, 6, 9, 12 and 15 days old were 28.7, 115.70, 162.27, 195.30 and 227.30 individual/larva, respectively, at water temperatures ranging between 25 and 28°C. (Figure 2).

Without feeding, the snake head fish larvae started to die in all experiments at 216 hr and totally died within 326 hr (13.5 days) after hatching (Figure 3). Water temperature ranged from 28.0 to 30.5°C.

4. Discussion

Food supply during the larval stage is an important factor in achieving high survival and growth rates. Mass mortality of larval and juvenile fish will often occur if the food supply is inadequate (Houde, 1978). Different species require different sequential food during the early life stages. Most freshwater fish are given rotifer or *Moina* as a first feeding (Tarnchalanukit *et al.*, 1982; Tawaratmanikul *et al.*, 1988; Vatcharakornyothin *et al.*, 1988), and artificial feeds for juveniles are generally in the form of fine crumbles of appropriate particle size. The larval snake head fish is no exception.

The type of feeding for larval snake head fish cultured such as *Moina* and commercial pellet is similar to that for other fishes, but time for feeding may be different. It was found that larval snake head fish of age 3-15 days (average total length 6.08-14.61 mm) consumed *Moina*. The larvae of age 12-15 days (average total length 10.79-14.61 mm) consumed both *Moina* and commercial pellet. Larvae aged more than 16 days consumed only commercial pellet. Watanabe *et al.* (1983) described the food regimes used most extensively in the larvae of various fish production in Japan. In newly hatched fish greater than 2.3 mm of body length, rotifers were exclusively given as an initial feed, when fish reached 7 mm or more, marine copepods such as *Tigriopus*, *Acartia*, *Oithona* and *Paracalanus* were given. Brine shrimp, *Artemia salina*, were frequently used for the larvae of many species during shortages of marine copepods. Larvae larger

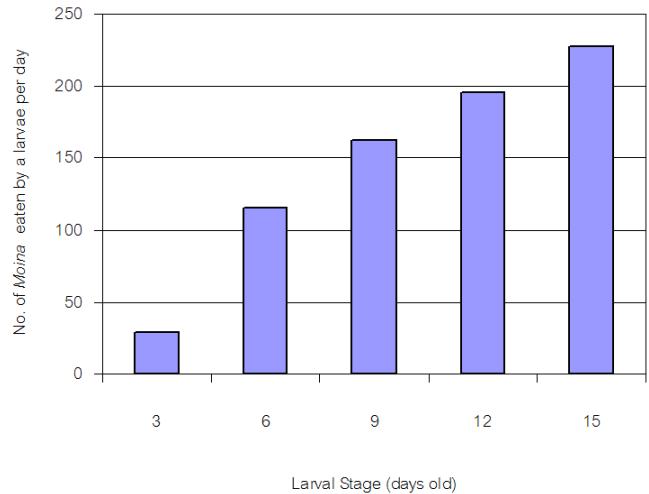


Figure 2. Number of food eaten per day by larval snake head fish

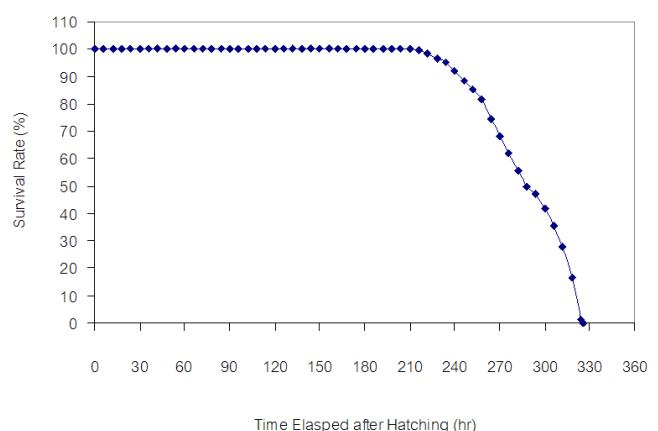


Figure 3. Survival of larval snake head fish after hatching without feeding at 28.0-30.5°C

than 10 to 11 mm were fed minced fish, shellfish and shrimp or an artificial diet. Tsukashima and Kitajima (1981) reported

the rearing of larval and juvenile filefish, *Stephanolepis cirrhifer*, up to the stage of young fish. They were fed rotifer, *Tigriopus japonicus*, *Artemia* and subsequently fish meat. Tarnchalanukit *et al.* (1982) reported that *Clarias batrachus* of age 2-15 days were fed on *Moina*, and fed with a commercial catfish pellet when they reached 10 days-old. Chaw-paknam *et al.* (1990) reported that fry nursing of two-spot glass catfish, *Ompok bimaculatus*, of age 3-15 days fed with *Moina* showed a better growth and higher survival rates than those fed with egg custard.

The snake head fish of age 3-15 days (average total length 6.08-14.61 mm) consumed zooplankton such as *Moina*. At this age the young snake head fish is classified as larval stage. Beyond 16 days of age, larvae consumed only commercial pellet, and this stage is sheer regarded as juvenile stage. The time for juvenile-stage development is similar to green catfish and climbing perch but it is earlier than sand goby and Siamese gourami. Larval green catfish of age 2-10 days is classified as larval stage during which live it consume *Moina* only, and the feed completely changed to commercial pellet when they were 16 days-old, which is classified as juvenile stage (Amornsakun *et al.*, 1997; Amornsakun *et al.*, 1998a). Larval climbing perch of age 3-15 days (average total length 3.02-12.60 mm) is classified as larval stage, consuming both rotifer and *Moina*, and the feed completely changed to commercial pellet when they were 16 days-old, which is classified as juvenile stage (Amornsakun *et al.*, 2004a). The sand goby of age 3-27 days is classified as larval stage, consuming zooplankton such as rotifer and *Artemia* at the start of feeding, and at 30-45 days-old it is classified as juvenile stage, when it consumes *Moina* and grinding fish (Amornsakun *et al.*, 2003a; Amornsakun *et al.*, 2003b). The Siamese gourami of age 3-13 days (average total length 3.88-8.27 mm) consumed only rotifer, the 13-18 days-old larvae (average total length 8.27-8.36 mm) consumed rotifer and *Moina* and the 18-25 days-old larvae is classified as larval stage (average total length 8.36-9.67 mm) which consumed only *Moina*. The 25-30 day-old Siamese gourami is classified as juvenile (average total length 9.67-11.26 mm), consumed *Moina* and artificial feed (Amornsakun *et al.*, 2004b).

For rearing larvae and juvenile fish daily the food uptake a very important. It was concluded that larval snake head fish of age 3-15 days feed with on *Moina*. The average uptake of *Moina* in the digestive tract per day of larvae age 3, 6, 9, 12 and 15 days old were 28.7, 115.70, 162.27, 195.30 and 227.30 individual/larva, respectively. This increases with larval age as 12.62, 50, 71.39, 85.92 and 100 %, respectively shown in Figure. 3. The numbers of prey consumed showed a similar trend to those of other fish. Amornsakun *et al.* (1998b) reported that *Moina* were eaten by fish larvae of green catfish, *Mystus nemurus*, in a range of 61.56-421.74 individual larvae⁻¹ day⁻¹. Amornsakun *et al.* (2004a) reported that the daily food uptake by larval climbing perch of age 3-15 days fed with rotifer or *Moina* depending on larval stage. The mean numbers of rotifer eaten in a day by 3, 6 and 9-day old larvae were 9, 16 and 19 individual/larvae, respectively. Roti-

fer were eaten by fish larvae in the range of 9-19 individual larvae⁻¹ day⁻¹. The mean numbers of *Moina* eaten in a day by 9, 12 and 15-day old larvae were 10, 98 and 113 individual/larvae, respectively. *Moina* were eaten by fish larvae in the range of 10-113 individual larvae⁻¹ day⁻¹.

Tawaratmanikul *et al.* (1988) reported that the numbers of *Moina* taken in a day by giant catfish, *Pangasianodon gigas*, larvae by the 2-3 day, 5-6 day and 8-9 day old larvae were 64, 396 and 341 individual, respectively. Hassan (1990) reported the amount of food taken in a day by larval and juvenile mullet, *Liza haematocheila*. A 23-day old larva and a 28-day old larva consumed about 1,900 and 3,300 rotifers a day, respectively, and a 31-day old larva and a 42-day old larva consumed about 440 and 2160 *Artemia* nauplii a day, respectively. Bryant and Matty (1980) reported optimum *Artemia* feeding rate for carp larvae, *Cyprinus carpio*, to be 200-250 % of their body weight on *Artemia* nauplii per day. It is very important to determine the suitable amount of food consumed by a larva per day at each stage of its sequential growth. Suitably estimating the amount food needed for a certain number of cultured larvae or juveniles will ensure better growth and survival as well as avoid unnecessary food wastage.

Without feeding, the larval snake head fish become debilitated and eventually started to die off in all experiments at 216 hr after hatching. A catastrophic mortality of 50% was observed at 228 hr after hatching and all died off within 326 hr after hatching at water temperatures of 28.0-30.5°C. Arul (1991) reported about 9% of larvae died when initial feeding was delayed by 2 days after yolk absorption. It was found to be similar to climbing perch, all died off within 348 hr after hatching at water temperatures of 27.0-30.5°C (Amornsakun *et al.*, 2004a). Larvae can tolerate feeding delay up to a certain point depending on the amount of yolk, temperature and other species-specific characteristics (May, 1974; Hunter, 1980; Holm, 1986). Mortality of larvae is greater than the other about 5 to 7 days after hatching, depending on the species. For example, mortality of northern anchovy, *Engraulis mordax*, was observed on the sixth day after hatching (Lasker *et al.*, 1970), on the seventh day after hatching for the grey mullet (Kuo *et al.*, 1973), on the sixth day after hatching for the milk fish (Chaudhuri *et al.*, 1978), on the fifth to seventh day after hatching for the larval dragonets, *Repomucenus* sp. (Eda *et al.*, 1993). In the seabass, *Lates calcarifer*, mortality was observed on the fifth day after hatching (Hassan and Amornsakun, 1996). In the Siamese gourami mortality was observed on the sixth day after hatching (Amornsakun *et al.*, 2004b). Ishibashi (1974) observed that the yolk sac of unfed *Tilapia sparranii* larvae was absorbed faster than that of fed larvae. Larvae of snake head fish are like other larvae in that after yolk is completely absorbed their mortality becomes pronounced, particularly 10.2 days after absorption, it is close to mortality of climbing perch 10.6 days after absorption (Amornsakun *et al.*, 2004a), but longer than in green catfish, which was 4 days after absorption (Amornsakun *et al.*, 1997) and 2 days after absorption for Siamese gourami

(Amornsakun *et al.*, 2004b). Lasker *et al.* (1970) experimented on delayed feeding period of *Engraulis mordax* and found in a catastrophic mortality after 2.5 days of complete absorption. The unfed larvae grow slowly, swim weakly, eventually falling to the bottom of the tank and dying.

It was concluded that larval snake head fish aged 3-11 days (average total length 6.08-10.86 mm) consumed *Moina*. The larvae of age 12-15 days (average total length 10.79-14.61 mm) consumed both *Moina* and artificial feed. Larvae aged more than 16 days consumed only commercial pellet (40% crude protein). The average uptakes of *Moina* in digestive tract per day of larvae age 3, 6, 9, 12 and 15 days old were 28.7, 115.70, 162.27, 195.30 and 227.30 individual/larva, respectively, at water temperatures ranging between 25 and 28°C. The starved larvae started to die at 216 hr and totally died within 326 hr after hatching at water temperatures ranging between 28.0 to 30.5°C.

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