Asian Fisheries Science **25** (2012):66-74

ISSN 0116-6514
E-ISSN: 2073-3720
https://doi.org/10.33997/j.afs.2012.25.1.006

Asian Fisheries Science
The Journal of the Asian Fisheries Society

Effect of Animal Origin Feeds and Frequency of Feeding on Growth, Survival and Cannibalism in *Wallago attu* (Bloch & Schneider) Larvae During Hatchery Rearing

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Abstract

The growth, survival and cannibalism of *Wallago attu* larvae were assessed using different animal origin feeds and frequency of feeding during hatchery rearing. The weight (189±11.85 mg) attained by the larvae fed on goat liver, was significantly higher ($P < 0.05$) than those fed on plankton (120±4.36 mg), fish (125±6.66 mg) and molluscs (139±4.06 mg). The specific growth rate, percent weight gain and final weight were similar for the other feeds. The final length, weight and specific growth rate were highest in larvae fed once per day followed by larvae fed 2-times, 3-times and 4-times per day, but overall biomass production was greatest at 3 or 4 feeds per day compared to feeding once a day. The percent survival increased significantly ($P < 0.05$) with increase of feeding frequency. More than 50% survival was observed in larvae fed 3-4 times a day with goat liver compared to 27% in larvae fed once a day. An inverse relation was also observed between feeding frequency and percent cannibalism. Therefore, goat liver is considered to be the best feed and resulted in lower cannibalism and increased survival during indoor rearing of *W. attu* larvae when fed 3-4 times a-day.

Introduction

Wallago attu (Bloch & Schneider, 1801) is generally preferred by the consumers in India for its soft flesh, good taste and flavour, and fetches a high price. This large freshwater catfish is well known for its high growth (Talwar and Jhingran, 1991) and silvery elegant look. The distribution, biology and nutritional qualities of this species have been studied in different occasions (Khawaja, 1966; Lilabati and Viswanath, 1996; Chondar, 1999). One of the major constraints in its culture is the non-availability of seed from the wild. Parameswaran et al. (1988) and Gupta et al. (1992) succeeded in induced breeding of this species. No information is available on the rearing techniques of *W. attu* larvae except some studies conducted in this laboratory (Giri et al. 2002; Sahoo et al. 2002a; Sahoo et al. 2002b). It seems difficult to rear the larvae due to high cannibalism during early life. Dutta-Munshi et al. (1990) and Anwar and Siddiqui (1992) confirmed the predatory habit of *W. attu* while studying them in the Ganga and Kali river ecosystem, respectively. Hatchery rearing techniques are indeed necessary to save and multiply this endangered species (CAMP, 1998).

Extensive studies have been conducted on the cannibalism during different life stages of important fish species *viz*. striped bass, *Morone saxatillis* (Braid and Shell, 1981); walleye,

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Stizostedion vitreum (Li and Mathias, 1982); pike, *Esox lucius* (Giles et al. 1986); *Clarias gariepinus* (Hecht and Appelbaum, 1988; Prinsloo et al. 1989); Atlantic cod, *Gadus morhua* (Folkvord, 1991). The availability of less space for activity (Li and Mathias, 1982), size differences (Giles et al. 1986) and long interval of feeding (Ketavic et al. 1989) are some of the causes which induce cannibalism. Non-availability of suitable feeds is another important cause, which also induces cannibalism during the larval stage. The importance of live as well as natural feed in larval rearing for several fish species have been studied earlier (Tubongbanua, 1987; Csengeri and Petitjean, 1987; Hashim et al. 1992; Mohanty et al. 1993; Burlow et al. 1993; Adeyemo et al. 1994). In the present study, attempts were made to rear *W. attu* larvae with different animal origin feeds during hatchery rearing. The frequency of feeding on larval survival, specific growth rate (SGR) and percent weight gain were studied during indoor rearing. Further, the cannibalism pattern due to feeding different feeds was also investigated.

Materials and Methods

Induced breeding

Females weighing 2-2.5 kg weight range were selected for breeding on the basis of bulged abdomen with round and red papilla, and optimum maturity was judged by seeing the uniform size of the eggs. The males with 1.5-2.0 kg of body weight were identified for their maturity on seeing pointed papilla and free oozing of milt. In mid June the selected males and females were injected with Ovaprim (SGnRH + Domperidon) @ 0.3 $mL^{\cdot}$ and 0.5 $mL{\cdot}kg^{-1}$ body weight, respectively and kept separately in circular fibre glass pools. At 8-10 hr of post-injection, the fish were hand stripped. The eggs were mixed thoroughly with milt for 2-3 min with addition of a little quantity of water, and released immediately into a circular hatching tank (1.5 m diameter, 1 m depth) with a provision of 3-5 L water exchange per minute. The process of hatching started after 18-20 hr of incubation and was completed within 2-3 hr from the onset of hatching. The hatchlings were collected and the body biometry, length and weight were recorded with the help of compound microscope provided with ocular micrometer, and digital electronic balance respectively, before releasing them in to the rearing tanks. The initial weight and length of larvae were 2.79±0.30 mg and 6.30±0.40 mm, respectively.

Feeding of larvae

Circular concrete tanks of 1.52 m diameter were allotted in triplicates for different animal origin feeds trial. Each tank was maintained at 272 L of water with continuous aeration and stocked with 544 larvae @ 2 $larvae{\cdot}L^{-1}$ (Sahoo et al. 2002b). Live plankton, boiled fish, boiled mollusc and goat liver were offered as animal origin feed sources. Plankton was offered fresh. The other three feeds were provided after making them into a paste. The feeds were provided twice daily from the day of stocking. The experiment was continued for a period of 10 days. Water was renewed twice (morning and evening) daily and during each morning census of larvae was conducted. Missing

larvae were considered lost due to cannibalism. At the end of the experiment, the final length and weight were recorded. The percent survival, percent weight gain and SGR were calculated as described by Sahoo et al. (2006).

Frequency of feeding to larvae

In the second experiment the effect of frequency of goat liver feeding on the rearing performance of *W. attu* larvae was studied, keeping all the experimental procedures same as described in the first experiment. The initial weight and length of larvae were 2.79±0.28 mg and 6.30±0.40 mm, respectively. The fish were fed with minced goat liver once, 2-times, 3-times and 4-times daily. Feeding was started at 9 am everyday for all feeding frequencies. For the single feeding group, minced liver was fed once daily at 9 am, while for two-times feeding group feeds were fed at 9 am and 3 pm. The meals for 3-times and 4-times fed groups were offered at 3 hr and 2 hr intervals, respectively. A part of minced product was fed to all fish at 9 am and the rest were stored in refrigerator for subsequent use during the day. The parameters related to the study were recorded in the same manner as recorded in the first experiment.

Water quality parameters like dissolved oxygen and alkalinity were analysed using methods described in APHA (1989) and pH was recorded by digital pH meter, once every 3 days and ranged from 5.6-6.1 $mg \cdot L^{-1}$, 128-138 mg $CaCO_3 \cdot L^{-1}$ and 7.4-7.8, respectively during the experimental period.

Data were analysed through one-way analysis of variance using GLM – SAS 1995 statistical package.

Results

Cannibalism among the larvae was observed at the end of the first day of hatching. Chasing among the larvae was not observed. The slow and methodological biting was seen by the cannibals. The cannibals quickly bite either the head or tail of the prey and swam with the prey inside the mouth. The prey jerked at the beginning but later remained motionless. In every occasion the predator completely engulfed the prey and there after became very sluggish. The cannibals became robust due to predation, which encouraged further efficient predation.

The rate of cannibalism among the larvae due to feeding different feeds is presented in Fig. 1. The larvae fed on goat liver showed significantly lower ($P < 0.05$) rate of cannibalism than that in other feed treatments. The percent cannibalism did not vary among the larvae fed either on plankton, fish or mollusc as feed. The change in body length, percent weight gain, SGR, and percent survival is presented in Table1. The final length and weight attained by larvae during 10 days of rearing in liver as diet was significantly higher ($P < 0.05$) than that attained in plankton, fish and mollusc fed larvae. The specific growth rate and percent weight gain also followed the similar trend as for final weight. The percent survival in the liver fed group was significantly highest in comparison to the

other three dietary treatments. The survival of larvae did not vary due to feeding fish, mollusc and plankton.

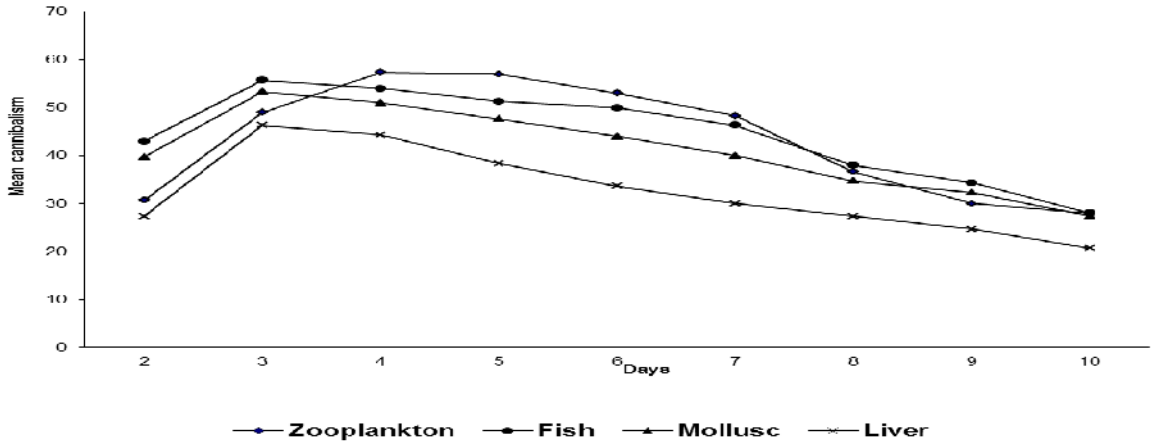

Fig. 1. Mean cannibalism of *Wallago* larvae fed on different animal origins during rearing.

In the second experiment goat liver was fed alone to larvae, since this feed proved best for the larvae in the first experiment. However in the second experiment, the goat liver was provided to the larvae at different feeding frequencies and the result is presented in Table 2. The length gain was significantly lower ($P < 0.05$) in larvae when fed either 3-times or 4-times daily in comparison to larvae fed once. The final weight was significantly higher ($P < 0.05$) in fish fed on goat liver once daily, followed by 2-times and 3-times, and the lowest gain was attained by the larvae fed four meals a day. The SGR in once fed larvae were highest followed by two, three and four times fed larvae, and the latter two feeding schedules were similar to each other. The percent weight gain did not vary significantly among the fish when fed on different frequencies during in-door rearing. The percent survival increased significantly with the increase in feeding frequency and an inverse relation was observed between feeding frequencies and the percent cannibalism (Fig. 2). A decreased ($P < 0.05$) total biomass of larvae was observed in single feeding treatment compared to 3 or 4 times fed larvae.

Table 1. Effect of different animal origin feeds on final length, weight, specific growth rate, percent weight gain and percent survival during indoor rearing of *W. attu* larvae.

Type of animal origin feed	Final weight (mg)	Final length (cm)	Specific growth rate	Percent weight gain	Percent survival
Zooplankton	120±4.36^{b}	2.49±0.10^{b}	37.57±0.35^{b}	4201±156.35^{b}	28.33±1.20^{b}
Fish	125 ± 6.66^{b}	2.57±0.20^{b}	37.97±0.54^{b}	4380±238.50^{b}	26.33±1.76^{b}
Mollusc	138.67±4.06^{b}	2.62±0.16^{ab}	39+_0.29^{b}	4870±145.41^{b}	32.00±3.06^{b}
Liver	189± 11.85^{a}	3.07±0.08^{a}	42.43±0.71^{a}	6674±424.73^{a}	48.33±1.45^{a}

Mean values bearing different superscripts in a column vary significantly (P < 0.05).

Table 2. The final length and weight, specific growth rate, per cent weight gain, percent survival of *W. attu* larvae in relation to frequency feeding of liver during hatchery raring.

No. of feeding	Final weight (mg)	Final length (cm)	Specific growth rate (SGR)	Percent weight gain (NS)	Percent survival	Total biomass (g.)
Once	270.43±11.61^{a}	3.42±0.33^{a}	45.56±0.34^{a}	9338±305.85	27.00±2.64^{c}	7.24±0.39^{b}
2-times	193.07±5.31^{b}	2.91±0.05^{ab}	42.09±0.27^{b}	6644±181.46	42.67±0.88^{b}	8.25±0.38^{ab}
3-times	174.57±5.15^{bc}	2.73±0.05^{b}	41.07±0.33^{c}	5999±208.72	51.00±1.15^{ab}	8.89±0.27^{a}
4-times	164.53±4.61^{c}	2.57±0.03^{b}	40.59±0.17^{c}	5645±116.23	53.66±2.02^{a}	8.81±0.09^{a}

NS: Not significant

Mean values bearing different superscripts in a column vary significantly (P < 0.05).

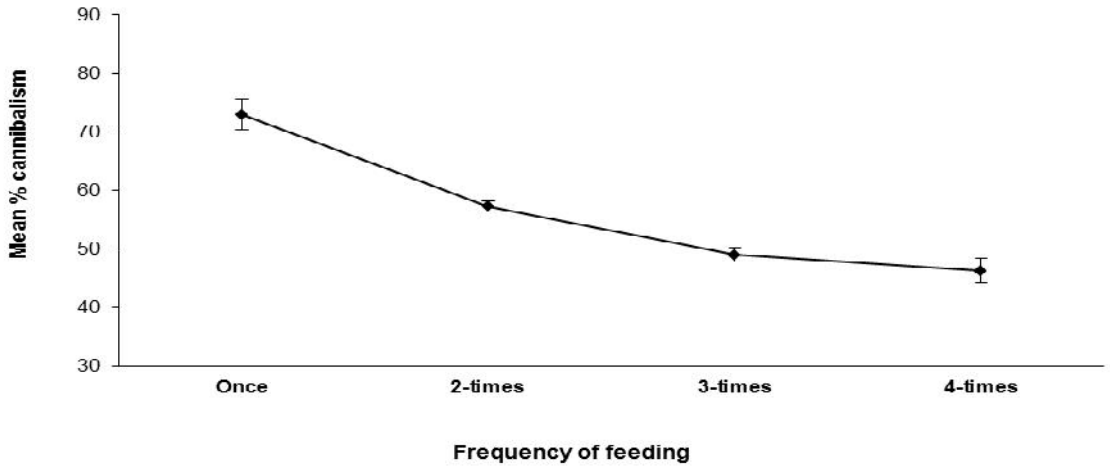

Fig. 2. Effect of frequency feeding of liver on mean cannibalism of *W. attu* larvae.

Discussion

Larvae culture is always dependent on the feed and suitable management manipulation, which varies according to the habit of the fish species. Cannibalism increased during the first half of the rearing period and decreased subsequently in the latter half (Fig. 1). The lower rate of cannibalism on the second day of life might be due to the uniform larval size in the tanks. In the subsequent days the cannibals became robust and were more efficient in predating on the weaker non-cannabalistic larvae, leading to size hierarchy. Similar size difference between cannibals and non-cannibals has been reported for *C. gariepinus* and *G. morhua* (Hecht and Appelbaum, 1988; Folkvord and Ottera, 1993). The prey detection and ingestion were perhaps easy for cannibals due to the greater population of larvae during initial stocking. In subsequent days, the size difference due to cannibalism among larvae led to more predation. The decrease in cannibalism during the last part of rearing might be due to availability of more space for activity and less number of surviving larvae in the tank. Li and Mathias (1982) reported that more space for activity and low stocking density of larval walleyes resulted in low cannibalism. The supplementation of exogenous feed must be used as a tool to decrease cannibalism among the larvae. The final weight and percent weight gain indicated that goat liver was the best feed amongst all for higher growth and survival of *W. attu* larvae. The plankton, fish and mollusc were less preferred feed for *W. attu* larvae compared to goat liver diet, for which the larvae attacked each other to satisfy their hunger, leading to higher cannibalism. The highest weight gained by larvae fed on liver could be due to better acceptability and utilisation of goat liver. The role of liver feed on growth could be due to high nutrient level, intact enzyme molecules in liver and low rate of leaching of nutrients from the hepatocytes. The similar increase in

survival and body weight gain were also reported in cyprinid hybrid fish (Csengeri and Petitjean, 1987), and *Labeo rohita* (Mohanty et al. 1993), when fed on liver slurry.

The availability of feed was considered to be the most important experimental variable for determining the rate of cannibalism in different fish species (Hecht and Appelbaum, 1988; Ketavic et al. 1989; Lewis and Heidinger, 1981). Even though, sufficient feed was supplied, feeding once or twice daily did not reduce cannibalism among the larvae which could be due to the fact that the larvae did not like to accept the feed exposed in water for a longer time. The increase in feeding frequency decreased the cannibalism among *Wallago* larvae when fed more than 2- times daily. The decrease in percent survival resulted in increased final mean weight, percent weight gain and SGR on once fed treatment; this was due to greater cannibalism among the fish. Fish fed more frequently during rearing resulted in higher survival. It was thus inferred that the increase in frequency of feeding resulted in higher survival, suppression of hunger and cannibalism, as also observed by Ketavic et al. (1989) in sea bass. Folkvord and Ottera (1993) also observed that 1 g cod juveniles were able to ingest sufficient amount of food to obtain good growth and survival when fed four times a day. The decrease of final weight, percent weight gain, SGR and total bio-mass in thrice and four times fed larvae are due to higher survival in those groups.

Conclusion

The study indicated that minced goat liver was the preferred feed in comparison to boiled fish, mollusc or live plankton alone and that the *Wallago* larvae performed best on goat liver during indoor rearing. Feeding of larvae for 3-4 times a-day resulted in decreased cannibalism and increased percent survival. In cases where liver is not feasible to feed the larvae, feeds like mollusc and fish may be used, less efficiently, to produce a good number of seed materials.

Acknowledgements

The authors are thankful to the Director, CIFA, Kausalyaganga, Bhubaneswar for providing facilities to conduct this experiment.

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Received: 03/11/2011; Accepted: 01/12/2011 (MS11-82)