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Article

Growth and survival rate of *Nandus nandus* (Hamilton 1822) larvae on some selected supplemental feeds in cistern

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Abstract: The aim of the investigation was to determine the effect of different food on growth and survival of *Nandus nandus* larvae. The experiment was conducted for 20 days in twelve (12) cisterns (9× 6×2.5ft) to assess the effect of Zooplankton, Artemia, Tubifex and Brand Nursery Feed on growth and survival of *N. nandus* larvae in cistern condition. The growth of *N. nandus* larvae varied significantly ($P<0.05$) with live feed and artificial feed. Zooplankton treatment showed the best growth performance and Brand Nursery Feed showed the poorest. There was significant difference in final weight of larvae fed with live and artificial feed. Final weight of live feed Zooplankton was 241.79±17.25g, Artemia-210.37±20.16g, Tubifex-226.36±15.72g and Brand Nursery Feedwas195.08±15.53g respectively. Specific growth rate (%) and percentage (%) weight gain were also best in case of Zooplankton fed *N. nandus* larvae. Different water quality parameters were more or less same in different treatments.

Keywords: *Nandus nandus*; mud perch; larvae; live feed; growth performance; zooplankton

1. Introduction

The larval stage of any fish species is very important and sensitive for their life stage. Induced breeding remains ineffectual due to deficiency of proper feed. For this reason, it is indispensible to fix the proper larval feed. If unable to anticipate or develop the proper larval feed then it will be impossible to take alive the larvae. That why to anticipate larval feed, this work has been initiated. All though induced breeding success of this fish has been reported by a few workers (Begum *et al.*, 2016; Pal *et al.*, 2003; Rakhi *et al*., 2015) and no more works seems to have been conducted solves its larvae rearing and feeding problems. *Nandus nandus* (Hamilton, 1822) commonly known as mud perch which belongs to Nandidae family under Perciformes order, locally called Meni, Bheda, Rayna or Nondoi, is a small food eater fish in Bangladesh. International union for Conservation of nature IUCN Red List of Bangladesh (2015) has enlisted mottled that fish. *N. nandus* is in their red list of near threatened (NT) category fishes of Bangladesh.

Degraded aquatic ecosystem inhibits availability of *N. nandus* for this reason nursery development for promoting availability of *N. nandus* larvae is very essential. To develop nursery technologies, feed selection is prerequisite. It is a carnivorous fish and preys on small shrimps and fishes, insects larvae etc. (Mustafa *et al*., 1980). Predatory behavior was observed by Das and Zamal (2000).

Pal *et al*. (2003) reported that live food is superior in case of growth and survival rate of *N. nandus* fry to artificial feed. Successful technology of breeding and rearing will help to culture this fish in shallow waters like rice fields. Only 16% survival rate was calculated by feeding zooplankton that was observed by Pal *et al*. (2003). Therefore, development of nursing technology of *N. nandus* larvae will contribute not only national

economy but also help to protect *N. nandus*. The present study was conducted to evaluate the effect of selected feeds on growth and survival percentage (%) of *N. nandus* in nursery system.

2. Materials and Methods

2.1. Study aria

This study was conducted at the hatchery complex in the campus of Bangladesh Fisheries Research Institute, Floodplain sub-station, Santahar, Bogra during 2011-2012.

2.2. Stocking of larvae

Twelve (12) cement cisterns (9×6×2.5ft) were used for the experiment. Time range was total 20 days. Five days old of *N. nandus* larvae produced by induced breeding technique using PG having an average initial length 0.50 cm and initial weight 4.13mg were stocked at the number of 1000/m^3. Before stocking cotton cloth was inserted into cistern for spawn shelter due to adhesive behavior of *N. nandus* larvae. Water depth of each cistern was 1.25 fit. Continuous water flow was maintained in cisterns to make sure regular Oxygen circulation and proper water quality. Excess water passed out through an outlet after maintaining the mentioned volume of water.

2.3. Treatment setup and preparation of different food

After rearing for 5 days, four types of supplementary feeds were tested for larvae rearing. They were divided into 4 groups and separately fed with Zooplankton, Artemia, Tubifex and Brand Nursery Feed as treatment 1 (T_1), treatment 2 (T_2), treatment 3 (T_3) and treatment 4 (T_4), respectively. There were three replications for each treatment.

2.4. Zooplankton collection from ponds

Zooplanktons were collected from ponds of Bangladesh Fisheries Research Institute, Floodplain sub-station, Santahar, Bogra by standard drop count method (APHA, 1995). Replicate plankton samples were collected by means of a bucket (50 litters) and filtered through bolting silk plankton net of 25µ. In general, smallest size of the main zooplankton groups are rotifers and just-hatched copepods, are important first foods for larval fish (Ludwig, 1999) so, the plankton net mesh size were selected at 25µ for collection the smallest zooplankton as a feed of *N. nandus*.

2.5. Tubifex Collection from natural source

Tubifex were collected from natural source of Bangladesh Fisheries Research Institute, (BFRI), Floodplain Sub Station (FPSS) campus in Santahar, Bogra, Bangladesh.

2.6. Artemia collection and re-capsulation

Artemia were collected from feed market and re-capsulated in captive condition. Re-capsulation procedures were maintained properly.

2.7. Nursery Brand Feed collection and proximate composition

Three Brand Nursery Feed of three feed company were collected from feed market for proximate analysis by the method of Association of Official Analytical Chemists (AOAC, 1980) to detect the higher amounts of protein percent for treatment T_4. Not only detecting the higher amounts of protein but another content percent also determined from the analysis. Another content were lipid, ash and moister.

2.8. Determination of growth and survival

The larvae were offered the feeds four times in a day by spreading method initially at the rate of 100, 80, and 60% of the total biomass of larvae for the first to last week's respectively. The dead fish were removed as soon as they were detected. Ten larvae of the stocked fish in each cistern were sampled at ten (10) days interval by using digital balance and graph paper. It was done in the morning before feeding. Length, weight, specific growth rate (%), weight gain, Percent Weight gain (%) and survival rate (%) were analyzed and recorded. Following formulas were used to determine the growth performance.

a) Weight gain (mg):

Mean final weight - Mean initial weight

b) Percent weight gain (%):

Mean final weight − Mean initial weight/Mean initial weight × 100

c) Specific growth rate (SGR) (mg/day):
{ln (FBW=Final live body weight (mg) – ln (IBW=Initial live body weight (mg)/D=Number of days } × 100
d) Percent of Survival (%):
(No. of fry alive / Total no. of fry stocked) × 100

2.9. Data analysis
The Statistical data were analyzed by DMRT (Duncan's Multiple Range Test) with one-way analysis of variance (ANOVA). Difference levels of significance were considered at an alpha of 0.05. It was performed by using SPSS statistical software package.

2.10. Water quality measurement
Physicochemical water quality parameters such as water temperature (ºC), dissolve oxygen (mg/l), pH, total alkalinity (mg/l), and ammonia (mg/l) were analyzed on the same day of sampling. A centigrade thermometer measured temperature of water. HACH water test kit (Model-FF-2, USA) was used to measure pH, dissolved oxygen (DO), total alkalinity, and ammonia (NH_3). Water quality of cistern was measured regularly.

3. Results
3.1. Proximate composition of selected Nursery Brand Feed
Higher amounts of protein-contained feed were used for treatment T_4. Proximate compositions of selected Brand Nursery Feed are shown in Table 1.

Table 1. Proximate composition of the Brand Nursery Feed.

Sl. No.	Item of Feed	Composition (%)
1	Protein	34.88%
2	Lipid	15.99%
3	Ash	17.43%
4	Moisture	10.66%

3.2. Determination of growth performance and survival
The effect of food on growth and survival percent of *N. nandus* larvae was investigated in the present study. Four diets were tested during the period of 20 days feeding trial. At the termination of the feeding trial, it was observed that larvae fed with Zooplankton showed better growth and survival rate. The growth pattern and survival of *N. nandus* larvae fed with Zooplankton, Artemia, Tubifex, and Brand Nursery Feed is presented in Table 2.
Among all the treatments, T_1 showed significantly highest ($P<0.05$) growth performance in weight (241.79±17.25g), length (2.02±0.28cm) and survival rate was 55. T_4 showed lowest growth performance in weight (195.08±15.53g), length (1.46±0.07cm). Survival rate of T_4 was 42.The weight gain attained by the larvae of T_1 and T_3 were significantly better than T_2 and T_4. However, T_2 and T_4 were no significant difference ($p>0.05$) between the weight gain. In case of % weight gain, the larvae of T_1 and T_3 showed significantly better than T_4. There were no significant differences between T_1 and T_3 and between T_2 and T_4.
The Specific Growth Rate % of T_3 and T_4 had significant difference. Significantly ($p<0.05$) highest survival rate was showed in T_1 than those of T_2 and T_4. Survival rate of T_1 was highest.

Table 2. Mean (±SD) growth performance of *N. nandus* spawn fed selected feeds for 20 days.

Treatment	T_1 Zooplankton	T_2 Artemia	T_3 Tubifex	T_4 Brand Nursery Feed	Level of significance
Initial length (cm)	0.50	0.50	0.50	0.50	NS
Initial weight (mg)	4.13	4.13	4.13	4.13	NS
Final length (cm)	2.02 ± 0.28^{b}	1.50 ± 0.09^{a}	1.59 ± 0.13^{a}	1.46 ± 0.07^{a}	*
Final weight (mg)	241.79 ± 17.25^{c}	210.37 ± 20.16^{ab}	226.36 ± 15.72^{bc}	195.08 ± 15.53^{a}	*
Weight gain (mg)	237.66 ± 17.25^{c}	206.24 ± 20.16^{ab}	222.23 ± 15.72^{bc}	190.95 ± 15.53^{a}	*
% weight gain	5754.48	4993.70	5380.87	4623.48	-
Specific Growth Rate (%)(mg)	20.35^{c}	19.64^{ab}	20.01^{bc}	19.28^{a}	*
Survival rate (%)	55^{c}	47^{ab}	50^{bc}	42^{a}	*

NS = Means are not significantly different ($P>0.05$)
* Mean values with different superscript letters in the same row indicate significant difference at 5% significance level.

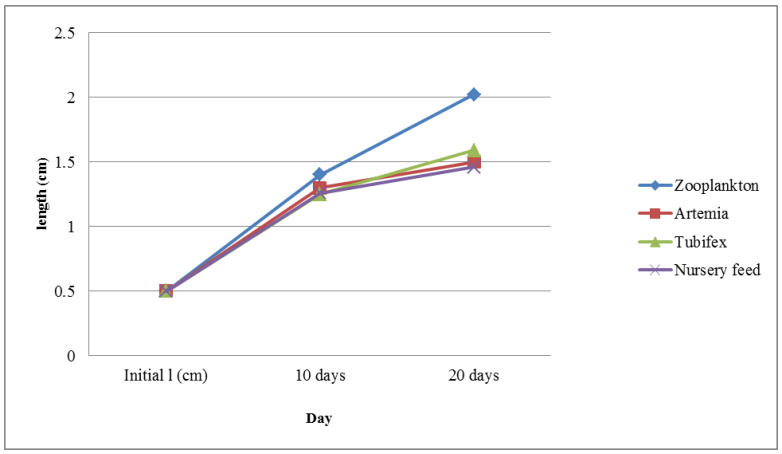

Figure 1. Mean length of *N. nandus* larvae in ten days interval under four treatments during the study.

3.3. Water quality measurement

The water quality parameters (Avg. ± SD) values obtained from the four (4) cisterns are given in Table 3. In the present study, the concentration of dissolved oxygen (DO) was found maximum in T_1 and minimum in T_2. Ammonia level was lowest in T_1 and maximum in T_4.

Table 3. Mean (±SD) values of water quality parameters of different treatment.

Treatment	Temperature (^{0} C)	pH	Total alkalinity	Dissolve Oxygen (mg/L)	Ammonia (mg/L)
Zooplankton (T_1)	28.60±0.15	7.52±0.11	189.73±2.10	7.19±0.12	0.08^b±0.01
Artemia(T_2)	28.50±0.15	7.41±0.12	190.88±2.36	7.07±0.08	0.11^a±0.02
Tubifex (T_3)	28.62±0.14	7.24±0.07	189.17±2.55	7.10±0.14	0.12^a±0.02
Brand Nursery Feed (T_4)	28.50±0.16	7.51±0.07	186.75±2.20	7.19±0.13	0.13^a±0.02
Level of Significance	NS	NS	NS	NS	*

NS = Means are not significantly different (P>0.05)
* Mean values with different superscript letters in the same Colum indicate significant difference at 5% significance level.

4. Discussion

The present study showed fed with live feed provided highest growth rate than artificial feed in case of carnivore fish was similar to Yasmin *et al*. (1998), Haque and Barua (1989). Islam *et al.* (2007) reported fed with artemia showed higher growth rate of *M. gulio* while fed with artificial feed gave poor growth and survival rate. Live food was better to growth and survival rate than ready feed because live food contained digestive enzyme and high protein, which were superior to growth of fish spawn. Alam and Mollah (1988) reported that *C. batrachus* larvae fed with live feed (*Tubifex sp.)* exhibiting significantly superior growth than artificial feed was similar to the present study. Aminul Islam *et al*. (1998) reported, *C. batrachus* showed better growth and survival was resemble to the present study, due to both species were carnivore. Kohinoor *et al*. (1999) stated Thai sharputi fed with live food showed lower growth than fed with formulated feed. It was occurred might be species variation and food habit variation. Pal *et al*. (2003) observed *N. nandus* larvae were fed with scrambled egg yolk, pasted tubifex worms, and zooplankton in duplicate aquaria. Only 16% survival rate was calculated by feeding zooplankton. No survival was observed among other food items. It was similar in case of feed type but dissimilar in case of survival rate to the present study.

Begum *et al*. (2016) found growth performance of *N. nandus* in nursery condition. It was 3.33 ± 0.05 mm initial length and 0.81± 0.03 mg initial weight in releasing time, after 20 days of rearing it reached 21.02± 0.24mm length, 520± 0.02mg weight and survival rate were 49.22%. They have given 250g wheat flour with six pieces boiled egg yolk, whichwas fed three times in a day (first three days). Fourth to sixth days 250g wheat flour, six piece boiled egg yolk with nursery brand feed were provide two times in a day and rest of fourteen days 500g wheat flour, 1kg mustard oil cake with 2 kg cow dung were supplied as feed at alternative day. That experiment was based on increasing the plankton production in nursery pond for natural feeding of *N. nandus* larvae.

Length measurement and survival percent is similar with Zooplankton (T_1) and Tubifex (T_3) but weight observation is dissimilar to the result of Begum N *et al*. (2016)`s observation. Probably natural condition and rearing technique was increasing the growth and survival (%) of *N. nandus* in nursery pond and cistern (in this study) conditions by using the zooplankton.

Rakhi *et al*. (2015) observed that, after completing the embryonic stage, 50 days long experiment of *N. nandus*, supplementation of four type foods, only live tubificid worm shown highest growth and survival rate, which Length was 3.4±0.1cm and weight 406.6± 27.99 mg and survival rate 97±1%, where initial Length and weight were 1.25±0.08cm and 38.8±7.96mg. Survival rate of four treatments were live tubificid 97±1%, Dry tubificid 78±2%, 1% DHA-73±3% and Phospholipide 63±3% respectively. In this study of 25 (5+20) days long growth experiment of *N. nandus*, T_1, T_2, T_3 and T_4 treatments result was similar with Rakhi *et al*. (2015)`s experiment. In this study, Specific Growth Rate (%) and Weight gain were highest. The day's differences were also double between two experiments. Though survival rates were better as reported by Rakhi *et al*. (2015) than this study.

The survival rate of *N. nandus* larvae (55%) fed with Zooplankton (T_1) was significantly better than those reared with Tubifex (T_3), Artemia (T_2) and Brand Nursery Feed (T_4), which result was also similar to Islam *et al*., 2007.

Ludwig (1999) reported that, zooplankton is required as a first food for many cultured fish; for others it contributes to faster growth and higher survival and Copepod nauplii, which are just-hatched copepods, are important first foods for larval fish. In general, most of fish fries are taken three main types of zooplankton as food sach as rotifers, copepods and cladocerans (Ludwig, 1999; Morris and Mischke, 1999). Growth and survival rate of *N. nandus* larvae were higher in case of fed with zooplankton than other live foods.

Water quality parameter plays an important role in aquaculture. In this study ammonia level was significantly ($P<0.05$) lower in Zooplankton (T_1) treated water bodies. It may also reason for superior growth of *N. nandus*. Almost the physicochemical conditions of all treatments were good and provided an acceptable range for the growth and survival of *N. nandus* larvae.

5. Conclusions

Feed is essential for the growth of all animals. High quality feed provides superior growth and low quality of feed provides inferior. Feed selection is necessary to achieve better growth. *N. nandus* is carnivore, so it needs live food. Supplementary feed does not provide better growth rate in case of *N. nandus* larvae. Among all live feeds, Zooplankton shows higher growth. This research will help to indicate the suitable food for higher growth of *N. nandus* larvae. The results obtained from the present study and the discussion made so far, it is assistive to say that, the *N. nandus* larvae can be reared successfully fed with live *zooplankton* sp.

Conflict of interest

None to declare.

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