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S Sharmin
Scientific Officer, Freshwater Station, Bangladesh fisheries Research Institute, Floodplain Sub-station, Santahar, Bogra, Bangladesh

DR Das
Senior Scientific Officer, Bangladesh Fisheries Research Institute, Floodplain Sub-station, Santahar, Bogra, Bangladesh

Md. Abdul Halim
Department of Aquaculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

MG Sarwer
Department of Fisheries, Head Quatar, Ramna, Dhaka, Bangladesh

Correspondence
Md. Abdul Halim
Department of Aquaculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Study on growth and survival rate of (*Nandus nandus*; Hamilton 1822) Spawn on some selected supplemental feeds in cistern condition

S Sharmin, DR Das, Md. Abdul Halim and MG Sarwer

Abstract
The present study was observed to determine the effect of different foods on growth and survival rate of *Nandus nandus* spawn in cistern condition. Feeding experiments were conducted for 20 days in 12 cisterns (each cistern 2.45×1.5×0.7 m^3) with three replication and four treatments T_1 (zooplankton), T_2 (artemia), T_3 (tubifex), and T_4 (nursery brand feed) respectively. It was observed that the growth of *Nandus nandus* spawn were varied significantly (P<0.05) with different feeds. The best growth was shown by *Nandus nandus* spawn fed T_1. The poorest growth rate was given by *Nandus nandus* spawn fed with T_4 containing (protein-34.88%, lipid-15.99%, ash-17.43%, moisture-10.66%). Other two treatments T_2 and T_3 showed more or less same result. There was no significant difference in survival rates of spawn fed with live food and prepared feed. Specific growth rate and % weight gain were also best in case of T_1. Different water quality parameters were more or less same in different treatments.

Keywords: *Nandus nandus* Spawn, Live feed, supplemental feeds

1. Introduction
Nandus nandus [11] locally called Meni, Bheda, or Nondoi is an indigenous vulnerable and small food fish in Bangladesh. International union for Conservation of nature [12] has enlisted mottled nandus *(N. nandus)* in their red list of threatened fishes of Bangladesh as a vulnerable taxon. Degraded aquatic ecosystem inhibits availability of *(N. nandus)* for this reason nursery development for promoting availability of (*N. nandus)* spawn is essential. To develop nursery technologies feed selection is prerequisite. It is a carnivorous fish and preys on small shrimps and fishes, insects larvae etc [17]. So, live food and artificial feed should be provided for nursing of (*N. nandus)* spawn. Predatory behavior was observed by [9, 23] reported live food is superior in case of growth and survival rate of *Nandus nandus* fry to artificial feed. Successful technology of breeding and rearing will help to culture this fish in shallow waters like rice fields that would play substantial role in the overall nutrition of the people of Bangladesh especially the poor and lower middle class people of rural Bangladesh [9]. Only 16% survival rate was calculated by feeding Zooplankton was observed by [23]. So development of nursing technology of *Nandus nandus* spawn will contribute not only to our national economy but also help to protect endangered (*Nandus nandus)* from extinction. The present study was conducted on growth and survival rate of this species during the nursery rearing in cement cisterns.

2. Materials and Methods
The experiment was conducted in 12 cement cisterns (2.45×1.5×0.7) m^3 at the hatchery of Bangladesh Fisheries Research Institute, Floodplain substation, Santahar, Bogra for 20 days during July to August 2015. Five days old *(Nandus nandus)* spawn produced by induced breeding technique using PG having an average initial length 0.502 cm & initial weight 4.13 mg were stocked 1000/m^2. Continuous water flow was maintained in cisterns. Excess water pass out through an outlet after maintaining the mentioned volume of water. Four supplemental feeds were tested and they were designated as four treatments T_1 (Zooplankton), T_2 (Artemia), T_3 (Tubifex), and T_4 (Nursery brand feed) respectively. The number of replication was three for each treatment.

Table 1: Nutritional Value of these Foods

Treatments			
T_1 (Zoolankton)	**T_2 (Artemia)**	**T_3 (Tubifex)**	**T_4 (Nursery brand feed)**
Most are Daphnia, Cyclops	Protein- 52.2%, Lipid-18.9%, Carbohydrate-14.8%, Ash- 9.8%.	Protein: 50-60% Fat: 10% min, Fibre: 2% max, Moisture: 4% max, Phosphorus 0.1% max, Ash 0.1% max.	Protein-34.88%, Lipid-15.99%, Ash-17.43%, Moisture-10.66%

Feeding was done four times in a day by spreading method initially at the rate 100%, 80%, 60% of the total biomass of spawn for the 1st to last week's respectively. The dead fish were removed as soon as they were detected. Twenty percent of the stocked fish in each cistern were sampled at weekly interval and length, weight, survival rate were recorded. Mean weight gain, length gain, survival rate were obtained from different treatments were recorded. Proximate analyses of the supplemental feeds tested were done according to [3] and the results were shown. The data obtained from the experiment were analyzed by DMRT (Duncan's Multiple Range Test) with one- way analysis of variance (ANOVA).

Analysis of growth data

a) Weight gain (g):

Weight gain = Mean final weight − Mean initial weight

b) Percent weight gain (%):

$$\%\text{Weight gain} = \frac{\text{Mean final weight} - \text{Mean initial weight}}{\text{Mean initial weight}} \times 100$$

c) Specific growth rate (% per day):

$$\text{SGR (\% per day)} = \times \frac{\log_e W_2 - \log_e W_1}{T_2 - T_1} 100$$

Where,

W_1 = Initial live body weight (g) at time T_1 (day)

W_2 = Final live body weight (g) at time T_2 (day)

Water quality parameters viz-temperature, pH, alkalinity dissolved oxygen and ammonia monitored frequently.

3. Results and Discussion

Table 2 Mean (±se) values of *Nandus nandus* spawn growth of different treatments.

Treatment	Survival rate %	Length (mm)	Weight gain (mg)	% weight gain	Specific growth rate
T_1 (Zooplankton)	49.38 ±.625	1.95 ±.20[a]	264.66 ±8.54[a]	6308.23 ± 91.04[a]	20.33 ±.025[a]
T_2 (Artemia)	48.88 ± 4.87	1.50 ±.09[b]	206.24 ±.93[b]	4993.70 ± 22.52[b]	19.63 ±.025[b]
T_3 (Tubefix)	46.00 ± 1.00	1.59 ±.12[b]	222.23 ±.56[b]	5380.87 ± 13.56[b]	19.98 ±.025[c]
T4 (Feed)	45.83 ± 3.53	1.46 ±.06[c]	190.95 ±.92[b]	4623.48 ± 22.28[b]	19.26 ±.025[d]
Level of Significance	NS	*	*	*	*

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.

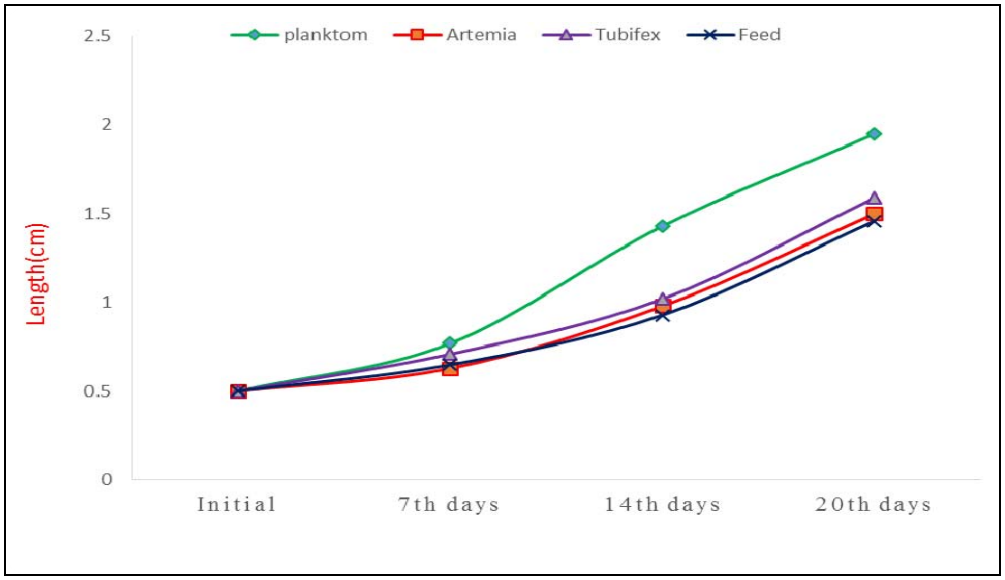

Fig 1: Length variation of *Nandus nandus* spawn on different treatments.

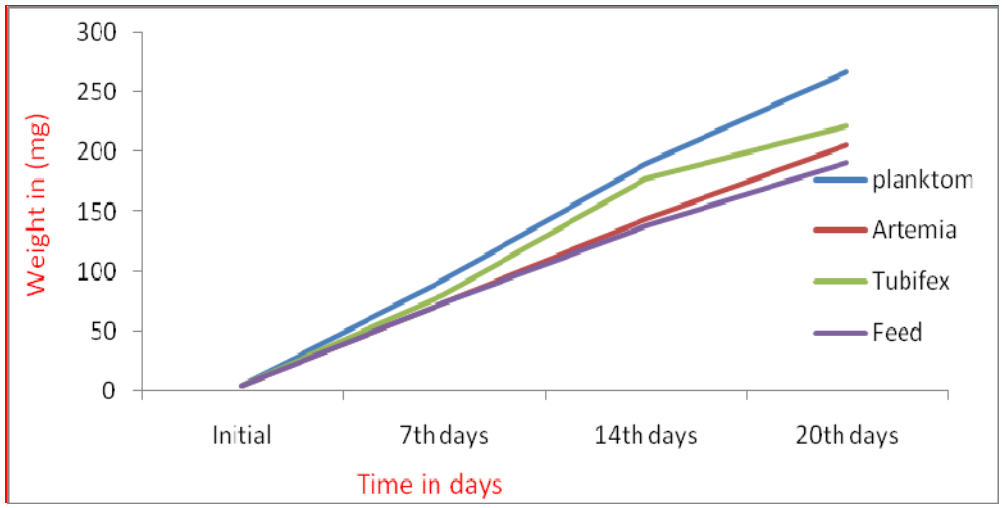

Fig 2: Weight variation of *Nandus nandus* spawn on different treatments.

Figure 1 and 2 represent the growth in length and weight of *Nandus nandus* spawn respectively at different times of the experimental period. Both length (Figure 1) and weight (Figure 2) of the fish increased with the increase of time in all treatments (T_1, T_2, T_3 and T_4). The growth pattern and survival rate of five days old *Nandus nandus* spawn fed with zooplankton, artemia, tubefex, and nursery brand feed were presented in Table 1. The mean (±se) values of length and weight of different treatment fed with T_1 represented significantly higher (P<0.05) in case of weight, length, and survival rate among all treatments. The present study showed fed with live feed provided higher growth rate than artificial feed in case of carnivore fish was similar to [10, 23]. Artemia fed showed higher growth rate of *M. gulio* while fed with artificial feed gave poor growth and survival rate [2]. Live food was better to growth and survival rate than prepared feed because live food contained digestive enzyme and high protein which were superior to growth of fish spawn. The *C. batrachus* larvae fed with live feed (*Tubifex sp)* exhibiting significantly superior growth than artificial feed was similar to the present study [1]. The low digestibility of feed might be also caused such type of growth. In contrast of [25] reported that *C. gariepinus* larvae fed with 69.8% dried torula yeast (*Candida utilis*) and 23.3% brown fish meal having protein content 55.4% which showed significantly better growth response than live food like Zooplankton. It was dissimilar to present study. Growth and survival rate of *Nandus nandus* spawn were higher in case of T_1 than other live food, it was occurred due to much zooplankton production and availability of zooplankton. It may be another caused Zooplankton was favorite to *Nandus nandus* spawn than other live food. The *Nandus nandus* larvae were fed with scrambled egg yolk, pasted *Tubifex* worms, and Zooplankton in duplicate aquria. Only 16% survival rate was calculated by feeding zooplankton. No survival was observed among other food items were observed by [23]. It was similar in case of feed type but dissimilar in case of survival rate to the present study.

Table 3: Mean (±se) values of water quality parameters of different treatments.

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 ± 0.010
Artemia (T_2)	28.50 ± 0.15	7.41 ± 0.12	190.88 ± 2.36	7.07 ± 0.08	0.11^a ± 0.021
Tubifex (T_3)	28.62 ± 0.14	7.24 ± 0.07	189.17 ± 2.55	7.10 ± 0.14	0.12^a ± 0.022
Nursery Feed (T_4)	28.50 ± 0.16	7.51 ± 0.07	186.75 ± 2.20	7.19 ± 0.13	0.13^a ± 0.019
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 row indicate significant difference at 5% significance level.

There was more or less same water quality parameters presented in all treatment water bodies. No significant variation was occurred. Ammonia level was significantly ($P<0.05$) lower in all treated water bodies. It may also reason to superior growth. In the present study water quality parameters like air temperature, water temperature, water pH, soil pH, DO (dissolve oxygen), ammonia, transparency and total alkalinity were maintained at suitable range as following the technique provided by [4, 13]. It was found that water temperature were T_1 (28.60 ± 0.15^{0}C), T_2 (28.50 ± 0.15^{0}C), T_3 (28.62 ± 0.14^{0}C) and (28.50 ± 0.16 ^{0}C) which report was similar [6, 15, 18, 19, 21]. The range of water temperature from 26.06 to 31.97°C is suitable for fish culture [5]. The water pH value of three treatments were T_1 (7.52 ± 0.11), T_2 (7.41 ± 0.12), T_3 (7.24 ± 0.07) and (7.51 ± 0.07) respectively. The pH from 6.5 to 9.0 is suitable for pond fish culture and pH more than 9.5 is unsuitable [13]. Different authors have reported a wide variations in pH from 7.18 to 7.24 [15], 7.03 to 9.03 [21], 6.8 to 8.20 [6] and 7.50 to 8.20 [7] in fertilized fish ponds and found the ranges to be productive. The DO (dissolve oxygen) of three treatments were T_1 (7.19 ± 0.12), T_2 (7.07 ± 0.08), T_3 (7.10 ± 0.14) and (7.19 ± 0.13) respectively which was similar [15, 19, 20, 26]. The amount of DO (dissolved oxygen) have been reduced in the morning hours in all treatments. The variations in total alkalinity in all the treatments were found in productive range for aquaculture ponds [5, 14, 16, 27].

4. Conclusion

Feed is an essential essential for the growth of all animals. High quality feed provides superior growth and lower quality of feed provided inferior growth. Feed selection is necessary to achieve better growth. *Nandus nandus* is carnivore, so it

needed live feed. Supplementary feed do not provide better growth rate. Among all live feed zooplankton showed higher growth. This research will help to identify which food is suitable for higher growth of *Nandus nandus* spawn. The results obtained from the present study and the discussion made so far it is assertive to say that *Nandus nandus* larvae can be reared successfully with live zooplankton sp.

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