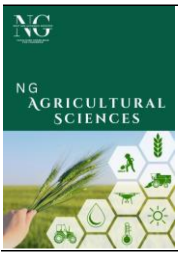

NG Agricultural Sciences
ISSN (Online): 3107-5053
Volume 1, Issue 1 (January-March), 2025, (23-28)

Original Research

Open Access

Growth and Survival of Shining Barb (*Pethia conchonius*) Spawn in Different Stocking Density

Chinmaya Nanda[1], Sambid Swain[1*], Samik Kumar Pradhan[2] and Ajay Kumar Prusty[2]

[1]Department of Fisheries Extension, School of Fisheries, Centurion University of Technology & Management, Odisha, 7651211, India
[2]Department of Agricultural Extension Education, M S Swaminathan School of Agriculture, Centurion University of Technology & Management, Odisha, 7651211, India

*Corresponding author email ID: sambid.swain@cutm.ac.in

HIGHLIGHTS

- The lowest stocking density (1 larva per liter) achieved the highest mean body weight and length.
- Survival rate was highest at the lowest stocking density (1 larva per liter).
- Water quality parameters remained within acceptable ranges across all stocking densities.

ARTICLE INFO

Article History:
Received: 07 February 2025
Revised: 06 March 2025
Accepted: 09 March 2025
Published: 31 March 2025

Keywords:
Shining Barb Spawn
Stocking Density
Growth
Survival
Aquaculture

ABSTRACT

This study investigated the effects of different stocking densities on the growth and survival of shining barb spawn (*Pethia conchonius*) in a 27-liter glass aquarium over 45 days. Each of the three stocking densities consisting of 1, 3, and 5 larvae per liter received three replicated trials. The larvae were fed with a mixed diet of zooplankton and artificial feed. Stocking density of one larva per liter resulted in the highest mean body weight together with maximum length measurements and the highest survival rate. An optimal water quality parameters were maintained identically across all the treatment. The study proved that when each spawn is placed in one liter of solution, the shining barb spawn grows best due to optimal environment conditions essential for aquaculture production, specifically fish farming. Future research can further explore the long-term effects of stocking density on fish health and development.

1. INTRODUCTION

Rosy barb (*Pethia conchonius*) is a benthopelagic fish species that occurs in subtropical regions of Asia. It is native to India, Bangladesh, Pakistan, Nepal, and Afghanistan. In India, it occurs in rivers like the river Ganga and its tributaries. Shining barb (*Pethia conchonius*) belongs to the family Cyprinidae and order Cypriniformes. Shining barb is one of the products of ICAR-Central Institute of Freshwater Aquaculture, Odisha (ICAR-CIFA) developed by selection. Shining barb is a improved variety of Rosy barb (*Pethia conchonius*) developed by selective breeding. The pink red shining male and golden yellow shining female are more beautiful than normal variety barbs (Rostika et al., 2017). Shining

https://doi.org/10.5281/zenodo.15109594

barb matures to 80-90 mm, but nearly all are full grown at length of 65-75 mm. They are omnivores. The color of the head is pink red shining in case of male while that of golden yellow shining belongs to female. They are eggs scatterers in nature, and eggs are gluey in structure (Dewi et al., 2021). One of the indispensable criteria for successful aquaculture practice is the larval rearing.

Raising the larval survival rate will allow the industry to meet market demand and boost profit without additional investment. With increasing density, density dependent factors controlling the growth of the fish begin to act at another density level for every species and culture condition (Roy et al., 2021). Keeping in view the great significance of Barb mainly shining barb, the present study was conducted to evaluate the impacts of fish stocking densities on growth and survival, fed with planktons supplemented with minimum spirulina pellet, adequate aeration and intermittent water exchange for 45 days (Hundley et al., 2018).

The shining barb (*Pethia conchonius*) is a tropical freshwater fish belonging to the family Cyprinidae. It is one of the success stories of ICAR-CIFA, Odisha. Shining barb is an improved variety of Rosy barb, which has been bred after 8-9 years of research by selective breeding (Sishodia et al., 2020). The pink red glow of male and golden yellow glow female are more appealing than the regular variety of barbs. They are essentially fragile but extremely peaceful towards other inhabitants and thus suitable for an aquarium environment. It is compatible with most aquarium fishes such as Angels, Gouramies, Loaches, Rasbora, Tetras, and Live bearers (Kusmini et al., 2020).

Shining barb (*Pethia conchonius*) attains 90-100 mm in length, but the majority of them are fully developed at 65-75 mm. They live for 2-3 years in their natural environment. The males live longer than females. Temperature and other environmental climatic conditions influence age and size at first sex maturity (Gantz et al., 2023). Their color gets intensified during their breeding seasons. The male is having a brighter pink red shining colour whereas female are golden yellow shining colour. Breeding of shining barb has been standardized at ICAR-CIFA, Odisha, and they informed that they reach sexual maturity in the first year age at a mean length of 40-50 mm. The fecundity also differs by age and female size. They are regarded as egg scatter and sticky in consistency. The female is capable of spawning 300-400 eggs. They breed all year round except winter months under improved management practices (Suhestri et al., 2021). Hapa breeding technology is predominantly applied for breeding the shining barb. Eggs need 60-70 hours at 24-26°C for incubation. The newly hatched larvae are about 1 mm in length and stick to the hydrilla plant. The larvae are free swimmers after 2-3 days of hatching and need live foods such as infusoria, rotifer, cyclops, and freshly hatched artemia etc, for one week (Roux et al., 2019).

Spawn rearing in nurseries is an important process in fish culture. The improper conditions and poor management can frequently result in extreme effects leading to fry mortality to the tune of 90-98 % (Sserwadda et al., 2018). Being aware of the best stock density is one of the fundamental factors of intensive fish culture. This density must be the resultant value of environmental needs of a particular fish species and widely interpreted economic efficiency (Kumar et al., 2021). Fish stocking density is the most sensitive parameter influencing the productivity of a culture system since it influences growth rate, size variation, and mortality. Stocking at higher densities gave greater production and reduces the total land requirement and water usage. The large stocking density can have negative impacts on survival and growth (Eid et al., 2019). Thus, predetermination and standardization of the optimal stocking density for every species must be done to achieve the optimal output.

When compared to food-fish production, the stocking densities where ornamental fishes have been held are quite low. For the most productive producers of ornamental fish in Asia, in Singapore, the stocking density has been documented as low as 0.02-0.1 fish/L to below 0.3 fish/L (Shen et al., 2020). Among other literature reported, values vary from 0.4 fish/L in angelfish, *Pterophyllum scalare* (Degani 1993), and swordtails, *Xiphophorus helleri* to 0.5 fish/lt for the gourami, *Trichogaster trichopterus* (Nahar et al., 2021). For common carp (*Cyprinus carpio*) larval rearing, the optimal stocking density was found to be 3 no./litre, while for koi carp the it is varied from 0.5 fish/litre to 3 fish/litre (Mane et al., 2017).

Various research has been carried out on the influence of stocking density, growth, and survival of koi carp (Cyprinus carpio) spawn with increasing density of the fish. density dependent factor that restrain fish growth come into play, at another density level for every spaces and culture condition (Kohinoor & Rahman, 2014; Nahar et al., 2021; Roy et al., 2021). Overstocking density typically results in a low survival rate, whereas lower stocking density gives rise to the high growth rate of fry. Aquaculturists usually grow their fish in aquaculture systems at high stocking densities to attain high productivity, even though the exact optimal stocking densities are highly variable depending on culture systems, fish species, and age of the fish (Eid et al., 2019).

2. MATERIALS AND METHODS

This experiment was carried out in the wetlab of Intensive Rearing Unit, School of Fisheries, CUTM. All preparations required for the breeding of shining barbs were carried out in the hatchery. Breeding tank was prepared and Water quality parameters, working area, etc. were ensured prior to the breeding program. Breeding of shining barb is identical to that of rosy barb. In general, breeding is done in a hapa (2.5×1.5×1.5 feet3) of 5 sides of mosquito net with a gap in the top side to facilitate entry of brood stock. Brooders (5-6 pair) in proportion 1:1 or 2:1 may be introduced in hapa immersed in water. Submersed nylon filaments can also be introduced in the tank for breeding these fish. Hydrilla planted in a soil earthen pot outdoors of the hapa in the tank may give protection to the newly hatched larvae. The male begins chasing the female, nudging her at sides of abdomen for egg release and male sprays milt upon the eggs for fertilization during the morning period. The entire spawning process lasts about 1-2 hours. The spawned eggs fall down through the mesh and cover the bottom of the tank. 60-70 hours at 24-26˚C is needed for the eggs to hatch. The hatchlings are around 1 mm long and stick to the hydrilla plant. The brooders have to be removed shortly after spawning and kept separately for the appropriate post breeding management. After 2-3 days of hatching, the larvae become free swimmers and require live foods like infusoria, rotifer, cyclops, and newly hatched Artemia, etc, for a week. Spawns (5 days old) were taken for stocking in six (6) different aquarium tanks of 27 litres of water in 3 different stocking densities in duplicate as T1, T2, and T3. The experiment was continued for 45 days. The water quality parameters like temperature, dissolved oxygen, Ph, P2O5, free CO2, alkalinity, NH4N, NO3N, and conductivity were monitored at weekly intervals. Spawn length and weight were taken at 15 days intervals from every tank.

3. RESULTS

3.1. Physicochemical Parameters of Water

Physicochemical water parameters like temperature (°C), pH, dissolved oxygen (mg L-1), free carbon dioxide (mgL-1), ammonia (mgL-1), nitrate-N (mg L-1), alkalinity, and conductivity were measured and are given in Table 1. Temperature of water varied from 24°C-27°C, and pH varied from 6.8 to 8.1 during the experimental period. Dissolved oxygen level was measured between 5.8 to 6.25 mg L-1, while free carbon dioxide was nil throughout the experiment. Ammonia - N and nitrate-N were measured between 0.02 to 0.07 mg L-1 and 0.02 to 0.05 mg L-1 respectively. Alkalinity and conductivity were measured between 84 to 110 mg L-1 and 0.23 to 0.45 ml. molar ml-1 respectively.

Table 1. Physico-chemical parameters of water for experiment during the experimental period of 45 days

Parameters	T1	T2	T3
Temperature	25.55 ± 0.43	25.55 ± 0.41	25.53 ± 0.39
DO	6.15 ± 0.04	6.08 ± 0.07	6.08 ± 0.46
pH	7.37 ± 0.15	7.33 ± 0.18	7.35 ± 0.19
P_2O_5	0.2 ± 0.01	0.1 ± 0.01	0.1 ± 0.02
Free CO_2	12.83 ± 1.19	13.73 ± 1.19	14.08 ± 1.17
Alkalinity	86.59 ± 1.29	94.00 ± 3.77	95.00 ± 3.68
NH_4N	0.04 ± 0.01	0.04 ± 0.02	0.03 ± 0.01
NO_3N	0.03 ± 0.01	0.02 ± 0.01	0.03 ± 0.02
Conductivity	0.35 ± 0.03	0.34 ± 0.03	0.33 ± 0.03

Table 2. Mean body weight of Shining barb (*Pethia conchonius*) larvae reared in different stocking density at different time point

Treatment	Zero day	15th day	30th day
T1	0.035^{a}±0.002	0.163±0.013	0.23±0.012
T2	0.033±^{a}0.002	0.073±0.013	0.08±0.013
T3	0.035±0.002	0.038±0.003	0.05±0.006

3.2. Mean body weight

The average body weight at stocking time was 0.035±0.002 mg. The average body weight of larvae at the 15th day of all treatments were significantly different (P<0.05) from one another. The T1 larval group had the maximum average body weight, and the T3 larval group had the minimum. The same trend was seen on the 30th and 45th days of sampling.

3.3. Mean body length

The average body length of the shining barb spawn when stoking was 1.00±0.10 mm. The average body length of larvae on day 15 was maximum in T1 and minimum in the T3 larval group. In this case, no difference was noted between the T1 and T2 larval groups. At 45th day, again similar pattern of body length was followed, but the T1 larvae group was not significantly different from the T2 group. Mean body length of the treatment did not show significant difference (P>0.05) among the groups at 30th day.

3.4. Weight gain (%)

In the present experiment, after 45 days of rearing of shining barb larvae, the highest weight gain (%) (0.236±0.012 mg) was recorded in the T1 larval group, whereas the lowest was in the T3 larval group (0.05±0.006 mg). Here, weight gain (%) in T1 was significantly different from other groups.

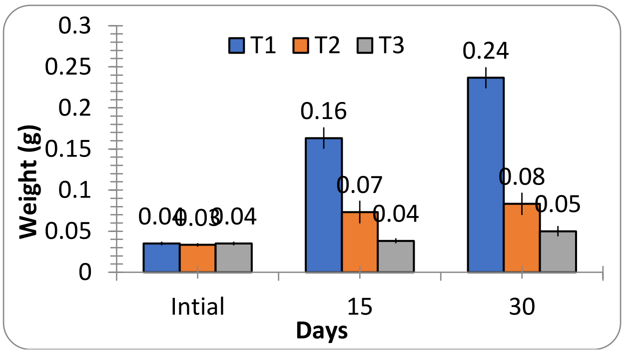

Figure 1. Weight gain (%) of Shining barb (*Pethia conchonius*) larvae reared in different stocking density

3.5. Length gain (%)

Length gain (%) in T1 larval group was also greater than the rest of groups. In current research maximum length gain (%) was found in T1 larval group (3.00±0.12 mm) while minimum length gain (%) was found in T3 group (1.73±0.04 mm).

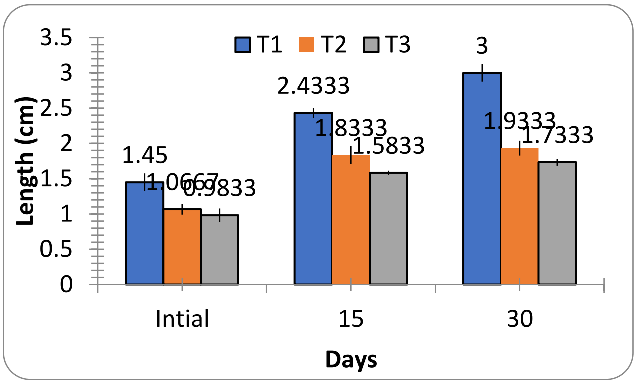

Figure 2. Length gain (%) of Shining barb (*Pethia conchonius*) larvae reared in different stocking density

3.6. Survivability (%)

In the current experiment, the larval survival at the end of the experiment was noted as highest for T1 group (94.44±1.85%) and T2 group (91.97±1.85%), while lowest in T3 group (73.33±8.88%). Survival was higher for T1 and T2 larval groups compared to the T3 larval group. At the experimental period, increased mortality was seen from the early days of rearing (most importantly T3) rather than later on.

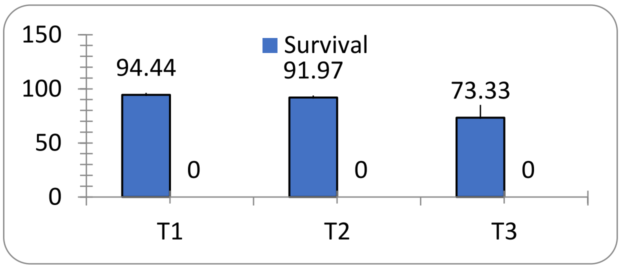

Figure 3. Survivability (%) of Shining barb (*Pethia conchonius*) larvae reared in different stocking density

Table 3. Mean body length of Shining barb *(Pethia conchonius)* larvae reared in different stocking density at different time point

Treatment	Zero day	15th day	30th day
T1	1.45±0.12	2.43±0.07	3.00±0.12
T2	1.06±^{a}0.07	1.83±0.12	1.93±0.10
T3	0.98±0.09	1.58±0.03	1.73±0.04

4. DISCUSSION

Large-scale fish cultivation entails fry stocking in earth ponds from which marketable fish are collected after 3-4 months of cultivation. The post-larval stage massive loss of fish is one of the bottlenecks in the industry where the mortality rate is extremely high before the fish attain a size of 1g (Watanabe & Miller, 2022). The spawn (5 days) were cultured in aquarium tanks with varied stocking density. The maximum mean body weight and mean body length were observed in T1 and T2 larval groups, and it was significantly different from the other treatment groups. This could be because of the lowest density in the T1 and T2 larval groups. It is an empirical fact that stocking density directly influences food supply, living space, and water quality. Roy et al. (2015) also revealed that there was a significant negative linear correlation between growth and stocking rate. Growth retardation at high stocking densities has been attributed by a number of workers, attributed such growth depression to lack of adequate space (Nahar et al., 2021). Physiological stress can also result in poor growth rate under dense stocking conditions in T2 and T3 larval groups, as reported in Rainbow Trout (*Salmo gairdneri*) and Coho Salmon (*Oncorhynchus kisutch*) (Ahmed et al., 2015).

Weight gain (%) and length gain (%) were much greater in the T1 larval group than in other larval groups. Increased stocking density caused a severe negative effect on the growth of grass carp (*Ctenopharyngodon idella*) in small impoundments (Motta et al., 2020). With one of the ornament fishes, that effect of the population density was also observed for growth rate with juvenile swordtails (*Xiphophorus helleri*), which were supplied to satiety, as well as for angelfishes (*Pterophyllum scalare*) albeit, the above experiment was set indoors and original size of the fish was well over 1g (Oké & Goosen, 2019).

Survivability at the larval stage was influenced by density of stocking. In this lowest survivability was observed in the T3 larva group, while maximum was in the T1 and T2 groups. The reduced survivability in the T3 larva group can be attributed to the space and food competition (Yadav et al., 2021). The water quality parameters also did not reveal any notable variation in the experimental tanks with varied stocking densities, demonstrating that greater stocking densities as used in the current experiments (5 no./litre) did not create any environmental stress.

5. CONCLUSIONS

The research evaluated shining barb spawn (*Pethia conchonius*) survival and growth by monitoring various stocking density conditions for 45 days. The study results showed that stocking density levels directly impacted these two factors. The condition of raising one larva per liter produced the highest mean body weight along with the maximal body length and survival numbers among all treatments. A reduced number of stock individuals creates more advantageous environmental elements for single-species development. The water quality parameters checked during the experiment showed acceptable levels across each tested stocking density, which demonstrates that these densities caused no substantial environmental stress to the system. The research demonstrates that appropriate adjustments to stock density levels enable better growth rates and survival chances in young fish. Such findings help the aquaculture sector, especially when raising ornamental fish species, including the shining barb. Additional research about stocking density effects on fish development, together with health aspects, would help develop sustainable and efficient aquaculture approaches.

Conflicts of Interest: The authors declare no conflicts of interest.

Funding: This research received no external funding.

Acknowledgments: The authors would like to express their gratitude to the Centurion University of Technology & Management for their support and assistance in conducting this research.

Author Contributions: Conceptualization, C.N. and S.S.; methodology, C.N.; validation, C.N., S.S., and S.K.P.; formal analysis, C.N.; investigation, C.N.; resources, C.N.; data curation, C.N.; writing—original draft preparation, C.N.; writing—review and editing, C.N., S.S., S.K.P., and A.K.P.; supervision, S.S. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Ahmed, G. U., Rahman, M. M., Alam, M. N., Alam, M. B., & Sarker, B. (2015). Impact of stocking density on growth and production performance of Vietnamese koi (Anabas testudineus) in semi-intensive culture system at Muktaghasa region of Mymensingh district. Research in Agriculture Livestock and Fisheries, 2(2), 335–341. https://doi.org/10.3329/ralf.v2i2.25019

Dewi, R. R. S. P. S., Kusmini, I. I., Radona, D., & Puteri, F. P. (2021). The performance of first generation Of domesticated javaean barb (Systomus orphoides) fry. In E3S Web of Conferences (Vol. 322, p. 02011). EDP Sciences. https://doi.org/10.1051/e3sconf/202132202011

Eid, A. E., Ali, B. A., & Elfeky, A. (2019). The influence of stocking density on growth and feed utilization in gilthead seabream (sparus aurata). Egyptian journal of nutrition and feeds, 22(2), 415-422. https://doi.org/10.21608/ejnf.2019.79440

Gantz, C. A., Miller, R., Wells, S., Sytsma, M. D., & Strecker, A. L. (2024). Mussel squeeze: Dissolved oxygen and temperature can “squeeze” zebra mussels out of invaded reservoirs. Management of Biological Invasions, 14(2), 301–320. https://doi.org/10.3391/mbi.2023.14.2.08

Hundley, G. C., Navarro, F. K. S. P., Ribeiro Filho, O. P., & Navarro, R. D. (2018). Integration of Nile tilapia (Oreochromis niloticus L.) production Origanum majorana L. and Ocimum basilicum L. using aquaponics technology. Acta Scientiarum. Technology, 40(1), e35460. https://doi.org/10.4025/actascitechnol.v40i1.35460

Kohinoor, A., & Rahman, M. (2014). Preliminary study on the production of common carp cultured in freshwater river cages. International Journal of Agricultural Research, Innovation and Technology, 4(1), 24–27. https://doi.org/10.3329/ijarit.v4i1.21086

Kumar, T. S., Reddy, D. R. K., Dharmakar, P., Swaroop, K. S. J., Rao, A. C., & Madhavan, N. (2021). Studies on growth and survival in nursery rearing phase of grey mullet (Mugil cephalus) for mariculture. Journal of Entomology and Zoology Studies, 9(1), 175-178. https://doi.org/10.22271/j.ento.2021.v9.i1c.8141

Kusmini, I. I., Radona, D., Prakoso, V. A., Gustiano, R., Soelistyowati, D. T., Carman, O., & Hidayat, K. W. (2020). Outbreeding performance of tinfoil barb Barbonymus schwanenfeldii from Java and Kalimantan for aquaculture development. In E3S Web of Conferences (Vol. 147, p. 01009). EDP Sciences. https://doi.org/10.1051/e3sconf/202014701009

Mane, A. M., Meena, D., Varghese, T., & Syamala, K. (2017). Effect of stocking density on the growth, survival and yield of carp fry reared in pens. International Journal of Current Microbiology and Applied Sciences, 6(4), 641-648. https://doi.org/10.20546/ijcmas.2017.604.079

Motta, J. H. S., Glória, L. S., Polese, M. F., de Souza, A. B., Neto, M. A. C., & Vidal Júnior, M. V. (2020). Stocking density influences common carp larval development. Can restocking processes activate compensatory growth consequent to previous high stocking density?. Spanish Journal of Agricultural Research, 18(3), e0608. https://doi.org/10.5424/sjar/2020183-15652

Nahar, N., Afrin, S., Hossain, M. I., Samad, M. A., Farhad, F. B., & Rahman, M. L. (2021). Influence of Stocking Density on Growth Performance of Labeo bata in Cage at River Padma, Rajshahi, Bangladesh. Asian Journal of Fisheries and Aquatic Research, 11(4), 1–11. https://doi.org/10.9734/ajfar/2021/v11i430208

Oké, V., & Goosen, N. J. (2019). The effect of stocking density on profitability of African catfish (Clarias gariepinus) culture in extensive pond systems. Aquaculture, 507, 385-392. https://doi.org/10.1016/j.aquaculture.2019.04.043

Rostika, R., Rizal, A., & Dewanti. (2017). Monosex Barb (Osteochilus hasselti) culture with reduction feed on economic efficiency and cost reduction at net cage in Cirata Reservoir. Current Research in Agricultural Sciences, 4(1), 7–13. https://doi.org/10.18488/journal.68/2017.4.1/68.1.7.13

Roux, N., Salis, P., Lambert, A., Logeux, V., Soulat, O., Romans, P., ... & Laudet, V. (2019). Staging and normal table of postembryonic development of the clownfish (Amphiprion ocellaris). Developmental Dynamics, 248(7), 545-568. https://doi.org/10.1002/dvdy.46

Roy, B., Pattadar, S., Ahsan, M., Alam, M., & Ali, M. (2015). Culture Practice of Thai Koi (Anabas Testudineus) With Different Stocking Densities at Tarakanda in Mymensingh District. Journal of Environmental Science and Natural Resources, 6(2), 191–196. https://doi.org/10.3329/jesnr.v6i2.22116

Roy, J., Terrier, F., Marchand, M., Herman, A., Heraud, C., Surget, A., Lanuque, A., Sandres, F., & Marandel, L. (2021). Effects of low stocking densities on zootechnical parameters and physiological responses of rainbow trout (Oncorhynchus mykiss) juveniles. Biology, 10(10), 1040. https://doi.org/10.3390/biology10101040

Shen, Y., Ma, K., & Yue, G. H. (2021). Status, challenges and trends of aquaculture in Singapore. Aquaculture, 533, 736210. https://doi.org/10.1016/j.aquaculture.2020.736210

Sishodia, R. P., Ray, R. L., & Singh, S. K. (2020). Applications of Remote Sensing in Precision Agriculture: A Review. Remote Sensing, 12(19), 3136. https://doi.org/10.3390/rs12193136

Sserwadda, M., Kagambe, E., & Van Stappen, G. (2018). The Brine Shrimp Artemia Survives in Diluted Water of Lake Bunyampaka, an Inland Saline Lake in Uganda. Water, 10(2), 189. https://doi.org/10.3390/w10020189

Suryaningsih, S., Sukmaningrum, S., Amurwanto, A., & Rofiqoh, A. A. (2021, July). Reproductive characters of hampala fish (hampala macrolepidota kuhl & Van Hasselt, 1823), correlation with body length. In IOP Conference Series: Earth and Environmental Science (Vol. 819, No. 1, p. 012013). IOP Publishing. https://doi.org/10.1088/1755-1315/819/1/012013

Watanabe, W., & Miller, G. (2022). Epinephelus striatus (Nassau grouper). In CABI Compendium. CABI International. https://doi.org/10.1079/cabicompendium.83953

Yadav, S. R., Chavan, B. R., Kumar Chadha, N., Naik, S. D., Krishnani, K. K., & Sawant, P. B. (2021). Effect of stocking density on growth performance, plankton abundance, body composition and haematological parameters of Etroplus suratensis (Bloch, 1790). Aquaculture Research, 52(10), 4752-4766. https://doi.org/10.1111/are.15309