Journal of Fish Nutrition
Volume 6 No. 3, September 2026
DOI: 10.29303/jfn.v6i3.11121

EFFECTS OF *Moina* sp. FEEDING FREQUENCY ON THE GROWTH PERFORMANCE AND SURVIVAL OF *Hemibagrus nemurus* LARVAE

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ABSTRACT

The Asian redtail catfish (*Hemibagrus nemurus*) is a freshwater species with high economic value and considerable aquaculture potential. However, the development of its culture is still constrained at the hatchery stage, particularly by the low survival rate of larvae during early rearing. This study aimed to evaluate the effect of *Moina* sp. feeding frequency on the growth performance and survival of *H. nemurus* larvae. The experiment was conducted for 15 days in June 2025 at the Microalgae and Fish Nutrition Laboratory, Faculty of Agriculture, Universitas Islam Riau, Pekanbaru, Indonesia. A completely randomized design with one factor was applied, consisting of five feeding frequencies and three replicates. The treatments were feeding *Moina* sp. at frequencies of 1, 2, 3, 4, and 5 times per day. Three-day-old larvae were used, with an initial average body weight of 0.01 ± 0.00 g and an initial average total length of 0.40 ± 0.00 cm. The observed parameters included final weight, final length, absolute weight gain, absolute length gain, specific growth rate, and survival rate. The results showed that feeding frequency had a significant effect on the growth and survival of *H. nemurus* larvae. The best performance was obtained at a feeding frequency of 5 times per day, resulting in a final weight of 0.09 ± 0.01 g, final length of 1.26 ± 0.01 cm, absolute weight gain of 0.09 ± 0.01 g, absolute length gain of 0.86 ± 0.01 cm, specific growth rate of 18.13 ± 0.38%, and survival rate of 82.00 ± 4.62%. Water quality parameters throughout the experiment remained within acceptable ranges for larval rearing. Therefore, feeding *Moina* sp. 5 times daily is recommended as the most effective feeding frequency to improve the growth and survival of *H. nemurus* larvae.

Key words: feeding frequency, growth, *Hemibagrus nemurus*, *Moina* sp., survival

INTRODUCTION

Hemibagrus nemurus is a freshwater fish species with considerable economic value and strong aquaculture potential. Demand for this species continues to increase due to its favorable flesh quality, while intensive exploitation from natural waters has contributed to a decline in wild stocks (Subagja *et al*., 2018; Radona *et al*., 2019;

Suharman *et al*., 2026). Despite the growing interest in farming *H. nemurus*, its culture development remains constrained by the limited availability of seed, which continues to hinder hatchery production and subsequent grow-out expansion.

One of the major constraints during the hatchery phase of *H. nemurus* is the low survival of larvae. The larval stage is highly critical because, at this period, fish possess a small mouth opening, an incompletely developed digestive system, and a high energy demand to support early growth and organ development (Valentine *et al*., 2017; Anizah *et al*., 2017; Hadi *et al*., 2024). Therefore, the success of larval rearing is strongly influenced by feed management, particularly the suitability of feed type to mouth size, prey capture ability, and nutrient availability during the early life stage (Melaku *et al*., 2024; Teye-Gaga *et al*., 2025).

Among the various live feeds used in freshwater hatchery practices, *Moina* sp. has high practical value. This cladoceran is widely used because it is relatively easy to culture, available in sizes suitable for fish larvae, and serves as a carrier of essential nutrients that support larval growth and resilience. Joshua *et al*. (2022) reported that *Artemia* and *Moina* are important live feeds in larviculture because their nutritional quality can be enhanced through enrichment, and changes in their nutrient composition directly affect larval performance. In addition, Hena *et al*. (2025) stated that cladocerans, including *Moina* sp., are rich in protein and lipids and play an important role in successful larval rearing. Thus, the use of *Moina* sp. for *H. nemurus* larvae is supported by strong biological and technical considerations.

However, the successful use of live feed is determined not only by feed type, but also by feeding frequency. Feeding frequency affects the opportunity of larvae to obtain food continuously, nutrient utilization efficiency, size uniformity, and survival throughout the rearing period. Recent evidence indicates that feeding frequency is a key management factor influencing growth and physiological performance in cultured fish. In a closely related species, *Hemibagrus wyckioides*, feeding frequency was shown to affect growth, digestive activity, intestinal microbiota composition, and gut health (Xu *et al*., 2025). More broadly, studies on other cultured fish species have also demonstrated that feeding frequency is an important factor regulating growth and immune responses (Hamed *et al*., 2024). Nevertheless, information regarding the feeding frequency of *Moina* sp. during the larval stage of *H. nemurus* remains limited. Therefore, this study was conducted to evaluate the effect of *Moina* sp. feeding frequency on the growth performance and survival of *H. nemurus* larvae during the early rearing period.

RESEARCH METHODS

Study site and experimental period

This study was conducted at the Microalgae and Fish Nutrition Laboratory, Faculty of Agriculture, Universitas Islam Riau, Pekanbaru, Indonesia, for 15 days in June 2025.

Experimental animals and live feed

The experimental fish were Asian redtail catfish larvae (*Hemibagrus nemurus*) obtained from the hatchery unit of the Faculty of Agriculture, Universitas Islam Riau. The broodstock had been artificially spawned through hormone injection, egg stripping of the female broodfish, and dissection of the male broodfish to obtain sperm. The larvae used in the experiment were 3 days old, corresponding to the stage at which the yolk sac had been completely absorbed, with an initial average body weight of 0.01

± 0.00 g and an initial average length of 0.40 ± 0.00 cm. The live feed used was *Moina* sp., obtained from a pure culture maintained at the same hatchery facility. *Moina* sp. were used without size grading, and no specific developmental stage was selected before feeding.

Experimental design and feeding treatments

The study employed an experimental method using a one-factor completely randomized design with five treatments and three replicates, resulting in 15 experimental units. Larvae were stocked at a density of 50 individuals per container in 10-L plastic jars filled with 5 L of water, for a total of 750 larvae. Each container was provided with continuous aeration.

All larvae received the same daily ration of *Moina* sp., equivalent to 20 individuals L^{-1} day^{-1}. Because each container contained 5 L of water and 50 larvae, this ration corresponded to 100 *Moina* individuals per container per day, or an average of two *Moina* individuals per larva per day. The total daily ration was divided as evenly as practicable among the scheduled feeding events for each treatment; thus, the treatments differed only in feeding frequency. The feeding frequency treatments were as follows: 1 time day^{-1} (07:00), 2 times day^{-1} (07:00 and 17:00), 3 times day^{-1} (07:00, 12:00, and 17:00), 4 times day^{-1} (07:00, 12:00, 17:00, and 23:00), and 5 times day^{-1} (07:00, 12:00, 17:00, 20:00, and 23:00).

Measured parameters

The main response variables included final body weight, final length, absolute weight gain, absolute length gain, specific growth rate, and survival rate. At each measurement occasion (initial and final), body weight and total length were measured from 10 larvae per container, corresponding to 20% of the stocked larvae. The larvae were randomly sampled from each container, and the same sample size and procedure were applied to all treatments and replicates. Survival rate was calculated from the total number of larvae in each container. Growth and survival were calculated according to Dewi *et al*. (2019) using the following equations:

$$WG = Wt - Wo$$

Where WG is absolute weight gain (g), Wt is the final average body weight (g), and Wo is the initial average body weight (g).

$$LG = Lt - Lo$$

Where LG is absolute length gain (cm), Lt is the final average length (cm), and Lo is the initial average length (cm).

$$SGR = [(\ln Wt - \ln Wo) / t] \times 100$$

Where SGR is the specific growth rate (% day^{-1}), Wt is the final average individual weight (g), Wo is the initial average individual weight (g), and *t* is the culture period (days).

$$SR = (Nt / No) \times 100$$

Where SR is the survival rate (%), Nt is the number of surviving larvae at the end of the experiment, and No is the number of larvae at the beginning of the experiment.

Water quality monitoring

Water quality parameters observed during the study included temperature, pH, dissolved oxygen, and ammonia. Temperature and pH were measured three times daily at 07:00, 12:00, and 19:00, whereas dissolved oxygen and ammonia were measured at the beginning and at the end of the experimental period.

Statistical analysis

Data on growth and survival were tabulated and tested for normality using the Shapiro–Wilk test and for homogeneity of variance prior to one-way analysis of variance (ANOVA). When significant differences among treatments were detected at the 95% level, the means were further compared using the Student–Newman–Keuls test. Water quality data were analyzed descriptively.

RESULTS

Feeding frequency of *Moina* sp. had a significant effect on the growth performance and survival of Asian redtail catfish larvae (*Hemibagrus nemurus*) ($P < 0.05$). As shown in Table 1, the best performance was obtained at a feeding frequency of 5 times day^{-1}, as indicated by a final weight of 0.09 ± 0.01 g, final length of 1.26 ± 0.01 cm, absolute weight gain of 0.09 ± 0.01 g, absolute length gain of 0.86 ± 0.01 cm, specific growth rate of 18.13 ± 0.38%, and survival rate of 82.00 ± 4.62%. In contrast, the lowest overall performance was generally observed in larvae fed once daily, particularly in terms of final weight (0.05 ± 0.00 g), specific growth rate (14.60 ± 0.15%), and survival rate (44.67 ± 3.53%). These findings indicate that a higher frequency of live feed distribution resulted in better larval growth and survival.

Table 1. Growth performance and survival of Asian redtail catfish larvae fed *Moina* sp. at different feeding frequencies.

Parameters	Feeding frequency of *Moina* sp. (times day^{-1})				
	1	2	3	4	5
Initial weight (g)	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
Initial length (cm)	0.40 ± 0.00	0.40 ± 0.00	0.40 ± 0.00	0.40 ± 0.00	0.40 ± 0.00
Final weight (g)	0.05 ± 0.00^{a}	0.07 ± 0.00^{bc}	0.06 ± 0.01^{ab}	0.08 ± 0.00^{c}	0.09 ± 0.01^{d}
Final length (cm)	1.22 ± 0.02^{a}	1.23 ± 0.01^{ab}	1.23 ± 0.01^{ab}	1.25 ± 0.01 ^{ab}	1.26 ± 0.01^{b}
Weight gain (g)	0.05 ± 0.00^{a}	0.06 ± 0.00^{bc}	0.05 ± 0.01^{ab}	0.07 ± 0.00^{c}	0.09 ± 0.01^{d}
Length gain (cm)	0.82 ± 0.02^{a}	0.83 ± 0.01^{ab}	0.83 ± 0.01^{ab}	0.85 ± 0.01 ^{ab}	0.86 ± 0.01^{b}
Specific growth rate (%)	14.60 ± 0.15^{a}	16.33 ± 0.31^{bc}	15.37 ± 0.62^{ab}	17.13 ± 0.06^{c}	18.13 ± 0.38^{d}
Survival rate (%)	44.67 ± 3.53^{a}	43.33 ± 5.21^{a}	68.67 ± 2.40^{b}	66.67 ± 2.91^{b}	82.00 ± 4.62^{c}

Note: Different superscript letters within the same row indicate significant differences ($P < 0.05$).

Regarding water quality, all treatments remained within relatively similar ranges, with temperature of 25-32°C, pH of 6-7, dissolved oxygen of 5.3 ppm, and ammonia of 0.168-0.187 ppm, as presented in Table 2.

Table 2. Water quality parameters during the experimental period.

Parameters	Feeding frequency of *Moina* sp. (times day^{-1})				
	1	2	3	4	5
Temperature (^{0}C)	25 - 32	25 - 32	25– 32	25– 32	25– 32
pH	6 – 7	6 -7	6 – 7	6 – 7	6 – 7
Dissolved oxygen (ppm)	5.3	5.3	5.3	5.3	5.3
Ammonia (ppm)	0.187	0.181	0.177	0.176	0.168

DISCUSSIONS

Biologically, these results are reasonable because the larval stage is the most sensitive phase to feed limitation. After yolk-sac absorption, larvae face high energy demands, whereas their digestive capacity, swimming ability, and prey-capture efficiency are still not fully developed. Under such conditions, live feed becomes particularly important because it is more compatible with larval mouth size, prey preference, and digestive ability. Teye-Gaga *et al*. (2025) emphasized that live feed remains an essential component in fish larviculture, while Joshua *et al*. (2022) reported that *Artemia* and *Moina* are important live feeds whose nutritional quality is closely associated with larval growth and resilience. Therefore, the positive response observed at higher feeding frequencies in the present study strengthens the view that successful larviculture depends not only on feed type, but also on the continuity of feed availability throughout the day.

In this study, all treatments received the same total daily ration, indicating that the differences among treatments primarily reflected the effect of feeding frequency rather than total feed quantity. This finding suggests that dividing the daily ration into more frequent feeding events increased the opportunity for each larva to access feed when needed, while also reducing periods without food intake. Such conditions may improve nutrient utilization efficiency and reduce competition among larvae. This interpretation is in agreement with Xu *et al*. (2025), who showed that feeding frequency affected growth and intestinal health in *Hemibagrus wyckioides*, and with Hamed *et al*. (2024), who reported that feeding frequency interacted with growth, immune response, and water quality in juvenile Nile tilapia. Although the species and life stages differed, both studies support the present findings that feeding frequency is a critical management factor influencing aquaculture performance.

The growth response in this study appeared to be more pronounced in weight-based parameters than in length-based parameters. Final weight, absolute weight gain, and specific growth rate showed clearer increases with increasing feeding frequency, whereas absolute length gain increased within a narrower range. This pattern indicates that during the 15-day rearing period, improvements in feeding management were reflected more rapidly in body biomass accumulation than in linear growth. Physiologically, a more stable supply of feed throughout the day likely allowed energy and nutrients to be utilized more efficiently for tissue formation. Thus, during the early larval stage, weight-based parameters appeared to be more sensitive indicators of the response to increasing *Moina* sp. feeding frequency.

Larval survival also showed a clear pattern. Survival rates at feeding frequencies of 1 and 2 times day^{-1} were still low, at 44.67 ± 3.53% and 43.33 ± 5.21%, respectively, then increased at feeding frequencies of 3 and 4 times day^{-1}, and reached the highest value at 5 times day^{-1}, namely 82.00 ± 4.62%. These results indicate that infrequent feeding was not sufficient to continuously meet larval nutritional requirements during this critical early life stage. Such conditions may increase the risk of feed deprivation, intensify competition among larvae, and ultimately reduce survival. The relevance of using *Moina* sp. for *H. nemurus* larvae is also supported by Dewi *et al*. (2019), who reported that *Moina* sp. contains 37.38% protein and 13.29% lipid and effectively promotes growth and survival in *H. nemurus* larvae. In addition, Joshua *et al*. (2022) emphasized that the nutritional quality of *Moina* and *Artemia* strongly determines larval performance in larviculture systems.

Because the variation in water quality among treatments was minimal, the observed differences in growth and survival were more likely attributable to feeding frequency than to changes in the rearing environment. Interestingly, ammonia concentration tended to decrease as feeding frequency increased, although the difference was relatively small. This pattern may indicate that a more even distribution of feed improved feed consumption by the larvae and reduced the accumulation of uneaten feed in the culture medium. Hamed *et al*. (2024) also demonstrated that feeding frequency may interact with water quality and physiological performance, suggesting that feeding schedules affect not only growth but also environmental stability during rearing.

Overall, the results of this study demonstrate that increasing the feeding frequency of *Moina* sp. provided clear biological and technical advantages in the rearing of *H. nemurus* larvae. The treatment of 5 times day^{-1} was the most effective, producing the highest growth and survival. These findings reinforce the view that optimizing live feed distribution schedules is a simple yet crucial management strategy for improving hatchery success. Teye-Gaga *et al*. (2025) identified live feed as a key component of successful larviculture, while Hena *et al*. (2025) highlighted the importance of managing cladoceran cultures, including *Moina* sp., as a strategic live feed resource in hatchery systems. Therefore, under the conditions of the present study, feeding *Moina* sp. 5 times per day can be recommended as the most effective strategy for the early rearing of *H. nemurus* larvae.

CONCLUSION

The feeding frequency of *Moina* sp. significantly affected the growth performance and survival of Asian redtail catfish larvae (*Hemibagrus nemurus*). Increasing the feeding frequency from 1 to 5 times per day tended to improve final weight, final length, absolute weight gain, absolute length gain, specific growth rate, and survival rate. The best performance was obtained at a feeding frequency of 5 times per day, resulting in a final weight of 0.09 ± 0.01 g, final length of 1.26 ± 0.01 cm, absolute weight gain of 0.09 ± 0.01 g, absolute length gain of 0.86 ± 0.01 cm, specific growth rate of 18.13 ± 0.38%, and survival rate of 82.00 ± 4.62%. Therefore, under the rearing conditions applied in this study, feeding *Moina* sp. 5 times daily is recommended as the most effective strategy to support the early rearing success of *H. nemurus* larvae.

DAFTAR PUSTAKA

Anizah, M. R., Saad, C. R., Kamarudin, & Rahim, A. A. (2017). Effect of dietary protein and protein energy ratio on the growth performance of lemon fin barb hybrid (*Hypsibarbus wetmorei X Puntius gonionotus*) larvae. *Iranian Journal of Fisheries Sciences, 16*(2), 711–721. https://doi.org/10.22092/IJFS.2018.114691

Dewi, A. T., Suminto, S., & Nugroho, R. A. (2019). Pengaruh pemberian pakan alami *Moina* sp. dengan dosis yang berbeda dalam *feeding regime* terhadap pertumbuhan dan kelulushidupan larva ikan baung (*Hemibagrus nemurus*). *Sains Akuakultur Tropis: Indonesian Journal of Tropical Aquaculture, 3*(1), 17-26. https://doi.org/10.14710/sat.v3i1.3267

Hamed, S., El-Kassas, S., Abo-Al-Ela, H. G., Abdo, S. E., Abou-Ismail, U. A., & Mohamed, R. A. (2024). Temperature and feeding frequency: interactions with growth, immune response, and water quality in juvenile Nile tilapia. *BMC Veterinary Research, 20*(1), 520. https://link.springer.com/article/10.1186/s12917-024-04366-4

Hena, S. M., Akanda, A. M., Ritu, J. R., Sumon, M. A. I., Haque, M. M., & Khan, S. (2025). Enhancing the efficiency of the cultivation of cladocerans (*Moina* sp. and *Diaphanosoma* sp.) through dietary diversification strategies. *Heliyon, 11*(1), e41608. https://doi.org/10.1016/j.heliyon.2024.e41608

Joshua, W. J., Kamarudin, M. S., Ikhsan, N., Yusoff, F. M., & Zulperi, Z. (2022). Development of enriched *Artemia* and *Moina* in larviculture of fish and crustaceans: a review. *Latin american journal of aquatic research, 50*(2), 144-157. https://doi.org/10.3856/vol50-issue2-fulltext-2840

Melaku, S., Geremew, A., Getahun, A., Mengestou, S., & Belay, A. (2024). Challenges and prospects of using live feed substitutes for larval fish. *Fisheries and Aquatic Sciences, 27*(8), 475–487. https://doi.org/10.47853/fas.2024.e45

Radona, D., Kusmini, I. I., Prakoso, V. A., Kristanto, A. H., & Fakhrurrazi, R. (2019). Evaluation on growth, survival and feed efficiency in three generations of domesticated Asian redtail catfish *Hemibagrus nemurus* (Valenciennes, 1840). *IOP Conference Series: Earth and Environmental Science, 348*(1), 012003. https://doi.org/10.1088/1755-1315/348/1/012003

Subagja, J., Prakoso, V. A., Arifin, O. Z., Suparyanto, Y., & Suhud, E. H. (2018). Pertumbuhan benih ikan baung (*Hemibagrus nemurus*) hasil domestikasi pada lokasi dengan ketinggian berbeda. *Media Akuakultur, 13*(2), 59–65. https://doi.org/10.15578/MA.13.2.2018.59-65

Suharman, I., Hasan, B., Hadi, K., & Caipang, C. M. A. (2026). Growth performance and feed efficiency of Asian redtail catfish (*Hemibagrus nemurus*) larvae in response to dietary shrimp protein hydrolysate. *Egyptian Journal of Aquatic Research, 52*(1), 86-91. https://doi.org/10.1016/j.ejar.2025.10.004

Teye-Gaga, C., Molnár, P. I., Mohammed, E. A. H., & Bársony, P. (2025). Utilization of live feeds in fish larviculture: A review. *Acta Agraria Debreceniensis,* 2, 103-116. https://doi.org/10.34101/actaagrar/2/15985

Valentine, S. A., Bauman, J. M., & Scribner, K. T. (2017). Effects of alternative food types on body size and survival of hatchery-reared lake sturgeon larvae. *North American Journal of Aquaculture, 79*(4), 275–282. https://doi.org/10.1080/15222055.2017.1330788

Xu, B., Wen, Z., Zheng, C., Tang, S., Xiao, T., Qiu, Y., & Liu, Q. (2025). Feeding frequency affects the growth performance and intestinal health of juvenile red-tail catfish (*Hemibagrus wyckioides*) with the same amount of daily feed. *Animals, 15*(11), 1621. https://doi.org/10.3390/ani15111621