INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 26, No. 4, p. 135-143, 2025
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Growth response of elvers (*Anguilla bicolor pacifica*) in tanks fed with different diets

Quirino G. Pascua*[1,2], Joshua U. Calipayan[1], Mark Stephen A. Pasaraba[1], John Lloyd B. Peregil[1]

[1]*Cagayan State University, Aparri Campus, Maura, Aparri, Cagayan, Philippines*

[2]*Iloilo State University of Fisheries Science and Technology, Tiwi, Barotac Nuevo, Iloilo, Philippines*

Article published on April 06, 2025

Key words: Specific growth rate, Feed conversion ratio, Survival rate, Efficiency

Abstract

This study investigated the growth response of elvers in tanks fed with different diets from March 1, 2024 to May 31, 2024. The study aimed to evaluate the (a) specific growth rates (both weight and length), (b) feed conversion ratio, and (c) survival rates. The results indicated that Treatment 2 (Taiwan Feeds) and Treatment 1 (China Feeds - Control) exhibited the highest specific growth rates in weight, with Treatment 2 recording 1±3.11 and Treatment 1 recording 0.8±0.40, while Treatment 3 (Formulated Feeds) exhibited the lowest specific growth rate in weight at 0.62±0.33. However, statistical analysis revealed no significant differences ($p>0.05$) on specific growth rates among all the treatments. On the other hand, Treatment 2 revealed the highest recorded SGR in terms of length at 1.67±0.19. Meanwhile, results on Feed Conversion Ratio (FCR) revealed that Treatment 1 with (2.11±0.33) is numerically efficient over the other two treatments. Survival rates for all three treatments were sustained at 100% over the 90-day culture period. These findings contribute valuable insights into optimizing elver growth under different feeding regimes, highlighting the potential efficiency of various feed sources in eel aquaculture at optimum culture environment.

***Corresponding Author:** Quirino G. Pascua ✉ quirinopascua@csu.edu.ph

Introduction

Eels are a high-end delicacy that has long been a favorite on the menus of Japanese restaurants. Compared to other freshwater fish, it has a high value. Eels have long been associated with Japanese, Chinese, or Korean cuisine in the Philippines. Nonetheless, it is envisaged that eels will be processed into a variety of goods in the future, increasing their domestic use and lowering their price. In rural estuaries, scoop nets were traditionally used by fishermen to catch glass eels. Some businesses and business people are now attempting to nurture this mysterious fish due to their popularity as a premium item. Because they make up nearly all aqua-cultured fish, glass eels are the most popular species for several reasons. Anguillid eels are catadromous, spawning in marine environments with the young migrating to fresh water. Eels breed in marine waters, with the eggs first hatching into leptocephalus larvae. Elvers succumbed to oxygen concentrations less than 2ppm; fingerling and larger eels were more tolerant of low dissolved oxygen (Cremer, 2009). Providing eels with the right food is important to their health and growth (Smith, 2022). For meat eaters, protein is an essential requirement (Boardman, 2024). Commercial foods are widely available, consisting of a protein paste for young eels and pellets for older eels (Moura *et al.*, 2012). These foods consist of high-quality fish proteins, oils, and nutrients to produce optimal growth (Santos *et al.*, 2023). The protein-based food, and also the high volume of eels that are kept together, mean that the water in the ponds or tanks becomes dirty quickly. Although very tolerant of many conditions, when the water becomes too dirty it can cause stress for the eels (Aya, 2022). This is another reason why access to lots of clean water is essential (Robert, 2024).

The critical period in eel culture is the period from glass eels to juveniles (Lee, 2003). Mortality occurs from a variety of factors, including disease, predation, and environmental stressors (Boardman, 2024). Slow growth or stunting is also observed in a large proportion of the eel population (Smith, 2022). To overcome these challenges, appropriate culture methods such as feeds and feeding, nutrition, and proper care and management are necessary (Martinez, 2018). These practices can help transition the eels from the glass eel stages to juvenile sizes with a reduced percentage of loss, making eel species more economically viable through commercial culture (Santos, 2023). Eel farms can be found in many nations, although Japan is by far the biggest producer, followed by European nations, Scandinavian nations, China, Taiwan, Australia, and Morocco (Smith, 2022). The farms typically start by obtaining stock, which often involves buying wild glass eels that are later sold and used to replenish the population on the farms (Boardman, 2024). For the most intensively farmed eels, tanks with recirculation systems are commonly utilized (Lee, 2022). These tank systems require easy access to plenty of clean water to ensure proper aeration and cleanliness (Aya, 2022). Additionally, electricity is needed to pump water throughout the system and maintain the ideal temperature (Martinez, 2018).

Eel farming is still dependent on wild glass eels collected from estuaries and tidal rivers (Liao *et al.*, 2002). Several fishing grounds in the Philippines are potential sources of glass eels for nursery culture. Wild eel stocks, mostly *A. marmorata*, are sourced from the Cagayan River. This eel species also comprised the bulk of the wild glass eel catch from the Pangi River (Valdez and Castillo, 2016). Lagonoy Gulf is also considered a potential glass eel fishing ground with a higher abundance of *A. bicolor pacifica* than *A. marmorata* (Nieves and Nolial, 2019). In Southern Mindanao, glass eel collection areas for *A. bicolor pacifica* include Rio Grande de Mindanao, Davao Gulf, and Sarangani Bay (Ame, 2021). The Philippine Bureau of Fisheries and Aquatic Resources (BFAR) disclosed that eels are cultured in 23 provinces (Ame, 2022). In these eel culture areas, farming techniques of the Philippine native eels are adopted mainly from the culture of European and Japanese eel species, which are commonly done in concrete tanks or ponds. The culture of glass eels or elvers in cages inside a concrete pond is not common, although this culture practice has been documented in the southern Philippines (Surtida, 2000). Examining the response of these two eel species reared simultaneously under cage conditions may offer an alternative culture method.

The aquaculture industry has experienced significant growth over the past decades, driven by the increasing demand for seafood and the depletion of wild fish stocks. Among the various species cultured, eels of the *Anguilla* genus have gained considerable attention due to their high market value and unique life history traits. *Anguilla* spp., commonly known as elvers, are juvenile eels that undergo extensive growth and development before reaching adulthood. In order to support the sustainable production of elvers in aquaculture, it is crucial to optimize their growth response through the implementation of appropriate feeding strategies. While natural diets such as live prey organisms have been traditionally used in elver rearing, the availability and reliability of these food sources pose significant challenges. Commercial feeds, on the other hand, offer a practical alternative for providing balanced and controlled nutrition to elvers, thereby enhancing their growth potential.

However, despite the potential benefits of commercial feeds, there is a need to evaluate their efficacy in promoting the growth of *Anguilla* spp. in a controlled tank environment. Several factors, including feed composition, digestibility, and feed conversion efficiency, can influence the growth response of elvers when fed commercial feeds. Understanding these factors and their impact on elver growth is essential for optimizing feeding protocols and maximizing production efficiency in the aquaculture sector.

Thus, this research aimed: a) to determine the Specific Growth Rate (SGR) of elvers (*A. bicolor pacifica*) in terms of weight and length using different diets, b) to determine the feed conversion ratio (FCR) of (*A. bicolor pacifica*) fed with formulated feeds, and c) to investigate the survival rate of elvers (*A. bicolor pacifica*).

Materials and methods

Study area

A private area along Punta, Aparri, Cagayan was the study site and was located at 18°21'28.3"N 121°38'03.7" E and was conducted from March 1, 2024 to May 31, 2024. The stocks were acquired at Minanga Weste, Buguey Cagayan.

Experimental treatments and design

There were three (3) treatments. The different treatments were the following:

T1 = China Feeds (Control)

T2 =Taiwan Feeds

T3 =Formulated Feeds (Ashnelia's Eel Feeds)

The experimental set-up was Complete Randomized Block Design (CRBD), as shown in the Fig. 1 below:

Fig. 1. Experimental set-up

Tank preparation process

In this study, we used circular tanks having a diameter of 0.76m and a height of 0.28m. The tank has a 3cm slope to the center facilitating the ease of draining and cleaning.

Installation of concrete tanks

In this study, the researchers used circular concrete tanks with a diameter of 0.76 m and a height of 0.28m with a volume of 0.13 m3 which was used to accommodate the elvers. A diameter of 2-inch PVC tube was installed at the center serving as drainage and aeration was installed using a diameter of 0.5-inch PVC with holes for the controller and silicone hose with sinker in it.

Stocking and stocking density

Stocking was done early in the morning to avoid stress. Total stocks (90 pieces) were acquired from a private eel farm owned by Mr. Alex Fariňas, located at

Minanga Weste, Buguey, Cagayan. Each tank was stocked with 10 pieces of elvers (*Anguilla bicolor pacifica*).

Feeds and feeding management

Daily Feed Ratio (DFR) was computed once a month serving as a guide for the researchers in feeding (Table 1). Three (3) treatments with three replicates were used in this study, consisting of a CP of 45% Formulated feeds, 43% China feeds, and 45% Taiwan feeds. In consideration of the characteristics of eels which were nocturnal or species that were active at night, the stocks were fed twice a day particularly 60% in 6:00 PM and 40% in 6:00 AM based on the computed DFR.

Table 1. Feeding guide

Days	Type of feed	Feeding rate	Feeding frequency
0-15	Dough	5%	2x a day
16-30	Dough	5%	2x a day
31-45	Dough	5%	2x a day
46-60	Dough	5%	2x a day
61- 75	Dough	5%	2x a day
76- 90	Dough	5%	2x a day

Water management

Water exchange was conducted in all tanks. The researchers used bricks for the elvers to hide to prevent them from accidentally being scooped. Subsequently, a dipper was used to remove all the water in the tank. Once the water was removed, the tank was cleaned using a sponge. Through the use of a hose incorporated into the pump well, the tank was resupplied with the same volume of water before draining.

Data gathering

Data on Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), and Survival Rate (%S) were taken into account for the whole duration of this study.

Weight (ABW) and length

Sampling of stocks was conducted every two weeks in each treatment, utilizing the entire stock population. During sampling, researchers used a scoop net to capture the elvers, transferring them to a basin filled with water. Subsequently, each elver was individually placed on a wet cloth, alongside a foot ruler to measure its length accurately and immediately each sample was weighed and then returned to the culture tanks to avoid stress. During the weighing of stocks, the elvers are placed in a tared basin filled with water on the weighing scale. The researchers meticulously recorded these parameters for computation.

Specific growth rate

$$\text{SGR (weight)} = \frac{\text{Final weight} - \text{initial weight}}{\text{culture period}} \times 100\%$$

$$\text{SGR (length)} = \frac{\text{Final length} - \text{initial length}}{\text{culture period}} \times 100\%$$

Feed conversion ratio

Feed Conversion Ratio was determined using the formula below:

$$\text{FCR} = \frac{\text{Total feed consumed}}{\text{Wet weight gain}}$$

Survival rate

Survival Rate was determined adopting the formula below:

$$\text{SR} = \frac{\text{Total stocks recovered}}{\text{Initial stocks}} \times 100\%$$

Data analysis

All data gathered on growth (SGR), FCR and percentage survival was subjected to One-Way ANOVA Test. Data on Feed Conversion Ratio (FCR) and Survival Rate was taken adopting the formula presented above. Comparisons of means were done using the (LSD). The Least Significant Difference (LSD) test is used when the difference between the population means is significant. This test helps to identify the populations whose means are statistically different. It helps identify significant differences between multiple groups or treatments in an experiment. By comparing the means of different groups and considering the variability within and between them. Its results can reveal whether there are statistically significant variations among the groups, allowing researchers to make informed decisions based on the observed differences.

Results and discussion

Specific growth rate (SGR) of A. bicolor pacifica

Fig. 2 displays the Specific Growth Rate of elvers in terms of weight. Treatment 2 (Taiwan) exhibits the highest overall mean SGR with (1±0.40) while the lowest overall SGR recorded was observed in Treatment 3 with (0.62±0.33), and Treatment 1 (China) came second with (0.8±0.61). The statistical results did not show a significant difference ($p>0.05$) among the treatments.

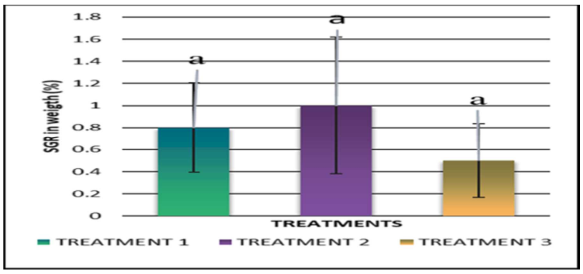

Fig. 2. Mean specific growth rate in weight of all treatments

The results of this study highlight the differential impacts of various feeding treatments on the growth performance of eels, as measured by specific growth rate in terms of both weight and length. Treatment 2, utilizing Taiwan eel feeds, demonstrated the highest SGR, indicating its efficacy in promoting growth in eels, implying potentially favorable conditions or specific practices contributing to enhanced growth. This observation aligns with existing studies highlighting the importance of environmental factors, feed quality, and management practices in aquaculture systems (Gjedrem *et al.*, 2012).

Although Treatment 3 exhibited the lowest SGR, it is essential to explore potential factors contributing to this outcome. Factors such as water quality, temperature, stocking density, and feed composition could influence growth rates in aquaculture settings (Mannan, 2012). Further investigation into these variables could provide insights into optimizing growth conditions for elvers.

Despite the observed differences in SGR among the treatments, the statistical analysis did not indicate a significant difference ($p>0.05$). This lack of significance suggests that while there are variations in growth rates across treatments, they may not be statistically significant within the scope of this study. However, it is essential to consider the sample size, duration of the study, and potential confounding variables that might influence the statistical outcomes (Hansen *et al.*, 2019).

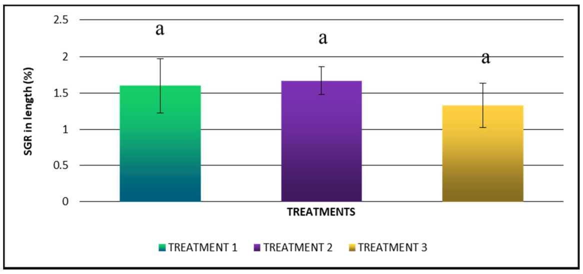

Fig. 3. Mean specific growth rate in length of all treatment

Moreover, research conducted by Lui *et al.* (2019) examined the digestibility of various ingredients commonly used in formulated feeds for eels. They observed differences in digestibility rates among ingredients selection and processing methods in formulated feeds that maximize nutrient absorption and utilization by eels.

Meanwhile, Fig. 3 indicates the highest recorded SGR in terms of length which was observed in Treatment 2 with (1.67±0.19) while the lowest SGR (length) was observed in Treatment 3 with (1.33±0.30). Results showed no significant difference with each other ($p>0.05$).

Feed conversion ratio of A. bicolor pacifica

FCR or Feed Conversion Ratio indicates the proportion of feed provided to the amount of weight gained by the animal within a specific time frame. Fig. 4 indicates that Treatment 2 has the highest overall mean FCR with (2.72±0.28) while the lowest overall FCR recorded was Treatment 1 with (2.11±0.33), and Treatment 3 with (2.4+0.20), respectively. The statistical results did not show a significant difference ($p>0.05$) among the treatments.

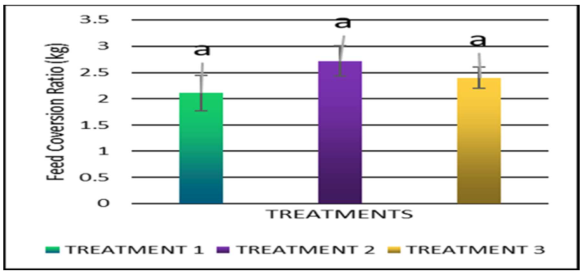

Fig. 4. Mean feed conversion ratio of different treatment

The results indicate that Treatment 1, utilizing China eel feeds, exhibited the lowest mean FCR among the three treatments, suggesting greater efficiency in converting feed to eel biomass. This finding aligns with previous studies that have highlighted the efficacy of China eel feeds in promoting optimal growth and feed utilization in eel farming operations. The superior performance of China eel feeds in terms of FCR may be attributed to their composition, which could include a balanced blend of nutrients tailored to the nutritional requirements of eels.

In contrast, Treatment 2, utilizing Taiwan eel feeds, demonstrated the highest mean FCR among the treatments. This result contradicts some earlier research suggesting that Taiwan eel feeds are comparable to or even superior to other alternatives in promoting efficient growth and feed conversion in eels (Lin *et al*., 2016). However, variations in feed composition, sourcing, and processing methods could contribute to the observed differences in FCR between studies.

Treatment 3, fed with formulated eel feeds, yielded a mean FCR intermediate between Treatment 1 and Treatment 2. While formulated feeds offer the advantage of precise control over nutrient composition and feed quality, the slightly higher FCR compared to China eel feeds may indicate areas for further optimization in feed formulation and nutrient utilization efficiency.

Further research could explore other aspects of feed response such as growth rates, nutrient utilization, and eel health parameters, to provide a more comprehensive understanding of the overall suitability of each feed type for eel cultivation. Additionally, investigating the long-term effects of feed type on eel growth and quality could offer valuable insights for optimizing feeding strategies in eel aquaculture (Pedersen, 2000).

Survival rate of A. bicolor pacifica

Survival rate refers to the percentage of organisms that survive a specific period of time. Survival rate typically calculated by dividing the number of surviving organisms at the end of the designated period over the initial number of organism stocked, then multiply it by 100 to express the result as a percentage. The survival rate of *A. bicolor pacifica* was determined after 90 days of culture in the three (3) treatments fed with China, Taiwan, Formulated feeds, respectively, obtaining a 100% survival rate.

The survival rates of eels were investigated under three different feeding treatments: Treatment 1 utilizing eel feeds sourced from China, Treatment 2 employing eel feeds from Taiwan, and Treatment 3 consisting of formulated feeds. Remarkably, all three treatments yielded a 100% survival rate (Fig. 5). Same observations were recorded in the study of Idris *et al*. (2015). This was presumably due to the quality and quantity of the feeds given to the eels were enough to sustain the basic needs of the fish. Sabariah (2010) also stated that a well-maintained environment specifically sustaining optimum levels of water parameters could be another factor affecting the fish survival rate.

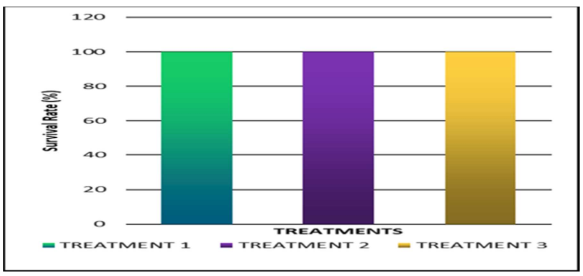

Fig. 5. Mean survival rate of *A. bicolor pacifica* in different treatments

This finding is consistent with several studies that have demonstrated the efficiency of various feeding regimes in promoting the survival of eels in aquaculture settings. For instance, a study by Li *et al.* (2019) compared the survival rates of Japanese eels fed with feeds sourced from different regions, including China and Taiwan. The researchers found that eels fed with feeds from both regions exhibited high survival rates, indicating the suitability of these feeds for eel cultivation.

Similarly, a study by Chen *et al.* (2020) investigated the use of formulated feeds in eel aquaculture and reported excellent survival rates among eels fed with such feeds. The formulated feeds provided a balanced nutritional profile tailored to the dietary requirements of eels, resulting in optimal growth and survival.

Furthermore, the findings of this study align with the broader literature on aquaculture feeding practices, which emphasizes the importance of selecting high-quality feeds to ensure the health and survival of cultured organisms. Whether sourced from specific regions or formulated to meet nutritional needs, the provision of appropriate feeds was essential for maximizing survival rates and overall productivity in eel farming operations.

Overall, this study highlights the efficacy of various feeding strategies, including the use of feeds sourced from China and Taiwan, as well as formulated feeds, in promoting the survival of eels in aquaculture systems.

Conclusion

The study concluded that Treatment 2 (Taiwan eel feeds) exhibited the highest specific growth rate (SGR) in terms of weight and length, while Treatment 3 (Formulated eel Feed) showed the lowest; however, the differences among treatments were not statistically significant, emphasizing the importance of selecting appropriate feed formulations and management practices to optimize growth performance and ensure the sustainability of eel aquaculture operations. All three treatments achieved a feed conversion ratio (FCR) of 1.5, indicating efficient feed-to-growth conversion, and obtained a 100% survival rate, underscoring the reliability of each feed option in supporting the overall health and growth of the elvers.

Based on these findings, it is recommended that future research delve deeper into the nutritional composition of these feeds and their impact on eel health to further refine feeding practices. Additionally, extending study durations to a minimum of five months or longer is suggested to gather comprehensive data and better assess growth patterns, while developing specific strategies for culturing *A. bicolor pacifica* to provide practical solutions for improving eel farming productivity.

Acknowledgements

Our sincerest gratitude is accorded to the following individuals who helped us in the success of this journey: Mr Arsenio Tagaca, Jr and Miss Monica Rosagas for providing us the space for the conduct of the study, to Prof. Glycinea de Peralta, the statistician, Prof. Salvador Miranda,Jr for his technical inputs, to Mr. Alexis Fariñas as the source of kuroko and China feeds and for sharing his expertise on Eel, to the parents of the researchers for their financial assistance, to John Michael Carascon, Angelo Abinan and Daniel Valencia the researchers friends for their help and assistance during the conduct of sampling and to CEO Audy Quebral of CSU Aparri for his outpouring support and guidance and to Dr. Roy Villanueva of ISUFST for his guidance.

References

Ame E, Mayor AD. 2022. Efficient fishing method to control the population of rice eel, *Monopterus albus* (Synbranchidae) in rice fields in Cagayan Valley, Philippines. The Philippine Journal of Fisheries **28**(2), 228–245.

Aya FA, Unida JCL, Garcia LMB. 2023. Effect of size grading on growth of yellow Pacific shortfin eel (*Anguilla bicolor pacifica*). Journal of Fish Biology **102**(5), 1237–1244.

Boardman R, Pinder AC, Britton R, Piper A, Gutmann RC, Wright R. 2024. Variability in the duration and timing of the estuarine to freshwater transition of critically endangered European eel *Anguilla anguilla*. Aquatic Sciences **86**, 1–12.

Chen S. 2020. Dietary lipid concentrations influence growth, body composition, morphology of the mid-intestine, and antioxidant status of marble eel (*Anguilla marmorata*). Aquaculture International **28**, 2287–2302.

Chen W, Liu C, Cheng C. 2019. Nutritional composition and digestibility of Taiwan eel feeds. Aquaculture Asia Pacific Magazine **15**(1), 34–37.

Cremer M. 2009. Eel culture in the Philippines. Proceedings of the Annual Meeting, World Mariculture Society **7**, 129–136.

Food and Agriculture Organization of the United Nations (FAO). 2010. *Anguilla japonica*. Cultured aquatic species information programme. In: Fisheries and Aquaculture. Rome: FAO.

Gjedrem T, Robinson N, Rye M. 2012. The importance of selective breeding in aquaculture to meet future demands for animal protein: A review. Aquaculture **350–353**, 117–129.

Hasan MR, Halwart M (eds). 2009. Fish as feed inputs for aquaculture: Practices, sustainability and implications. FAO Fisheries and Aquaculture Technical Paper No. 518. Rome: FAO.

Idris A, Patang P. 2023. Influence of different protein doses on digestibility levels and food retention in reared eel fish. Egyptian Journal of Aquatic Biology and Fisheries **27**(6), 1007–1024.

Karipoglou C, Nathanailides C. 2009. Growth rate and feed conversion efficiency of intensively cultivated European eel (*Anguilla anguilla* L.). International Journal of Fisheries and Aquaculture **1**, 11–13.

Kuo IP, Liu CS, Yang SD, Liang SH, Hu YH, Nan FH. 2022. Effects of replacing fishmeal with defatted black soldier fly (*Hermetia illucens* Linnaeus) larvae meal in Japanese eel (*Anguilla japonica*) diet on growth performance, fillet texture, serum biochemical parameters, and intestinal histomorphology. Aquaculture Nutrition **2022**, 14.

Lee CH, Kim SH, Lee KW, Han GS, Byun SG, Lim HJ, Lee DY, Choi J. 2018. Effects of dietary lipid level on growth performance, feed utilization, fatty composition and antioxidant parameters of juvenile walleye pollock, *Gadus chalcogrammus*. Aquaculture Reports **19**.

Lee WC, Chen YH, Lee YC, Liao C. 2003. The competitiveness of the eel aquaculture in Taiwan, Japan, and China. Aquaculture **221**(1–4), 115–124.

Li P, Li ZU, Wu Y. 2021. Interactive effects of temperature and mercury exposure on the stress-related responses in freshwater fish. Aquaculture Research **52**(5), 2070–2077.

Liao C. 2002. Promoting tropical eel in the Philippines – Southeast Asian Fisheries Development Center (SEAFDEC) Repository. Fish for the People **20**(3), 36–38.

Lin CK, Wang YS, Lin YC, Chen SH, Shiau SY. 2016. Dietary phosphorus requirement of juvenile eels, *Anguilla marmorata*, and effects of phytase supplementation on growth, feed utilization, body composition, and phosphorus discharge. Aquaculture **452**, 156–163.

Lui G. 2019. An oxygen vacancy-rich semiconductor-supported bi-functional catalyst for efficient and stable zinc-air batteries. Advanced Materials **3**(6).

Mannan M, Islam S, Ruksana H, Nowara S, Nowara M. 2012. Impact of water quality on fish growth and production in semi-intensively managed aquaculture farm. Bangladesh Journal of Environmental Sciences **23**, 108–113.

Moura A, Dias E, López R, Antunes C. 2022. Regional population structure of the European eel at the southern limit of its distribution revealed by otolith shape signature. Fishes **7**(3), 135.

Murrieta-Martínez CL, Soto-Valdez H, Pacheco-Aguilar R, Torres-Arreola W, Rodríguez-Felix F, Márquez E. 2018. Edible protein films: Sources and behavior. Packaging Technology and Science **31**, 113–122.

Pedersen MI. 2000. Long-term survival and growth of stocked eel, *Anguilla anguilla* (L.), in a small eutrophic lake. Journal of Fisheries and Marine Research **12**, 71–76.

Robert R. 2024. Variability in the duration and timing of the estuarine to freshwater transition of critically endangered European eel *Anguilla anguilla*. Aquatic Sciences **86**(1), 1–12.

Santos F, Baure J, Santos MN. 2023. Mixed methods approach in documenting aquaculture practices and market dynamics of the freshwater eel *Anguilla* spp. industry in the Philippines. The Philippine Journal of Fisheries **30**(1), 77–96.

Valdez A, Castillo T. 2016. Abundance and distribution of freshwater eel in Pangui River, Maitum, Sarangani Province. Aquaculture Research and Development **7**(2).

Zhang M, Wu X, Zhai S. 2022. Effect of dietary compound acidifiers supplementation on growth performance, serum biochemical parameters, and body composition of juvenile American eel (*Anguilla rostrata*). Fishes **7**(4), 203.