



Aquarium keeping and the ornamental fish trade: balancing psychological, educational, and conservation benefits with environmental and ethical challenges

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Abstract. Aquarium keeping represents a multifaceted hobby that combines leisure, scientific engagement, and educational opportunities. Its practice offers well-documented psychological benefits, including stress reduction, mood enhancement, and attentional focus, while also fostering responsibility and empathy in caretakers. Beyond individual well-being, aquariums serve as accessible microcosms for ecological research and citizen science, supporting conservation initiatives and enhancing public understanding of biodiversity. The hobby's educational value is underscored by hands-on learning experiences that integrate biology, chemistry, and environmental science, promoting critical thinking and ecological literacy. However, aquarium keeping is accompanied by significant limitations. The global ornamental fish trade, particularly between Southeast Asia and the European Union, poses challenges related to sustainability, traceability, biosecurity, and invasive species introduction. Wild capture, unsustainable harvesting practices, and insufficient regulation can negatively impact natural populations and ecosystems, while ethical concerns about animal welfare persist. This review synthesizes current knowledge on the benefits and limitations of aquarium keeping and highlights the need for informed, responsible practices to balance personal, scientific, and ecological interests.

Key Words: aquarium keeping, ornamental fish trade, psychological benefits, education, conservation, biodiversity, invasive species, animal welfare, sustainability, EU-Southeast Asia trade.

Purpose of the study. The purpose of this review is to critically examine the complex interplay between the benefits and limitations of aquarium keeping, encompassing psychological, educational, and scientific dimensions, while simultaneously evaluating the environmental, ethical, and regulatory challenges posed by the ornamental fish trade. By synthesizing empirical evidence and recent trade data, particularly on the EU-Southeast Asia aquarium commerce, the study aims to provide a comprehensive understanding of how this hobby influences human well-being, learning, conservation efforts, and global biodiversity, and to identify pathways for responsible and sustainable practices.

Aquarium keeping: benefits and limitations. Aquarium keeping, as a structured and intentional hobby, has long been recognized for its multifaceted benefits, spanning psychological well-being, scientific contribution, education, and the cultivation of responsibility. At its core, the practice involves the recreation of aquatic ecosystems within controlled environments, allowing individuals to observe, maintain, and interact with aquatic life in a manner that bridges leisure and applied knowledge (Petrescu-Mag et al 2013; Gavrioloaie et al 2025). The appeal of aquariums is not merely aesthetic; rather, it is

deeply rooted in their capacity to influence human cognition and emotion in measurable and meaningful ways (Collins et al 2020).

One of the most extensively documented benefits of aquariums is their positive impact on mental health. Observing aquatic organisms in a calm, controlled environment has been shown to reduce stress, lower blood pressure, and promote relaxation. This phenomenon is often attributed to the rhythmic and predictable movement of fish, as well as the visual qualities of water, which can induce a meditative state (Oldfield & Bonano 2023). In clinical settings, aquariums have been integrated into waiting rooms, psychiatric facilities, and long-term care institutions as a non-invasive therapeutic tool. Patients suffering from anxiety disorders, depression, or cognitive decline frequently exhibit improved mood and reduced agitation when exposed to such environments (Lundberg & Srinivasan 2021). The sensory experience provided by aquariums, combining visual, auditory, and even tactile stimuli, can function as a form of environmental enrichment that supports emotional regulation and attentional focus (Petrescu-Mag & Bud 2017).

From a scientific perspective, aquariums serve as valuable microcosms for studying ecological interactions, animal behavior, and environmental dynamics. Even at a hobbyist level, maintaining an aquarium requires an understanding of biological cycles such as nitrification, the balance of chemical parameters including pH, ammonia, nitrites, and nitrates, and the interdependence of species within an ecosystem (Marchio 2018). This hands-on engagement fosters a practical comprehension of ecological principles that might otherwise remain abstract. Moreover, aquarists sometimes contribute to citizen science by breeding rare species, documenting behavioral patterns, or maintaining populations of organisms that are difficult to study in the wild. In certain cases, captive breeding programs initiated by enthusiasts have supported conservation efforts, particularly for species threatened by habitat loss (Müller et al 2018; Şerban & Grigoraş 2018; Arisyanto et al 2024; Garcia et al 2025; Horváth et al 2025; Lam et al 2025; Marzuqi et al 2025; Pertiwi et al 2025).

The educational value of aquariums is equally significant. For children, adolescents, and students, the aquarium can function as an interactive learning platform that integrates biology, chemistry, and environmental science (Petrescu-Mag 2025a, b, c). Unlike passive forms of learning, aquarium maintenance requires continuous observation, hypothesis testing, and problem-solving (Kelly et al 2022). For instance, identifying the cause of fish stress or disease necessitates an understanding of water chemistry, nutrition, and species compatibility. This process cultivates critical thinking and scientific literacy. Additionally, aquariums can enhance awareness of biodiversity and ecological fragility, encouraging a deeper appreciation for aquatic environments such as rivers, lakes, and oceans (Tlustý et al 2013).

Closely linked to education is the role of aquarium keeping in fostering responsibility. The maintenance of an aquarium demands consistency, discipline, and long-term commitment. Aquatic organisms are entirely dependent on the caretaker for survival, requiring regular feeding, water changes, equipment monitoring, and health assessments. This responsibility can be particularly beneficial for younger individuals, as it instills a sense of accountability and empathy toward living beings. Delayed consequences, like poor water quality or disease outbreaks, reinforce routine and attentiveness (Petrescu-Mag 2007).

Despite these advantages, the aquarium hobby is not without its drawbacks, particularly when considered from the perspective of biodiversity and environmental ethics. One of the primary concerns is the impact of the ornamental fish trade on wild populations (Petrescu-Mag et al 2013). Many species are still collected from natural habitats (Saputra et al 2024), sometimes through unsustainable or destructive practices. Overharvesting can lead to population declines and disrupt local ecosystems. In extreme cases, methods such as the use of cyanide for fish capture have caused significant collateral damage to coral reefs and other marine life. Even when collection methods are less harmful, the removal of organisms from their native environments can alter ecological balances.

Another issue arises from the potential introduction of non-native species into local ecosystems. Aquarium owners who release unwanted fish or plants into the wild may inadvertently contribute to biological invasions. These introduced species can outcompete native organisms, spread diseases, and cause long-term ecological damage. Such

outcomes are often difficult to reverse and highlight the broader environmental responsibility associated with the hobby (Bud et al 2006; Petrescu & Mag 2006; Petrescu & Mag 2007; Petrescu-Mag & Gavriloiu 2019; Mousavi-Sabet 2023).

In addition to biodiversity concerns, there are practical and economic disadvantages. Aquarium setup and maintenance can be costly, particularly for larger or more complex systems such as marine or reef aquariums. Equipment such as filtration systems, lighting, heaters, and testing kits requires initial investment and ongoing maintenance. Energy consumption is another factor, as aquariums often rely on continuous operation of electrical devices. Furthermore, the time commitment involved in maintaining water quality and ensuring the health of inhabitants can be substantial, potentially becoming burdensome for individuals with limited availability. Ethical considerations also emerge regarding animal welfare. Not all species adapt well to captivity, and inadequate conditions, such as insufficient space, poor water quality, or incompatible tank mates, can lead to chronic stress and reduced lifespan. The commercialization of the hobby sometimes prioritizes aesthetic appeal over the well-being of organisms, leading to practices such as selective breeding for exaggerated traits that may compromise health.

Aquarium keeping represents a complex and multifaceted activity that offers significant psychological, educational, and scientific benefits while simultaneously posing notable environmental, ethical, and practical challenges. Its value as a hobby lies not only in the enjoyment it provides but also in its capacity to connect individuals with broader ecological systems (Petrescu-Mag & Bud 2017). However, this connection entails responsibility, requiring informed and conscientious practices to mitigate its negative impacts, particularly on biodiversity and animal welfare (Nursan et al 2025; Quiao et al 2025; Ruslan et al 2025; Saputra et al 2025).

The EU-Southeast Asia ornamental aquarium trade: recent evidence. The ornamental aquarium trade links Southeast Asia’s rich aquatic biodiversity with the European Union’s large, high-value import market. Research shows this commerce is economically significant but poorly documented at species level, complicating assessments of sustainability, conservation impacts and biosecurity.

Scale, structure and main trade flows. For marine ornamental fish alone, EU imports in 2014-2021 averaged about EUR 24 million per year and around 26 million individual specimens, making the EU the largest import market by value for these products (Biondo et al 2024). Between 2014 and 2021, 61 countries exported marine ornamental fish to the EU, with Southeast Asia (especially Indonesia, the Philippines, Sri Lanka, and Singapore as a hub) identified as a primary source region for coral-reef species (Pinnegar & Murray 2019; Biondo & Burki 2020; Pouil et al 2020; Biondo & Calado 2021; Biondo et al 2024). These key economic and geographic features of the EU–Southeast Asia ornamental trade are summarized in Table 1.

Table 1

Key economic and geographic features of EU-Asia ornamental trade (summarized by Consensus 2026)

<i>Aspect</i>	<i>Evidence for EU-Southeast Asia link</i>	<i>References</i>
Main source region	Indo-Pacific coral reefs, especially Southeast Asia	Biondo & Burki 2020; Biondo & Calado 2021; Pouil et al 2020; Pinnegar & Murray 2019
Trade value (EU, marine)	~EUR 24 million year ⁻¹ , 26 million fish (2014-2021)	Biondo et al 2024
Global share (freshwater)	90% of traded species captive-bred, mainly in Asian farms	Evers et al 2019; King 2019; Anjur et al 2021
Major Asian exporters	Singapore, Indonesia, Malaysia, Thailand among key suppliers	Evers et al 2019; Novák et al 2025; Pouil et al 2020; Pinnegar & Murray 2019; Anjur et al 2021

Globally, the ornamental fish trade (freshwater and marine) is estimated at USD 15-30 billion per year, about 90% in freshwater species, most bred in Asian facilities, notably Singapore, Malaysia, Indonesia and other developing countries (Evers et al 2019; Anjur et al 2021). Marine ornamentals, in contrast, are still 90-95% wild-caught from coral reefs, largely in the Indo-Pacific, including Southeast Asia, and then exported to major markets such as the EU, USA and Japan (King 2019; Pinnegar & Murray 2019; Biondo & Burki 2020; Pouil et al 2020).

Species composition, sources and trade hubs. In EU marine imports (2014-2021), 1,452 species of ornamental reef fishes were recorded, but about one-third of specimens lacked species-level identification, reflecting weak traceability (Biondo & Burki 2020; Biondo & Calado 2021; Biondo et al 2024). In European freshwater ornamental aquaculture, imports come mainly from Singapore, Indonesia, Thailand, Brazil, Colombia, Peru and Nigeria, with Singapore also acting as a major trans-shipment and redistribution hub (Evers et al 2019; Pinnegar & Murray 2019; Pouil et al 2020; Anjur et al 2021; Novák et al 2025).

Across the global industry, about 1,000 freshwater species are widely available out of more than 5,300 on sale, but market turnover is dominated by roughly 30 common species; the total number of freshwater and brackish species traded has now exceeded 7,900 worldwide, many supplied from Asian breeding centers and imported into Europe (Evers et al 2019; Novák et al 2020; Novák et al 2025).

Regulation, data systems and biosecurity. The EU uses the TRACES electronic system to monitor live animal movements, including marine ornamental fish, but current reporting often aggregates data and omits species-level details, leaving EU authorities “unable to find Nemo and Dory” reliably (King 2019; Trujillo-González et al 2019; Biondo & Burki 2020; Biondo & Calado 2021; Biondo et al 2024). Proposals emphasize making exporters in source countries (notably in Southeast Asia) report exact species, numbers, origin (collection locality vs transit hub) and whether wild-caught or aquaculture-bred as a condition for EU market access (Trujillo-González et al 2019; Biondo & Burki 2020; Pouil et al 2020; Biondo & Calado 2021; Biondo et al 2024).

At the same time, EU legislation on invasive alien species and animal health increasingly affects ornamental imports, and molecular tools (e.g., environmental DNA and genetic tracing in crayfish) show that many non-native aquarium organisms in Europe originate from the Asian ornamental trade (King 2019; Trujillo-González et al 2019; Jones et al 2021; Novák et al 2025; Oficialdegui et al 2025).

Discussion on EU-Southeast Asia ornamental aquarium trade. Research portrays a tightly interlinked commercial relationship in which Southeast Asia is a primary producer and collector of ornamental fishes and invertebrates, and the EU is a high-value, high-volume import market. Marine ornamentals are mainly wild-caught in Indo-Pacific reefs, while most freshwater species are bred in Asian aquaculture and shipped to Europe. However, incomplete, non-standardized trade data and limited species-level traceability mean that precise, product-specific trade balances between the EU and Southeast Asia cannot yet be quantified reliably from current scientific sources.

EU measures on ornamental aquatic wildlife: when wild-capture is forbidden. The European Union regulates wild capture of aquatic organisms for the ornamental trade mainly through biodiversity, invasive-species and wildlife-trade law, not a single aquarium law. Bans typically apply to specific species or pathways (invasive, endangered, or illegally sourced), while other captures remain permitted under controls.

Invasive alien species and ornamental trade. Species of Union concern (Regulation 1143/2014): For listed invasive alien species, trade, transport, keeping, breeding and release are prohibited in EU territory, with only narrow licensing possibilities (Coughlan et al 2020; Patoka et al 2017; Puzkarski & Śniadach 2022). This covers several aquatic and

semi-aquatic species relevant to the pet and pond trade (e.g. turtles, crayfish) (Dee et al 2013; Patoka et al 2018; Coughlan et al 2020).

Member States must also prevent unintentional introduction or spread, which can lead to de facto bans on capture and movement for high-risk species (Coughlan et al 2020; Puzzkarski & Śniadach 2022).

For turtles such as *Trachemys scripta*, trade was banned in the EU under implementing rules of 1143/2014; imports ceased after 2016 (Dee et al 2013) (Table 2).

Table 2

Examples of prohibited or targeted groups (summarized by Consensus 2026)

<i>Situation</i>	<i>Regulatory consequence</i>	<i>References</i>
Listed invasive alien species	Capture for trade and keeping generally banned (very limited exemptions)	Dee et al 2013; Patoka et al 2017; Patoka et al 2018; Coughlan et al 2020; Puzzkarski & Śniadach 2022
Aquatic plants on EPPO / national invasive lists	Recommended/implemented bans on import, sale and intentional release	King 2019; Coughlan et al 2020; Tinacci et al 2025
Invasive crayfish species of Union concern	Legal restrictions on trade; ongoing illegal trade noted	Auliya et al 2016; Patoka et al 2018

CITES, wildlife trade and endangered species. The EU applies and tightens CITES rules via Wildlife Trade Regulation (EC 338/97), allowing the Scientific Review Group to block imports of species or from countries when sustainability is doubtful (Biondo et al 2024).

For CITES-listed ornamental reef fish and invertebrates, this can mean no legal import or commercial use of wild-caught specimens if trade is judged unsustainable (Biondo et al 2024; Wróblewski et al 2025).

Illegal, unreported or unsustainable capture. Illegal capture of native species for ponds and aquaria is recognised as a problem; studies call for prohibiting stocking of potential invaders and enforcing bans on illegal capture and sale of native species (Calado 2006; Genovesi et al 2015).

In the amphibian trade, authors recommend restricting or suspending trade for threatened, range-restricted and nationally protected species, effectively forbidding wild capture for commerce (Di Blasio et al 2023).

Weak enforcement can leave regulations as “dead letters”, but where enforced, illegal wild capture is clearly prohibited (Tollington et al 2015; Auliya et al 2016; Patoka et al 2017; Pinn et al 2021).

Habitat protection and no-take zones. Creation of marine protected areas and “no-take zones” is proposed or used to ban any harvest, including ornamental collection, in defined sites to protect vulnerable ecosystems and key species (Champion et al 2010; Genovesi et al 2015; Biondo et al 2024).

Discussion on EU measures related to ornamental aquatic wildlife. EU law forbids wild capture for the aquarium/pond trade when species are listed as invasive alien species of Union concern, CITES/EU wildlife trade assessments block import or use, species are nationally protected or threatened with recommended trade suspension, or collection occurs illegally (including in no-take zones and protected areas). Other captures remain allowed but are increasingly managed via permits, quotas, and monitoring systems.

Conclusions. Aquarium keeping offers substantial benefits that extend beyond recreational enjoyment, including improvements in mental health, development of responsibility, and opportunities for informal scientific education. Aquariums act as

interactive learning tools and platforms for citizen science, supporting ecological literacy and conservation awareness. The hobby also facilitates engagement with complex ecological processes, providing insight into species interdependence and environmental management. Nonetheless, significant limitations exist, particularly regarding biodiversity conservation, animal welfare, and trade ethics. The ornamental fish industry, especially in the EU-Southeast Asia corridor, highlights challenges of species traceability, illegal or unsustainable wild capture, and the potential introduction of invasive species. Effective regulation, ethical breeding practices, and public awareness are essential to mitigate these impacts. Overall, the value of aquarium keeping lies in its capacity to connect individuals with aquatic ecosystems, but this connection demands conscientious stewardship to ensure the welfare of organisms, the sustainability of trade practices, and the preservation of natural habitats.

Conflict of interest. The authors declare that there is no conflict of interest.

References

- Anjur N., Sabran S. F., Daud H. M., Othman N. Z., 2021 An update on the ornamental fish industry in Malaysia: *Aeromonas hydrophila*-associated disease and its treatment control. *Veterinary World* 14(5):1143-1152.
- Arisyanto A., Diatin I., Effendi I., Hadiroseyani Y., 2024 Performance of an aquabusiness regarding the cultivation of *Symphysodon* sp. in a conventional system and a smart system. *AAFL Bioflux* 17(6):2427-2442.
- Auliya M., García-Moreno J., Schmidt B., Schmeller D., Hoogmoed M., Fisher M., Pasmans F., Henle K., Bickford D., Martel A., 2016 The global amphibian trade flows through Europe: the need for enforcing and improving legislation. *Biodiversity and Conservation* 25(13):2581-2595.
- Biondo M., Burki R., 2020 A systematic review of the ornamental fish trade with emphasis on coral reef fishes-an impossible task. *Animals* 10(11):2014.
- Biondo M., Burki R., Aguayo F., Calado R., 2024 An updated review of the marine ornamental fish trade in the European Union. *Animals* 14(12):1761.
- Biondo M., Calado R., 2021 The European Union is still unable to find Nemo and Dory - Time for a reliable traceability system for the marine aquarium trade. *Animals* 11(6):1668.
- Bud I., Mag I. V., Petrescu R. M., 2006 [Invasive fish species in the freshwater ecosystems of Romania and their impact on the aquatic environment]. *Environment & Progress* 7:15-21. [in Romanian]
- Calado R., 2006 Marine ornamental species from European waters: a valuable overlooked resource or a future threat for the conservation of marine ecosystems? *Scientia Marina* 70(3):389-398.
- Champion P., Clayton J., Hofstra D., 2010 Nipping aquatic plant invasions in the bud: weed risk assessment and the trade. *Hydrobiologia* 656(1):167-172.
- Collins C., Corkery I., McKeown S., McSweeney L., Flannery K., Kennedy D., O'Riordan R., 2020 An educational intervention maximizes children's learning during a zoo or aquarium visit. *The Journal of Environmental Education* 51(5):361-380.
- Coughlan N., Cuthbert R., Dick J., 2020 Aquatic biosecurity remains a damp squib. *Biodiversity and Conservation* 29(9):3091-3093.
- Dee L., Horii S., Thornhill D., 2013 Conservation and management of ornamental coral reef wildlife: Successes, shortcomings, and future directions. *Biological Conservation* 169:225-237.
- Di Blasio L., Chiesa S., Arcangeli G., Donadelli V., Marino G., 2023 Alien species associated with new introductions and translocations of commercial bivalves in Italian marine waters. *Sustainability* 15(4):3536.
- Evers H. G., Pinnegar J. K., Taylor M. I., 2019 Where are they all from? - sources and sustainability in the ornamental freshwater fish trade. *Journal of Fish Biology* 94(6):909-916.

- Garcia L. N., Rodrigues de Lara G., Merino G. E., 2025 Practical differentiation between species and sexes of juvenile ornamental fish in the genus *Nematobrycon* and new localities for the species. *AACL Bioflux* 18(6):2532-2537.
- Gavriloaie C., Maxim A., Bordea D., Moldovan B., Popescu M., Braşovean I., 2025 Pigments and pigment cells underlying coloration in the guppy *Poecilia reticulata* Peters, 1859. *Poec Res* 15(1):36-41.
- Genovesi P., Carboneras C., Vilà M., Walton P., 2015 EU adopts innovative legislation on invasive species: a step towards a global response to biological invasions? *Biological Invasions* 17(5):1307-1311.
- Horváth J., Tóth A., Weissenbacher A., Gagiu A., Bernáth G., Nagy B., Varga Á., Nagy A., Grigoraş G., Pándi I., 2025 Ex situ conservation of the thermal rudd *Scardinius racovitzai*. *Oryx* 59(5):550-550.
- Jones M., Alexander M. E., Snellgrove D., Smith P., Bramhall S., Carey P., Henriquez F., McLellan I., Sloman K. A., 2021 How should we monitor welfare in the ornamental fish trade? *Reviews in Aquaculture* 14(2):770-790.
- Kelly K. R., Ocular G., Austin A., 2022 Adult-child science language during informal science learning at an aquarium. *The Social Science Journal* 59(4):532-542.
- King T., 2019 Wild caught ornamental fish: a perspective from the UK ornamental aquatic industry on the sustainability of aquatic organisms and livelihoods. *Journal of Fish Biology* 94(6):925-936.
- Lam H. S., Hue N. T. N., Ngoc D. T. H., Tram D. T. T., Dang D. H., Tai N. T. T., Ben H. X., Ha D. V., Khanh P. T., Ngan N. T. M., Minh-Thu P., 2025 Improvement of reproductive performance of clown anemonefish, *Amphirion ocellaris* (Cuvier, 1830), with vitamin C. *AACL Bioflux* 18(1):185-199.
- Lundberg A., Srinivasan M., 2021 Effect of the presence of an aquarium in the waiting area on the stress, anxiety and mood of adult dental patients: A controlled clinical trial. *PLoS One* 16(10):e0258118.
- Marchio E. A., 2018 The art of aquarium keeping communicates science and conservation. *Frontiers in Communication* 3:17.
- Marzuqi M., Slamet B., Sukarman, Melianawati R., Adam M. A., Ismi S., Subaidah S., Sumarwan J., Hardanu W., Ruliaty R., Putro D. H., Rusdi I., Supono, Setiawati K. M., Mahardika K., Nur'amaliyah L. S., Zafran, 2025 Dietary astaxanthin and shrimp meal enhance skin pigmentation in *Plectropomus leopardus* (Lacepède, 1802) during the grow-out phase. *AACL Bioflux* 18(6):2722-2733.
- Mousavi-Sabet H., 2023 Confirmed presence of the exotic guppy *Poecilia reticulata* Peters, 1859 from southern Iran with length-weight data. *Poec Res* 13(1):9-13.
- Müller T., Bernáth G., Horváth Á., Várkonyi L., Grigoraş G., Gagiu A., Cameron T., 2018 Artificial propagation of the endangered Rumanian endemic warm water rudd (*Scardinius racovitzai* Müller 1958, Cyprinidae, Cypriniformes) for conservation needs. *Egyptian Journal of Aquatic Research* 44(3):245-249.
- Novák J., Hohl D., Stuchlík M., Hofmann J., Tlustý M., Magalhães A., Maceda-Veiga A., Akmal S., Yue G., Kumkar P., Marr S., Sara J., Stern N., Rhyne A., Furse J., Kalous L., Patoka J., 2025 Revisiting the history of ornamental aquaculture in Europe to understand the benefits and drawbacks of freshwater fish imports. *Reviews in Aquaculture* 17(2):13008.
- Novák J., Kalous L., Patoka J., 2020 Modern ornamental aquaculture in Europe: early history of freshwater fish imports. *Reviews in Aquaculture* 12(4):2042-2060.
- Nursan M., Yusuf M., Rakhman A., Fr A. F. U., Widiyanti N. M. N. Z., Lestari B. D. I., Majdi A. Z., 2025 Developing strategies for supporting sustainable capture fisheries in the Mandalika special economic zone, Central Lombok Regency, Indonesia. *AACL Bioflux* 18(3):1402-1411.
- Oficialdegui F., Bláha M., Prati S., Lipták B., Weiperth A., Bányai Z., Maciaszek R., Patoka J., Scheers K., Lemmers P., Petutschnig J., Petrtyl M., Petrusek A., Kouba A., 2025 Contrasting patterns of genetic variability in pet-traded red swamp crayfish *Procambarus clarkii* and its feral populations. *Freshwater Biology* 70(2):e70008.
- Oldfield R. G., Bonano P. E., 2023 Psychological and social well-being of bony fishes in zoos and aquariums. *Zoo Biology* 42(2):185-193.

- Patoka J., Bláha M., Kalous L., Kouba A., 2017 Irresponsible vendors: Non-native, invasive and threatened animals offered for garden pond stocking. *Aquatic Conservation-marine and Freshwater Ecosystems* 27(3):692-697.
- Patoka J., Magalhães A., Kouba A., Faulkes Z., Jerikho R., Vitule J., 2018 Invasive aquatic pets: failed policies increase risks of harmful invasions. *Biodiversity and Conservation* 27(11):3037-3046.
- Pertiwi R. P. C., Prayitno S. B., Hutabarat J., Basuki F., Sulisty I., 2025 Morphoanatomical indexes of female Siamese fighting fish *Betta splendens* under different photoperiod regimes. *AACL Bioflux* 18(1):259-268.
- Petrescu R. M., Mag I. V., 2006 Non-native biological invaders: *Ictalurus (Ameiurus) nebulosus* (Lesueur 1819). *Acta Ichtiologica Romanica* 1:221-234.
- Petrescu R. M., Mag I. V., 2007 Non-native aquarium fish in Romanian freshwaters. *Acta Ichtiologica Romanica* 2:189-196.
- Petrescu-Mag I. V., 2007 [Sex Manipulation in Guppyculture]. AcademicPres, Cluj-Napoca. [in Romanian]
- Petrescu-Mag I. V., 2025a Aggression, sexual selection, and neuroendocrine regulation in *Betta splendens*: an integrative mini-review. *Studia Universitatis Vasile-Goldiș Arad Seria Științele Vieții* 35(3).
- Petrescu-Mag I. V., 2025b Behavioral plasticity, honest signaling, and parental investment in *Betta splendens*: an integrative review across environmental and evolutionary contexts. *Studia Universitatis Vasile-Goldiș Arad Seria Științele Vieții* 35(3).
- Petrescu-Mag I. V., 2025c Sexual selection in animals: pigment-based signaling and eco-evolutionary trade-offs. *Studia Universitatis Vasile-Goldis Arad Seria Științele Vieții* 35(3).
- Petrescu-Mag I. V., Bud I., 2017 Aquariology: The mysteries of the submersed universe. *ABAH Bioflux* 9(2):65-76.
- Petrescu-Mag R. M., Creanga S., Petrescu-Mag I. V., 2013 Mendelian laws in aquaculture and cuniculture: simple and efficient. *AACL Bioflux* 6(2):111-114.
- Petrescu-Mag R. M., Pășărin B., Șonea C. G., Petrescu-Mag I. V., 2013 Customer preferences and trends for aquarium fish in Transylvania (Romania). *North-West Journal of Zoology* 9(1):166-171.
- Petrescu-Mag, I. V., & Gavriloaie, C. (2019). The invasion mediated by aquarium hobbyists in the case of water lettuce, *Pistia stratiotes*. *AAB Bioflux* 11(3):144-147.
- Pinn E., Macleod K., Tasker M., 2021 Conservation of transnational species: the tensions between legal requirements and best scientific evidence. *Aquatic Conservation: Marine and Freshwater Ecosystems* 31(11):3291-3310.
- Pinnegar J., Murray J., 2019 Understanding the United Kingdom marine aquarium trade - a mystery shopper study of species on sale. *Journal of Fish Biology* 94(6):917-924.
- Pouil S., Tlustý M., Rhyne A., Metian M., 2020 Aquaculture of marine ornamental fish: overview of the production trends and the role of academia in research progress. *Reviews in Aquaculture* 12(2):1217-1230.
- Puszkarski J., Śniadach O., 2022 Instruments to implement sustainable aquaculture in the European Union. *Marine Policy* 144:105215.
- Quiáo M. A. D., Sanchez A. P., Won M. E. Q., Nabua E. B., 2025 Ethno-ecological significance and conservation implications of marine and coastal species in Misamis Oriental, Philippines. *AACL Bioflux* 18(6):2870-2885.
- Ruslan B. M., Adrianto L., Nuryartono R. N., Yulianto G., Yulianto I., Agung M. F., Kurniawan A., Fauzi I., Muslim, 2025 Institutional structure and challenges of internalizing ocean accounting in spatial management at conservation areas. *AACL Bioflux* 18(6):3050-3064.
- Saputra F., Zulfadhli, Nasution M. A., Syarif A. F., Maftuch, Lubis F., 2024 Length-weight relationship and condition factors of endemic jielabu betta fish (*Betta dennisyongi* Tan, 2013) in water canals in Beutong Hills, Aceh Province, Indonesia. *AACL Bioflux* 17(4):1560-1568.
- Saputra R. Z., Prihantoko K. E., Wijayanto D., 2025 Performance analysis of a multi-purpose winch integrated with the UAV Phantom 3 type for marine conservation and survey applications. *AACL Bioflux* 18(4):1828-1845.

- Șerban C., Grigoraș G., 2018 Structural and morphometric study of scales in Petzeia Rudd (*Scardinius Racovitzai* Müller 1958). *Applied Ecology and Environmental Research* 16(5):6063-6076.
- Tinacci L., Nodari S., Vitali A., Liuzzo G., Corti I., Armani A., 2025 Analysis of the Italian regulatory framework on the welfare of aquatic organisms, with a focus on live crustaceans. *Food Policy* 131:102814.
- Tlusty M. F., Rhyne A. L., Kaufman L., Hutchins M., Reid G. M., Andrews C., Boyle P., Hemdal J., McGilvray F., Dowd S., 2013 Opportunities for public aquariums to increase the sustainability of the aquatic animal trade. *Zoo Biology* 32(1):1-12.
- Tollington S., Turbé A., Rabitsch W., Groombridge J., Scalera R., Essl F., Shwartz A., 2015 Making the EU legislation on invasive species a conservation success. *Conservation Letters* 10(1):112-120.
- Trujillo-González A., Edmunds R., Becker J., Hutson K., Hutson K., 2019 Parasite detection in the ornamental fish trade using environmental DNA. *Scientific Reports* 9(1):5173.
- Wróblewski P., Maciaszek R., Świderek W., 2025 Pinchy Business: Poland's Ornamental Crayfish Trade in 2024. *Animals* 15(17):2594.
- *** Consensus, 2026 An AI-powered search engine for research. Available online at <https://consensus.app>. Consensus NLP, Inc. [Consensus is not an author].

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