Ornamental fish culture and trade in Mexico

Hernández-López, Marcos[1]; Lango-Reynoso, Fabiola[1]; Castañeda-Chávez, María R.[1]; Montoya-Mendoza, Jesus[1]; Castellanos-Onorio, Olaya P.[2]; Diaz-González, Mario[2]; Martínez-Cárdenas, Leonardo[3]

[1] Tecnológico Nacional de México, Instituto Tecnológico de Boca del Río, Carretera Veracruz-Córdoba Km 12, A. P. 68. Boca del Río, Veracruz, México. C.P. 94290.
[2] Tecnologico Nacional de México, Instituto Tecnológico de Veracruz; Av. Miguel Ángel de Quevedo 2779, Formando Hogar, Veracruz, México. C.P. 91897.
[3] Universidad Autónoma de Nayarit, Secretaria de Investigación y Posgrado, Ciudad de la Cultura Amado Nervo s/n, Tepic, Nayarit, México. C.P. 63190.
* Correspondence: leonardo_martinez@uan.edu.mx; fabiolalango@bdelrio.tecnm.mx

ABSTRACT
Objective: To present the situation and context regarding the commercialization of ornamental fishes in Mexico, their principal commercialized species and its impact when extracted from their natural habitat.
Design/methodology/approach: This research was carried out by searching and compiling bibliographic literature, as well as consulting articles in different databases, for subsequent analysis and information processing.
Results: In Mexico, more than 25 million ornamental fish are sold per year, ornamental aquaculture production is mainly concentrated in the state of Morelos, with the Guppy and Japanese as the most produced and consumed fish within the national territory: however, some native species are extracted from natural aquatic systems in Mexico with serious consequences.
Limitations on study/implications: There is scarce information because various producers and extractors of ornate fish do not have permits, so it is difficult to keep a record of their activities, likewise the trade in marine species does not have official records of their catches and sales.
Findings/conclusions: The Poecilidae family is the most cultivated fish in Mexico. The most sold fish in Mexico are the Guppy (*Poecilia reticulata*) and the goldfish (*Carassius auratus*), both produced mainly in the state of Morelos.

Keywords: Ornamental fish, Aquarism, exotic species, aquaculture

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INTRODUCTION

Nowadays, the ornamental fish trade has grown considerably, due to its wide acceptance and its good development prospects (Lango-Reynoso *et al.*, 2012; Evers *et al.*, 2019) being one of the markets with the highest profits, which reach 30 billion dollars annually. In Mexico, approximately 45 million freshwater ornamental fish are sold annually, and in recent years, national production has consolidated as a business with

prospects for social and economic growth that is developing satisfactorily, as a result of the growing demand from the aquarium sector (Cedillo *et al.*, 2001; Ramírez-Martínez *et al.*, 2010; Brito, 2018). Ornamental aquaculture activity in Mexico generates around 48 thousand jobs and an economic impact estimated at 800 million pesos, and although it is a relatively recent economic activity, it is projected to have favorable growth in the coming years due to the increase in demand for ornamental fish (Villaseñor-Garrido *et al.*, 2020).

MATERIALS AND METHODS

A bibliographic search was carried out in which the selection of information was carried out by searching different online databases and scientific search engines, such as: Elsevier-Scopus, SCIELO and Google Scholar. Data from the FAO and official pages were also consulted, as well as digital repositories of different universities and book chapters.

RESULTS AND DISCUSSION

Marketing of ornamental fish in Mexico

At the national level, ornamental fish farming has increased its production from three million organisms per year in the nineties to more than 25 million today, which represents a sustained annual growth of 14%, which contributes to the generation of more than 40 thousand direct jobs, making it of great importance to the population (Ruiz, 2022). At the national level, ornamental fish production is concentrated in the states of Morelos, Jalisco, Yucatán, and Veracruz. However, the state where most ornamental fish are produced and bred is Morelos, while Mexico City is considered the distribution center, as it is there that the fish produced in the producing states are sold and from there they are distributed throughout the national territory (Villaseñor-Garrido *et al.*, 2020). Within Mexican territory, ornamental fish production comes from aquaculture farms, most of which, 333, are located in the state of Morelos, where more than 20 million organisms are produced annually (Ramírez-Martínez *et al.*, 2010; Brito, 2018; Villaseñor-Garrido *et al.*, 2020; Ruíz, 2022), and the largest concentration of these aquaculture farms within the state of Morelos are located in the municipality of Ayala (Brito, 2018), in which 54.65% of farms registered for the state are located, this is due, among other things, to the fact that this region has a favorable climate for raising fish in ponds (21-25 °C) and also a factor that influences is the accessibility to markets, since it is located close to communication routes and marketing channels (Brito, 2018; Cortés *et al.*, 2025).

In Mexico there are two main models of ornamental fish production: in ponds and in "breeding rooms", the first corresponds to tanks exposed to environmental conditions, so there is no precise control of them and the breeding rooms, which are indoor facilities in which water quality is controlled for the breeding of more demanding species (Espinosa *et al.*, 2011).

The production and trade of ornamental fish in Mexico focuses mainly on freshwater species, since there are limitations in the marine aquarium industry, which are related to the lack of technological implementation that allows long-term economic viability, since the technology to establish aquaculture farms producing marine species is very expensive

and is beyond the reach of national producers, so it is a poorly developed activity, despite having national species with potential in aquariums (Lango-Reynoso *et al.*, 2012).

Traded species

In Mexico, the most sold ornamental fish (Table 1) belong to six main families: Poecilidae with 34 species, Cyprinidae 19, Cichlidae 14, Characinidae 9, and Anabantidae with 6 species, all of them freshwater species (Devezé *et al.*, 2008). However, of all of them, the ones that sustain almost all the sales of specimens are the Poecilidae (Devezé *et al.*, 2004; Maya *et al.*, 2007). With its largest representative, the Guppy, as the most sold and most in-demand fish along with the goldfish, this is attributed to the fact that both species are highly resistant to changes in the quality of the farming water and do not require very sophisticated facilities (Espinosa *et al.*, 2011), Although these fish could be considered cheap at first glance, as their prices are around four pesos; however, their profit is in the sales volume, since 191 tons of guppies and 124 tons of goldfish are sold per year, obtaining greater profits with the goldfish (of about 28%) but higher sales with guppies (Devezé, 2008). In the case of marine fish, there is no precise information on sales or marketing (Dávila-Camacho *et al.*, 2019). The main groups of marine fish that have dominated the market belong to the families: Pomacentridae, Acanthuridae, Balistidae, Labridae, Pomacanthidae y Chaetodontidae, Most of which come from Indonesia, the Philippines, Sri Lanka, the Maldives and the Central Pacific islands (Lango-Reynoso *et al.*, 2012; Villaseñor-Garrido *et al.*, 2020).

Extraction of native fish

The extraction of native freshwater ornamental fish in Mexico can primarily cause the deterioration of aquatic systems, resulting in a loss of biodiversity and an imbalance in food chains. This is due to the extraction of fish from their natural habitat. This not only reduces their local populations but also deteriorates natural environments. Many species of ornamental fish have very restricted distribution areas, making their collection a risk factor for extinction. Likewise, the extraction of ornamental fish itself includes inappropriate practices that cause environmental damage, such as the use of cyanide in marine fish

Table 1. Main species of fish marketed in Mexico and their origin.

Common name	Scientific name	Origin
Guppy	*Poecilia reticulata*	Southamerica
Goldfish	*Carassius auratus*	Asia
Angel fish	*Pterophyllum scalare*	Central America and Southamerica
Cebra fish	*Danio rerio*	Asia/India
Betta	*Betta splendens*	Asia
Molly	*Poecilia sphenops*	Native
Platy	*Xiphophorus maculatus*	Native
Sword tail	*Xiphophorus helleri*	Native
Nun fish	*Gymnocorymbus ternetzi*	Southamerica

(Salazar *et al.*, 2008), It also encourages invasive species to replace those extracted (Jelks *et al.*, 2008; Miller *et al.*, 2009). Among the freshwater fish of which there is a record of being extracted for ornamental purposes for national consumption, are cichlids such as the guapote *Trichromis salvini* (Ruíz, 2022), firemouth cichlids (*Thorichthys* spp.), among which stands out *T. helleri*, the genus *Vieja*, and poecilids of the genus *Xiphophorus* (Lorán *et al.*,2006; Ramiréz *et al.*, 2004; Lorán-Núñez *et al.*, 2013 Del Moral-Flores *et al.*, 2018; López-Segovia *et al.*, 2024).

On the other hand, extractions of native fish have been reported in the north of the country, among which the desert pupfish stand out (*Cyprinodon macularis*), the little sardine (*Cyprinella* sp.), the mexican stone roller (*Campostoma ornatum*), the Pacific topote (*Poecilia butleri*), the Del Sonoyta puppy (*Cyprinodon eremus*), the green belly (*Agosia chrysogaster*), These are endemic to the north of the country and are taken abroad, mostly to the United States and France, where they are distributed to the rest of the European countries (Hignette, 2003; Varela-Romero & Hendrickson, 2009).

There are no exact figures regarding the extraction of marine fish from Mexico, as they are not considered a consumer fishery; however, various studies indicate that the main endemic marine fish extracted is the giant meerkat (*Opistognathus rhomaleus*), the fine pointed big mouth (*Opistognathus punctatus*), the blue dotted big mouth (*Opistoganthus rosenblatti*), the angel of Cortés (*Pomacanthus zonipectus*) and the queen angel *Holocanthus passer*, which in recent years has been the subject of various studies focused on achieving its reproduction in captivity, These are caught in the Gulf of California legally, but it is believed that many more species are being extracted illegally because their extraction responds to demand without considering biological or environmental aspects (Gijón-Díaz *et al.*, 2017; Pérez-Velázquez, & González-Félix, 2025).

Ornamental aquaculture as a conservation method

Captive cultivation of ornamental fish can help sustain the aquarium industry and mitigate the impact on the environment by reducing the need to collect specimens from wild native populations, so that in the future it will not be necessary to extract any native fish from their habitat, since as the cultivation and maintenance techniques for each species are adapted and standardized, to meet market demand, With this, the volumes of wild fish extraction will be depleted (Lango-Reynoso *et al.*, 2012; Vivas, 2019), In addition, the goal is for fish from aquaculture to be higher quality specimens and in better health than wild ones, so ornamental aquaculture includes the breeding of species that are difficult to collect or whose natural populations are already low, so aquaculture can be a useful tool in the recovery of populations where they had already been eradicated, all because breeding in captivity allows the production of organisms without depending on direct extraction from the environment (Tlusty, 2002; Lango-Reynoso *et al.*, 2012). Aquaculture is a basic tool for conservation programs for native and endangered species, and even many species used in aquariophilia have been maintained and bred for conservation and preservation purposes (Dykman, 2012) such as the barbo *Puntius tetrazoma* and the pygmy botia (*Botia sidthimunki*) and also in the case of species such as the blue arowana (*Osteoglossum ferreirae*) of which their populations are in serious danger and aquaculture is projected as the best alternative

to be able to meet the demand it has in the market, so for native species of Mexico this type of aquaculture focused on conservation would also be of great importance (Tlusty, 2002; Barajas-Pardo *et al.*, 2017), As has been achieved in the populations of the godeid *Zoogoneticus tequila*, because it was extinct in its natural environment and thanks to stocks maintained in captivity, from which breeding stock were obtained, work has been done on repopulation in its natural habitat (Domínguez *et al.*, 2018).

CONCLUSIONS

Mexico is a country with a significant market for ornamental fish, most of which are produced in the central region of the country, where most ornamental fish farms are concentrated. The national market is dominated by two main species: the goldfish (*C. auratus*) and the guppy (*P. reticulata*), which support most of the trade. However, there is also the capture of native fish for ornamental purposes, which leads to serious ecological problems. Therefore, the use of aquaculture is proposed as a tool to avoid overexploitation and conserve native species.

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