

# State of the art of poecilid fish (Pisces: Poeciliidae) in México

Hernández-López, Marcos<sup>1</sup>, Lango- Reynoso, Fabiola<sup>1</sup>, Castañeda-Chávez, María R.<sup>1</sup>,  
Montoya-Mendoza, Jesus<sup>1</sup>, Castellanos-Onorio, Olaya<sup>2</sup>, Diaz-González, Mario<sup>2</sup>,  
Martínez-Cárdenas, Leonardo<sup>3\*</sup>

<sup>1</sup> 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.

<sup>2</sup> Tecnológico Nacional de México, Instituto Tecnológico de Veracruz, Av. Miguel Ángel de Quevedo 2779, Formando Hogar, Veracruz, México. C.P. 91897.

<sup>3</sup> Universidad Autónoma de Nayarit Dirección postal: Ciudad de la Cultura Amado Nervo s/n. Tepic, Nayarit. Mexico. C.P. 63190.

\* Correspondence: leonardo\_martinez@uan.edu.mx

## ABSTRACT

**Objective:** To present a review about the knowledge of the fish of the family poecilidae in Mexico.

**Design/methodology/approach:** The present review was carried out through the search and bibliographic compilation of literature, as well as in the consultation of articles in different databases, for its subsequent analysis.

**Results:** Mexico has a great diversity of poeciliids with 105 species registered, 64 are endemic, most are in some category of protection, distributed throughout the national territory, mainly in the Usumacinta River basin. In this area, their reproductive biology and feeding have been studied, which vary according to the species. Their culture in Mexico, focuses on the commercialization of ornamental species both native and exotic.

**Limitations on study/implications:** The poecilid fishes are a well study group; however, the information about the mexican species is scattered and in different areas are limited.

**Findings/conclusions:** Mexico is the country with the greatest diversity of poecilid fish worldwide, most of which are in some category of protection, and are a group well distributed throughout the national territory, with potential as environmental indicators and toxicological studies.

**Keywords:** Fish, Bioindicator, Life stories, Native species, invasive species, Diversity.

**Citation:** Hernández-López, M., Lango- Reynoso, F., Castañeda-Chávez, M. R., Montoya-Mendoza, J., Castellanos-Onorio, O., Diaz-González, M., & Martínez-Cárdenas, L. (2022). State of the art of poecilid fish (Pisces: Poeciliidae) in México. *Agro Productividad*. <https://doi.org/10.32854/agrop.v15i11.2355>

**Academic Editors:** Jorge Cadena Iniguez and Libia Iris Trejo Téllez

**Received:** July 29, 2022.

**Accepted:** November 18, 2022.

**Published on-line:** December 20, 2022.

*Agro Productividad*, 15(11). November. 2022. pp: 51-56.

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## INTRODUCTION

Fish are the most diverse group of vertebrates on the planet, and they have a great variety, high endemism, as well as ecological and economic value (Espinosa-Pérez, 2014). The poeciliids present a tropical distribution, in the American continent from the United States United to Argentina (Gómez-Márquez *et al.*, 1999), the Poeciliidae family is of great importance, both ecologically and economically due to its commercialization as ornamental fish (Miller *et al.*, 2009), In recent years the study of poeciliids has not been limited only to their biodiversity, in addition to this, various species of poeciliids have served as models for studies on evolution, ecology, behavior and genomics (Stockwell



& Henkanaththegedara, 2011), and more recently they have been used in studies of biomonitoring and bioaccumulation of toxins in aquatic habitats where they inhabit, due to their wide diversity and easy adaptation to captivity (Trujillo-Jimenez & Toledo, 2007; Ramírez-Ayala *et al.*, 2020).

## MATERIALS AND METHOD

The selection of bibliographic material was carried out by searching in different databases and scientific search engines data from the National Fish Collection of the Institute of Biology of the National Autonomous University of Mexico (UNAM), the Global Biodiversity Information Facility (GBIF), the IUCN Red List of Species and the official Mexican standard for environmental protection and native species (NOM-059-SEMARNAT-2010) in its last update (2019), as well as digital repositories from different universities and book chapters. To delimit the information found in the different sources, was, considering those that refer to poeciliids species with natural distribution and introduced within the national territory (Mexico).

## RESULTS AND DISCUSSION

### Biodiversity and conservation

According to the data obtained, 105 species of fish belonging to the Poeciliidae family are distributed throughout the Mexican territory, which represents 30.17% of the 348 species of Poeciliids registered worldwide, this species richness is higher than the last data published for this family with 81 species described for Mexico (Miller *et al.*, 2009). For this reason, the poeciliids continue to be the group of fish with the highest number of species in Mexico, followed by the cyprinids with 76 species and the cichlids with 48 species (Miller *et al.*, 2009). The Poeciliidae family in Mexico it is represented by 14 genera, highlighting the following: *Xiphophorus*, *Gambusia* and *Poeciliopsis*, for presenting the largest number of species with 25, 24 and 22 species respectively. Among this genus, *Xiphophorus*, occupies an important place, since in Mexico there are 89.28% of the 28 species described worldwide (Albornoz-Garzón & Villa-Navarro, 2017). In Mexico, from the total registered species, more than half (54.28%) are in some category of protection, either by international or national organizations, some species such as: *Priapella bonita*, *Xiphophorus couchianus* and *Xiphophorus meyeri*. are considered extinct by international organizations while in Mexico they are considered in danger of extinction (SEMARNAT, 2010) From the 64 endemic Mexican poeciliids more than half (60.93%) are considered under some category of conservation (Jelks *et al.*, 2008). In Mexico 10 exotic species, became invasive in many water bodies in the country, displacing native species, such as: *Poecilia reticulata*, while *Pseudoxiphophorus bimaculatus*, *Xiphophorus helleri* and *Poeciliopsis infans* although they are Mexican, have been introduced into bodies of water where they are not native, becoming invasive (Torres-Orozco & Pérez, 2009).

### Distribution

The Poeciliidae family in Mexico, inhabits fresh waters and some brackish waters (Gómez-Márquez *et al.*, 1999). This can be associated with the fact that in a good part of

the Mexican territory the two great continental biogeographic zones of America converge: the nearctic and neotropical regions (Torres-Orozco & Pérez, 2009). The poeciliids are distributed throughout the entire national territory; however, the Usumacinta ichthyofaunistic region stands out for being one of the most studied, within this region there is many endemisms (Tobler *et al.*, 2008; Miller *et al.*, 2009). A relevant fact about this province is that large poeciliid species live there, being the largest of them *Belonesox belizanus* family that can measure up to 20 cm in standard length (SL) while *Poecilia catemacensis* and *Poeciliopsis catemaco* occupy the second and fourth place respectively (Escalera, 2011; Pires *et al.*, 2011; García-Villar *et al.*, 2019).

### Feeding

Although some members of the Poeciliidae family have been kept in captivity and their diet is known, few studies on their biology have been carried out under natural conditions with native species (Trujillo-Jiménez & Toledo, 2007). Within this category, the Mexican species feed mainly on invertebrates, particularly insects, others are omnivores, detritivores, planctophages or carnivores such as *Belonesox belizanus*, which feeds on fish (Greven & Brenner, 2008; Sánchez & Regil, 2011).

### Reproductive aspects and life stories

Reproductive aspects of some native species such as *Poeciliopsis occidentalis* have been studied, finding that females born in places with less food availability reach sexual maturity in one year (Constantz, 1979). *P. bimaculatus* has also been studied, whose total length at sexual maturity was determined, 27 mm in males and 40 mm in females, a fertility of 7-79 embryos at the time of analysis, and it was determined that females live more than two years, while males only one (Olinger *et al.*, 2016). Reproductive aspects of *Xiphophorus* species, such as *X. pygmaeus*, *X. multienatus* and *X. nigrensis*, have been studied, it has been reported that the size of the litter depends on the size of the female and the time of year without presenting superfetation, unlike other species such as *Poeciliopsis gracilis*, which do present this pattern (Morris & Ryan, 1992; Frías, 2015).

### Culture

In Mexico, the production and culture of poeciliids has focused mostly on exotic species, with *P. reticulata* being the most cultivated, mainly for ornamental purposes, followed by native species: *P. sphenops*, *X. helleri* and *X. maculatus*, in their ornamental varieties, (Maya *et al.*, 2007; Scotto, 2020).

Species such as *P. velifera*, *P. maylandi* and *B. belizanus* have also been bred for conservation and insect control purposes, while *P. velifera* and *P. sphenops* are cultivated in their wild form as food for fish with commercial importance (Rodríguez *et al.*, 2020).

### Diseases

The study of diseases of the native poeciliids of Mexico is limited and has been focused on their parasites, both external and internal, as for ectoparasites the lerneosis, a disease caused by copepods, is a great problem in crops of ornamental poeciliids, as it causes

reproductive damage in the internal and external characteristics, causing death (Maya *et al.*, 2007). The most studied group of internal parasites are the helminths, of which there are 46 species that parasitize native Mexican poeciliids, and to a lesser extent the monogeneans, being *P. mexicana* the host with the most species of registered helminths (24 species), the role of exotic species as vectors of parasites has also been studied, affecting native poeciliids, which are especially susceptible due to geographic restriction (Razo-Mendivil *et al.*, 2013; Salgado-Maldonado *et al.*, 2020).

### Bioindicators

In recent years, various species of Mexican poeciliids have been object of toxicological studies, due to the relatively easy maintenance and little space required, highlighting *X. helleri* and *Cnesterodon decemmaculatus*, in pesticide toxicity studies and *G. yucatanensis* who has been used in the toxicity evaluation presented by various sun blockers. (Hernández, 2019; Ramírez-Ayala *et al.*, 2020; Pérez-López *et al.*, 2020). Native poeciliids have been used as bioindicators in various studies: to assess the water quality in the ecosystem, to determine environmental flows, define protection zones within nature reserves (Torres-Bugarín *et al.*, 2007), as well as insect biomonitoring tools based on their stomach content, to determine biotic integrity indices (Carbajal-Becerra *et al.*, 2020).

### CONCLUSIONS

Mexico is a country with a great diversity of poeciliid species, in which its endemisms and native species stand out, there is little biological information about them, while production and cultivation are focused on species of commercial interest for aquaculture; However, in recent years, research has been carried out in which they are used as biological indicators to monitor contamination in water bodies, a field in which they have great potential in Mexico. The present work synthesizes information on Mexican species, being able to serve as a base for future investigations.

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