Mexican Molly (*Poecilia sphenops*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2011
Revised, February 2018
Web Version, 8/28/2019

Photo: I. Dominguez. Licensed under Creative Commons BY-NC-ND. Available: https://www.inaturalist.org/photos/297374. (February 2018).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2017):

"Central and South America: Mexico to Colombia."

From Nico et al. (2018):

"Atlantic Slope of eastern Mexico from north of Veracruz City to Guatemala (Brett and Turner 1983; Miller 1983). Some authors state it ranges south to Colombia (Wischnath 1993) but that may be the result of taxonomic confusion."

From Bagley et al. (2015):

"Whereas others have considered *P. sphenops* to meet its southern range limit in eastern Guatemala or western Honduras [Schultz and Miller 1971; Ptacek and Breden 1998; Miller 2005; Alda et al. 2013], our results suggest that its range […] extends further south, terminating at the lake district of Nicaragua, in Lake Nicaragua and its northern tributaries […]"

Status in the United States

From Nico et al. (2018):

"**Nonindigenous Occurrences**: This species is known from the Salt River near its confluence with the Gila River, Arizona, in and around the Salton Sea and from the Santa Ana River in southern California (St. Amant and Hoover 1969; Lee et al. 1980 et seq.; Dill and Cordone 1997); unspecified area(s) of Florida (Courtenay et al. 1974); the Ruby River, Madison County, Montana (Lee et al. 1980 et seq.); and several springs and tributaries to Lake Mead, and the Las Vegas Wash, Meadow Valley Wash, and White River drainages, Nevada (W. Courtenay, personal communication, Scoppettone 1993). Also found in several locations of Puerto Rico (Grana, personal communication)."

"Previously listed as established in Hawaii (Maciolek 1984); however, recent reports indicate those fish are actually hybrids (Mundy 2005 […])."

"**Status**: Locally established in Montana and Nevada: failed in Florida; reported from California and Arizona. Established in Puerto Rico."

This species is in trade in the United States (see also "Remarks" and "Human Uses," below, for discussion of hybrids and varieties of *P. sphenops* present in the aquarium trade).

From PetSmart (2018):

"Black Molly […] $2.49 […] Scientific Name *Poecilia sphenops species*"

From LiveAquaria (2019):

"Gold Dust Molly
(*Poecilia sphenops*) […]
$ 3.19"

Chapman et al. (1993) report 314,900 individual *P. sphenops* imported into the United States in October 1992.

Means of Introductions in the United States

From Nico et al. (2018):

"Introductions have resulted from escapes, intentional releases from fish farms, and releases by aquarists (Lee et al. 1980 et seq.; Dill and Cordone 1997)."

Remarks

From Nico et al. (2018):

"Distinguishing characteristics were given by Miller (1983). However, there appers [*sic*] to be a good deal of confusion among species of shortfin mollies in the literature. […] This species is part of the *P. sphenops* complex (Rosen and Bailey 1963; Schultz and Miller 1971; Brett and Turner 1983; Miller 1983). Formerly known as *Mollienesia sphenops*."

"Some, conceivably all, of the records of this species in the United States may turn out to represent one of the other members of the *P. sphenops* species complex and not *P. sphenops*. For instance, the Hawaiian records of *P. sphenops* (Maciolek 1984) and that of *P. mexicana* (Devick 1991) are now considered the same fish (*Poecilia* sp.; Mundy 2005). Similarly, Schoenherr (1979) reported taking *P. sphenops* from a canal northwest of the Salton Sea in California; however, according to Dill and Cordone (1997), later authors questioned the identification and therefore did not include *P. sphenops* in their listings of California fishes (e.g., Hubbs et al. 1979; Shapovalov et al. 1981). At least five members of the *P. sphenops* species complex have been reported from the United States (Courtenay and Hensley 1979)."

From Animal-World (2015):

"Most mollies available [in the aquarium trade] today are selectively bred and are often hybrids. The fish we see are usually beyond the point of clearly belonging to any of the three original species [*P. latipinna*, *P. sphenops*, *P. velifera*]."

"The years of selective development of these three, however, has produced a myriad of fantastic colors and patterns. They range from the solid ebony of the Black Molly, to the orangey rusted speckles of the Sunburst Molly, and the spotted Silver Molly, to name just a few. The albino coloring comes from the "sailfin" species."

"Most often the large-fin types are cross breeds of the Short-finned Molly *P. sphenops* and the Sailfin Molly *P. latipinna*. These cross breeds include the Lyretail, Moonfish, and Flag."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

"Kingdom Animalia
  Subkingdom Bilateria

Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Cyprinodontiformes
Suborder Cyprinodontoidei
Family Poeciliidae
Subfamily Poeciliinae
Genus *Poecilia*
Species *Poecilia sphenops*"

From Eschmeyer et al. (2018):

"Current status: Valid as *Poecilia sphenops* Valenciennes 1846. Poeciliidae: Poeciliinae."

Size, Weight, and Age Range

From Froese and Pauly (2017):

"Max length : 7.5 cm SL male/unsexed; [Velázquez-Velázquez et al. 2015]; common length : 4.0 cm TL male/unsexed; [Hugg 1996]"

From Nico et al. (2018):

"10 cm TL, but commonly smaller."

Environment

From Froese and Pauly (2017):

"Freshwater; brackish; benthopelagic; pH range: 7.5 - 8.2; dH range: 11 - 30; […] 18°C - 28°C [Riehl and Baensch 1996; assumed to be recommended aquarium water temperatures]"

Climate/Range

From Froese and Pauly (2017):

"Tropical; […] 24°N - 1°S, 101°W - 69°W"

Distribution Outside the United States

Native

From Froese and Pauly (2017):

"Central and South America: Mexico to Colombia."

From Nico et al. (2018):

"Atlantic Slope of eastern Mexico from north of Veracruz City to Guatemala (Brett and Turner 1983; Miller 1983). Some authors state it ranges south to Colombia (Wischnath 1993) but that may be the result of taxonomic confusion."

From Bagley et al. (2015):

"Whereas others have considered *P. sphenops* to meet its southern range limit in eastern Guatemala or western Honduras [Schultz and Miller 1971; Ptacek and Breden 1998; Miller 2005; Alda et al. 2013], our results suggest that its range […] extends further south, terminating at the lake district of Nicaragua, in Lake Nicaragua and its northern tributaries […]"

Introduced

According to Froese and Pauly (2019), *P. sphenops* has been introduced to Trinidad, Spain, Slovakia, Singapore, Japan, Indonesia, Hungary, the Czech Republic, the Philippines, and Canada. Establishment is known for Trinidad, Singapore, Japan, and Hungary.

From Piazzini et al. (2010):

"During a survey on the distribution of *Melanopsis etrusca* (Brot 1862), a gastropod endemic to the thermal waters of southern Tuscany (Bodon et al. 2005), we discovered an ichthyofauna composed mainly of non-native tropical fishes […] in a small stream, Fossa Calda (municipality of Campiglia Marittima, province of Livorno). Some species, [including] *Poecilia sphenops* Valenciennes 1846 […] have never been reported established in Euro-Mediterranean natural freshwater environments (Kottelat and Freyhof 2007) […] Two of these tropical species (*P. pardalis* and *P. sphenops*) were represented by sporadic specimens (2 of the former and 1 of the latter, respectively) […]"

From Magalhães and Jacobi (2017):

"Although more than 50 non-native fish species are currently found in Brazilian headwater creeks (Bizerril, Lima, 2001; Magalhães, Jacobi, 2008), a group of seven poeciliids deserve special attention as a threat to native communities due to negative impacts such as changes in the structure of the native fish assemblages and biotic homogenization: [including] black molly *P. sphenops* Valenciennes in Cuvier, Valenciennes, 1846 […]"

Means of Introduction Outside the United States

From Amaoka et al. (2001):

"It is believed that small fish were introduced into this area [a drainage area of the hot spring at Kojyohama, Shiraoi-cho, Shiraoi-gun, southern Hokkaido, Japan] longer than 20 years ago to assist in reducing mosquito populations."

From NIES (2018):

"Deliberate: As pet animal. Most of molly distributed as pet is black variety "black molly" [a selectively bred variety of *P. sphenops*], whereas the introduced population in Hokkaido is not this variety."

From Magalhães and Jacobi (2017):

"[Poeciliids] all have been introduced into headwater creeks of the southeastern region mainly as by-products of aquaculture-related activities (Bizerril, Lima, 2001; Castellani, Barrella, 2006; Alves et al., 2007; Magalhães, Jacobi, 2008)."

Short Description

From Headlie (2015):

"The wild variety of the common or short-finned molly […] has dull silvery colouration, with dispersed black dots on its skin and a bright yellow fringe on the ends of its rounded dorsal and caudal fins. Individuals of this species exhibit wide ranges of colour variation that mainly incorporates silver, black and yellow-orange. The body is oblong with a round caudal peduncle and a small dorso-ventrally flattened head with protruding jaws that function as a scraping tool, ideal for rasping algae from benthic surfaces. Its mouth also possesses many rows of very small teeth, with the outer row being the largest and reducing in size with each successive row. *Poecilia sphenops* displays sexual dimorphism whereby males are smaller (8cm compared to 12cm of females) and more colourful, particularly males' larger caudal fins (Mills and Vevers, 1982). Males also have a gonopodium (modified fin) to transfer sperm during mating."

"Female *Poecilia sphenops* have a dark patch that appears between the abdomen and the anal fin (gravid spot) […] which is present only when carrying young and forms as a result of dark tissue of the uterus pushing against the thin muscle wall of the abdomen (Seriously Fish, 2015)."

Biology

From Headlie (2015):

"*Poecilia sphenops* inhabits mainly fresh water systems, in shallow areas, spending little time in coastal brackish waters (Wischnath, 1993) before returning to freshwater biotopes. […] Anomalies have occurred, as it has been found living and breeding in coastal sea waters and brackish swamps. This is a reflection of the species' exceptional success as generalist; hardy and highly adaptable. They mostly occur in schools under floating vegetation or near structures in the water (Maciolek, 2005). Being a tolerant species these mollies are able to exploit the thin film of oxygen rich surface water with their mouths, and can survive in oxygen-depleted habitats."

"Fertilization occurs internally and is accomplished via highly modified anal fins of males called the gonopodium. *Poecilia sphenops* produce broods of 10-140 live young, the number of which produced depending on the maturity and size of the female (Seriously Fish, 2015). Gestation periods may vary between 3-4 weeks, depending upon temperature. In addition, females store

sperm and can give birth on multiple occasions throughout the year (Wischnath, 1993). The young mollies stay in schools (groups) of similarly-sized fish […]."

Human Uses

From Froese and Pauly (2017):

"Fisheries: of no interest; aquarium: highly commercial"

"The black variety (Black molly) [selectively bred variety of *P. sphenops*] is a very popular aquarium fish and is marketed throughout the world [Welcomme 1988]."

From Animal-World (2015):

"After the Molly was introduced to the hobby in 1899, the popularity of this fish grew very rapidly. The Common Molly *P. sphenops* and the Sailfin Molly *Poecilia latipinna* represented two basics types, distinguished by either short or long fins. A black variety of the Short-finned Molly *P. sphenops*, called the Black molly, is a very popular aquarium fish that is sold throughout the world."

"Hybridized specimens began appearing as early as the 1920s. As Mollies rose in popularity, they were selectively bred to produce a multitude of strains with different fin shapes and color patterns. Wild fish are now more rare in the hobby, and most of the fish sold in aquarium stores are usually countless generations away from their wild-caught ancestors. A vast number of available Mollies are commercially bred in the Far East and Eastern Europe."

This species is in trade in the United States.

From PetSmart (2018):

"Black Molly […] $2.49 […] Scientific Name *Poecilia sphenops species*"

From LiveAquaria (2019):

"Gold Dust Molly
(*Poecilia sphenops*) […]
$ 3.19"

Chapman et al. (1993) report 314,900 individual *P. sphenops* imported into the United States in October 1992.

Diseases

No OIE-listed diseases (OIE 2019) have been documented for this species.

Poelen et al. (2014) lists the following as parasites of *Poecilia sphenops*: *Gyrodactylus bullatarudis, Valipora minuta, Glossocercus auritus, Dendrouterina papillifera,*

Gyrodactylus costaricensis, *Posthodiplostomum minimum*, and *Parvitaenia aurita* (Benesh et al. 2017, Smithsonian Institution, no date).

From Froese and Pauly (2017):

"Parasitic Copepod Infestation (general), Parasitic infestations (protozoa, worms, etc.) Capillaria Infestation 5, Parasitic infestations (protozoa, worms, etc.)"

Threat to Humans

From Froese and Pauly (2017):

"Harmless"

3 Impacts of Introductions

From Nico et al. (2018):

"Introduced populations have adversely affected the Moapa dace *Moapa coriacea* and the White River springfish *Crenichthys baileyi* (both endangered species) and are a potential threat to other native fishes in the Pahranagat Valley, Nevada (Lee et al. 1980 et seq.). Scoppettone (1993) attributed the effects on the Moapa dace to be caused by *P. mexicana*, so the question of identity is raised again."

4 Global Distribution

Figure 1. Known global distribution of *Poecilia sphenops*. Map from GBIF Secretariat (2019). The southern limit of the native distribution of *P. sphenops* is unresolved in the literature (see Section 1); the widest available interpretation of native range (extending south to Colombia) was used in the climate matching analysis. Points in Italy and Japan represent populations established in thermal waters (Piazzini et al. 2010, Amaoka et al. 2001), so these points were not included in the climate matching analysis. No georeferenced occurrences are available for the species distribution in Brazil or Hungary. See Figure 2 for information on U.S. distribution.

5 Distribution Within the United States

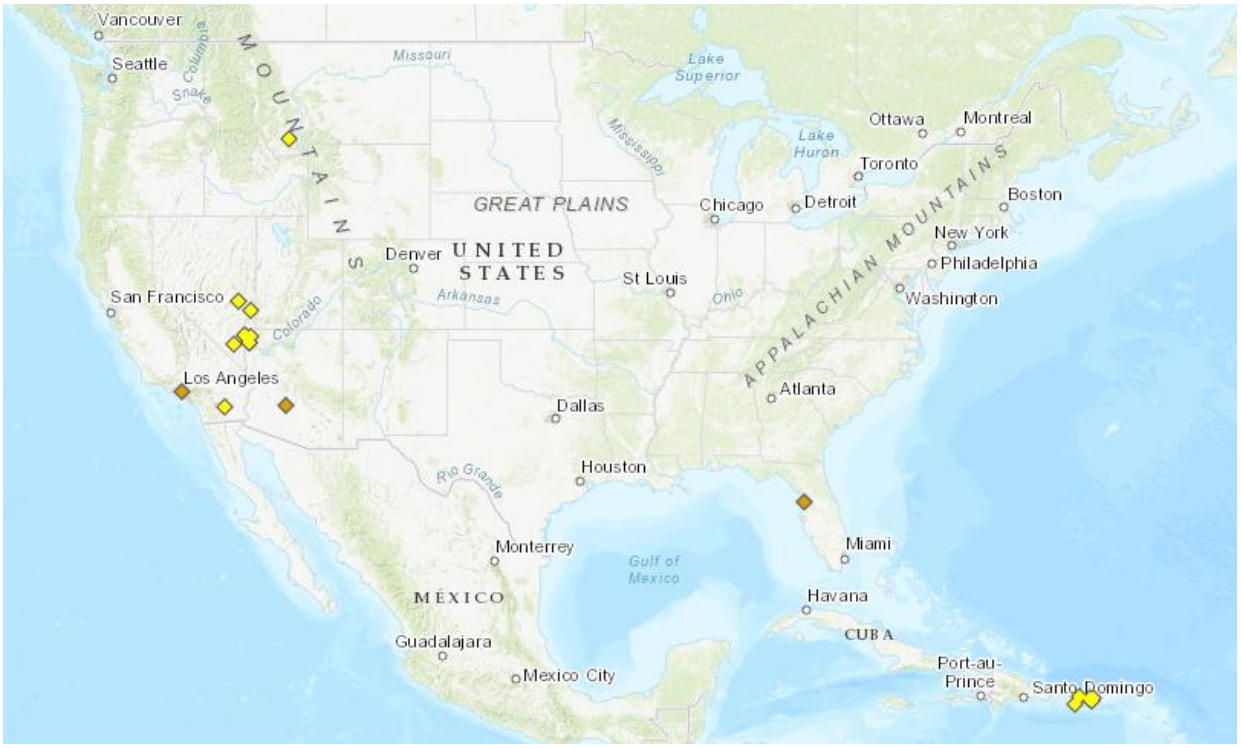

Figure 2. Known distribution of *Poecilia sphenops* in the United States. Map from Nico et al. (2019). Yellow points indicate established occurrences, and orange points indicate other collection locations. Only established occurrences were used as source locations for the climate matching analysis. The point in Montana represents a population established in a thermal water body, so it was also excluded from the climate matching analysis.

6 Climate Matching

Summary of Climate Matching Analysis

The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.234, indicating a high overall climate match. (Scores of 0.103 and greater are classified as high.) The climate score was high in Arizona, California, Colorado, Florida, Idaho, New Mexico, Nevada, Oregon, Texas, Utah, Washington, and Wyoming. Montana had a medium climate score, and all other states had a low climate score. Overall the East had a low climate match, except for coastal areas from South Carolina to Louisiana, where the climate match was medium to high. The west had a medium to high match from Montana in the north to Texas in the south, except along the northern Pacific Coast and the Cascade and Sierra Nevada Mountain ranges, where the climate match was low.

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; United States, Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Trinidad and Tobago, Singapore) and non-source locations (gray) for *Poecilia sphenops* climate matching. Source locations from GBIF Secretariat (2019) and Nico et al. (2019).

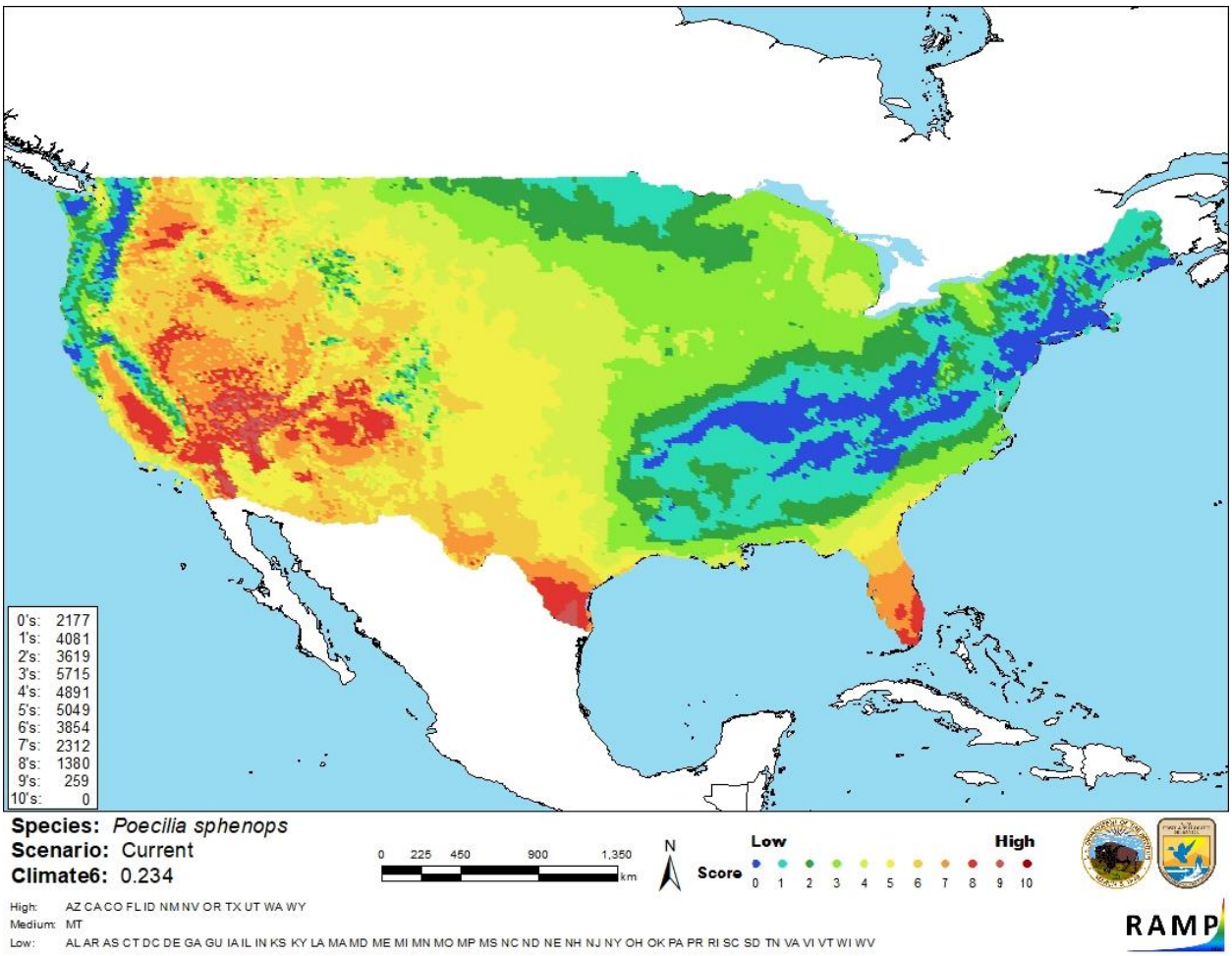

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Poecilia sphenops* in the contiguous United States based on source locations reported by GBIF Secretariat (2019) and Nico et al. (2019). 0= Lowest match, 10=Highest match.

The "High", "Medium", and "Low" climate match categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

There is adequate information available on the biology of *Poecilia sphenops.* However, difficulties in distinguishing among members of the *P. sphenops* species complex and between *P. sphenops* and *P. mexicana* affect the accuracy of distributional information and information on impacts of introduction of *P. sphenops*. There is disagreement in the literature on the southern limit of the native distribution of *P. sphenops* as well as on the species identity of one of the

nonnative populations established in the United States. More information on impacts of introduction of this species is needed. The certainty of this assessment is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Poecilia sphenops, Mexican Molly, is a poeciliid fish native to Mexico and Central America. This species and its hybrids are common in the aquarium trade, including in the United States. *P. sphenops* is currently established outside its native range in the United States, Trinidad, Singapore, Hungary, Italy, Japan, and Brazil; the populations in Italy, Japan, and the U.S. State of Montana occur in thermal springs. Taxonomic confusion is common among *P. sphenops* and closely related species. *P. sphenops* was reported to negatively affect the Moapa dace (*Moapa coriacea*) and the White River springfish (*Crenichthys baileyi*), two endangered species in the United States. However, a later author attributed the effects on *M. coriacea* and *C. baileyi* to *P. mexicana*. Without confirmation that *P. sphenops*, and not a congener, is negatively affecting the endangered species, the history of invasiveness is "none documented." *P. sphenops* has a high climate match with the contiguous United States, with the areas of highest match in the southeastern and southwestern United States. The certainty of assessment is low because of taxonomic uncertainty and the lack of scientifically defensible evidence of negative impacts of introduction. Overall risk assessment category for *P. sphenops* is "Uncertain."

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Low**
- **Overall Risk Assessment Category: Uncertain**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

Amaoka, K., F. Muto, and A. Mikami. 2001. *Poecilia sphenops* naturally breeding in Shiraoi-cho, southern Hokkaido. Japanese Journal of Ichthyology 48(2):109-112.

Animal-World. 2015. Mollies: Short-finned Molly, Sailfin Molly, Mexican Sailfin Molly. Animal-World, Ridgecrest, California. Available: http://animal-world.com/encyclo/fresh/livebearers/molly.php. (August 2019).

Bagley, J. C., F. Alda, M. F. Breitman, E. Bermingham, E. P. van den Berghe, and J. B. Johnson. 2015. Assessing species boundaries using multilocus species delimitation in a morphologically conserved group of Neotropical freshwater fishes, the *Poecilia sphenops* species complex (Poeciliidae). PLoS ONE 10(4):e0121139.

Chapman, F. A., S. A. Fitz-Coy, E. M. Thunberg, and C. M. Adams. 1997. United States of America trade in ornamental fish. Journal of the World Aquaculture Society 28(1):1-10.

Eschmeyer, W. N., R. Fricke, and R. van der Laan, editors. 2018. Catalog of fishes: genera, species, references. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp. (February 2018).

Froese, R., and D. Pauly, editors. 2017, 2019. *Poecilia sphenops* (Valenciennes, 1846). FishBase. Available: http://www.fishbase.ca/summary/Poecilia-sphenops.html. (February 2018, August 2019).

GBIF Secretariat. 2019. GBIF backbone taxonomy: *Poecilia sphenops*, Valenciennes, 1846. Global Biodiversity Information Facility, Copenhagen. Available: https://www.gbif.org/species/5203748. (August 2019).

Headlie, S. 2015. *Poecilia sphenops* (Common Molly). *In* The online guide to the animals of Trinidad and Tobago. Department of Life Sciences, University of the West Indies, St. Augustine, Trinidad and Tobago. Available: https://sta.uwi.edu/fst/lifesciences/sites/default/files/lifesciences/documents/ogatt/Poecilia_sphenops%20-%20Common%20Molly.pdf. (February 2018).

ITIS (Integrated Taxonomic Information System). 2018. *Poecilia sphenops* (Valenciennes in Cuvier and Valenciennes, 1846). Integrated Taxonomic Information System, Reston, Virginia. Available: https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=165904#null. (February 2018).

LiveAquaria. 2019. Tropical fish for freshwater aquariums: Gold Dust Molly livebearer. LiveAquaria, Rhinelander, Wisconsin. Available: https://www.liveaquaria.com/product/2942/gold-dust-molly?pcatid=2942&c=1101+2942. (August 2019).

Magalhães, A. L. B., and C. M. Jacobi. 2017. Colorful invasion in permissive Neotropical ecosystems: establishment of ornamental non-native poeciliids of the genera *Poecilia/Xiphophorus* (Cyprinodontiformes: Poeciliidae) and management alternatives. Neotropical Ichthyology 15(1):e160094.

Nico, L., P. J. Schofield, M. Neilson, and B. Loftus. 2018, 2019. *Poecilia sphenops* Valenciennes in Cuvier and Valenciennes, 1846. U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, Florida. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=864. (February 2018, August 2019).

NIES (National Institute for Environmental Studies). 2018. *Poecilia sphenops*. *In* Invasive species of Japan. National Research and Development Agency, National Institute for

Environmental Studies, Tsukuba, Japan. Available: https://www.nies.go.jp/biodiversity/invasive/DB/detail/50250e.html. (February 2018).

OIE (World Organisation for Animal Health). 2019. OIE-listed diseases, infections and infestations in force in 2019. World Organisation for Animal Health, Paris. Available: www.oie.int/animal-health-in-the-world/oie-listed-diseases-2019/. (August 2019).

PetSmart. 2018. Black Molly. Available: https://www.petsmart.com/fish/live-fish/goldfish-betta-and-more/black-molly-4031891.html. (February 2018).

Piazzini, S., E. Lori, L. Favilli, S. Cianfanelli, S. Vanni, and G. Manganelli. 2010. A tropical fish community in thermal waters of southern Tuscany. Biological Invasions 12(9):2959-2965.

Poelen, J. H., J. D. Simons, and C. J. Mungall. 2014. Global Biotic Interactions: an open infrastructure to share and analyze species-interaction datasets. Ecological Informatics 24:148-159.

Sanders, S., C. Castiglione, and M. H. Hoff. 2018. Risk Assessment Mapping Program: RAMP, version 3.1. U.S. Fish and Wildlife Service.

Yong, D. L., B. W. Low, A. Ang, M. Woo, and C. Ho. 2014. Multiple records of aquatic alien and invasive species in diets of native predators in Singapore. BioInvasions Records 3(3):201-205.

10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

Alda, F., R. G. Reina, I. Doadrio, and E. Bermingham. 2013. Phylogeny and biogeography of the *Poecilia sphenops* species complex (Actinopterygii, Poeciliidae) in Central America. Molecular Phylogenetics and Evolution 66:1011–1026.

Alves, C. B. M., F. Vieira, A. L. B. Magalhães, and M. F. G. Brito. 2007. Impacts of nonnative fish species in Minas Gerais, Brazil: present situation and prospects. Pages 291-314 *in* T. M. Bert, editor. Ecological and genetic implications of aquaculture activities. Springer Press, Dordrecht, The Netherlands.

Benesh, D. P., K. D. Lafferty, and A. Kuris. 2017. A life cycle database for parasitic acanthocephalans, cestodes, and nematodes. Ecology 98:882.

Bizerril, C. R. S. F., and N. R. W. Lima. 2001. Espécies de peixes introduzidos nos ecossistemas aquáticos continentais do estado do Rio de Janeiro, Brasil. Comunicações do Museu de Ciências e Tecnologia da Pontificia Universidade Catolica do Rio Grande do Sul Série Zoologia 14(1):43-59.

Bodon, M., S. Cianfanelli, G. Manganelli, E. Pezzoli, and F. Giusti. 2005. Mollusca Gastropoda Prosobranchia ed Heterobranchia Heterostropha. Pages 79-81 *in* S. Ruffo, and F. Stoch, editors. Checklist e distribuzione della fauna italiana. Memorie del Museo Civico di Storia Naturale di Verona, 2.serie, Sezione Scienze della Vita 16.

Brett, B. L. H. and B. L. Turner. 1983. Genetic divergence in the *Poecilia sphenops* complex in Middle America. Systematics and Ecology 11:127-137.

Castellani, D., and W. Barrella. 2006. Impactos da atividade de piscicultura na bacia do Rio Ribeira do Iguape, SP - Brasil. Boletim do Instituto de Pesca 32(2):161-71.

Courtenay, W. R., Jr., and D. A. Hensley. 1979. Survey of introduced non-native fishes. Phase I report. Introduced exotic fishes in North America: status 1979. Report submitted to National Fishery Research Laboratory. U.S. Fish and Wildlife Service, Gainesville, Florida.

Courtenay, W. R., Jr., H. F. Sahlman, W. W. Miley, II, and D. J. Herrema. 1974. Exotic fishes in fresh and brackish waters of Florida. Biological Conservation 6(4):292-302.

Devick, W. S. 1991. Patterns of introductions of aquatic organisms to Hawaiian freshwater habitats. Pages 189-213 *in* New directions in research, management and conservation of Hawaiian freshwater stream ecosystems. Proceedings of the 1990 symposium on freshwater stream biology and fisheries management, Division of Aquatic Resources, Hawaii Department of Land and Natural Resources, Honolulu, Hawaii.

Dill, W. A., and A. J. Cordone. 1997. History and status of introduced fishes in California, 1871-1996. California Department of Fish and Game Fish Bulletin, volume 178.

Hubbs, C. L., W. I. Follett, and L. J. Dempster. 1979. List of the fishes of California. California Academy Science Occasional Papers 133:1-51.

Hugg, D. O. 1996. MAPFISH georeferenced mapping database. Freshwater and estuarine fishes of North America. Life Science Software. Dennis O. and Steven Hugg. Edgewater, Maryland.

Kottelat, M., and J. Freyhof. 2007. Handbook of European freshwater fishes. Kottelat, Cornol & Freyhof, Berlin.

Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980 et seq. Atlas of North American freshwater fishes. North Carolina State Museum of Natural History, Raleigh, North Carolina.

Maciolek, J. A. 1984. Exotic fishes in Hawaii and other islands of Oceania. Pages 131-161 *in* W. R. Courtenay, Jr., and J. R. Stauffer, Jr., editors. Distribution, biology, and management of exotic fishes. The Johns Hopkins University Press, Baltimore, Maryland.

Maciolek, J.A. 2005. Exotic fishes in Hawaii and other islands of Oceania. The Johns Hopkins University Press, Baltimore, Maryland.

Magalhães, A. L. B., and C. M. Jacobi. 2008. Ornamental exotic fish introduced into Atlantic Forest water bodies, Brazil. Neotropical Biology and Conservation 3(2):73-77.

Miller, R. R. 1983. Checklist and key to the mollies of Mexico (Pisces: Poecilidae, *Poecilia*, subgenus *Mollienesia*). Copeia 1983(3):817-822.

Miller, R. R. 2005. Freshwater fishes of México. The University of Chicago Press, Chicago.

Mills, D., and G. Vevers. 1982. The Golden encyclopedia of freshwater tropical aquarium fishes. Golden Press, Racine, Wisconsin.

Mundy, B. C. 2005. Fishes of the Hawaiian Archipelago. Bishop Museum Bulletins in Zoology Number 6.

Ptacek, M. B., and F. Breden. 1998. Phylogenetic relationships among the mollies (Poeciliidae: Poecilia: Mollienesia) based on mitochondrial DNA sequences. Journal of Fish Biology 53:64–82.

Riehl, R., and H. A. Baensch. 1996. Aquarien Atlas, volume 1, 10th edition. Mergus Verlag GmBH, Melle, Germany.

Rosen, D. E., and R. M. Bailey. 1963. The poeciliid fishes (Cyprinodontiformes), their structure, zoogeography, and systematics. Bulletin of the American Museum of Natural History 126:1-176.

Schoenherr, A. A. 1979. Niche separation within a population of freshwater fishes in an irrigation drain near the Salton Sea, California. Bulletin of the Southern California Academy of Science 78(1):46-55.

Schultz, R. J., and R. R. Miller. 1971. Species of the *Poecilia sphenops* complex (Pisces: Poeciliidae) in Mexico. Copeia 1971(2):282-290.

Scoppettone, G. G. 1993. Interactions between native and nonnative fishes of the upper Muddy River, Nevada. Transactions of the American Fisheries Society 122(4):599-608.

Seriously Fish. 2015. *Poecilia sphenops*. Available: http://seriouslyfish.com/species/Poecilia-sphenops/.

Shapovalov, L., A. J. Cordone, and W. A. Dill. 1981. A list of freshwater and anadromous fishes of California. California Fish and Game 67(1):4-38.

St. Amant, J. A., and F. G. Hoover. 1969. Addition of *Misgurnus anguillicaudatus* (Cantor) to the California fauna. California Fish and Game 57(2):330-331.

Smithsonian Institution. No date. U.S. National Parasite Collection Database. Available: http://invertebrates.si.edu/parasites.htm.

Velázquez-Velázquez, E., M. Maza-Cruz, A. E. Gómez-González and J. A. Navarro-Alberto, 2015. Length-weight relationships for 32 fish species in the Grijalva River Basin, Mexico. Journal of Applied Ichthyology 31:413-414.

Welcomme, R. L. 1988. International introductions of inland aquatic species. FAO Fisheries Technical Paper 294. Food and Agriculture Organization of the United Nations (FAO), Rome.

Wischnath, L. 1993. Atlas of livebearers of the world. Tropical Fish Hobbyist Publications, Inc., Neptune City, New Jersey.