

DANIELA REIS JOAQUIM DE FREITAS  
(ORGANIZADORA)

PRODUCCIÓN CIENTÍFICA EN  
**CIENCIAS**  
BIOLÓGICAS

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## APRESENTAÇÃO

Las Ciencias Biológicas estudian los seres vivos y todas sus relaciones entre sí y con el medio ambiente. Es un campo muy amplio, que engloba diferentes áreas de conocimiento, y que puede ser aplicado en el área de la educación, la investigación, la bioconservación ambiental, la salud, etc.

El trabajo “Producción ciencia en Ciencias Biológicas” está enfocado a discutir la formación del conocimiento en varias áreas que conforman el gran dominio de las Ciencias Biológicas, brindando al lector una visión variada y amplia de lo que se produce en esta área en la actualidad. En este trabajo contamos con seis capítulos compuestos por artículos científicos originales basados en trabajos de investigación.

Los trabajos descritos en este libro abordan temas relacionados con las ciencias de la salud como microbiología, zoología y ecología de especies, botánica, divulgación científica, medio ambiente, biodiversidad y bioconservación. Esta multidisciplinariedad es de gran importancia, ya que la investigación con diferentes perspectivas profesionales tiende a proporcionar una visión más amplia y una mayor aplicabilidad en la vida cotidiana del lector.

Creemos que este trabajo enriquecerá su conocimiento y demostrará que la ciencia puede ser muy placentera. Atena Editora, buscando la calidad, tiene a su disposición un cuerpo editorial compuesto por maestros y doctores formados en las mejores universidades de Brasil, para la revisión de sus obras. Por lo tanto, está asegurado que tiene un trabajo de excelente calidad en sus manos. Esperamos que disfrute de su lectura. ¡Buenos estudios!

Daniela Reis Joaquim de Freitas



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# CAPÍTULO 4

## *Girardinichthys viviparus* ESPÉCIES ENDÊMICAS DO VALE DO MÉXICO

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### *Girardinichthys viviparus* ENDEMIC SPECIES OF THE VALLEY OF MEXICO

**ABSTRACT:** A population of Chapultepec splitfin *Girardinichthys viviparus* was registered in the urban Lake Alameda Oriente. Biometry data for females and males are including for first time for this urban lake of Mexico City. The main causes of risk reported for this species in the aquatic system are water depletion and habitat alteration by treated wastewater used to keep the water level of lake.

**KEYWORDS:** Freshwater, urban lake, threatened species, fish.

### *Girardinichthys viviparus* ESPECIE ENDÊMICA DEL VALLE DE MÉXICO

**RESUMO:** Uma população de Chapultepec splitfin *Girardinichthys viviparus* foi registrada no lago urbano Alameda Oriente. Os dados de biometria para mulheres e homens estão incluídos pela primeira vez neste lago urbano da Cidade do México. As principais causas de risco relatado para esta espécie no sistema aquático são o esgotamento da água e alteração do habitat por águas residuais tratadas usadas para manter o nível de água do lago.

**PALAVRAS-CHAVE:** Água doce, lago urbano, espécies ameaçadas, peixes.

### INTRODUCTION

Mexico is among the five countries in the world with the highest biological diversity, not only because it has a large number of species, but also in terms of other aspects such as ecosystem and genetic variability (Neyra and Duran, 1998; Bezaury *et al.*, 2000). In addition, the Mexican territory includes areas whose biodiversity is poorly known (CONABIO, 2002). Family Goodeidae is between the most important Mexican freshwater fishes. This fish are grouped in only Mexicans who are characterized by sexual dimorphism, prenuptial courtship and viviparity, which lead to a series of morphological, anatomical and physiological characteristic of the group (Díaz-Pardo and Ortíz-Jiménez, 1986). Goodeidae family in

Mexico is represented by approximately 42 species viviparous fish (Paulo-Maya and Trujillo-Jiménez, 2000), includes 36 live-bearing species largely confined to the Rio Lerma basin in the highlands of Central Mexico (Espinosa *et al.* 1993; Moyle and Cech, 2000; Miller *et al.*, 2005; De la Vega-Salazar, 2006). At present, mexclapique or Chapultepec splitfin (*Girardinichthys viviparus*) is endemic to basin of Mexico: Lakes Xochimilco, Zumpango, Texcoco, Chapultepec (Alvarez del Villar and Navarro, 1957; cited in Sedeño-Díaz and López-López, 2009). Although Espinosa *et al.* (1993) cited to *G. viviparus* as endemic to the Valley of Mexico, also there are records that indicate their presence in the upper basin of Pánuco in the Tula River (Alvarez del Villar, 1970; Díaz, 2002) and Lake Tecocomulco (Miranda *et al.*, 2009).

In Mexico, there has been no detailed limnological study (Arredondo-Figueroa and Flores-Nava, 1992, Martínez-Arroyo and Jáuregui, 2000; Schueler and Simpson, 2001), despite the biological and economic importance many inland water bodies and mainly in urban areas, and such bodies of water have been modified by the constant supply of nutrients (Quirós, 2007).

Urban lakes are important aquatic environments for large cities, because they are recreation areas for its inhabitants (Labounty, 1995; Elías-Fernández *et al.*, 2006). They are very different from other lakes: they are shallow, vary greatly in size, depth, relationship drained area/surface water body, water balance, nutrient cycling and trophic status, highly artificial and often hypertrophic yet more people come into contact with them than rural, natural lakes. This aquatic system have received little attention in the limnological and watershed management literature, and our knowledge of their ecology and management is poor (Birch and McCaskie, 1999; Schueler and Simpson, 2001; Espinosa-Castillo, 2008).

Nowadays the urban lakes in Mexico City continue to play an important societal role as sources of fisheries, cultural and recreation, and they are highly valued by the Mexican people. They are also of great interest to aquatic scientists, having unique limnological and biotic characteristics and supporting numerous endemic species. We present a short communication on a threatened freshwater fishes from central Mexico.

## **MATERIALS AND METHODS**

During an ongoing study of environmental quality and biota of Lake Alameda Oriente (Fig. 1), a total of 281 fishes were collected in two peripheral areas of Lake Alameda Oriente (19°26'N; 99°03' W; 2234 m.a.s.l.) in March 2008, with a seine 5 m long and 1.0 m deep, with 5 mm mesh. 81 specimens were fixed in 10 % formaldehyde. Specimens were then transported to the laboratory; measurements were made by vernier callipers reading to 0.1 mm and weighed to the nearest 0.01 g and dissected to determine sex. Some specimens were returned to the water. The sex ratio was analyzed for the whole population. The statistical significance of the ratio results was established by a goodness of fit Chi-squared

test ( $\chi^2$ ).

A covariance analysis was conducted to determine whether or not there were significant differences at  $p < 0.05$  for the length-weight relationship between both sexes. The Total length (TL)-total body weight (TW) relationship was calculated by a power regression between these variables for each sex using the formula:

$$TW = aTL^b$$

where TW is the body weight, SL the standard length,  $b$  the growth exponent or length-weight factor, and  $a$  is a constant. The values of  $a$  and  $b$  were estimated by means of a linearized form of that equation by taking (base 10) logarithms on both sides and estimating the values of  $\log(a)$  and  $\log(b)$  by means of a linear regression, using ordinary least-squares regression. Student's  $t$ -test was used to the hypothesis of isometric growth (Pauly, 1984). The catalogue number of voucher specimens is IB-UNAM 14728.

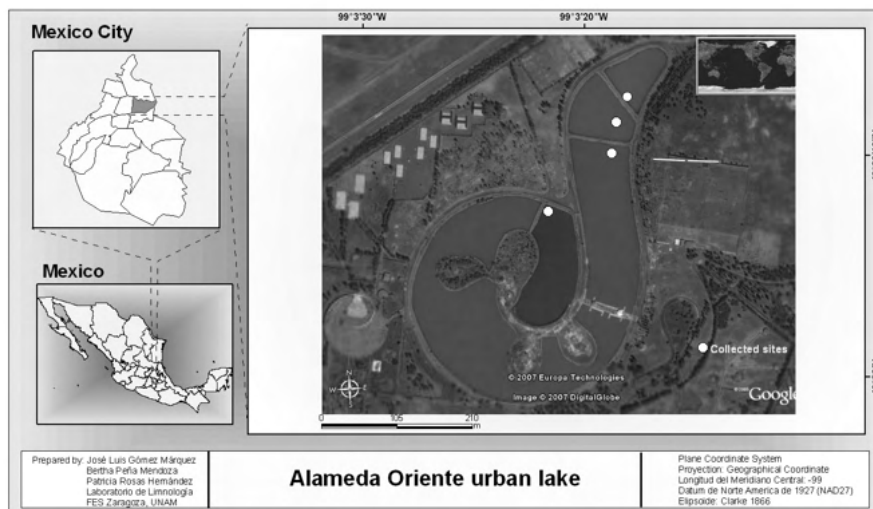


Fig. 1 Study area of Alameda Oriente urban lake.

## RESULTS

Among the fishes captured, 81 specimens of Chapultepec splitfin *Girardinichthys viviparus* (Bustamante 1837) were identified following the descriptions provided in previous publications (Alvarez del Villar, 1970; Radda and Meyer, 2003; Miller *et al.*, 2005) such as the black colour of the breeding male; the presence of 18–26 rays in the anal fin; dark blotch above anus small and inconspicuous or absent; fin base longer than longest rays and dorsal and anal base with the same length in males; rudimentary gonopodium with 6–8 anal branched and short rays, separated by notch from remainder of fin. Diagnosis and measurements are given in Table 1. Some specimens were deposited in the Fishes

Laboratory of Biology Institute, U.N.A.M., in order to check the identity of the species.

These data constituting the first record of total body length (TL), standard body length (SL), and body weight (TW) for males and females of this species in the urban lake. Total body length and weight ranged from 18 to 49 mm and 0.07 to 1.92 g for males, and from 20 to 61 mm and 0.06 to 3.98 g for females. Females were larger than males ( $t$ -value = 10.78;  $p < 0.05$ ) (Fig. 2).

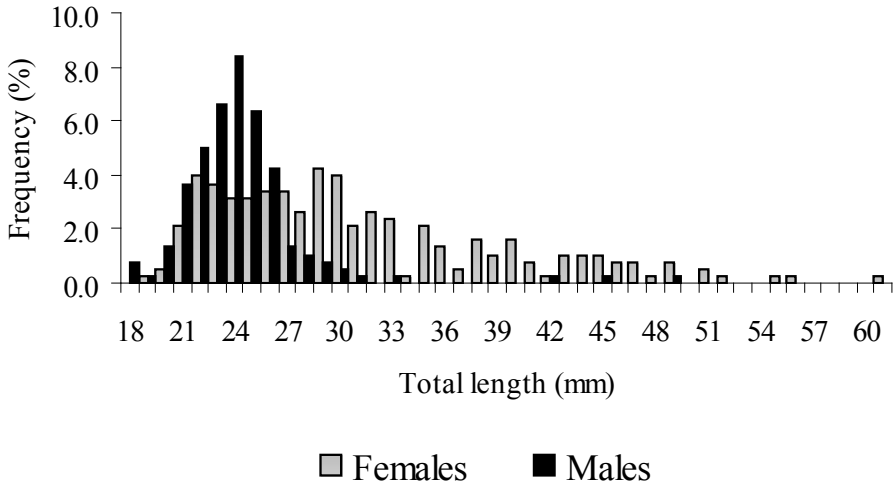


Fig. 2. Length-frequency distribution of *Girardinichthys viviparus* at Alameda Oriente urban lake, Mexico City.

Of the 81 adults specimens dissected, 24 (29.6%) were males and 57 (70.4%) were females. The sex ratio of the catch as a whole was 2.4:1 (female:male), significantly different from a 1:1 ratio ( $\chi^2 = 13.44$ ,  $p < 0.05$ ). The females dominated significantly in this aquatic system in the monitoring.

	Lt(mm)	Ls(mm)	Bw(mm)	D	P	V	A	C
Females	35.9±9.7 (20-61)	30.6±8.7 (17-53)	8.4 ±3.4 (4-17)	19±0.8 (18-21)	16±0.5 (15-16)	6±0.4 (5-6)	20±1.1 (18-23)	29±1.9 (24-31)
Males	27.7±6.9 (18-49)	23.1±6.2 (15-42)	5.7 ± 2.6 (3-13)	19±1.0 (18-20)	16±0.5 (15-16)	6±0.2 (5-6)	20±1.0 (19-22)	27±1.8 (24-30)

Table 1. Lengths (mm), weight (g) and meristic traits of *Girardinichthys viviparus* specimens studied from Lake Alameda Oriente, distinguishing males (n = 24) and females (n = 57). Values are means ± S.D., range in parentheses.

LT, total length; LS, standard length; Bw, body weight; D, dorsal fin rays; P, pectoral fin rays; V, ventral fin rays; A, anal fin rays; C, caudal fin rays.

Length-weight relationship: This relation was evaluated for all individuals, and for each sex separately (females and males), although there is not significant difference between the male and female slopes of TW-TL regressions (ANCOVA;  $F = 0.18$ ,  $p > 0.05$ ). These equations are given below:

Females:	TW = 0.000003	TL <sup>3.445</sup> ;	$R^2 = 0.980$ ,	$p < 0.05$
Males:	TW = 0.000006	TL <sup>3.267</sup> ;	$R^2 = 0.937$ ,	$p < 0.05$
All fishes:	TW = 0.000004	TL <sup>3.402</sup> ;	$R^2 = 0.975$ ,	$p < 0.05$

Weight increased allometrically with size (Fig. 3), since  $b$  value had a significant difference from 3 ( $t = 8.049$ ,  $p < 0.05$  for females, and  $t = 2.816$ ,  $p < 0.05$  for males). For the same length, females weight were equals than males.

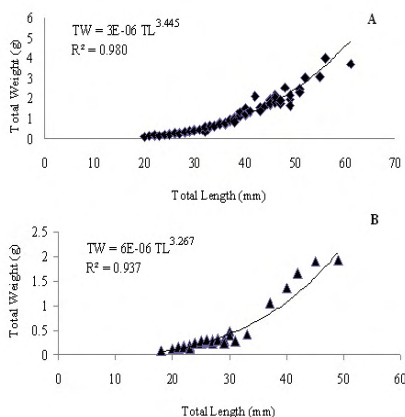


Fig. 3. Length-weight relationship for females (A) and males (B) of *Girardinichthys viviparus*.

## DISCUSSION

The specimens collected in Lake Alameda Oriente were bigger in contrast with those reported by Miranda et al. (2008) and Sedeño-Díaz and López-López (2009). Probably, in this aquatic system the fishes have good environmental and trophic condition to survive, it has to adapt to a stressful environment for the type of treated wastewater used to keep the lake level, mainly in dry season.

Nikolsky (1963) mentioned that the larger sizes of females result from a differential growth rate with respect to males. In our study, females probably have higher survivorship rates due to their larger size, are longer-lived than males, and are more resistant to the rigors

of reproductive effort. Cházaro (1989) cited that the larger size of *C. jordani* is influenced by changes in the food supply and represents an adaptive response of the population to environmental changes, as in this urban lake occurred.

Sex ratio for *G. viviparus* in Alameda Oriente urban lake indicates that males and females have different abundances, and in this case deviation from the expected 1:1 (male:female) was significant. Nikolsky (1963) pointed out that the sex ratio varies considerably from one species to another, but in the majority of cases it is close to one, and may vary from one year to the next in the same population. Moreover, in this study the female:male sex ratio was 2.4:1 and variations in sex ratio could reflect natural population dynamics.

With respect to a differential sex distribution, van Aerle *et al.* (2004), Devlin and Nagahama (2002) and Guerrero-Estévez and Moreno-Mendoza (2009) pointed out that there is a large variety of mechanisms of sexual determination. These may be genetic, or depend on environmental conditions such as temperature, pH, and community factors, all of which can influence sexual proportion in a population. In addition, van Aerle *et al.* (2004) cited that there are a wide range of chemicals discharged into the environment that mimic hormones, especially estrogens, and sex steroids play an important role in the regulation of sexual differentiation, and this could be affect to the population.

Respect to the relationship between length and weight, Ricker (1979) mentioned that when fish have a *b* coefficient value significantly different from three, the growth is allometric. This is the case of the present study, body grows slower in length than weight, and an exponent more greater than 3 would indicate that the fish becomes heavier as it increases in size. Probably in this aquatic system the population has acceptable conditions of food. In addition, the relationship between length and weight provides an index frequently used by fisheries biologists to quantify the state of well-being of a fish (Wootton, 1990).

Lake Alameda Oriente is an artificial water body in the basin of Valle de Mexico. This basin covered the region that now is the modern Mexico City and environments. The other former bodies of water that formed the Gran Cuenca now are either greatly altered or extremely contaminated by secondarily-treated wastewater (Elías-Fernández *et al.*, 2006).

Lake Alameda Oriente varies from 8 to 9 ha, depending on the quantity of seasonal rainfall and domestic wastewater that receives. The lake has turbid and shallow waters, normally with 0.5–1.5 m maximum depth. Water temperature between 16 to 25 °C, dissolved oxygen range from 0.63 to 24.9 mg/L, pH alkaline (mean 9.8 units), sodium, bicarbonates, carbonates and sulphates are the dominant ions and bigger proportions of calcium, and magnesium are present (Montaño, 2010).

The natural distribution of *G. viviparus* was restricted to two localities in the central and southern parts of the central basin of Mexico, Lakes Texcoco and Zumpango (Miller *et al.*, 2005). According to literature, *G. viviparus* has been reported around of Mexico City, Lake Chalco, Lake Xochimilco, Lake Chapultepec, Requena reservoir, and Lake Texcoco



(Navarrete *et al.*, 2003). Recently this species has been discovered and reported by Miranda *et al.* (2008) in Lake Tecocomulco, Hidalgo, which is the only remaining natural water body in the Valle de Mexico basin (Caballero *et al.*, 1999). However, Navarrete *et al.* (2003), Navarrete *et al.* (2004) and Sedeño-Díaz and López-López (2009) mentioned that *G. viviparus* is known to be extinct in Lake Zumpango and Requena reservoir, as a result of receives domestic and industrial wastewater.

Direct anthropogenic effects have altered and contaminated its natural environment (Contreras-Balderas *et al.*, 2003; Navarrete *et al.*, 2004; Contreras-Balderas, 2005; De la Vega-Salazar, 2006) and in particular as a result of water exploitation for urban, agricultural and industrial needs (Díaz-Pardo and Ortíz-Jiménez, 1985; De la Vega-Salazar, 2006). Furthermore, it is under considerable pressure from a range of anthropogenic activities, including water extraction for consumption, habitat degradation by pollution, reductions in surface water levels and the introduction of exotic species mainly (Soto-Galera and Paulo, 1995; Lyons *et al.*, 1998; Contreras-Balderas, 2005; De la Vega-Salazar and Macías-García, 2005; Contreras MacBeath and Rivas, 2007).

*G. viviparus* is an endangered goodeid with an extremely reduced range of distribution in the Mexican plateau, only known from a few locations near to Mexico City (Navarrete *et al.*, 2003; Navarrete *et al.*, 2004). This species has been catalogued as part of the numerous threatened freshwater fishes of Mexico (Williams and Miller, 1990; Contreras-Balderas *et al.*, 2003; Contreras-Balderas, 2005; Sedeño-Díaz and López-López, 2009; Diario Oficial, 2010).

Nowadays, this species appears to be abundant in Lake Alameda Oriente, but due to the protected status of the species an attempt was made at this time to provide a more precise estimation of population biology with the not many data obtained. The greatest threats to the long-term existence of *G. viviparus* in the lake emerge from tourist activities and their effect on the lake habitat such as irrigation for surrounding fields. Lake Alameda Oriente should be protected as it hosts the largest population of *G. viviparus* ever discovered. Urgent conservation and management measures are needed to preserve both the volume of the body of water and its quality as a natural habitat for this species.

In all countries, a conservation strategy should be developed to protect remaining natural communities that support a relatively intact native fish fauna. The introduction and establishment of non-native species have resulted in severe declines of native fishes in México (Contreras-Balderas, 2005; Contreras MacBeath and Rivas, 2007).

Canonico *et al.* (2005), Gozlan (2008) and Schlaepfer *et al.* (2011) mentioned that non-native species can cause the loss of biological diversity (i.e., genetic, species, and ecosystem diversity) and threaten the well-being of humans when they become invasive. However, in some cases, they can also provide conservation benefits. Non-native species can also have desirable effects on an ecosystem. Numerous species have been repeatedly and deliberately introduced outside their native range for agricultural, ornamental,

aquaculture and recreational purposes. As a result non-native species are integral to the culture and economies of most countries.

Freshwater ecosystems in Mexico are specifically vulnerable due to degradation and exploitation to be subject, making it difficult to establish conservation strategies for species of this family. However, it is necessary to recognize the importance of developing specific programs to protect water quality and habitat, and to ensure the conservation of flora and fauna of freshwater. The destruction of biotopes all around Mexico City is dramatic and gets worse rapidly. The last surviving fish species endemic to the basin of Mexico requires urgent protection of its population as cited by Miranda et al. (2008) and Sedeño-Díaz and López-López (2009).

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## REFERENCES

- Álvarez del Villar, J. 1970. Peces Mexicanos (Claves). Comisión Nacional Consultiva de Pesca. Instituto Nacional de Investigaciones Biológico Pesqueras. S.I.C. México. 166 p.
- Alva, M. A. F. and Otto, E. S. P. 2006. Estrategias de manejo de la calidad del agua de los lagos del Distrito Federal. In: El agua en la ciudad de México. Encuentro Internacional de Experiencias por el Agua. Tlalocan. Festival Internacional por el Agua. 14 al 16 de marzo. Palacio de Minería, D.F., México. Pp. 505-509.
- Arredondo-Figueroa, J. L. and A. Flores-Nava. 1992. Características limnológicas de pequeños embalses epicontinentales, su uso y manejo en la acuicultura. *Hydrobiológica* 3/4: 1-10.
- Bezaury, C. J. E., R. Waller, L. Sotomayor, X Li, S. Anderson, R. Sayre and B. Houseal. 2000. Conservation of biodiversity in Mexico: Ecoregions, sites and conservation targets. The Nature Conservancy Mexico, Division, Conservation Science and Stewardship. 122 p.
- Birch, S. and J. McCaskie. 1999. Shallow urban lakes: a challenge for lake management. *Hydrobiologia* 395-396: 365-378.
- Caballero, M., S. Lozano, B. Ortega, J. Urrutia and J.L. Macias. 1999. Environmental characteristics of Lake Tecocomulco, northern basin of Mexico, for the last 50,000 years. *Journal of Paleolimnology* 22: 399-411
- Canonico, C. G., A. Arthington, K.J. Mccrary and L.M. Thieme. 2005. The effects of introduced tilapias on native biodiversity. *Aquatic Conservation: Marine and Freshwater Ecosystems* 15: 463-483. DOI: 10.1002/aqc.699.

Cházaro O. S. 1989. Estudio sobre algunos aspectos de la Biología del charal *Chirostoma jordani* en el embalse Trinidad Favala, Edo. de México. Tesis de Licenciatura. ENEP-Iztacala. UNAM. México. 78 p.

CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad). 2002. Lista de regiones hidrológicas prioritarias. <http://www.conabio.gob.mx/conocimiento/regionalizacion/doctos/Hlistado.html> (accessed March 2011).

Contreras-Balderas S. and P. Almada-Villela. 1996. *Girardinichthys viviparus*. In: IUCN (2007). 2007 IUCN Red List of Threatened Species. Available from [www.iucnredlist.org](http://www.iucnredlist.org) (accessed March 2010).

Contreras-Balderas, S., P. Almada-Villela, M. L. Lozano-Vilano and M. E. García-Ramírez. 2003. Freshwater fish at risk or extinct in México. A checklist and review. *Review of Fish Biology and Fisheries* 12: 241–251.

Contreras-MacBeath, T. and J.M. Rivas. 2007. Threatened fishes of the world: *Notropis boucardi* (Günther 1868) (Cyprinidae). *Environmental Biology of Fishes* 78: 287–288. DOI 10.1007/s10641-006-0039-8.

Contreras-Balderas, S. 2005. Conservation Status of Mexican Freshwater Viviparous Fishes. In M. C. Uribe and H. J. Grier, editors. *Viviparous Fishes*. New Life Publications, México. Pp. 415-423.

Cooper, III F.R. 1991. Some considerations for managing urban lakes. In K. J. Hatcher, editor. *Proceedings of the 1991 Georgia Water Resources Conference*, March 19 and 20. Institute of Natural Resources. The University of Georgia, Georgia. Pp. 173-174.

De la Vega-Salazar, M.Y. and C. Macías-García. 2005. Principal Factors in the Decline of the Mexican Endemic Viviparous Fishes (Goodeinae:Goodeidae). In M. C. Uribe and K. J. Grier, editors. *Viviparous Fishes*. New Life Publications, México. Pp 506-513.

De la Vega-Salazar, M.Y. 2006. Estado de conservación de los peces de la familia Goodeidae (Cyprinodontiformes) en la mesa central de México. *Revista de Biología Tropical*. (*International Journal of Tropical Biology*) 54(1): 163-177. Devlin, H. R. and Y. Nagahama. 2002. Sex determination and sex differentiation in fish: an overview of genetic, physiological, and environmental influences. *Aquaculture* 208: 191–364.

Diario Oficial. 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010. Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. 30 de diciembre 2010. México, D.F. 78 p.

Díaz-Pardo, E. and D. Ortiz-Jiménez. 1986. Reproducción y ontogenia de *Girardinichthys viviparus* (Pisces:Goodeidae). *An. Esc. Nal. de Cienc. Biol., IPN, México, D.F.* 30(1-4): 45-66.

Díaz, P. E. 2002. *Girardinichthys viviparus*. Peces en riesgo de la Mesa Central de México. Laboratorio de Ictiología y Limnología, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional. Bases de datos SNIB-CONABIO. Proyecto W039. México. D.F. 6 p. available from <http://www.conabio.gob.mx/conocimiento/ise/fichasnom/Girardinichthysviviparus00.pdf> (accessed July 2011).

Elías-Fernández, G., N. A. Navarrete-Salgado, J. L. Fernández-Guzmán and G. Contreras-Rivero. 2006. Crecimiento, abundancia y biomasa de *Poecilia reticulata* en el lago urbano del parque Tezozomoc de la ciudad de México. *Revista Chapingo. Serie Ciencias Forestales y del Ambiente* 12(2): 155-159.

- Espinosa, P.H., M. T. D. Gaspar and P. M. Fuentes. 1993. Listado Faunístico de México. III. Los peces dulceacuícolas mexicanos. Instituto de Biología, UNAM, México. 99 p.
- Espinosa-Castillo, M. 2008. Procesos y actores en la conformación del suelo urbano en el ex lago de Texcoco. *Economía. Sociedad y Territorio* VIII (27): 769-798.
- Guerrero-Estévez, S. and N. Moreno-Mendoza. 2009. Sexual determination and differentiation in teleost fish. *Reviews in Fish Biology and Fisheries* DOI 10.1007/s11160-009-9123-4.
- Gozlan, R. E. 2008. Introduction of non-native freshwater fish: is it all bad? *Fish and Fisheries* 9: 106–115.
- Labounty, J. 1995. What's an urban lake worth? *Lakeline* 15: 6-7.
- Lyons, J., G. González-Hernández, E. Soto-Galera and M. Guzmán-Arroyo. 1998. Decline of freshwater fishes and fisheries in selected drainages of best-central Mexico. *Fisheries* 23(4): 10-17.
- Martínez-Arroyo, A. and E. Jáuregui. 2000. On the environmental role of urban lakes in Mexico City. *Urban Ecosystems* 4: 145–166.
- Miller, R. R., W. L. Winckley and S. M. Norris. 2005. *Freshwater fishes of México*. The University of Chicago, Chicago. 490 p.
- Miranda, R., D. Galicia, G. Pulido-Flores and S. Monks. 2008. First record of *Girardinichthys viviparus* in Lake Tecocomulco, Mexico. *Journal of Fish Biology*: doi:10.1111/j.1095-8649.2008.01929.x
- Montaño, S. I. 2010. Aspectos hidrobiológicos en dos esclusas del lago artificial del Parque de la Alameda Oriente. Tesis de Licenciatura, FES Zaragoza, UNAM, México. 92 p.
- Moyle, P. B. and J. J. Cech. 2000. *Fishes. An Introduction to Ichthyology*. Prentice-Hall Inc. New Jersey. 612 p.
- Navarrete, S. N. A., G. R. Contreras and G. F. Elias. 2003. Abundancia y estatus sanitario del mexclapique (*Girardinichthys viviparus* Bustamante) en cuerpos de agua del centro de México. *Revista Chapingo. Serie Ciencias Forestales y del Ambiente* 9(2): 143–146.
- Navarrete, S. N. A., G. R. Contreras, G. F. Elias and M. L. B. Rojas. 2004. Situación de *Girardinichthys viviparus* (especie amenazada) en los lagos de Chapultepec, Zumpango y Requena. *Revista de Zoología* 15: 1–6.
- Neyra, G. L. and L. S. Durand. 1998. Biodiversidad. In CONABIO. *La diversidad biológica de México: Estudio de País, 1998*. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México. Pp. 62-102.
- Nikolsky, G.V. 1963. *The Ecology of Fishes*. Academic Press. New York. USA. 352 p.
- Paulo-Maya, J. and P. Trujillo-Jiménez. 2000. Nueva especie de *Ilyodon* (Cyprinodontiformes:Goodeidae) de la cuenca del río Balsas, México. *Revista de Biología Tropical* 48: 465-472.

- Quirós, R. 2007. Manejo y recuperación de lagos urbanos. Documento de Trabajo del Área de Sistemas de Producción Acuática No. 6. Facultad de Agronomía, Universidad de Buenos Aires, Argentina. 16 p.
- Radda, A.C. and M. K. Meyer. 2003. Description of *Girardinichthys ireneae* sp.n. from Zacapu, Michoacan, Mexico, with remarks on the genera *Girardinichthys* Bleeker, 1860 and *Hubbsina* De Buen, 1941 (Goodeidae, Pisces). Die Annalen des Naturhistorischen Museums in Wien, Serie B 104: 5–9.
- Ricker, W. E. 1979. Growth rates and models. In: W.S. Hoar, D.J. Randall & J.R. Brett (eds.). Fish Physiology. Academic Press, London. VIII: 677-743.
- Schlaepfer, A. M., F. D. Sax and D. J. Olden. 2011. The potential conservation value of non-native species. Conservation Biology 25 (3): 428–437. DOI: 10.1111/j.1523-1739.2010.01646.x
- Schueler, T. and J. Simpson. 2001. Why urban lakes are different. Urban Lakes Management 3: 747-750.
- Sedeño-Díaz, J. E. and E. López-López. 2009. Threatened fishes of the world: *Girardinichthys viviparus* (Bustamante 1837) (Cyprinodontiformes:Goodeidae). Environmental Biology of Fishes 84: 11–12.
- Soto-Galera, E. and J. M. Paulo. 1995. Peces dulceacuícolas Mexicanos. XI. *Allotoca dugesii* (Cyprinodontiformes: Goodeidae). Zoología Informa, IPN 31: 5-15.
- van Aerle, R., T.J. Runnalls & C.R. Tyler. 2004. Ontogeny of gonadal sex development relative to growth in fathead minnow. Journal of Fish Biology 64: 355–369.
- Williams, J. E. and R. R. Miller. 1990. Conservation status of the North American fish fauna in fresh water. Journal of Fish Biology 37 (Supplement A): 79-85.
- Wootton, J.R. 1990. Ecology of teleost fishes. Fish and Fisheries Series 1. Chapman & Hall. New York. USA. 404 p.

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