



How Many Fish Species Are in North America?

Authors: Schmitter-Soto, Juan J., Bemis, Katherine E., Dowling, Thomas E., Espinosa-Pérez, Héctor S., Findley, Lloyd T., et al.

Source: Ichthyology & Herpetology, 112(4) : 615-618

Published By: The American Society of Ichthyologists and Herpetologists

URL: <https://doi.org/10.1643/i2023047>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

How Many Fish Species Are in North America?

Juan J. Schmitter-Soto¹, Katherine E. Bemis², Thomas E. Dowling³,
Héctor S. Espinosa-Pérez⁴, Lloyd T. Findley⁵, Carter R. Gilbert⁶,
Karsten E. Hartel⁷, Robert N. Lea⁸, Nicholas E. Mandrak⁹,
Margaret A. Neighbors¹⁰, H. J. Walker, Jr.¹¹, and Lawrence M. Page¹²

The joint American Fisheries Society and American Society of Ichthyologists and Herpetologists Committee on Names of Fishes has updated the list of the species of fishes in the three countries of North America. This contribution provides succinct analyses of the changes in these data over the eight editions, for example, the discovery of new species and exotic species, as well as the conservation status of the fishes in the three countries and by habitat. There are 5,089 species of fishes in North America: 1,254 in Canada, 3,821 in the United States, and 3,261 in Mexico; 107 of them are introduced established species and 37 are extinct.

El Comité sobre Nombres de Peces, un comité conjunto de la Sociedad Americana de Pesquerías y la Sociedad Americana de Ictiólogos y Herpetólogos, ha publicado la última edición de la lista de especies de peces en los tres países de Norteamérica. Esta contribución ofrece análisis sucintos de los cambios a lo largo de las ocho ediciones, por ejemplo el descubrimiento de nuevas especies y de especies exóticas, así como el estado de conservación de los peces, en los tres países y por hábitat. Hay 5089 especies de peces en Norteamérica: 1254 en Canadá, 3821 en los Estados Unidos, 3261 en México; 107 de ellas son especies introducidas establecidas y 37 están extintas.

Le Comité sur les Noms des Poissons, un comité conjoint de la Société Américaine de Pêcheries et de la Société Américaine des Ichthyologistes et Herpetologistes, a publié la dernière édition de la liste des espèces de poissons dans les trois pays de l'Amérique du Nord. Cette contribution fournit des analyses succinctes des changements survenus au cours des huit éditions, par exemple la découverte d'espèces nouvelles et d'espèces exotiques, ainsi que l'état de conservation des poissons, dans les trois pays et par habitat. Il y a 5089 espèces de poissons en Amérique du Nord: 1254 au Canada, 3821 aux États-Unis, 3261 au Mexique; 107 d'elles sont des espèces introduites établies et 37 sont éteintes.

THE Committee on Names of Fishes, a joint committee of the American Fisheries Society and the American Society of Ichthyologists and Herpetologists, has revised the list of species of fishes (*sensu lato*, including ray-finned fishes, hagfishes, lampreys, and chondrichthyans, but now excluding cephalochordates) present in Canada, Mexico, and the United States (Page et al., 2023). The list has been published approximately every ten years since 1948 (range 9–13 years, mean 10.7 years), and this has included eight editions. It has long been the reference for standard common and scientific names of fishes. However, the longevity of the endeavor also allows for interesting comparisons over time and space.

The objective of this contribution is to offer examples of comparisons, such as the rate of discovery of new species, the recording of new invasive exotics, and the conservation status of fishes in the three countries and by habitat.

MATERIALS AND METHODS

North America is understood here as the marine and terrestrial area within the political boundaries of its three largest countries, Canada, Mexico, and the United States (excluding non-continental territories). The criteria used to include species in the list are discussed by Page et al. (2023). In addition to common names in three languages (English for all three countries, French for Canada, and Spanish for Mexico), scientific names, and higher taxa, the list identifies: (a) North American countries in which the species is present; (b) occurrence in oceans and/or freshwaters; (c) native or introduced status; (d) whether it is extinct, completely or only in nature; and (e) author and year of original description. Comparative data for non-North American countries in our analysis presented here were extracted from FishBase (Froese and Pauly, 2023).

⁹ University of Toronto Scarborough, Toronto, ON, Canada; Email: nicholas.mandrak@utoronto.ca.

¹² Florida Museum of Natural History, Gainesville, Florida; Email: lpage@flmnh.ufl.edu.

⁸ California Academy of Sciences, San Francisco, California; Email: rnllea@comcast.net.

¹¹ Scripps Institution of Oceanography, La Jolla, California; Email: hjwalker@ucsd.edu.

⁵ Centro de Investigación en Alimentación y Desarrollo, Guaymas, Sonora, Mexico; Email: ltfindley@gmail.com.

¹⁰ Natural History Museum of Los Angeles County, Los Angeles, California; Email: mneighbors@prodigy.net.

⁴ Universidad Nacional Autónoma de México, Mexico City, CDMX, Mexico. Deceased.

³ Wayne State University, Detroit, Michigan; Email: thomas.dowling@wayne.edu.

⁶ Florida Museum of Natural History, Gainesville, Florida. Deceased.

¹ El Colegio de la Frontera Sur, Chetumal, QR, Mexico; Email: jschmitt@ecosur.mx. Send correspondence to this address.

² National Systematics Laboratory, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, and Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C.; Email: BemisK@si.edu.

⁷ Curatorial Associate (Retired), Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; Email: karstenehartel@gmail.com.

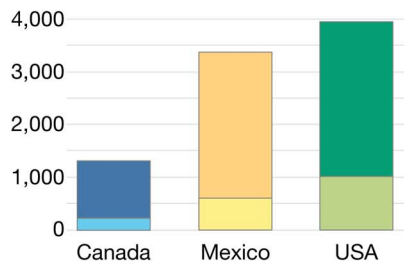
Submitted: 19 June 2023. Accepted: 8 June 2024. Associate Editor: M. P. Davis.

© 2024 by the American Society of Ichthyologists and Herpetologists DOI: 10.1643/i2023047 Published online: 6 December 2024

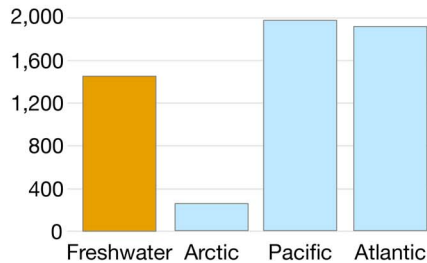
5,089 species of fishes occur in North America and its contiguous Exclusive Economic Zones



A Species diversity in marine and freshwater



B Species diversity by habitat



C Extinct and introduced species

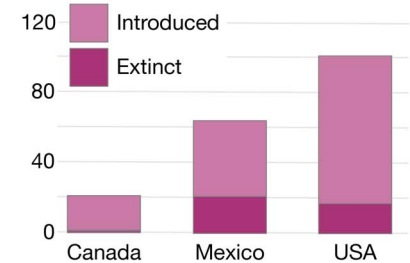


Fig. 1. Region covered by the 8th edition of *Common and Scientific Names of Fishes from the United States, Canada, and Mexico* prepared by the American Fisheries Society/American Society of Ichthyologists and Herpetologists (AFS/ASIH) Committee on Names of Fishes. Canada, the USA, and Mexico and their respective exclusive economic zones (EEZs) are shown. Note that Hawaii, Puerto Rico, and other territories outside of continental North America are not included in the list. Dashed lines indicate the ocean boundaries. (A) Species richness, showing the number of marine versus freshwater species in each country (darker tones represent marine species). (B) Species richness by habitat (freshwater in orange, marine in blue). (C) Number of introduced and extinct species in each country.

The number of species in North America was reviewed by country, habitat (ocean or freshwater), and native or introduced status, as were some of the changes in these data throughout the decades. Most statistics are descriptive, but linear regressions were applied where appropriate ($P < 0.05$).

RESULTS AND DISCUSSION

The short answer to the question posed in the title is: 5,089 species of fishes occur in North America (Fig. 1). The number of species in this list has increased nine-fold over the eight editions (Fig. 2), and the number of families covered increased from 260 in 2004 to 336 in 2023.

The unevenness of the increase in number of species in successive list editions is due in part to changes in the criteria used to include them. In 1948, the list included only better-known commercial, recreational, and a few non-game species in Canada and the United States. In 1960, it was expanded to include all fish species occurring in fresh and

marine waters less than 200 m in depth in Canada and the United States. Fishes occurring in Mexico were first included in 2004, and species occurring in the exclusive economic zones (EEZs) at depths greater than 200 m were added in the 2023 edition. These changes largely explain the substantial increase from the 3,874 species listed in 2013 (N.B.: six species of cephalochordates were included in the 2004 and 2013 editions) to 5,089 species in the 2023 edition.

There are 107 established introduced species. This number does not include translocations within the same country from native to non-native regions, which likely more than doubles the count (Espinosa-Pérez and Ramírez, 2015; Mandrak, 2023). There are 20 established introduced species in Canada, 43 in Mexico, and 84 in the United States; the latter are mostly tropical species released or escaped in Florida, where the number has increased from 12 in the 1980s (Lof-tus and Kushlan, 1987) to 48 in more recent years (Robins et al., 2018).

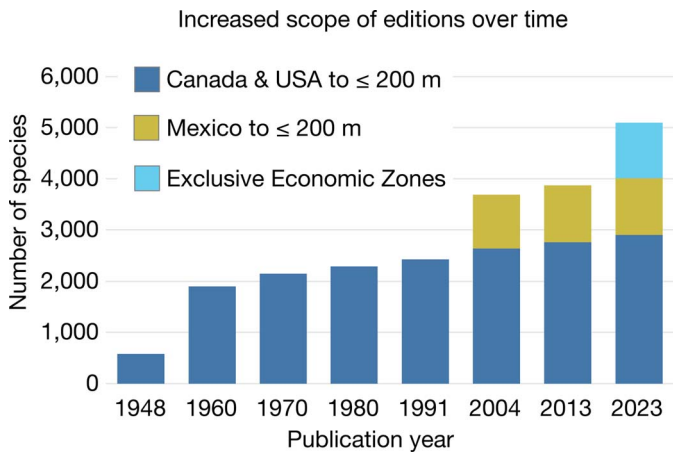


Fig. 2. Scope of the eight editions of the book on common and scientific names of fishes of North America. The number of species varies in part because of criteria for inclusion of fishes for each edition (only commercial and recreational species in 1948, addition of Mexican fishes in 2004, addition of broader EEZ fishes in 2023), but also for scientific reasons (species new to science, new records, and established introductions).

In addition to changes in the criteria for inclusion, the steady increase in the number of species is also a result of increased knowledge of the species that occur in North America over time. New records are documented as a result of new exploration and range expansions, possibly due to climate change (Conti et al., 2015; Walker et al., 2020) or introductions (Villéger et al., 2011). Fish species new to science are described continually, as attested by Fricke et al. (2023). The rate of discovery is slowing in Mexico, although the development of ichthyology in Mexico started many decades later than in the rest of North America (Álvarez del Villar, 1949; Norris and Castro-Aguirre, 2005). The discovery rate in the other two countries increased marginally, at least until a decade ago (Fig. 3). The reason for this could be that the number of ichthyologists is far greater in the United States, and molecular methods are used more frequently in that region. It could also be due to a higher natural ichthyodiversity (e.g., in Appalachia, as discussed below). Additional factors for these differences may include variation in the geographic area of the three countries and the range of ecosystems and communities in each country. For example, the dominance of tropical environments in Mexico and in Florida, USA and the comparative importance of polar environments in Canada and Alaska, USA (Wilkinson et al., 2009) may play a role.

Unfortunately, the number of extinctions has increased since the beginning of the 20th century. In the 8th edition, the book lists 37 extinct species, three of which are extinct in nature but surviving in captivity. This is an increase from 32 species listed in the previous edition. Burkhead (2012) estimated the year of extinction for species that disappeared prior to 2010. Some species, including the Graceful Priapella (*Priapella bonita*), went extinct as early as 1906. Many others went extinct in the 1980s, 1990s, or later. There are some inconsistencies between our reports and the assessments in the Red List (IUCN, 2023). *Priapella bonita* appears as Data Deficient in the Red List despite active exploration failing to collect it for several decades (Miller et al., 2005: 251). The Alberca Silverside, *Chirostoma bartoni*, is listed as Critically Endangered despite the sole

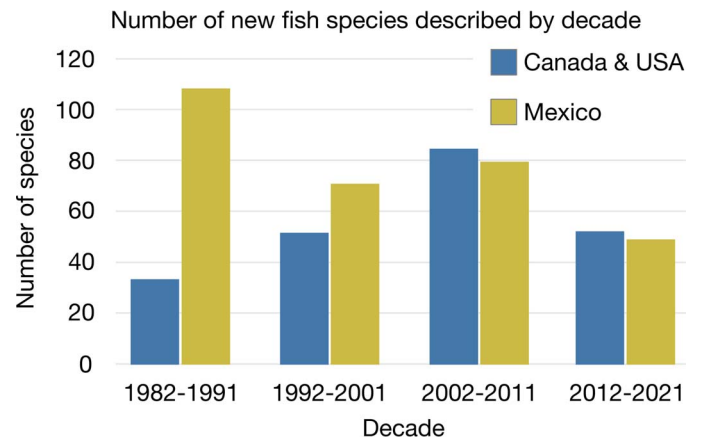


Fig. 3. Number of fish species newly described from Canada and USA (blue) and Mexico (gold) in the last four decades. For Mexico, the number of newly described species is decreasing ($r^2 = 0.79$), whereas for the rest of North America it is increasing ($r^2 = 0.28$). Data from Page et al. (2023).

locality, a crater lake in western Mexico, completely drying out in 2006 (Jelks et al., 2008). Additionally, there is some positive news. The Tequila Splitfin, *Zoogoneticus tequila*, formerly extinct in nature, was successfully reintroduced to the Teuchitlán Springs by a team at the Universidad Michoacana de San Nicolás de Hidalgo, Mexico (Domínguez-Domínguez et al., 2018).

Including extinct species, Canada has 1,254 fish species (25% of the total North American ichthyofauna), Mexico 3,261 species (64%), and the United States 3,821 species (75%; Fig. 1). Within North America's EEZ, there are 1,924 Atlantic Ocean species (38%), 1,982 Pacific Ocean species (39%), 265 Arctic Ocean species (5%), and 1,453 freshwater species (29%; Fig. 1). There are 25 species native or non-native (0.5% of the North American total, 2.0% of the Canadian ichthyofauna) present only in Canada, 287 (5.6%, 8.8%) only in Mexico, and 1,141 (22.4%, 29.9%) only in the United States. These percentages do not add up to 100% because many species are present in multiple countries and oceans. There are 564 species (12%) that occur in all three countries, some of which are established introductions from outside of North America (e.g., Goldfish, *Carassius auratus*, and Common Carp, *Cyprinus carpio*), but most of the widespread species are native (e.g., Pacific Lamprey, *Entosphenus tridentatus*, and Green Sturgeon, *Acipenser medirostris*). The enormous difference in fish species richness and endemism between the United States and the other North American countries is due mostly to the remarkable number of endemic percid and leuciscid fishes in Appalachia (Hocutt and Wiley, 1986). Anas and Mandrak (2021) have discussed the roles of environmental, historical, and anthropogenic factors behind this pattern.

Froese and Pauly (2023) report that the total number of fish species in each of the countries is about 20% lower than what we report. Specifically, they report 104 fewer species for Canada, 620 fewer species for Mexico, and 688 fewer species for the United States. The difference is most likely due to FishBase reporting deep-sea species for a given ocean rather than for a given country, even if within the EEZ. With the updated data, the United States and Mexico should be included among the eight countries with the greatest diversity of fishes in the world (Fig. 4).

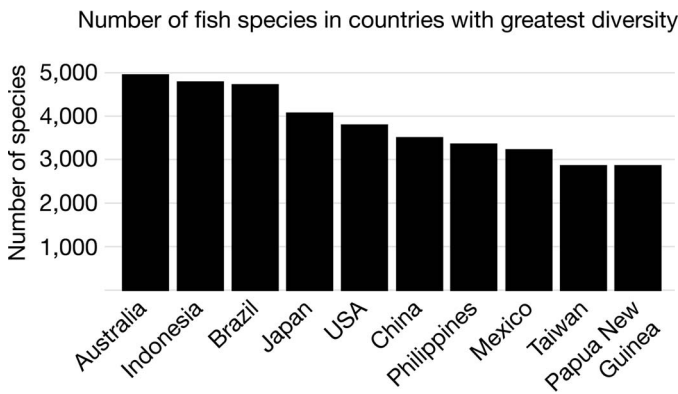


Fig. 4. Number of fish species reported in the ten countries with the greatest ichthyodiversity in the world. Canada occupies the 24th place. Data for United States and Mexico from Page et al. (2023); other country data from Froese and Pauly (2023).

Conclusion.—Deeper and more continuous analyses than presented in this paper could be accomplished if the list published in *Common and Scientific Names of Fishes from the United States, Canada, and Mexico* moved to an online format (Page et al., 2013). The Committee on Names of Fishes will work toward this goal in the upcoming years. Yet, in any form, the list remains a valuable resource not just for the standardization of common names, but it also can be the source for a comprehensive monitoring of the North American ichthyofauna. The results presented in this short paper are merely selected examples of the possible analyses.

DATA ACCESSIBILITY

Unless an alternative copyright or statement noting that a figure is reprinted from a previous source is noted in a figure caption, the published images and illustrations in this article are licensed by the American Society of Ichthyologists and Herpetologists for use if the use includes a citation to the original source (American Society of Ichthyologists and Herpetologists, the DOI of the *Ichthyology & Herpetology* article, and any individual image credits listed in the figure caption) in accordance with the Creative Commons Attribution CC BY License.

LITERATURE CITED

- Álvarez del Villar, J. 1949. Ictiología dulceacuícola mexicana. I. Resumen histórico de los estudios ictiológicos. *Revista de la Sociedad Mexicana de Historia Natural* 10:309–327.
- Anas, M. U. M., and N. E. Mandrak. 2021. Drivers of native and non-native freshwater fish richness across North America: disentangling the roles of environmental, historical and anthropogenic factors. *Global Ecology and Biogeography* 30:1232–1244.
- Burkhead, N. M. 2012. Extinction rates in North American freshwater fishes, 1900–2010. *BioScience* 62:798–808.
- Conti, L., L. Comte, B. Hugueny, and G. Grenouillet. 2015. Drivers of freshwater fish colonisations and extirpations under climate change. *Ecography* 38:510–519.
- Domínguez-Domínguez, O., R. Hernández-Morales, M. Medina-Nava, Y. Herrerías-Diego, D. Tafolla Venegas, A. L. Escalante Jiménez, L. H. Escalera-Vázquez, and G. García. 2018. Progress in the reintroduction program of the Tequila Splitfin in the springs of Teuchitlán, Jalisco, Mexico, p. 38–42. *In: Global Reintroduction Perspectives: 2018. Case Studies from around the Globe*. P. S. Soorae (ed.). IUCN, Gland, Switzerland.
- Espinosa-Pérez, H. S., and M. Ramírez. 2015. Exotic and invasive fishes in Mexico. *Check List* 11:1–13.
- Fricke, R., W. N. Eschmeyer, and R. Van Der Laan (Eds.). 2023. *Eschmeyer's Catalog of Fishes: Genera, Species, References*. <https://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>
- Froese, R., and D. Pauly (Eds.). 2023. *FishBase*. World Wide Web electronic publication. <https://www.fishbase.org>
- Hocutt, C. H., and E. O. Wiley. 1986. *The Zoogeography of North American Freshwater Fishes*. Wiley, New York.
- IUCN. 2023. *The IUCN Red List of Threatened Species*. <https://www.iucnredlist.org>
- Jelks, H. L., S. J. Walsh, N. M. Burkhead, S. Contreras-Balderas, E. Díaz-Pardo, D. A. Hendrickson, J. D. Lyons, N. E. Mandrak, F. McCormick, J. S. Nelson, S. P. Platania, B. A. Porter, C. B. Renaud, J. J. Schmitter-Soto . . . M. L. Warren Jr. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. *Fisheries* 33:372–407.
- Loftus, W. F., and J. A. Kushlan. 1987. Freshwater fishes of southern Florida. *Bulletin of the Florida State Museum Biological Sciences* 31:147–344.
- Mandrak, N. E. 2023. Freshwater fish introductions in Canada. *In: Freshwater Fisheries in Canada*. C. T. Hasler, J. G. Imhof, N. E. Mandrak, and S. J. Cooke (eds.). American Fisheries Society, Bethesda, Maryland.
- Miller, R. R., W. L. Minckley, and S. M. Norris. 2005. *Freshwater Fishes of México*. University of Chicago Press, Chicago.
- Norris, S. M., and J. L. Castro-Aguirre. 2005. History of Mexican freshwater ichthyology, p. 48–62. *In: Freshwater Fishes of México*. University of Chicago Press, Chicago.
- Page, L. M., K. E. Bemis, T. E. Dowling, H. S. Espinosa-Pérez, L. T. Findley, C. R. Gilbert, K. E. Hartel, R. N. Lea, N. E. Mandrak, M. A. Neighbors, J. J. Schmitter-Soto, and H. J. Walker, Jr. 2023. *Common and Scientific Names of Fishes from the United States, Canada, and Mexico*. Eighth edition. American Fisheries Society, Bethesda, Maryland.
- Page, L. M., H. S. Espinosa-Pérez, L. T. Findley, C. R. Gilbert, R. N. Lea, N. E. Mandrak, and R. L. Mayden. 2013. New seventh edition of *Common and Scientific Names of Fishes*: changes include capitalization of common names. *Fisheries* 38:188–189.
- Robins, R. H., L. M. Page, J. D. Williams, Z. S. Randall, and G. E. Sheehy. 2018. *Fishes in the Fresh Waters of Florida*. University of Florida Press, Gainesville, Florida.
- Villéger, S., S. Blanchet, O. Beauchard, T. Oberdorff, and S. Brosse. 2011. Homogenization patterns of the world's freshwater fish faunas. *Proceedings of the National Academy of Sciences of the United States of America* 108:18003–18008.
- Walker, H. J., Jr., P. A. Hastings, J. R. Hyde, R. N. Lea, O. E. Snodgrass, and L. F. Bellquist. 2020. Unusual occurrences of fishes in the Southern California Current System during the warm water period of 2014–2018. *Estuarine, Coastal and Shelf Science* 236:106634.
- Wilkinson, T., E. Wiken, J. Bezaury-Creel, T. F. Hourigan, T. Agardy, H. Herrmann, L. Janishevski, L. Morgan, and M. Padilla. 2009. *Marine Ecoregions of North America*. Commission for Environmental Cooperation, Montreal.