

Why is *Poecilia wingei* a distinct species from other species of the genus?

^{1,2}Tudor Păpuc, ³Claudia Balint, ^{4,5}Ruxandra M. Petrescu-Mag

¹ Faculty of Animal Science and Biotechnologies, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania; ² Bioflux SRL, Cluj-Napoca, Romania;

³ Department of Environmental Engineering and Protection, Faculty of Agriculture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania;

⁴ Faculty of Environmental Science and Engineering, Babes-Bolyai University, Cluj-Napoca, Romania; ⁵ Gembloux Agro-Bio Tech, University of Liège, Gembloux, Belgium.

Corresponding author: T. Păpuc, tudor.papuc@usamvcluj.ro

Abstract. Fish taxonomy is a highly controversial scientific area. For a long time, Endler's livebearers (ELB) were considered to belong to the guppy fish species *Poecilia reticulata* Peters, 1859. This paper explains the arguments according to which *Poecilia wingei* Poeser, Kempkes & Isbrücker, 2005 (ELB) is considered a distinct species from *P. reticulata*. While ELB and the guppy are similar in many ways, they are considered distinct species due to differences in their morphology, genetics, and behavior. One of the primary differences between ELB and the guppy is their natural range. ELB is found only in a small region of northeastern Venezuela, while the guppy is distributed throughout a wider range that includes northern South America, Central America, and the Caribbean. Another important difference is their physical appearance. ELB is generally smaller and more slender than the guppy, with a more pointed caudal fin. The coloration of ELB is also more variable and complex, with males displaying an intricate pattern of spots and stripes. There are also differences in their reproductive behavior. ELB tends to have smaller broods and shorter gestation periods than the guppy, and the males use a different method of mating. The separation of the two species relies heavily on the evolutionary species concept and the principles of the splitter current of taxonomists today. According to the evolutionary species concept, there is no place for subspecies. Subspecies have been elevated to species rank.

Key Words: evolutionary species concept, guppy, ELB, Endler's, splitter taxonomy.

Introduction. Fish taxonomy is a highly controversial scientific area. For a long time, Endler's livebearers (ELB) were considered to belong to the guppy fish species *Poecilia reticulata* Peters, 1859 (Lindholm & Breden 2002). In this paper, we aim to explain the arguments according to which *Poecilia wingei* Poeser, Kempkes & Isbrücker, 2005 (ELB) is considered a distinct species from *P. reticulata*.

What Is a Species in the General Sense? A species is a group of living organisms that share characteristics and can interbreed and produce fertile offspring (Petrescu-Mag et al 2018). The concept of a species is fundamental to biology and is used to categorize and study the diversity of life on Earth.

There are different ways to define a species. Many biologists and scientists have proposed various criteria over time (von Linne 1735; Regan 1926; Mayr 1942, 1976). Some of the most commonly used species concepts include the biological species concept, the morphological species concept, the phylogenetic species concept, the ecological species concept, and others (Kovacs & Petrescu-Mag 2022).

Regardless of the specific species concept used, a species is generally considered a fundamental unit of biological classification and is used to describe the diversity of life on Earth. Species can be further subdivided into subspecies or varieties, and they can be grouped into higher-level taxonomic categories, such as genera, families, orders, classes, phyla, and kingdoms. The concept of a species is important for understanding the

complexity and diversity of life on Earth and for studying the relationships and interactions between different groups of organisms.

The Most Widely Accepted Species Concept in Fish Taxonomy. The current, most accepted species concept in fish taxonomy is the evolutionary species concept (Wiley & Mayden 2000; Kottelat & Freyhof 2007; Nowak et al 2009). The evolutionary species concept defines a species as a lineage of organisms that has its own evolutionary trajectory and has evolved independently from other lineages (Simpson 1961; Wiley 1978, 1981). This concept emphasizes the importance of evolutionary history and the idea that species are products of divergent evolution.

According to the evolutionary species concept, a species is defined by its unique combination of genetic, morphological, and behavioral characteristics, distinguishing it from other lineages. These characteristics arise through the accumulation of genetic differences over time, driven by natural selection and other evolutionary forces.

One of the key ideas of the evolutionary species concept is that species are defined by their reproductive isolation from other lineages. This means that members of a species are able to interbreed and produce viable offspring. In contrast, individuals from different species are not able to produce viable offspring or produce offspring that are infertile. The evolutionary species concept is widely used in evolutionary biology and has influenced our understanding of the origin and diversification of life on Earth.

According to the evolutionary species concept, there is no place for subspecies. Subspecies have been elevated to species rank (Stoian et al 2018).

By What Criteria Was *P. wingei* Separated from *P. reticulata*? ELB (Figure 1) and the guppy are closely related species of freshwater fish that belong to the family Poeciliidae (Petrescu-Mag 2008). However, while they share many physical and behavioral characteristics, they are considered distinct species due to several key differences.



Figure 1. Endler's livebearer (*Poecilia wingei*) male (photo: By Emilio17 - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=24963327>; Schories et al 2009).

One of the primary differences between ELB and the guppy is their natural range. ELB is found in only a small region of northeastern Venezuela. At the same time, the guppy is distributed throughout a wider range that includes northern South America, Central America, and the Caribbean (Petrescu-Mag 2007).

Another important difference is in their physical appearance. ELB is generally smaller and more slender than the guppy, with a more pointed caudal fin. The coloration of ELB is also more variable and complex, with males displaying an intricate pattern of spots and stripes. There are also differences in their reproductive behavior. ELB tends to have smaller broods and shorter gestation periods than the guppy, and the males use a different method of mating (Poeser et al 2005).

While ELB and the guppy are similar in many ways, they are considered distinct species due to these differences and others in their morphology, genetics, and behavior.

What Is the Effect of the Splitter Trend in Taxonomy? The splitter tendency in taxonomy refers to the practice of elevating subspecies or varieties to the rank of species, increasing the number of recognized species (Silva et al 2020; Thaxton et al 2022). This trend has been observed in various groups of organisms, including birds, mammals, reptiles, and insects, and has been driven by advances in genetic and morphological techniques, as well as changing views on species concepts and definitions.

The effect of the splitter trend in taxonomy is a matter of debate among biologists and taxonomists. Proponents of this approach argue that it reflects a more accurate and precise understanding of the diversity and evolutionary history of life on Earth. They suggest that by recognizing more species it is easier to capture the unique adaptations, ecological roles, and evolutionary trajectories of different lineages. However, critics of the splitter trend argue that it can lead to excessive proliferation of taxonomic names, making it difficult to communicate and organize information about the diversity of life. They also argue that it can lead to inconsistencies in the classification of organisms, as different taxonomists may use distinct criteria for recognizing species.

Additionally, the splitter trend can have practical implications for conservation and management efforts. Newly recognized species may require different conservation strategies or management plans if they have different ecological requirements or distributions. This can increase the complexity and cost of conservation efforts, particularly for species that are already threatened or endangered. Overall, the splitter trend in taxonomy has both potential benefits and drawbacks, and its effects may depend on the specific group of organisms, the criteria used for recognizing species, and the context in which the taxonomy is applied.

Conclusions. While ELB and the guppy are similar in many ways, they are considered distinct species due to the presented differences and some other ones in their morphology, genetics, and behavior.

One of the primary differences between ELB and the guppy is their natural range. ELB is found only in a small region of northeastern Venezuela. At the same time, the guppy is distributed throughout a wider range that includes northern South America, Central America, and the Caribbean.

Another important difference is in their physical appearance. ELB is generally smaller and more slender than the guppy, with a more pointed caudal fin. The coloration of ELB is also more variable and complex, with males displaying an intricate pattern of spots and stripes. There are also differences in their reproductive behavior. ELB tends to have smaller broods and shorter gestation periods than the guppy, and the males use a different method of mating.

The separation of the two species relies heavily on the evolutionary species concept and the principles of the splitter current of taxonomists today. According to the evolutionary species concept, there is no place for subspecies. Subspecies have been elevated to species rank.

Conflict of Interest. The authors declare that there is no conflict of interest.

References

- Kottelat M., Freyhof J., 2007 Handbook of European freshwater fishes. Kottelat, Cornol and Freyhof, Berlin, 646 p.
- Kovacs E., Petrescu-Mag I. V., 2022 What is the species concept most currently accepted by zoologists? AES Bioflux 14(2):57-61.
- Lindholm A., Breden F., 2002 Sex chromosomes and sexual selection in poeciliid fishes. The American Naturalist 160(S6):S214-S224.
- Mayr E., 1942 Systematics and the origin of species. Columbia University Press, New York, 383 p.
- Mayr E., 1976 Species concepts and definitions. In: Topics in the philosophy of biology. Springer Netherlands, pp. 353-371.
- Nowak M., Petrescu-Mag I. V., Mierzwa D., Popek W., 2009 On some interesting Romanian gudgeons (Cyprinidae: Romanogobio) found in the collection of Museum and Institute of Zoology PAS. AES Bioflux 1(2):81-88.
- Petrescu-Mag I. V., 2007 [Manipulation of the sexes in guppyculture]. AcademicPres, Cluj-Napoca. [In Romanian].
- Petrescu-Mag I. V., 2008 [Biophysiological characterization of *Poecilia reticulata* and its particularities]. ABAH Bioflux Pilot (b):1-56. [In Romanian].
- Petrescu-Mag I. V., Botha M., Gavrioloaie C., 2018 *Lepus x Oryctolagus cuniculus*: incompatibilities of behavioral and molecular nature. Rabbit Gen 8(1):23-25.
- Poeser F. N., Kempkes M., Isbrücker I. J., 2005 Description of *Poecilia (Acanthophaelus) wingei* n. sp. from the Paría Peninsula, Venezuela, including notes on *Acanthophaelus Eigenmann*, 1907 and other subgenera of *Poecilia* Bloch and Schneider, 1801 (Teleostei, Cyprinodontiformes, Poeciliidae). Contributions to Zoology 74(1-2):97-115.
- Regan C. T., 1926 Organic evolution. Report of the British Association for the Advancement of Science 1926:75-86.
- Schories S., Meyer M. K., Scharl M., 2009 Description of *Poecilia (Acanthophaelus) obscura* n. sp., (Teleostei: Poeciliidae), a new guppy species from western Trinidad, with remarks on *P. wingei* and the status of the "Endler's guppy". Zootaxa 2266(1):35-50.
- Silva C., Snak C., Davidse G., Van Den Berg C., Oliveira R. P., 2020 Assessing the molecular diversity of Hildebrandia (Poaceae, Panicoideae): reaching a compromise between the splitter and the lumpers. Botanical Journal of the Linnean Society 192(1):121-147.
- Simpson G. G., 1961 Principles of animal taxonomy (No. 20). Columbia University Press, 247 p.
- Stoian R. O., Botha M., Petrescu-Mag I. V., 2018 Beekeeping in Romania and artificial insemination of honey bee, *Apis mellifera*. State of the art. ABAH Bioflux 10(2):93-121.
- Thaxton C., Goldstein J., DiStefano M., Wallace K., Witmer P. D., Haendel M. A., Hamosh A., Rehm H. L., Berg J. S., 2022 Lumping versus splitting: How to approach defining a disease to enable accurate genomic curation. Cell Genomics 2(5):100131.
- Von Linné C., 1735 Systema naturae sive regna tria naturae systematice proposita per classes, ordines, genera et species. Haak.
- Wiley E. O., 1978 The evolutionary species concept reconsidered. Systematic Zoology 27(1):17-26.
- Wiley E. O., 1981 Remarks on Willis' species concept. Systematic Zoology 30:86-87.
- Wiley E. O., Mayden R. L., 2000 The evolutionary species concept. In: Species concepts and phylogenetic theory. Wheeler Q. D., Meier R. (eds), Columbia University Press, New York, pp. 70-89.
- *** https://en.wikipedia.org/wiki/Poecilia_wingei [Last view: 30.12.2022]

Received: 19 November 2022. Accepted: 30 November 2022. Published online: 30 December 2022.

Authors:

Tudor Păpuc, Faculty of Animal Science and Biotechnologies, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Calea Mănăştur, 400372 Cluj-Napoca, Cluj, Romania, e-mail: tudor.papuc@usamvcluj.ro

Claudia Balint, Department of Environmental Engineering and Protection, Faculty of Agriculture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Calea Mănăştur, 400372 Cluj-Napoca, Cluj, Romania, e-mail: claudia.balint@usamvcluj.ro

Ruxandra Mălina Petrescu-Mag, Faculty of Environmental Science and Engineering, Babes-Bolyai University, 30 Fantanele St., 400294 Cluj-Napoca, Romania, e-mail: malina.petrescu@ubbcluj.ro

This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

How to cite this article:

Păpuc T., Balint C., Petrescu-Mag R. M., 2022 Why is *Poecilia wingei* a distinct species from other species of the genus? Poec Res 12(1):29-33.