

Tales of vanishing worlds: the Catarina pupfish and the Sixth Mass Extinction

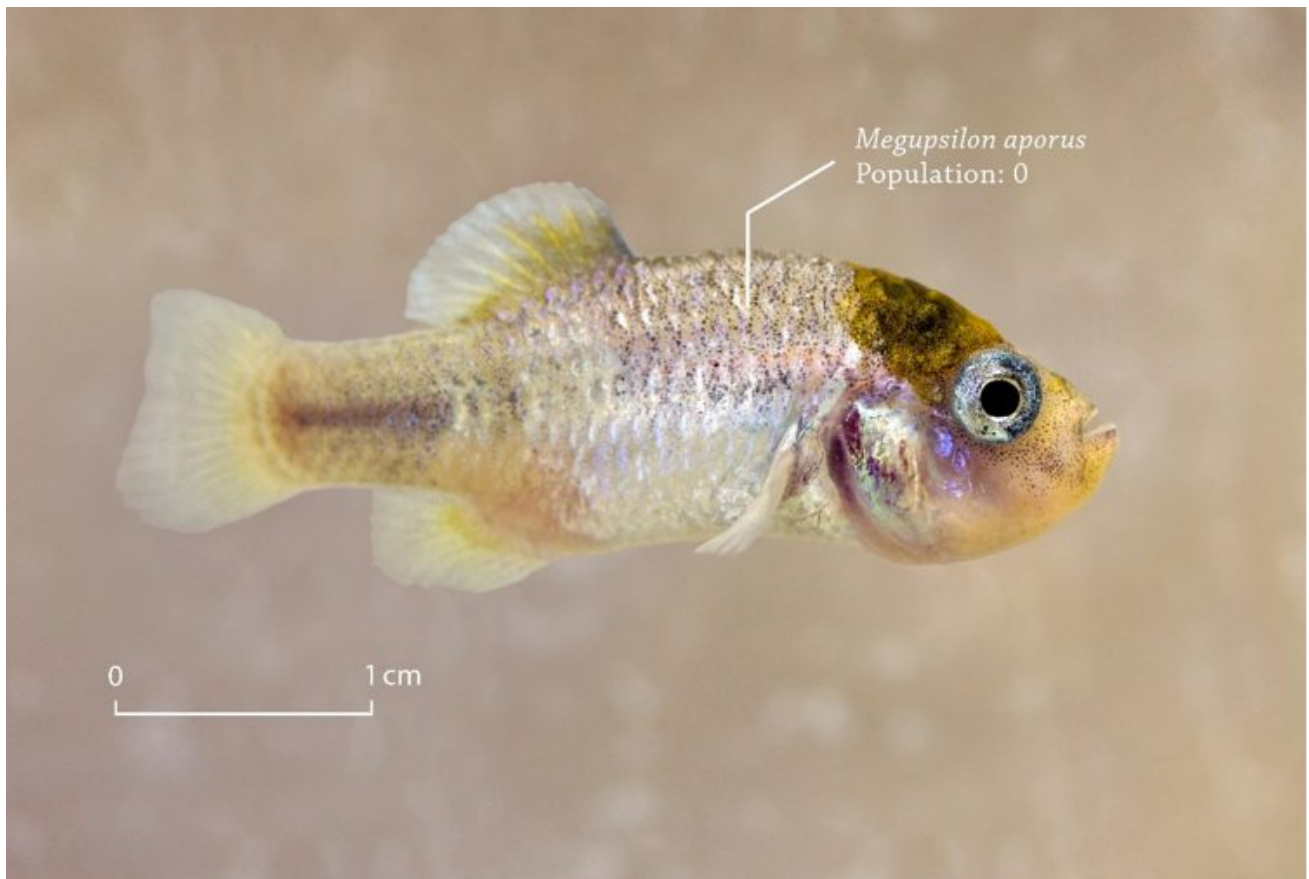
By Lourdes Martinez-Estevez & Gerardo Ceballos, 25th February 2020

'It's a moral question about whether we have the right to exterminate species.'

- David Attenborough

Life on Earth has changed significantly over the last century. On the one hand, through ever-advancing research, we have deepened our knowledge and understanding of ecosystems, intimately studied thousands of species, and uncovered the intricate systems that sustain natural processes. On the other hand, for the first time in the history of humanity, we are witnessing an unprecedented decline in species and population numbers, primarily caused by human activities. This biological annihilation, as it has been termed, is leading to the Sixth Mass Extinction event in the planet's history (Ceballos et al., 2017). It is also rapidly altering the web of life and undermining ecosystem services essential for supporting human existence.

There have been five mass extinction events over the last 500 million years. These periods were characterized by an accelerated rate of species extinction occurring over short geological timescales (i.e. thousands or hundreds of thousands, rather than millions of years). All previous mass extinctions were caused by natural disasters, including the most widely known event some 66 million years ago, during which most dinosaurs disappeared. Recent evidence has shown that in the current period, human activities are leading to dramatically accelerated extinction rates, hundreds of times faster than background rates (Ceballos et al., 2015). This rapid rate of species extinction poses moral, philosophical, ethical, social, and economic challenges. Action is needed urgently to counteract the rate of these losses if we are to restore ecosystems' functions and balance.



The last male Catarina pupfish *Megupsilon aporus*, photographed in the laboratory of Christopher Martin at the University of California, Berkeley. Photo: Christopher Martin.

Twenty years ago, Gerardo Ceballos had a vision of publishing a series of books about vertebrate groups in Mexico. 'The Endangered Birds of Mexico' (Ceballos & Marquez, 2000; in Spanish), and 'The Wild Mammals of Mexico' (Ceballos & Oliva, 2005; Ceballos, 2014), were the first two volumes of the series. In 2016, he published 'The Freshwater Fishes of Mexico at Risk of Extinction' (Ceballos et al., 2016; in Spanish), with contributions from leading freshwater fish specialists in the country. As he compiled information for the book, Ceballos learned that 14 species of fishes endemic to Mexico had become extinct and that many more with highly restricted distributions were at serious risk of extinction as a result of human activities.

Among them, the Catarina pupfish *Megupsilon aporus* was at the time categorized as Extinct in the Wild on the IUCN Red List (changed from Critically Endangered, according to the 1996 assessment), surviving only in captivity. However, Arcadio Valdés González, the leading expert on the species and the first author on our publication, told us that the last captive population had actually died off in 2014. This was depressing news for all involved. At only 4 cm long, the Catarina pupfish may have been small in size, yet learning about its irretrievable loss had a profound emotional impact on us.



Left: The Catarina pupfish, the most recent extinct freshwater fish, endemic to Mexico. Top: male, bottom: female. Right: Catarina pupfish. Photos: Daniel Garza Tobón.

The extinction of this species, less than 50 years after it was first described, was particularly saddening for two main reasons. Firstly, the species was the only representative of the genus *Megupsilon* (Miller & Walters, 1972), and it was endemic to a single freshwater spring in Nuevo Leon, Mexico. This means that, from an evolutionary and biological perspective, we lost a unique taxon. Secondly, although the deteriorating condition of the spring and the possible consequences for its unique wildlife were known at the time, no measures were taken to reduce or stop the overexploitation of water, which ultimately caused the desiccation of the Catarina pupfish's water spring. Protecting the habitat of this micro-endemic species would have been crucial to ensure its persistence and could have been achieved with relatively little effort and at a moderate cost, but there was, and still remains, a lot to do to manage freshwater sources in Mexico effectively.

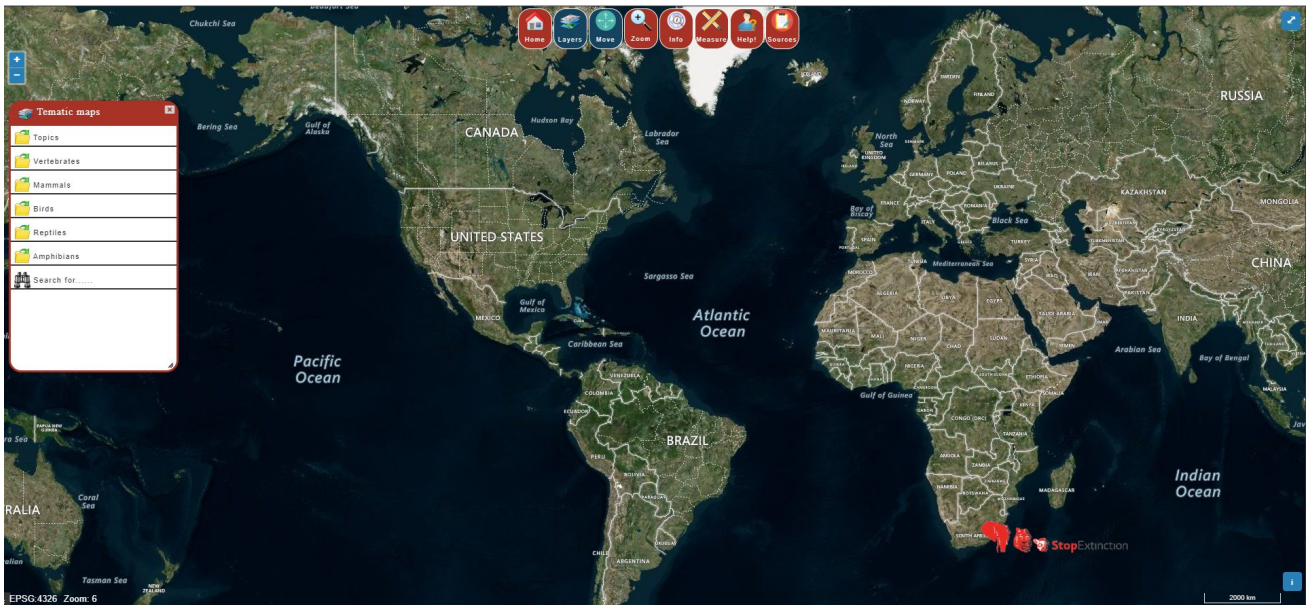


Water spring before desiccation. Photo courtesy of Lourdes Martínez Estévez.

Habitat loss caused the extinction of the Catarina pupfish, and it is threatening thousands of species. Humans have modified more than 70% of terrestrial and 60% of marine habitats. The most recent report from the UN estimates that one million animal and plant species are facing extinction in the next few decades as a result of habitat loss and degradation, overexploitation, poaching, climate change, pollution, and invasive species (Diaz et al., 2019).

Although humans are the cause of the Sixth Mass Extinction, we can also be the solution. To help reverse the current trend of biodiversity loss, Ceballos, Martinez, and others have developed Stop Extinction (www.stopextinctions.org) as a global initiative. The initiative aims to foster international collaboration and generate commitment to stop the loss of species and populations worldwide. Stop Extinction's primary goals are:

1. To achieve a voluntary agreement between nations to undertake ambitious efforts to combat the current extinction crisis.
2. To develop a database to provide information on vertebrate species distribution and conservation status to make informed management decisions.
3. To create public awareness of the species extinction crisis and the impact on human well-being.



Stop Extinction database, globalbiodiversity.net.

Stop Extinction will also follow the recommendations made on the recently proposed Zero draft of the post-2020 global biodiversity framework by the UN Convention on Biological Diversity to reverse the trend of biodiversity loss by 2030 and stabilize ecosystems by 2050 (CBD, 2020). The current extinction crisis needs to be a priority, treated with the same urgency as climate disruption. Although there is still time to act, the window of opportunity to reduce or reverse the extinction trends is only 2–3 decades. Now is the time to protect our living companions, stop the destruction of our natural heritage, and ensure the survival of humankind.

The article [The extinction of the Catarina Pupfish *Megupsilon aporus* and the implications for the conservation of freshwater fish in Mexico](#) is available in *Oryx—The International Journal of Conservation*.

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Lourdes Martinez-Estevez is a PhD candidate at the University of California, Santa Cruz. She is interested in wildlife conservation and has worked in terrestrial, freshwater, and marine ecosystems.

Gerardo Ceballos is an ecologist and conservationist widely recognized due to his work on global patterns of biodiversity distribution and extinction risk in vertebrates. He has made an enormous contribution to conservation in Mexico by promoting the establishment of national protected areas and the first Mexican endangered species act. His scientific research on biological annihilation and the sixth mass extinction are widely publicized.