Shoal would like to thank collaborators Ralf Britz, João Pedro Fontenelle, Praveenraj Jayasimhan, Cüneyt Kaya, Ad Konings, Nathan Lujan, Ken Maeda, Lucia H. Rapp Py-Daniel, Wentian Shi, and Leando Melo de Sousa for their support in the writing of this report.

Furthermore, we wish to thank Jon Fong and Richard van der Laan from the California Academy of Sciences and Eschmeyer’s Catalog of Fishes for their support in providing the full list of freshwater fish species described in 2021, along with the IUCN SSC FFSG for guidance and support, and The Fishmongers’ Company for providing the funding that enabled us to produce this report.


Shoal is the global initiative to halt extinctions and recover populations of the most threatened freshwater species around the world. Learn more about their work at shoalconservation.org.

The IUCN SSC FFSG has a mission of achieving conservation and sustainable use of freshwater fishes and their habitats through generating and disseminating sound scientific knowledge, creating widespread awareness of their values and influencing decision making processes at all levels.

Eschmeyer’s Catalog of Fishes database was begun in the 1980s at the California Academy of Sciences by Bill Eschmeyer. It is the primary resource for current knowledge on the kinds of fishes, and is updated continuously as new species are described.

Funding for this report was provided by The Fishmongers’ Company’s Fisheries Charitable Trust, which engages in a wide range of projects and grant funding to support marine and freshwater conservation, fisheries, aquaculture and fish trading in the UK.
Each year, hundreds of freshwater fish species are discovered and described by scientists for the first time.

The numbers may seem surprising - in 2021 alone, there were 212 species of freshwater fish that were formally recorded as new species - but each new discovery proves there is still much about the world of wonder underneath the surface of the planet’s rivers, lakes and wetlands that remains unknown.

What can each of these discoveries teach us?

- Each new species description increases knowledge about the relationships among species and how long it has been since they diverged from common ancestors, deepening our understanding of evolution.
- Morphological descriptions help us to understand adaptations, which informs knowledge of the relationships and interactions of species with their environment and other organisms. For example, morphology can indicate feeding behaviours or habitat preferences, and that information is essential for managing fisheries, assessing potential impacts of environmental changes on species, and conserving threatened species.
- Knowledge of the levels of species richness in specific locations can help conservationists prioritise where to focus their work in order to get more bang for buck when implementing actions on the ground.
- An understanding of taxonomic relationships enables us to identify species that are especially genetically unique. These species should be prioritised for conservation, as they may represent the only (or one of very few) species in an entire genus.
- And each finding may lead to new research that could literally help the future of humanity. Turn to p.10 to see how Danionella cerebrum has already helped research into neuroscience.

Scientists go to great lengths to discover and describe our amazing fish diversity, facing huge challenges along the way, including lack of resources and lack of government interest, not to mention the difficulties and risks associated with field work in regions such as the Amazon and the jungles of Southeast Asia. And they face an uphill battle to describe this incredible biodiversity before it is lost forever. In this Age of Extinction, it is an uphill battle to describe this incredible biodiversity before it is lost forever. In this Age of Extinction, it is

This 2021 edition will be the first of an annual release of New Species reports. Shoal is compiling the newly discovered freshwater fish species to help raise awareness and increase the chances of freshwater biodiversity conservation receiving much needed funding before it is too late.

Species: Hopliancistrus wolverine


Location: Rio Xingu basin, Brazil.

Highlight: Possesses three strong spikes that it uses for defence.

It grows up to 15cm long and inhabits rock crevices in the rapids of the Rio Xingu, where males are likely to guard their offspring.

Despite their tough-sounding name, Wolverine plecos are herbivorous and graze algae and detritus. But their ‘super strong’ odontodes can inflict real damage: Lucia H. Rapp Py-Daniel, one of the researchers on the 2021 description paper, said: “When I first collected tricornis in the Tapajós river basin, we all had our fingers injured or bleeding by the violence of them trying to pinch us with their big lateral hooks on the head. At the field in the Tapajós, the fishermen started calling them ‘Buffalo Bill’.”

She added that this behaviour has not been observed in any other loricariid (a family of armoured catfish), even those that possess large spines.

The species described from research into the tricornis have been popular in the aquarium trade for many years, without it being known that they are distinct species. Many are bred in captivity, but they face possible threats in the wild from the construction of dams that are being planned in the Tapajós River basin.
Both of these species are liquorice gouramis: tiny, jewel-like fish that inhabit tea coloured tannin-stained peat swamps in Southeast Asia. They are labyrinth fish – that is, they have a supplementary breathing structure known as the labyrinth which enables them to use oxygen from the air, gulped from the mouth. This adaptation allows them to survive in the oxygen-poor waters of peat swamps.

Juelin has intense red down the flanks and white stripes along the fins, set against a black background.

Researchers note that the population density was once very high: in 2017, over 100 specimens were collected from a water pool around 20m² in size in just 40 minutes, using three handheld nets. However, the edge of the distribution area is under growing pressure from encroaching agriculture, and one of the swamps where the species was formally collected was drained and converted to a paddy field in 2019, likely causing an extirpation of that population.

The species is restricted to a few adjoining forest streams and swamps belonging to the same river.

Researchers are calling for it to be listed as Critically Endangered: in their ‘Diagnoses of two new species of Parosphromenus (Teleostei: Osphromenidae) from Bangka Island and Kalimantan, Indonesia’ paper, published in 2021, they said they based this on the species’ ‘very restricted distribution area in a single river system on a single small island (<50 km²) with less than three known locations; and the fact that this habitat has been facing direct threats from human activities since 2018. Since there are no significant environmental conservation projects in this area, the survival of this species in the near term is clearly imperilled’.

Kishi, like Juelin, is a bright and beautiful species, with a reddish colour on its tail fin.

It is confined to a single river in Kalimantan, Indonesia, which has been converted into an irrigation canal for a large oil palm plantation. Its range is so small that the location has been kept hidden in an attempt to make it more difficult for collectors to remove the species.

The habitat is described as ‘extremely impacted’, and ‘any further works on the plantation may eradicate the only known location of this species’.
While investigating the taxonomy of the Euphrates in August 2019, a new species of trout was discovered in the Murat River. Research suggests that *Salmo baliki*’s range is confined to the Sinek Stream in the Murat River’s drainage. Due to trout being a desirable food source for humans, overfishing is already putting serious pressure on the species.

Cüneyt Kaya, one of the researchers involved in describing *S. baliki*, said, “Ghost fishing is the most common threat. The second most common threat to all trout species in Anatolia is the use of casting nets, which destroy the fish nests carrying future generations due to the heavy sinkers. They are a major threat, especially to salmonids that spawn on the stream floor. The use of casting nets is forbidden in Turkey: the regulations are strict, but unfortunately not practiced. People either do not know about them, or there are not many penalties issued”.

Kaya added that, “Pollution and habitat degradation due to human alterations of the area are further threats to the trout species in Anatolia”.

Müneever Oral, a research fellow at Recep Tayyip Erdogan University, explained why Anatolia is such a hotspot for trout species: “Turkey harbours remarkable biodiversity, as it is geographically located at the intersection of three global biodiversity hotspots: the Caucasus, the Mediterranean and the Irano-Anatolian. Anatolia provided a secure refuge for species throughout the Ice Age, while most counterparts were facing extinction further north”.

Although adults of each of the three species live and reproduce in small freshwater streams, it is thought that their larvae are carried downstream into the ocean and can be transported by ocean currents to different remote islands.

“*Lentipes kijimuna* and *L. bunagaya* are rarely seen in Okinawa,” explained Dr. Ken Maeda, first author of the study and staff scientist in the Marine Eco-Evo-Devo Unit at the Okinawa Institute of Science and Technology Graduate University (OIST). “So we think that these species we encountered here were born somewhere else in Southeast Asia and transported to Okinawa when they were larvae.”

Maeda added that, “Their migration and larval life are not fully understood yet. More research is required to reveal them”.

**SALMO BALIKI**

**Species:** *Salmo baliki*

**Researchers:** Turan, D., Aksu, I., Oral, M., Kaya, C., Bayçelebi, E. - see reference 4.

**Location:** Murat River, Turkey.

**Highlights:** Thought by some to be a ‘healer fish’ that cures stomach ailments. One of 16 trout species to have been described from Turkey.

**KIJIMUNA and BUNAGAYA GOBIES**

**Species:** *Lentipes kijimuna* and *Lentipes bunagaya*


**Location:** Okinawa, Japan.

These highly attractive gobies are named after wood spirits of Okinawan folk mythology Kijimuna and Bunagaya, who are usually described as having red skin and hair.

They both have a similar body form to a known species - *Lentipes armatus* - but Kijimuna and Bunagaya goby males display unique colour patterns with the bright red markings that give the species their names. DNA research proves they are all separate species.

Although adults of each of the three species live and reproduce in small freshwater streams, it is thought that their larvae are carried downstream into the ocean and can be transported by ocean currents to different remote islands.
**DANIONELLA CEREBRUM**

**Location:** Turbid streams on the southern and eastern slopes of the Bago Yoma mountain range, north of Yangon in southern Myanmar.

**Researchers:** Britz, R., Conway, K., Rüber, L. - see reference 6.

**Highlight:** Used in neurophysiological studies as they display complex behaviours and their brains are observable without harming the fish.

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This tiny critter has been sitting under the noses of neuroscientists for at least five years before it was discovered as a new species. Displays of complex behaviour, coupled with a remarkable anatomy where the skull roof is missing and the brain is covered by a thin layer of skin, has made Danionella cerebrum a model organism in neurophysiological research.

Until 2021, it was thought that *D. cerebrum* was *D. translucida*. The species are tiny, only slightly longer than a thumbnail, and identical to the naked eye. But molecular analyses confirmed not only that they were separate species, but only distantly related, having split from each other around 13.3 million years ago.

With the spreading popularity of *D. translucida* as a model organism in neuroscience, Ralf Britz, from the Senckenberg Natural History Collections, Dresden, and lead author on the paper describing the species, decided to do some research into the tiny fish. He studied the skeleton with his colleague from Texas A&M, Kevin Conway, and Lukas Rüber from the Natural History Museum in Bern looked into the genetics. Britz said: “We compared published genetic data and additional genetic samples, as well as the skeleton of preserved lab Danionella with our samples and found what neuroscientists had called translucida was actually an undescribed species. It swam unrecognized in tanks in several labs in the US and Europe”.

He added that, “In the end it was detective work. Once you have this hypothesis that you are dealing with two things, you start to look more thoroughly and then discover more and more morphological differences. These are times when you have a Eureka moment, and these are really satisfying”.

*Danionella* species have proven useful to scientists. According to Britz, “They combine characteristics that you would not find in any other vertebrates: They are tiny and transparent and have the anatomical condition of a larval fish in some parts of their body, and the condition of an adult fish in others. They do not have a skull roof and their brain, as in larval fish, is only covered by skin. This makes it optically accessible in the live animal without much problem. But they also have a complex apparatus to receive sounds and to also produce them, and these sounds are important for their intraspecific communication, which results in quite a complex behavioural repertoire. You would not find this in a larval fish. Both these characteristics are ideal for a vertebrate animal whose brain function you want to study. If you had to invent a vertebrate model animal, it would be very much like *Danionella*”.

The sounds the fish produce is a drumming, possibly produced by a strip of cartilage that works like a drumstick on the swim bladder. All *Danionella* males can make this sound, but the females do not have the necessary physiology. The sound is so loud, that aquarists have reported hearing the drumming coming from the fish tanks. Impressive, for such a tiny species.

So the species’ simple body, complex behaviour, and the chance for researchers to view the brain without intervention offers the possibility of making links between brain activity and behaviour. Britz said: “Brain function between a fish and a human is dramatically different at many levels, but there are some basic similarities. And it is these basic, general similarities one is interested in. How is information in the brain processed? This is a very general question for which the model organism *Danionella* can provide answers”.

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**A net containing Danionella specimens (shown by arrows) © Ralf Britz**

**Ralf Britz and Oliver Crimmen catching Danionella cerebrum in Myanmar © Ralf Britz**

[Image of Danionella cerebrum male © Ralf Britz]

[Image of Danionella cerebrum female © Ralf Britz]
MUMBAI BLIND EEL

Species: Rakthamichthys mumba


Location: Jogeshwari West, Mumbai, India.

Highlight: Has no eyes, fins or scales.

It was discovered by Tejas Thackeray, a naturalist and the son of chief minister of Maharashtra, Uddhav Thackeray, in, somewhat ironically for a blind fish, a 40 foot well on the premises of a school for the blind.

Jayasimhan Praveenraj from the Division of Fisheries Science ICAR-Central Island Agricultural Research Institute, and the researcher who discovered the species, said: “Due to its long isolation in a subterranean habitat, the Mumbai blind eel evolved to become remarkably unique”.

Back in 2012, an image of an unreco gnised pink, eyeless eel surfaced on social media. Thackeray and his team contacted the person who posted the image but, due to the specimen having been poorly preserved in liquor (from a non-availability of ethanol), it was unable to be examined.

The researchers had an inking this new fish species was out there, hidden in other wells in Mumbai. Thackeray and his team - Yogendra Satam and Yogesh Satam - received a tip-off from a man who had observed the ‘pink worm’ fish many times in the grounds of a school for the blind. They drained the water from the well for three days, and when the water was about 1.5 feet, they collected the species which had flushed out through the aquifers. It was sent to Praveenraj for official description.

Many subterranean fish species have been discovered in India’s Western Ghats over the past few years. Praveenraj explained why: “The Western Ghats is a biodiversity hotspot. The land mass was formed after the breakup from the ancient Gondwanaland, which led to formation of India as an isolated land mass. This has contributed a great deal to its speciation and biodiversity. Some of the amphibian and fish species in the Western Ghats are thus of Gondwana origin and remain unchanged over millions of years”.

ETOWAH BRIDLED DARTER

Species: Percina freemanorum


Location: Etowah River system in Georgia, specifically in Long Swamp Creek, Amicalola Creek, and the upper portion of the Etowah River, USA.

Highlight: The only freshwater fish species from to be described from the USA in 2021.

Some may think the waterways of the USA are so well researched that new species wouldn't crop up there. Well, the Etowah bridled darter has other ideas!

The only freshwater fish species described in the USA in 2021 is named after University of Georgia freshwater ecologists Mary and Byron ‘Bud’ Freeman: two legendary ecologists who have worked for decades on fish and their ecosystems.

The Freemans have been at the forefront of freshwater species and ecosystem research for decades, and have authored hundreds of papers between them. According to UGA Today, ‘Much of their work has been done in the Etowah River system, bringing attention to the region’s status as a hotspot of aquatic biodiversity. Their findings have informed efforts to protect species diversity throughout the Southeast and beyond: Many of the freshwater species in the area, including Percina freemanorum, are found nowhere else in the world and are considered imperiled’.

Thomas Near, evolutionary biologist and the ichthyologist who identified the species, said: “The citizens of Georgia have a wonderful Etowah River watershed, and any limits to impacts from human activity are in a large part due to the efforts of Mary and Bud Freeman. From the very start of my career, both Mary and Bud were always encouraging, freely open with their observations and data, and helped set a tone of collegiality among the large community of scientists studying the species-rich North American aquatic biodiversity”.

John Wares a professor of genetics and ecology and curator of genomics and aquatic invertebrates at the Georgia Museum of Natural History added that the Freemans, “have helped revitalise a pride for people in terms of what the diversity of the Southeast is about. They are a really unique resource for us here at the University of Georgia, and I think their impact has been huge across the Southeast and beyond.”

Naming this little darter freemanorum is a nod to the appreciation and respect of the Freemans from the research team.
METRIACLIMA GALLIREYAE

Species: Metriaclima gallireyae


Location: Lake Malawi.

Highlight: Live in gastropod shells on the lake bed.

These attractive cichlids are rare in that they are one of only a handful of Lake Malawi cichlids that live in gastropod shells on the lake bed. This behaviour is well known from cichlids in Lake Tanganyika, but it is much less common in Lake Malawi. Individuals can grow up to 100mm and are often seen in large groups of up to 20 individuals in the vicinity of empty shells of Lanistes nyassanus.

The researchers note that: 'Both sites where this small species was observed contained either many football-sized rocks (Gallireya Reef) or large slabs of sandstone (Chitimba Bay) that may provide additional shelter to individuals that were not able to secure an empty shell for protection'.

PARATRYGON ORINOCENSIS and PARATRYGON PARVASPINA

Species: Paratrygon orinocensis and Paratrygon parvaspina

Researchers: Loboda, T., Lasso, C., Rosa, R., Carvalho, M. - see reference 11.

Location: Orinoco basin, Venezuela

This report would not be complete without acknowledging the two species of stingray discovered in the Orinoco basin. Although information about the species is currently very limited, there are only 39 species of freshwater stingray, all of which are venomous. Of these 39, 14 were described in the past decade.

Part of the reason such a high proportion have been discovered recently is that there are more people working on freshwater stingrays than ever before. There are now three major centers of research: in Brazil, in Colombia, and in Toronto, Canada.

Reproductive cycles of P. orinocensis and P. parvaspina are related to rainy seasons, and anthropogenic impacts on environmental conditions are the biggest threat to population viability.

Capoeta raghazensis, Eagderi S., Mousavi-Sabet S. 2021. Capoeta raghazensis, a new species of algae-scraping cyprinid from the Raghaz Canyon in Hormuz basin, southern Iran (Teleostei: Cyprinidae). FishTaxa 22: 37-44. Iran. Found only in a river in the Raghaz Canyon, which is approximately 4km long, with 64 cascades and over 100 natural pools).


Angola. Breeding males establish a territory, construct a bubble-nest, attract mates, and guard eggs and embryos.

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