

Mongabay Series: Beyond Protected Areas

Interlinking of rivers could flood India's freshwater with invasive fish

by Max Martin on 27 December 2023

- *About a third of the total area in India provides suitable habitat for invasive alien fish, aiding their countrywide spread, including in biodiversity hotspots.*
- *Using species occurrence records with select environmental variables and species distribution models, a new study by ATREE reports that 12 species of invasive fish can become widespread.*
- *Scientists are urging for careful assessments and policy changes*

amidst global concern about invasive species and their effects on freshwater ecosystems and the livelihoods dependent on them.

New research shows that India's ambitious

Interlinking of Rivers (ILR) programme

(<https://www.pib.gov.in/PressReleasePage.aspx?PRID=1895759>) can spread invasive, alien fish

to waterbodies that are home to endangered fish species, posing ecological, economic, and livelihood threats. ILR envisages 30

connections amongst some of the major Himalayan and peninsular rivers through a countrywide network of canals, reservoirs and channels, to manage water shortages and

() floods.

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The threatened environments listed by the new study

([https://link.springer.com/article/10.1007/s10661-](https://link.springer.com/article/10.1007/s10661-023-12012-z)

[023-12012-z](https://link.springer.com/article/10.1007/s10661-023-12012-z)) published in *The Environmental Monitoring and Assessment* include the biodiversity hotspots of the Western Ghats, northeast India and the Sundarbans delta.

"India's proposed river linking projects ... may cause homogenization that may threaten our rare and endemic freshwater biota," noted

M. Nobinraja of S. M. Sehgal Foundation

Centre for Biodiversity and Conservation,

Ashoka Trust for Research in Ecology and the Environment (ATREE), Bengaluru and colleagues, in their new study.

"Predominantly introduced for food, pet trade and biocontrol, these species wreak havoc in the invaded areas," Nobinraja told Mongabay India.

Conversation



*The Amazon sailfin catfish, recorded from Assam in 2018.
Photo by Sofiur R. Khan/India Biodiversity Portal.*

Threat to biodiversity

Invasive species affect biodiversity and ecosystems by increasing competition for food and taking up space which, coupled with changing biotic environments, habitat degradation and pollution, often negatively affects native species populations. In the case of invasive fish, which may display aggressive territorial behaviour, it can cause a decline in the number of native fish, which in turn, affects fishing livelihoods. Globally, habitat destruction, increasing aquaculture and the introduction of ornamental species are altering freshwater ecosystems.

Researchers and co-authors of the study, Nobinraja, N. A. Aravind and G. Ravikanth used species occurrence records with select environmental variables and deployed species distribution models to identify, map and assess trends in biological invasion.

“Our study looked at how these alien species are invading newer areas and how they might spread in the future in rivers and lakes. We

explored the plans to link rivers in India and found they might make matters worse," said Ravikanth, Senior Fellow, ATREE.

About a third (31%) of the total area in India provides suitable habitat for invasive alien fish, the study found. The major river basins of Pennar, Kaveri, Godavari, Krishna and Mahanadi that spread across central and southern India were found to be highly vulnerable to invasion.

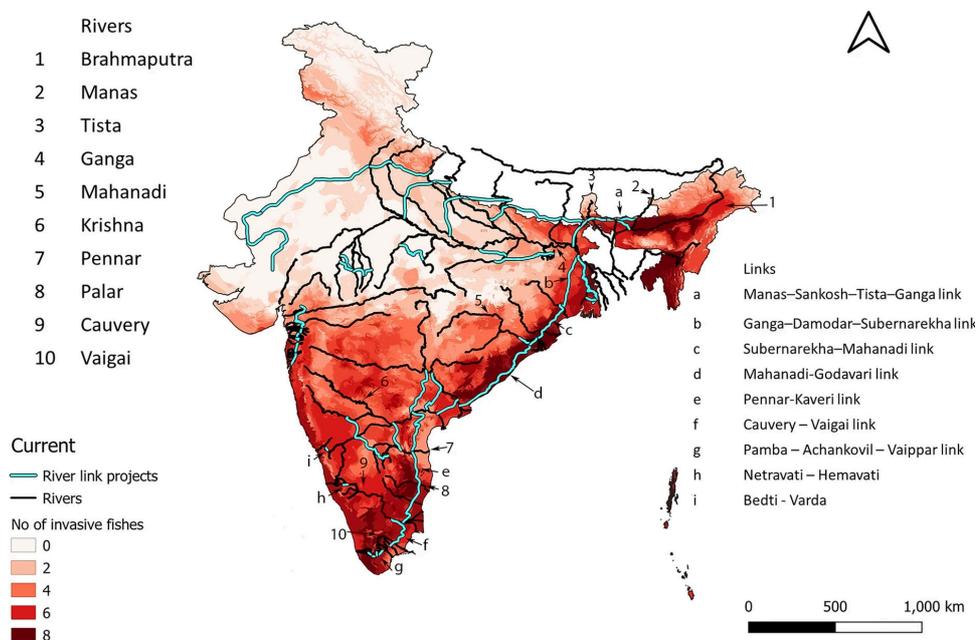
Read more: Checking spread of invasive alien fish as India faces climate extremes (<https://india.mongabay.com/2021/05/checking-spread-of-invasive-alien-fish-as-india-faces-climate-extremes/>)

Aliens have landed!

The authors modeled the current distribution of 12 alien fish identified by the Centre for Biodiversity Policy and Law (CEBPOL) and the National Biodiversity Authority (NBA) of India. They are *Cyprinus carpio* (common carp), *Clarias gariepinus* (African catfish), *Gambusia affinis* (western mosquitofish), *Gambusia holbrooki* (eastern mosquitofish), *Hypophthalmichthys nobilis* (bighead carp), *Oreochromis mossambicus* (Mozambique tilapia), *Oreochromis niloticus* (Nile tilapia), *Poecilia reticulata* (guppy) and four species of *Pterygoplichthys* (sailfin catfish) – *pardalis*, *multiradiatus*, *disjunctivus* and *anisitsi*. *Gambusia*, native to the USA and *Poecilia* from South America are widely used in mosquito control. *Pterygoplichthys* are popular ornamental fish. The rest are from different East European, African and Asian countries and are grown in aquaculture farms in India. *Gambusia* has shown the highest area of occupancy in the study. It covers over ten times more area than *Pterygoplichthys*. However, *Pterygoplichthys* has the highest

potential for range expansion in a changing climate. Range expansion denotes how a species spreads in new geographical areas. *Hypophthalmichthys nobilis*, native to China, has a suitable habitat in the Narmada, Mahi, Mahanadi, Kaladan, Irrawaddy, Godavari, Ganges, and Damodar river basins, the study showed.

Nobinraja and colleagues warn that the Manas-Sankosh-Tista-Ganga link leading to the Sundarbans delta of Ganga and Brahmaputra could make one of India's most important biodiversity hotspots that support the livelihoods of thousands of fishers vulnerable to biological invasion.



India's rivers and proposed river linking map overlaid on the potential current distribution of invasive alien fishes. Image source: Nobinraja, M., Aravind, N.A. & Ravikanth, G. Opening the floodgates for invasion—modelling the distribution dynamics of invasive alien fishes in India. Environ Monit Assess 195, 1411 (2023). <https://doi.org/10.1007/s10661-023-12012-z>

Spreading through links

The Subarnarekha-Mahanadi link that connects with southern India can expose threatened and endemic species to alien species. Krishna and Kaveri (Cauvery) basins are also crucial areas for endemic and threatened fish species according to the study.

The Kaveri-Vaigai link, Pamba-Achankovil-Vaippar link and the Netravati-Hemavati link that connects the west-flowing rivers with the Kaveri and the link between the Bedti and Varda can make the endemic and endangered species vulnerable to invasion, the study added.

The ATREE team also looked at future biological invasion patterns under different climate scenarios projected till 2100. In the minimum greenhouse gas emission scenario (denoted as Representative Concentration Pathways or RCP 2.6), the *Gambusia* and *Poecilia reticulata* species might further spread towards southwestern and northeastern India, projects the study. There would be a 2% reduction in niche suitability for invasive alien fish under this scenario. However, the study found a 91% increase for all the 12 species, under the maximum greenhouse gas emission scenarios (RCP 8.5).

"Interbasin water transfers such as river interlinking are recognised as major pathways for the expansion of aquatic invasive species," P. R. Jayachandran, a coastal-marine ecologist who has studied the invasive species in the Kerala backwaters, told Mongabay India.

"These efforts can have aggressive and detrimental effects on waterways as they tolerate a wide range of environmental conditions, compete with native species for resources, reproduce rapidly and prey on native species, leading to a loss of biodiversity and disruption of food webs." Invasive alien fish can also impact human and animal health, Jayachandran added.



Poecilia reticulata, or wild guppies. Photo (https://commons.wikimedia.org/wiki/File:Guppy_pho_0048.jpg) by Per Harald Olsen/Wikimedia Commons.

the Sundarbans.

While the Brahmaputra and Manas river systems presently have more than four invasive alien species that dominate fisheries, the Sundarbans fisheries are dominated by native fish. *Pterygoplichthys* (sailfin catfish) that have little market value is projected to spread aggressively in the region. "They can live in poor water quality, breed prolifically around the year and have no predators in India," Bijukumar said. They are also known to live outside water under wet conditions for hours. Within the last few decades, these fish have entered critical wetlands in the country, replaced native species and impacted fishing, he added.

Scientists have repeatedly called for such assessments and policy measures after noticing a massive spread of alien fish across India. A 2021 study (<https://doi.org/10.14321/ae hm.024.02.10>) in the Western Ghats Biodiversity Hotspot waterbodies using the Geographical Information System showed 28 alien fish species including *Gambusia* and *Poecilia*. Major reservoirs serve as spawning hubs of alien fish introduced by aquarium trade and aquaculture, the study noted.

A 2011 review (<https://doi.org/10.1111/j.1753-5131.2010.01039.x>) by Atul K. Singh of the National Bureau of Fish Genetic Resources, Lucknow, and colleagues found over 300 alien species imported to India "intentionally or illegally". They include 291 ornamental species, 31 aquaculture species and two fish that eat larvae. The list included some of the world's worst invasive species such as *Cyprinus carpio*, *Oreochromis niloticus* (Nile tilapia), *Aristichthys nobilis*, *Pygocentrus nattereri* (red-bellied piranha) and *Pteriggoplichthys* in the inland waters.



Home and commercial aquariums, which often include pet exotic fish, are a significant pathway for introduction of exotic fish. Image for representation only. Photo by Biswarup Ganguly/Wikimedia Commons.

A global threat

Invasive alien species enter new habitats by inadvertent or deliberate release, escape, through contaminants from hatcheries, across river corridors, as stowaways and in unaided introduction, Singh pointed out in a 2021 overview

(<https://doi.org/10.14321/ae hm.024.02.05>). The study predicted about 29% increase in the invasive *tilapia* and *Cyprinus carpio* in the Ganges in the coming decades. Single species

tilapia invasion facilitated multiple-species invasion in what is termed in the study as an “invasion meltdown”.

The invasion of species in farming, forestry, and fishing is recognised as a global threat. Alien fish invasion and overharvesting (<https://www.iucn.org/news/species/202012/european-bison-recovering-31-species-declared-extinct-iucn-red-list>) are some of the leading causes of species extinction, as IUCN notes: “All of the 17 freshwater fish species endemic to Lake Lanao and its outlet in the Philippines are now Extinct (15 species) or Critically Endangered (Possibly Extinct) (two species). The extinctions were caused by predatory introduced species, compounded by overharvesting and destructive fishing methods.”

The United Nations' Food and Agriculture Organization (FAO (<https://www.fao.org/3/a0113e/A0113E03.htm>)) notes that over 40 binding international agreements – some not yet in force – refer to alien species, a fourth of them relevant to aquatic environments. “Treatment of alien species in aquatic ecosystems in global multilateral agreements is neither comprehensive nor entirely consistent. Marine ecosystems currently have somewhat better coverage than freshwater ecosystems,” as FAO points out.

Careless introduction of ornamental fish to promote aquarium trade with no biosafety measures should stop, Bijukumar said.

Meanwhile, Nobinraja called for an “urgent assessment” to comprehend the current and future distribution patterns of invasive alien fish.

Read more: Marine debris transporting invasive species along the southeastern coast (<https://india.mongabay.com/2023/10/marine-debris-transporting-invasive-species-along-the-southeastern-coast/>)

Banner image: Gambusia is a large genus of fish, containing over 40 species and found primarily in freshwater. It is also known as mosquitofish. Photo by M. Nobinraja.

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