



Effect of Invasive Alien Species in Aquatic Environment

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Invasive alien species (IAS) in aquatic environments refer to non-native species that have been intentionally or unintentionally introduced into ecosystems outside their natural range and may negatively impact the native flora, fauna and ecological processes. These invasions can lead to significant environmental, economic and social consequences. Humans have effectively transported thousands of species around the globe, and with accelerated trade, the rate of introduction has increased over time. Aquatic ecosystems seem to be at particular risk from invasive species because of threats to biodiversity and human needs for water resources. Invasive alien species have emerged as the second most significant threat to global biodiversity after habitat destruction, and it is expected to surpass soon the damage caused by habit destruction and fragmentation factors (Surendra *et al.*, 2013). Freshwater ecosystems have more incredible biodiversity per surface area than marine and terrestrial ecosystems (Dudgeon *et al.*, 2006). Freshwater ecosystems also play an active role in nutrient and water cycling, translating into goods and services for human societies. At the same time, freshwater ecosystems have been profoundly transformed by invasive species from various taxonomic groups. Over 2,000 plants and animals from all over the world have been introduced to Britain. Most are harmless, but 10-15% spread and become invasive non-native species. Nearly one-fifth of the Earth's surface is at risk of plant and animal invasions, with severe environmental consequences. Introducing invasive alien flora and fauna in India is a significant cause of species endangerment and extinction in aquatic ecosystems, including inland wetlands (Harrison and Stiasny, 1999).

Status of alien fish species

Several studies have definitively demonstrated the impact of invasive fish species on native aquatic biodiversity, including the disruption of vulnerable and economically valuable indigenous fish species. Studies have focused on how the invasion affects the indigenous community's socioeconomic and cultural values.

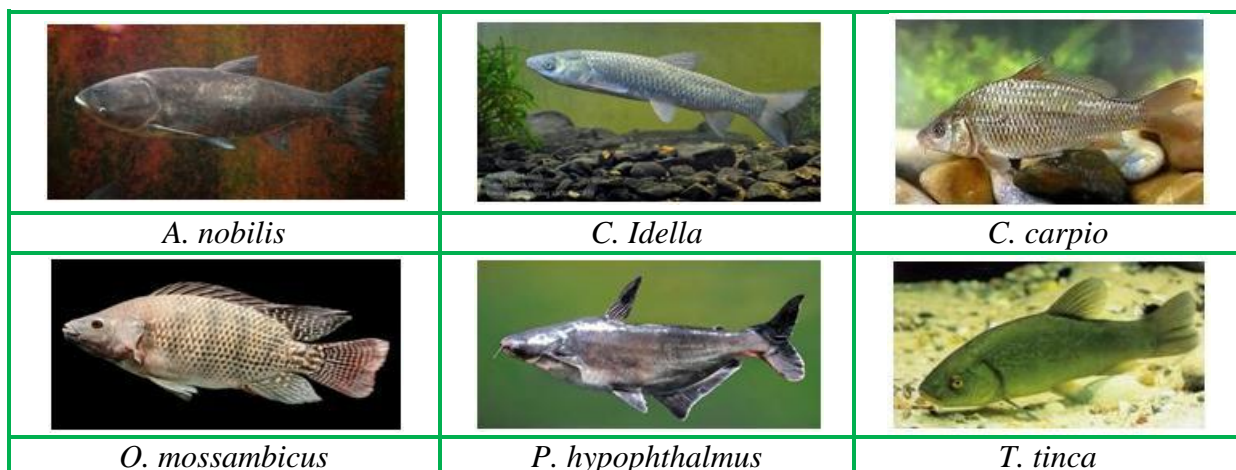
Table 1: Important exotic aquaculture fish species with their current invasive status

Sr. No.	Species	Invasive status	Native place
1	<i>Aristichthys nobilis</i>	I	-
2	<i>Ctenopharyngodon Idella</i>	I	Nilgiri, Tamil Nadu
3	<i>Oreochromis mossambicus</i>	I	West Bengal

4	<i>Pangasianodon hypophthalmus</i>	NA	West Bengal
5	<i>Cyprinus carpio</i>	I	Odisha
6	<i>Tinca tinca</i>	NA	Tamil Nadu
7	<i>Hypophthalmichthys molitrix</i>	I	Odisha

Here are some of the effects of invasive alien species in aquatic environments:

- Biodiversity Loss:** Invasive species can outcompete native species for resources such as food, habitat, and space. This competition can lead to declining native species populations and sometimes even extinctions. Reduced biodiversity can disrupt ecosystem stability and function.
- Altered Ecosystem Structure and Function:** Invasive species can disrupt the natural balance of ecosystems by changing nutrient cycling, predation patterns, and habitat availability. These changes can cascade through the food web, affecting other species and ecosystem processes.
- Habitat Modification:** Invasive species can modify or degrade habitats, making them less suitable for native species. They may alter physical structures, such as plants or substrates and change water quality parameters, affecting the ecosystem's overall health.
- Disease Transmission:** Invasive species can introduce new diseases to native populations with no natural immunity. This can lead to disease outbreaks among native species, causing population declines.
- Hybridization:** Introducing non-native species can sometimes lead to hybridization with native species, resulting in genetic contamination and loss of genetic diversity within native populations.
- Economic Impacts:** Invasive species can have significant financial consequences. They can clog waterways, disrupt navigation, damage infrastructure (such as dams and water treatment facilities), and impact fisheries, aquaculture, and tourism industries.
- Human Health Risks:** Some invasive aquatic species can harm human health. For example, certain invasive plants can create breeding grounds for disease vectors like mosquitoes, while toxic algal blooms can produce harmful toxins that affect water quality and human health.
- Restoration Challenges:** Once invasive species become established, they can be difficult to control or eradicate. Removal efforts may require significant resources and long-term management strategies, making ecosystem restoration complex and challenging.
- Biological Invasions:** Invasive species can spread to new areas through various means, including ballast water discharge from ships, aquaculture activities, recreational boating, and accidental aquarium releases. Climate change and increased global trade can exacerbate the spread of invasive species by creating more suitable habitats and pathways for their introduction.



Challenges

1. The Ministry of Jal Shakti, namely the Department of Water Resources, River Development and Ganga Rejuvenation (MOWR), has given significant importance to implementing the Interlinking of Rivers (ILR). The primary objective of ILR is to promote more equitable water distribution by increasing water availability in regions susceptible to drought and reliant on rainfall. In the 39th meeting conducted on 23rd August 2016, a standing committee of the National Board for Wildlife (NBWL) of the Ministry of Environment, Forest and Climate Change (MoEF&CC), together with other leading research institutions such as the Wildlife Institute of India (WII), expressed the opinion that the Interlinking of Rivers (ILR) did not have any negative impact on wildlife (NBWL 2020). The committee did not consider the possibility of invasive alien species entering or being introduced through ILR into newly created aquatic ecosystems. The interconnection of many water bodies from diverse locations has facilitated the flow of aquatic organisms, incredibly invasive alien fish species.
2. Consequently, this will worsen the current problem of invasion. For example, *Badis badis*, *Pethia gelius*, *Osteobrama cotio* and *Lepidocephalus guntea* have invaded Chennai lakes only after the interlinking of Krishna River. Subsequently, the suckermouth catfish migrated into the Krishna River following the establishment of the interconnection between the Godavari River and the Krishna River.
3. In 1952, the Mozambique tilapia (*O. mossambicus*) was introduced in India, and the Fisheries Department actively promoted its cultivation in local ponds, lakes, and reservoirs. Subsequently, it was recognized that the excessive reproduction of the species surpasses the native species in terms of competition.
4. In India, 19 states and Union Territories support cloud shops to promote different ornamental organisms, including alien ornamental fish and aquatic plants. Most invasive species can escape from hobbyists, traders, and stocking/breeding sites into the wild, where they eventually transform into invasive species and seriously harm aquatic resources.
5. Due to intense flooding brought on by the intensified storm and the accompanying rainfall, foreign fish in aquaculture ponds, aquarium tanks, and other pre-existing habitats may easily find new places to live.

Eradication and Control Methods

Eradication refers to the actions to eliminate invasive species from a particular environment. Every invaded alien species can be controlled effectively if actions are taken immediately after their invasion. Various methods can be adopted to control/eradicate them. The techniques are explained below.

- a. Mechanical control method:** In this method, invasive species are removed directly by either hand or machinery or by completely draining the water bodies that have become invaded. Some tools involved are netting, dewatering, fishing and trapping. Dewatering the whole water body to eliminate the alien species may also threaten the biodiversity and native commercial species. Still, this loss is much less than the devastating losses caused by the IAS to human health and the other long-term effects caused to the ecosystem.
- b. Biological/Bio-control control methods:** This method uses those species that are predators, parasites or competitors to these invasive species. In contrast to mechanical methods, biological processes are cheap, autonomous, have a lower risk to human health, have a permanent effect, and seem well accepted by the public—for instance, the introduction of *Gambusia* spp. in controlling the mosquitoes.
- c. Chemical control methods:** This method uses chemicals to control unwanted alien species. Chemicals like pesticides or defoliants are used in maintaining. Even though this

method is very effective with short-term effects, usage of these toxic chemicals may have direct or indirect detrimental effects on non-target species and ecology.

Conclusion

The presence of invasive alien species in aquatic environments has far-reaching and often detrimental effects on ecosystems, biodiversity, economies and even human health. These non-native species, introduced intentionally or unintentionally, can disrupt natural balance and processes, leading to ecological and economic consequences. Biodiversity loss, altered ecosystem structure and function, habitat modification, disease transmission, hybridization, economic impacts, human health risks, and restoration challenges are all notable outcomes of invasive species invasions.

References

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