



NOAA FISHERIES SERVICE



The lionfish (*Pterois volitans*) invasion in the North Western Atlantic and Caribbean represents one of the most rapid marine invasions in history. (Photo credit: NOAA).



Zebra mussels (*Dreissena polymorpha*) cost the United States billions of dollars each year through economic losses and control costs. (Photo credit: NOAA Great Lakes Environmental Research Lab).

What are Aquatic Invasive Species?

Aquatic invasive species (AIS) are marine, estuarine, or freshwater organisms that, when introduced into new habitats, negatively affect aquatic ecosystems as well as human use of these natural resources. These non-native species impact our environment and the diversity of life on our planet in many ways; in addition to the severe and permanent damage to the habitats they invade, AIS also adversely affect individuals by hindering economic development, preventing recreational and commercial activities, decreasing the aesthetic value of nature, and serving as vectors of human disease. The table below provides a list of the three classes of adverse impacts caused by AIS:

Types of Aquatic-Invasive-Species Impacts		
Environmental Effects	Economic Impacts	Wildlife and Public Health
Predation	Industrial Water Users	Disease Epidemics
Parasitism	Municipal Water Supplies	West Nile Virus
Competition	Nuclear Power Plants	Cholera Risk
Introduced Pathogens	Commercial Fisheries	Parasites
Hybridization	Recreational Activities	
Habitat Alterations	Shipping	

How are Aquatic Invasive Species Transported?

AIS can arrive through many different pathways, but most AIS arrive as a direct result of human activity. Common pathways of introduction include:

- Ballast water operations
- Bio-fouling of ship hulls
- Release of unwanted pets and fishing bait
- Release or escape of classroom and laboratory animals
- Transportation on recreational boats and equipment
- Escape from aquaculture facilities, nurseries, or water gardens
- Intentionally stocked as food or recreational sources
- Release as biological control of existing an existing invader
- Introduction for habitat restoration or erosion control efforts

Following introduction, AIS must become established within its new location before the species is considered invasive. All invasive species, aquatic and terrestrial, tend to share common characteristics that allow them to thrive following their arrival to a new environment. Common traits of invaders include:

- Fast growth
- Rapid reproduction
- High dispersal ability
- Lack of natural predators
- Ability to survive in a wide range of environmental conditions
- Ability to consume a variety of food resources
- Ability to adapt to changing environmental conditions
- Ability to displace native species by utilizing limited resources more efficiently



Why Should We Care about Aquatic Invasive Species?

Environmental Effects

The impacts of invasive species are second only to habitat destruction as a cause of global biodiversity loss. In fact, introduced species are a greater threat to native biodiversity than pollution, harvest, and disease combined. AIS impact the habitats they invade by reducing the abundance of native species and altering ecosystem processes. They impact native species through predation, competition for food and space, hybridization, as well as the introduction of harmful pathogens and parasites. AIS may also alter normal functioning of the ecosystem by altering fire regimes, hydrology, nutrient cycling and productivity.

Economic Impacts

AIS are seen as a threat not only to biodiversity and ecosystem functioning, but also to economic development. They reduce production of fisheries, decrease water availability, block transport routes, choke irrigation canals, foul industrial pipelines, degrade water quality, accelerate filling of lakes and reservoirs, and decrease property values. Through damage to human enterprises, invasive species inflict an enormous economic cost; the cost to manage both aquatic and terrestrial species is estimated at \$137 billion per year to the U.S. economy alone. This number is likely an underestimate as it does not consider ecosystem health or the aesthetic value of nature, which can influence tourism and recreational revenue. Estimating the economic impacts associated with AIS is further confounded as monetary values cannot be given to extinction of species or loss biodiversity and ecosystem services.

Public Health

Throughout recorded history, epidemics such as malaria, yellow fever, typhus, and bubonic plague have used introduced organisms as vectors and reservoirs. More recently, West Nile virus was introduced into the United States through an infected bird or mosquito. Waterborne disease agents, such as cholera bacteria (*Vibrio cholerae*), and causative agents of harmful algal blooms are often transported in the ballast water of ships. The effect of AIS on public health extends beyond the immediate effects of disease and parasites as chemicals used to control invasive species can pollute soil and water. Other AIS, such as invasive mussels, may increase human and wildlife exposure to organic pollutants such as Polychlorinated biphenyls (PCBs) and Polycyclic aromatic hydrocarbons (PAHs) as these toxins accumulate in their tissues and are passed up the food chain.

Aquatic Invasive Species: What Can Be Done?

Once established, AIS are very costly to eradicate. Prevention is the most cost effective and environmentally sensitive tool to control invasive species. Preventing new invasions requires creative approaches to education and outreach, screening and injurious wildlife prohibitions, and rapid response techniques.

Even the best prevention efforts will not stop all invasions. When a new invasion occurs, the best strategy is early detection and rapid response. This includes actively monitoring habitats in order to discover newly established species, reporting sightings of previously unknown species in an area, and working quickly and diligently to keep the species from becoming established and spreading. Such efforts increase the likelihood that invasions will be addressed successfully while populations are still localized and population levels are not beyond that which can be contained and eradicated.

Control and management is necessary in areas where AIS are already established to prevent their further spread and lessen their impacts on native ecosystems. In some cases, containment of AIS can buy time while new control methods are developed that offer hope for eradication. Because AIS do not always behave as they do in their native habitats, research is often needed before appropriate control and management measures can be identified.



The highly invasive nature of purple loosestrife (*Lythrum salicaria*) allows it to form dense stands that replace native plants that provide a quality source of nutrition for wildlife (Photo credit: National Park Service).

For further information on Aquatic Invasive Species issues please contact:
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