



# Exotic, Invasive, Alien, Nonindigenous, or Nuisance Species: No Matter What You Call Them, They're a Growing Problem

Human activities are profoundly affecting the earth's surface. Human population growth has contributed a variety of stresses on natural ecosystems, including the unintentional introduction of various nonindigenous species.

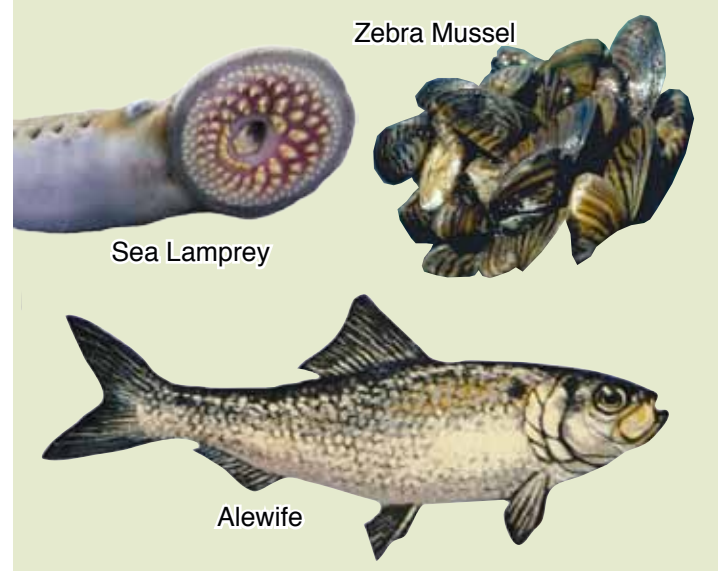
## What is the Difference between Exotic, Nonindigenous, Non-Native, Alien, Nuisance, and Invasive Species?

In general, these terms all refer to plants, animals, or microscopic organisms living outside their native range. Among these terms, the major difference is between **nonindigenous** and **invasive**.

A "**nonindigenous**" species is an organism (plant, animal, microbe) found living beyond its historic native range, which is usually taken as the area where it evolved to its present form. Executive Order 13112 of February 3, 1999, defined "**alien**" species as "any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native" to the particular ecosystem in which it is found. Thus, **alien** can be used interchangeably with **nonindigenous**. The terms **exotic** and **non-native** are both synonyms for **nonindigenous**. So **nonindigenous = alien = exotic = non-native**.

Public Law 101-636 (Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990) defined an aquatic **nuisance** species as a **nonindigenous** species that "threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters." Similarly, Executive Order 13112 defined **invasive** species as an **alien** species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Thus, **invasive** and **nuisance** species are synonymous and can be used interchangeably.

An **invasive** species is also, by definition, **nonindigenous**, but not all **nonindigenous** species are invasive. For example, coho, chinook, and pink salmon are favored **nonindigenous** sport fish in the Great Lakes, but are not considered **invasive** or a **nuisance**. These salmon could also be called **alien** or **exotic** with respect to the Great Lakes. The zebra mussel, on the other hand, is an **invasive** (or **nuisance**) species, as well as **nonindigenous**. In an interesting case of turn-about, the alewife, a **nonindigenous** fish that was first reported in the Great Lakes in 1873 was considered a costly nuisance species in the mid-20<sup>th</sup> century. Now it is considered a valuable (but still nonindigenous) food source for salmon and lake trout, which support a multi-billion dollar sport fishery.



The term "**invasive**" is severely overused – very often we see reference to "**invasive**" species when the subject is actually **nonindigenous** or **non-native** species.

## Why Should We Care About Them?

### A Costly National Problem

The full extent of the economic costs of invasive species is hard to identify, and many estimates appear to be pure speculation. The following examples, many provided by Dean Wilkinson (NOAA), are factual estimates, but represent just the "tip of the iceberg":

- In 2006, the state of Florida reported spending \$100M per year on all aquatic invasive species, and Jefferson Parish Louisiana spent \$500K for repairs of canal banks damaged by nutria.
- A University of New Hampshire study found that property values on lakes infested with Eurasian watermilfoil were reduced by an average of 17 percent.
- In areas of Washington state infested by Japanese oyster drills, net profits in aquaculture facilities have been reduced by 55 percent.
- In 1997, a paper mill in Michigan spent \$1.4M to remove 400 cubic yards of zebra mussels from its intake.
- The annual expenditure in the Great Lakes for control of the sea lamprey is about \$13M per year.
- Charles O'Neill (NY Sea Grant) estimates that expenditures from 1989-2002 by the power industry to keep zebra mussels from blocking cooling pipes in the Great Lakes and Mississippi basins was \$1.5-2 billion.

- Over \$10M have been spent so far to construct electric barriers on the Chicago Sanitary and Ship Canal to try to block Asian carp from entering the Great Lakes.
- The recent spread of viral hemorrhagic septicemia (VHS) virus in the Great Lakes has led to tight restrictions on baitfish sales and fish hatchery and stocking operations, with resultant, as yet undetermined, economic losses.

These are just a few illustrative examples. The problem is nationwide and economic costs are mounting.

## Ecosystem Impacts and Costs

Whether or not a particular non-native species is a direct nuisance to humans, it may have profound impacts on the native plants and animals in an ecosystem.

When a new species becomes established in an ecosystem, it usually does not have any local predators and often outcompetes native species for food and habitat. One of the most well documented ecological impacts of a species invasion was that of the sea lamprey in the Great Lakes, which devastated the lake trout fishery during the 1940s and 1950s. Without this top predator, populations of prey fish like the alewife multiplied out of control.

An invasive comb jelly was introduced into the Black Sea in the early 1980s and caused the collapse of the entire Black Sea anchovy fishery.

Zebra and quagga mussels are associated with increased occurrence of toxic algal blooms in areas like western Lake Erie, Saginaw Bay, and Green Bay, as well as inland lakes.

Round gobies are aggressive fish with no economic value that have displaced native fish in the Great Lakes from their critical spawning habitat.

Asian carp have all but replaced the normal population of native fish in areas of the Missouri and Mississippi River systems.

Invasive algae carried by hull fouling threaten Hawaii coral reefs by covering and smothering the coral.

Many of these changes are irreversible and require that human use of invaded ecosystems be adapted to the presence of the new species, sometimes at considerable economic cost.

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## So Why are These Species Suddenly Invading Now?

The spread of exotic species is not new. Plants, animals, and microscopic organisms may invade new territories naturally by finding their way across or around significant natural barriers (such as oceans). Historically, such invasions have occurred at a very slow rate, but human activities have been helping to speed up this movement. A Canadian study calculated that humans have increased the dispersal of some aquatic organisms up to 50,000 times their natural rate.

- ◆ Over the last 50 years, technological advances have greatly increased the speed of transportation. Globalization of world markets and the end of the Cold War increased the volume of overseas trade and the opportunities for transporting species. The increasing rates of new aquatic species invasions reported for many coastal aquatic ecosystems appear to parallel the expansion of human global economic trade.
- ◆ Construction of canals in the late 1800's and early 1900's directly breached natural barriers to species movement between many adjacent watersheds. For example, Niagara Falls blocked species passage between the Atlantic Ocean and the upper Great Lakes until the construction of the first Welland Canal in 1829.



Comb jelly. Image courtesy of Richard Harbison, WHOI.

- ◆ A large cargo ship can move and discharge millions of gallons of ballast water and the organisms it contains. The ballast tanks of cargo ships have been identified as the largest single contributor to the global movement of aquatic species.

- ◆ Water quality in coastal zones and harbors has improved, making it easier for new species to survive.

- ◆ Another large source of potentially invasive species has been the garden, aquaria, bait, and live feed trades. A fisherman getting bait at his local store can buy live worms imported from Asia -- unthinkable a century ago. The Northern snakehead fish, found in Maryland and Florida, was imported live into the United States and sold in fish markets.

- ◆ The increasing discovery rate for new invaders may also reflect wider recognition and attention to the problem -- we are more aware and looking harder.

Multiple routes and multiple means of transport have greatly increased the opportunities for species to enter new habitats, with unpredictable and possibly costly results.