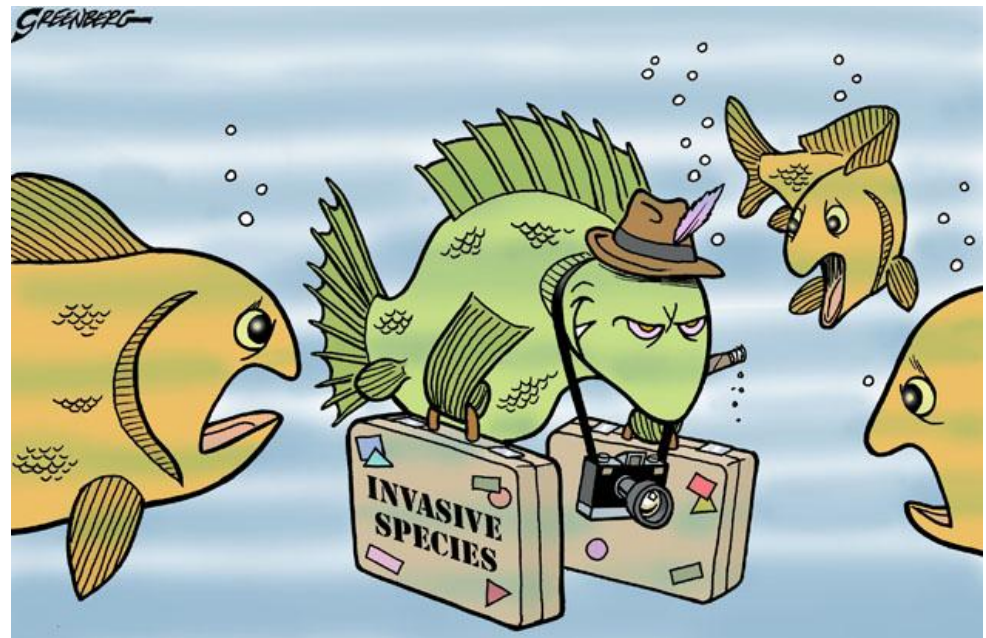


# INVADERS



## Invasive species

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# Definition

**Invasive species**, also called **invasive exotics** or simply **exotics**, is a nomenclature term and categorization phrase used for flora and fauna, and for specific restoration-preservation processes in native habitats, with several definitions:

## First definition

- the most used definition
- applies to introduced species (also called "non-indigenous" or "non-native") that adversely affect the habitats and bioregions they invade economically, environmentally, and/or ecologically.
- Such invasive species may be either plants or animals and may disrupt by dominating a region, wilderness areas, particular habitats, or wildland-urban interface land from loss of natural controls (such as predators or herbivores).

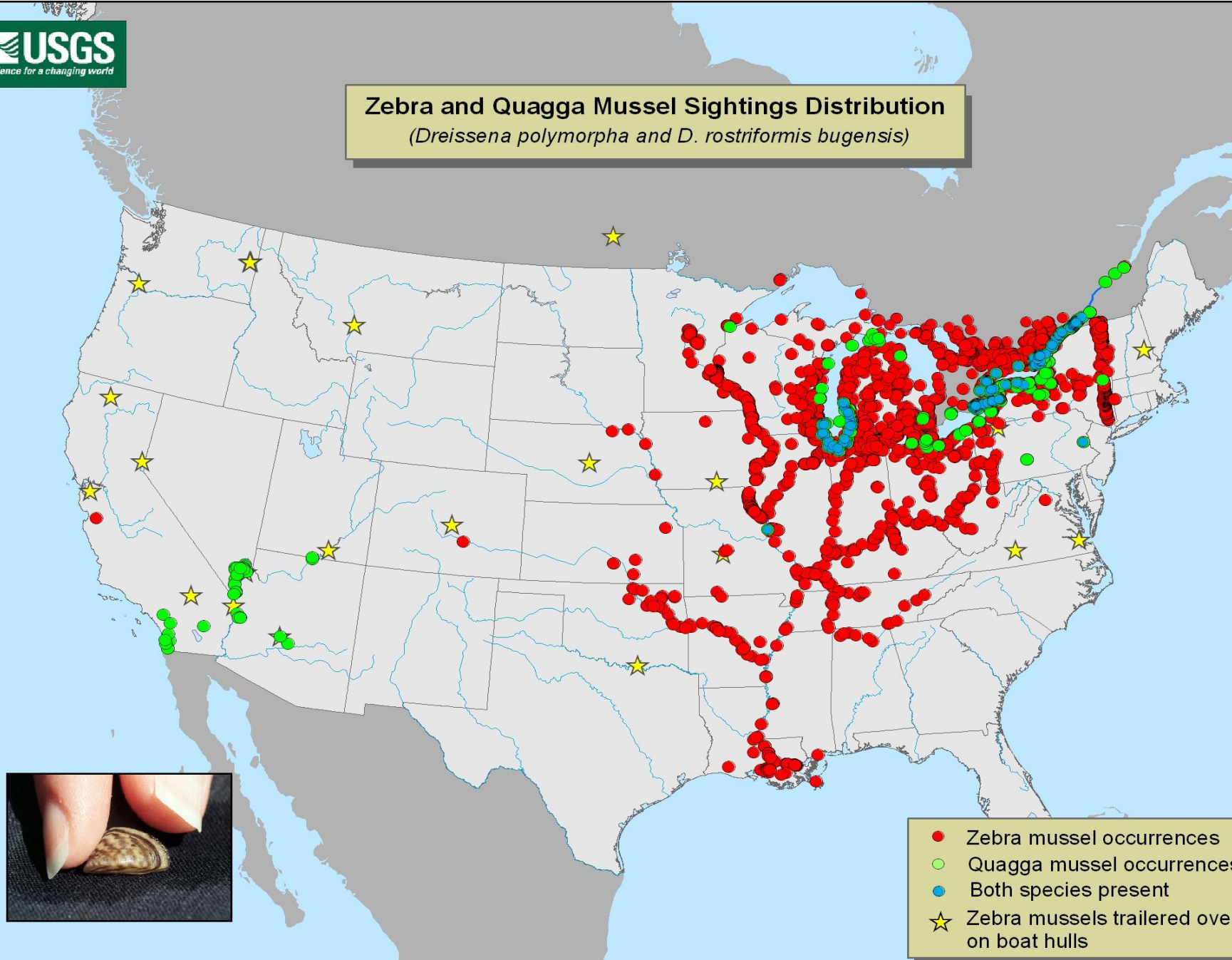
## Example:

The **zebra mussel**, *Dreissena polymorpha*

- freshwater mussel
- originally native to the streams of southern Russia
- The native distribution of the species is in the Black Sea and Caspian Sea in Eurasia
- However, it has been accidentally introduced in many other areas, and has become an invasive species in many different countries worldwide (North America, Great Britain, Ireland, Italy, Croatia, Spain, Sweden....)
- They disrupt the ecosystems by monotypic colonization, and damage harbors and waterways, ships and boats, and water treatment and power plants.
- Water treatment plants are most impacted because the water intakes bring the microscopic free-swimming larvae directly into the facilities.
- The Zebra Mussels also cling on to pipes under the water and clog them.



**Zebra and Quagga Mussel Sightings Distribution**  
(*Dreissena polymorpha* and *D. rostriformis bugensis*)



- Zebra mussel occurrences
- Quagga mussel occurrences
- Both species present
- ★ Zebra mussels trailed overland on boat hulls

## The second definition

- includes the first, but broadens the boundaries to include indigenous or *native* species, with the *non-native* ones, that disrupt by a dominant colonization of a particular habitat or wildlands area from loss of natural controls (i.e.: predators or herbivores).
- Deer are an example, considered to be overpopulating their native zones in the Northeastern and Pacific Coast regions of the United States.



## The third definition

- identifies invasive species as a *widespread nonindigenous species*
- not every nonindigenous or "introduced" species has an adverse effect on a nonindigenous environment.
- A non adverse example is the common goldfish ([\*Carassius auratus\*](#)), though common outside its native range globally, it is rarely in harmful densities to a native habitat.





adverse example:

Asian carp - Great lakes

<http://bcove.me/ulmupbw7>

# Species-based mechanisms

While all species compete to survive, invasive species appear to have specific traits or specific combinations of traits that allow them to outcompete native species

Common invasive species traits include:

- Fast growth - must survive at low population densities before it becomes invasive in a new location
- Rapid reproduction
- High dispersal ability
- Phenotypic plasticity (the ability to alter growth form to suit current conditions)
- Tolerance of a wide range of environmental conditions (Ecological competence)- nutrients, light, physical space, water or food
- Ability to live off of a wide range of food types (generalist)



# Ecosystem-based mechanisms

- the amount of available resources and the extent to which those resources are used by organisms determines the effects of additional species on the ecosystem
- stable ecosystems - equilibrium exists in the use of available resources
- These mechanisms describe a situation in which the ecosystem has suffered a disturbance which changes the fundamental nature of the ecosystem.
- Every species occupies a *niche* in its native ecosystem; some species fill large and varied roles, while others are highly specialized.
- Some invading species fill niches that are not used by native species, and they also can create new niches

# Ecology



## Native "invaders,,

- some native species can, under the influence of events, such as long-term rainfall changes or human modifications to the habitat, increase in number and range and become invasive by expanding into new areas and disturbing the balance of species in the new area (Gobiidae – Europa)

## Vectors

- Non-native species have many *vectors* but most invasions are associated with human activity
  - humans typically carry specimens greater distances than natural forces;
1. accidental introduction
    - aquaculture
    - Pet trade
    - Ballast water (zebra mussel, round goby – great lakes)
    - Fish bait
  2. Intentional introduction
    - to feel more "at home,, in Australia, European colonists introduced european fish species
    - *Gambusia affinis* – introduced directly into ecosystems in many parts of the world as a biocontrol to lower mosquito populations which in turn negatively affected many other species in each distinct bioregion

# Impact

## 1. Ecological

- If introduction is successful - invasive species can change the functions of ecosystems

Eq- *Caulerpa taxifolia* – Adriatic sea

- seaweed was accidentally released into coastal waters of the Mediterranean Sea just below the Oceanographic Museum of Monaco in 1984.
- Ten years later - *Caulerpa* cover 30 km<sup>2</sup>
- Destroyed native plants (*Posidonia* sp.)
- nickname "Killer Algae"



## 2. Economical

### **Benefits**

- Non-native species can have benefits. Asian oysters, for example, better filter water pollutants than native oysters.
- They also grow faster and withstand disease better than natives.
- Biologists are currently considering releasing this mollusk in the Chesapeake Bay to help restore oyster stocks and remove pollution.

## Costs

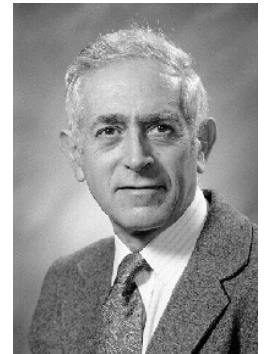
- Economic costs from invasive species can be separated into direct costs through production loss in agriculture and forestry, and management costs.
- Estimated damage and control cost of invasive species in the U.S. alone amount to more than \$136 billion annually

## Estimated annual costs associated with non-native species:

<u>Group</u>	<u>costs (in millions)</u>
Plants (purple loosestrife, weeds)	34,000
Mammals (feral pigs, rats)	37,000
Birds (pigeons, starlings)	2,000
Fishes	1,000
Arthropods (ants, termites, other pests)	19,000
Mollusks (zebra mussel, asian clam)	1,200
Microbes (plant pathogens, animal disease)	41,000

All organisms

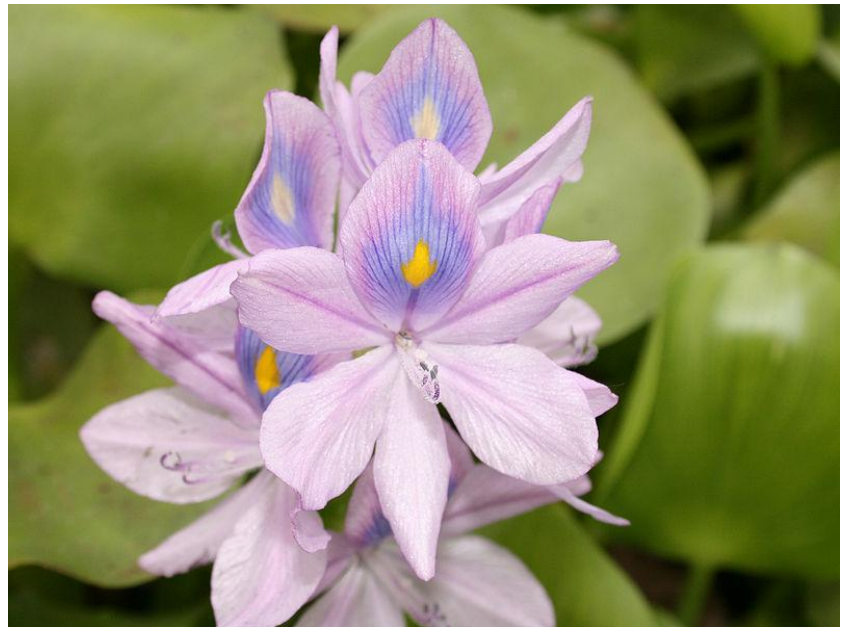
over \$136 billion per year



Source: Pimentel et al. 2000 BioScience

## Economic opportunities

- Some invasions offer potential commercial benefits.
- silver carp and common carp can be harvested for human food and exported to markets already familiar with the product, or processed into pet foods, or mink feed.
- Vegetative invasives such as water hyacinth (aquatic plant) can be turned into fuel by methane digesters



## Tourism and recreation

- Invasive species can impact outdoor recreation, such as fishing, hunting, hiking, wildlife viewing, and water-based activities.
- They can damage a wide array of environmental services that are important to recreation, including, but not limited to, water quality and quantity, plant and animal diversity, and species abundance.
- Eurasian Watermilfoil ([\*Myriophyllum spicatum\*](#)) in parts of the US, fill lakes with plants complicating fishing and boating







## Biodiversity

- Biotic invasion is considered one of the five top drivers for global biodiversity loss and is increasing because of tourism and globalization
- Invasive species may drive local native species to extinction via competitive exclusion, niche displacement, or hybridization with related native species.
- Hybridization with *Salmo trutta*-endemic Croatian *Salmo obtusirostris salonitana*; river Jadro



## Genetic pollution

- Native species can be threatened with extinction through the process of *genetic pollution*.
- Genetic pollution is unintentional hybridization and introgression, which leads to homogenization or replacement of local genotypes as a result of either a numerical or fitness advantage of the introduced species
- Genetic pollution can operate - through introduction or through habitat modification, bringing previously isolated species into contact.

# Prevention

- Education
- Research is still needed - generalities?
- Monitoring programs - early detection
- Prevent establishment - quarantine
- Increased communication among agencies
- Increase regulations