

INTRODUCTION



Peter Verstege, USACE

Prevention is the goal—the Corps of Engineers distributes educational materials because the public is our first line of defense against invasive species.

The U.S. Army Corps of Engineers is pleased to present this educator's guide for the America's Most Unwanted traveling trunk. Developed by the Corps' Invasive Species Leadership Team, the traveling trunk provides an interactive display and other learning tools for use in visitor centers and other instructional venues by Corps rangers and environmental staff. The trunk contains hands-on species identification materials as well as games and audiovisual materials.

This Educator's Guide provides talking points for presentations, instructions for game play, and supporting materials. The goal is to educate the general public—from kids to adults—on invasive species, negative impacts they have, and management approaches.

INCLUDED IN THE TRAVELING TRUNK

The America's Most Unwanted traveling trunk includes a number of items that you can use to customize your presentation for different audiences and age groups. Here is an overview of materials.

Educator's Guide

Directions for games, videos, and electronic presentations are accompanied by talking points and suggestions for customizing your program.

America's Most Unwanted

Specimens and replicas of some of America's most common invasive species allow visitors to examine species up close. Associated identification cards provide an overview of each species, how it got here, how it threatens our ecosystems, and where it can be found.

Meet the Invaders Memory Game

Geared to the youngest of visitors, the memory game helps children get acquainted with invasive species. Props for game play are included.

Hitchhikers from Another Ecosystem Game

Geared to older children, the game helps visitors recognize how we can have an impact in stopping the threat and spread of invasive species. Props for game play are included.

DVD

An accompanying DVD includes a seven-minute introductory video, an electronic presentation, photographs and posters of invasive species, and customizable and printable handouts for visitors.



Jessica Spencer, USACE

Birds can spread invasive plants. Here, a robin eats Brazilian pepper seeds.

ITEMS TO GATHER AHEAD

Before your presentation, gather the following items depending on the needs at your site.



- Laptop with DVD player and presentation software
- Large display screen or projection surface
- Table: for specimen display
- Handouts: visitor takeaways can be customized to your region and printed

Invasive zebra mussels in Wisconsin

IDEAS FOR ORGANIZING YOUR PRESENTATION

The America's Most Unwanted traveling trunk elements can be presented in less than an hour.

Introduction (8–10 minutes)

You can begin your presentation by showing the seven-minute video. Produced by the U.S. Army Corps of Engineers, this fun look at invasive species is appropriate for general audiences.

You can also begin your presentation by showing the graphic presentation. This allows you to customize talking points to specific audiences and regions.

A Hands-on Look at Invasive Species (10 minutes)

After providing an overview of what invasive species are, consider passing out the specimens or allow visitors to handle the specimens at the display table.

Game Play (20 minutes)

Lead the group in one of the games. Play *Meet the Invaders* with the youngest visitors (kindergarten through 3rd grade). Play *Hitchhikers from Another Ecosystem* with older children (3rd grade through 12th grade).

Wrap-up (5–10 minutes)

Provide time for follow-up questions and visitor takeaway messages and handouts.

TALKING POINTS

Key Characteristics of Invasive Species

- An invasive species is an organism that is non-native to an ecosystem and whose introduction causes economic or environmental harm or harm to human, animal, or plant health.
- An invasive species can be a plant, animal, or other organism such as a microbe.
- Invasive species can be found in every type of habitat. They can be found in lakes, rivers, wetlands, oceans, forests, croplands, and your backyard!
- Many species such as food crops and livestock are non-native. Their value when managed is beneficial; however, some can become invasive.



Invasive Australian pine fruit in Florida

Invasives and Threats to Biodiversity

- Biodiversity is a term given to the variety of life on Earth. It is a measure of the variety of different plants and animals in a particular ecosystem.
- Invasive species can change ecosystems by altering habitats and predator-prey relationships, and by competing with native species for resources.
- Examples:
 - Asian carp (bighead and silver carps) were intentionally introduced to control plankton in aquaculture. They have used rivers to expand their range and over time increased population size to dominate newly invaded ecosystems. They are voracious eaters and outcompete some native species for food resources. Silver carp are also leaping fish, which poses an injury threat to boaters and water skiers.
 - Zebra mussels were accidentally introduced into many waterways through the release of ship ballast water. They compete with native species and adhere to boats, water pipes, and navigational buoys. Large clusters of zebra mussels can disrupt municipal water supply systems and hydropower facilities.
 - Some invasives are the result of escaped livestock or released pets. Feral pigs disturb habitats through rooting behaviors. Burmese pythons pose a threat to native species and humans as well.
- Invasive species can be serious threats. They impact wildlife and fisheries habitats, and can be a threat to human health. They also have a tremendous economic impact in the cost of eradication and control efforts.
- About 40% of Threatened and Endangered species in the U.S. are at risk primarily due to invasive species.



Water hyacinth grows alongside a native plant, American lotus, in Mississippi.

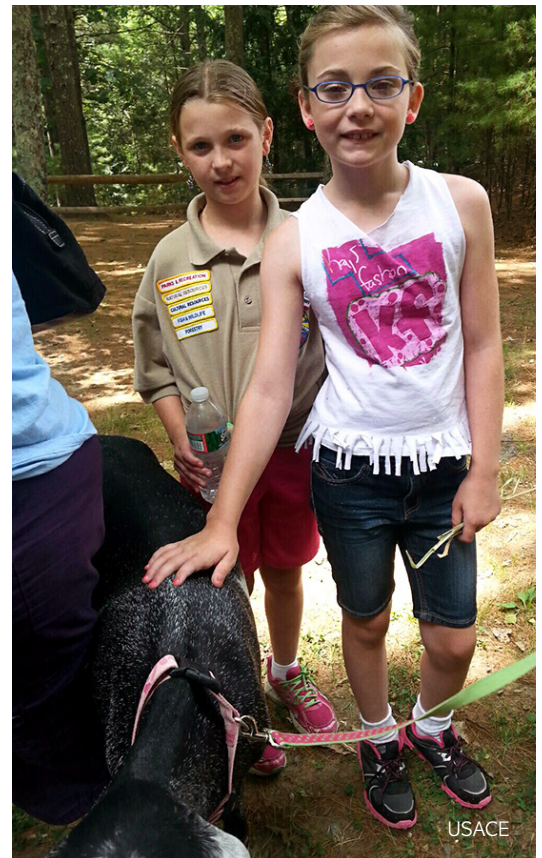
Sources of Invasive Species

- Invasive species are introduced to our ecosystems through both natural and human pathways. Invasive species continue to be introduced today.
- Some invasive species are spread through natural pathways including wind and water currents.
- Some invasive species are introduced through human pathways. Humans intentionally introduce invasive species through ornamental plantings, released pets, or new crops or cultures. Humans also unintentionally introduce invasive species through the release of ballast water, and shipping of soil, plants, and animals.

Preventing Invasive Species

- Find out what the invasive species are in your area, and learn how to avoid spreading them and how to control them.
- For hikers, remember to clean your boots and equipment. Invasive species can hitchhike to new areas on your gear.
- For anglers, clean and dry your gear of all water and vegetation. Don't release fish except into the body of water they came from. Don't release bait—it may not be native to the area.
- For boaters, drain and clean your boat and trailer before leaving an area.
- Don't release your pet fish, reptile, amphibian, bird, or aquarium plants into the environment. Return unwanted pets to the pet store, give them to a hobbyist, or take them to an adoption shelter.
- For gardeners, use plants that are native to your area.
- To learn more, join a native plant or fish and wildlife group.

A Junior Ranger raises goats to control invasive species.



Controlling Invasive Species

- Invasive species are managed at different levels as the infestation is introduced, established, and during expansion.
- There are several ways that invasive species can be controlled. Steps taken include:
 - 1 - Prevention: do not allow the species into a given area; protect natural areas through law and regulation, screening and monitoring. Examples are the Federal Noxious Weed Act, the USDA Animal and Plant Health Inspection Service, boat monitoring, and boat wash stations. Education is also a key component of prevention; creating public awareness about the threat of invasive species can prevent the spread of new infestations.
 - 2 - Early detection and rapid response: use of control techniques to eradicate a new infestation and prevent establishment of the species. The end result would be the species is no longer present. An example is the National Park Service Strike Teams, which are regionally based with staff that respond to new infestations and eradicate the species quickly.
 - 3 - Eradication: in some cases, the goal is total elimination of the invasive species and its seeds, roots, rhizomes, or eggs from an area.
 - 4 - Control: when eradication is impossible, the goal is suppression or maintenance control of an invasive species to the point that its impact is minimized.



Jessica Spencer, USACE



Luis Miguel Bugallo Sanchez

Beetles are used as a biological control to reduce numbers of air potatoes.

Controlling Invasive Species (cont'd)

- Control and management: when a species is established, annual activities are required to prevent it from causing detrimental impacts to the environment, flood control, navigation, and food supply. This requires the most funding and the largest level of effort.
 - Biological control is the intentional introduction or release of natural enemies (insects, parasites, herbivores, or pathogens) from their native range for controlling a non-native invasive species. Grazing animals (goats and cows) to reduce invasive weeds are another example of biological control.
 - Mechanical control refers to mowing, hoeing, hand-pulling, and tillage operations. This includes the use of mulching equipment and aquatic harvesters.
 - Physical control is the alteration of the environment to control invasive species, such as pool drawdown, flooding, burning, mulching, placement of benthic barriers, and planting cover crops to increase competition.
 - Chemical control is the use of registered pesticides to control or eradicate a species. A great deal of research goes into the development of chemical control methods and their effects on the environment.
 - Control and management often requires a combination of approaches, takes time, and requires follow-up monitoring and re-treatment as necessary.

SPECIES PROFILES

The trunk contains invasive plant and wildlife species specimens. These specimens are durable and can be examined up close by visitors. Accompanying profile cards detail the threats posed by these species.

Giant Salvinia

Giant salvinia is a floating aquatic fern that reproduces so fast it can double in number in about nine days. Dense mats of giant salvinia growing on the water surface prevent light penetration and oxygen transfer, which can cause problems for native aquatic organisms that need sunlight and oxygen for growth.

Native region: Brazil

Introduction: 1990s, a popular aquarium plant first reported in South Carolina waterways

Spread: Disperses by fragmenting and can be transported by boats, trailers, wading birds, and waterfowl

Range: Prevalent in lakes and in the backwaters of rivers throughout the South, but reported from Virginia to California and Hawaii



US Army Corps of Engineers



Water Hyacinth

Water hyacinth is a floating aquatic plant that threatens native plants and fish by blocking sunlight and lowering dissolved oxygen levels. It forms dense colonies that impede boat traffic and clog irrigation channels.

Native region: South America

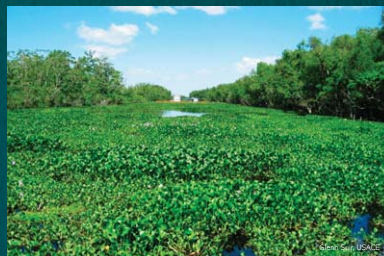
Introduction: 1884; a popular water garden plant first introduced into Louisiana waterways

Spread: Reproduces new plants from lateral stems and from seed

Range: Prevalent in lakes and slow flowing rivers throughout the South, but also reported in Wisconsin, California, and New York



US Army Corps of Engineers



Salt Cedar / Tamarisk

Salt cedar is a shrub or small tree that develops a deep tap root that allows it to absorb a large quantity of water. It out competes native plant species, and provides little food value for native wildlife species. It deposits large amounts of salt on the soil surface.

Native region: Asia and Europe

Introduction: 1823; an ornamental plant that was introduced by nurseries on the East Coast, and later on the West Coast

Spread: Each flower produces thousands of seeds that can spread by wind or water

Range: Prevalent near water in desert regions of the West



Hydrilla

Hydrilla is an aquatic plant that grows almost entirely underwater, forming a dense canopy at the water's surface. The dense growth interferes with boating, swimming, and fishing, clogs irrigation and flood control channels, and can alter water quality and dissolved oxygen levels. Hydrilla can grow one inch a day, and can reach lengths of 30 feet.

Native region: Southeast Asia and Australia

Introduction: 1950s in Florida, a popular aquarium plant

Spread: Reproduces and spreads to new areas by stem fragments that hitchhike on boats and trailers; also produces tubers and turions that can grow into new plants

Range: Lakes and rivers throughout the southern U.S., north to New England, west to California and Washington



Feral Pig

Feral pigs have grayish guard hairs and are typically dark in color. They disturb soil and vegetation by extensively rooting.

Native region: Europe and Asia

Introduction: 1500s, Spanish explorers first imported pigs as a food source, and in the 1930s, ranchers introduced European wild hogs

Spread: Reproduce year round and form large free-ranging populations

Range: Prevalent in forested and agricultural areas throughout the Southeast and South through Texas, and in regions of the Midwest, Oregon, and California



Burmese Python

Burmese pythons are some of the world's largest snakes. They have few predators and prey on native species.

Native region: Southeast Asia

Introduction: Uncertain; wild populations were likely established by escaped or intentionally released pets

Spread: Can be established through releasing pets in the warmer regions of the U.S.

Range: Wetlands, grasslands, and forests near permanent sources of water in South Florida



Zebra & Quagga Mussels

Closely related species, zebra and quagga mussels out compete native species and can adhere to just about anything: boats, water pipes, and navigation buoys. Large clusters of zebra and quagga mussels disrupt hydropower and water treatment facilities, smother native mussels, and alter aquatic food chains.

Native region: Eurasia, particularly Russia

Introduction: Zebra mussels were first reported in 1986, followed by quagga mussels in 1989; both were introduced via untreated ship ballast water in the Great Lakes

Spread: Easily spread by boats and can float into new water courses

Range: Prevalent in the Great Lakes and documented in more than 130 river systems in the U.S. and Canada; also established in many lakes and reservoirs



Silver & Bighead Carp

Closely related species, silver and bighead carp can cause ecosystem damage in many ways: as large, aggressive fish they can outcompete with natives; as opportunistic feeders, they eat large quantities of plankton; and they breed rapidly, overwhelming water courses.

Native region: Asia

Introduction: 1972–73; first introduced in aquaculture to control phytoplankton and zooplankton levels, and a likely escapee from a fish farm

Spread: Quickly become the dominant species in new habitats

Range: Widespread in large rivers and some lakes in Mississippi, Ohio, and Missouri River basins



Emerald Ash Borer

Emerald ash borers are beetles whose larvae feed under the bark of ash trees. They burrow back and forth between the bark and outer sapwood when they feed, creating S-shaped patterns in the wood. They survive for several years in living trees and can survive in firewood and other products.

Native region: Asia and Eastern Russia

Introduction: 1990s; accidentally introduced in Michigan in a shipment of wood packing material

Spread: Spreads with the movement of forestry products such as firewood, wood chips, and lumber

Range: Prevalent in hardwood forests and urban trees in parts of the East and Midwest



Nutria

Nutria are large, semi-aquatic rodents that damage wetland habitats by burrowing and feeding on aquatic vegetation. They contribute to erosion and disturb agricultural areas, causing damage to rice and sugarcane crops.

Native region: South America

Introduction: 1930s; introduced for fur production and likely escaped or were intentionally released when the fur industry declined

Spread: Mating season lasts all year; gestation is about 4 months and 1–11 pups may be born; can adapt to a wide range of environmental conditions

Range: Prevalent in wetlands, lakes, and rivers in the South, Atlantic coast, and Pacific Northwest



Brown Tree Snake

Brown tree snakes are mildly venomous and use constriction and venom to immobilize their prey. This species lives in trees, shrubs, and forests and preys on birds, reptiles, and bats. They feed at night and have decimated the bird population on the island of Guam.

Native region: Australia, Indonesia, New Guinea

Introduction: 1945–1952; accidentally introduced to Guam as a stowaway in ship cargo

Spread: Easily transported as stowaways in ship and air cargo

Range: Primarily found on trees on the island of Guam



Asian Long-Horned Beetle

Asian long-horned beetles bore into hardwood trees such as maple, elm, birch, and poplar. The adult female chews a crater through the tree bark and inserts a single egg into the inner cambium layer. The larvae bore deep into the heartwood and eventually kill the tree.

Native region: Asia

Introduction: 1996; accidentally introduced to New York in cargo

Spread: Adults can fly up to 400 miles in search of a host tree, where they lay eggs

Range: Isolated populations in hardwood forests and urban trees in parts of the Northeast and Midwest U.S.



Japanese Honeysuckle

Japanese honeysuckle is a climbing, woody vine that crowds out native plant species. Reaching lengths of up to 80 feet, it can twist around trunks and stems of native plants and form a dense canopy, which smothers underlying plants.

Native region: East Asia

Introduction: Early 1800s; introduced as an ornamental plant, and as deer browse and erosion control

Spread: Produces abundant seed that is dispersed by birds and can develop new plants from root crowns or runners

Range: Widespread in forests and urban areas throughout the South, New England, and the Great Lakes regions



Sea Lamprey

Sea lampreys are parasites that prey on other fish species by sucking their blood and body fluids. They resemble eels, but are members of an ancient family of “jawless fishes” that were around before the time of the dinosaurs.

Native region: Atlantic Ocean

Introduction: 1835; first discovered in Lake Ontario, and later in Lake Erie in 1921

Spread: Spread originally through the Welland Canal, and quickly through the Great Lakes

Range: Widespread throughout the Great Lakes and tributaries



Yellow Star Thistle

Yellow star thistle grows up to five feet in height in woodlands, pastures, and roadsides. It is toxic to horses, fatally affecting their nervous systems. Quick to establish in open fields, this species causes problems on military bases in the West, when parachutes, clothing, and personnel come in contact with its thorny spines.

Native region: Europe and Asia

Introduction: 1800s; accidentally in contaminated crop seed

Spread: Seed is transported primarily by road maintenance equipment, vehicle undercarriages, movement of contaminated hay and seed, and to a lesser extent by humans and animals

Range: Concentrated in grasslands of California & western states, but can be found as far east as New York



Laura Parsons, University of Idaho, PSES, Bugwood.org



Robert M. H. Jones, University of Idaho, PSES, Bugwood.org

Common Buckthorn

Common buckthorn is a shrub or small tree that can grow to 25 feet in height. It forms dense stands that crowd out native species and dominate ecosystems.

Native region: Europe and Western Asia

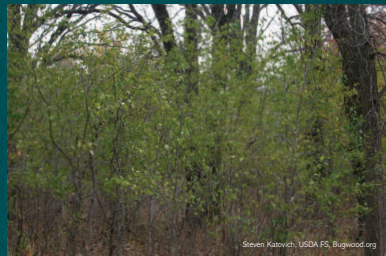
Introduction: Early 1800s as an ornamental shrub

Spread: Birds and wildlife eat the seeds and help spread the plant, and regrowth can occur after cutting or burning

Range: Widespread in forests and urban areas throughout the Northeastern, Midwestern, and Western U.S.



Eric A. McInnell, U. Conn., Bugwood.org



Steven Katsch, USDA FS, Bugwood.org

Kudzu

Often called “the vine that ate the South,” kudzu kills or degrades native plants by smothering them under blankets of leaves and girdling woody stems and tree trunks.

Native region: Asia

Introduction: First introduced in 1876 as an ornamental plant, and widely used in the 1930s and 40s for erosion control

Spread: As many as 30 vines can grow from a single crown, and vines can grow 60 feet in a season at a rate of one foot per day

Range: All terrestrial environments in the Southern U.S., north to Maryland, and west to Arkansas and Texas



Nancy Lorenzen, Auburn University, Bugwood.org



Wesley S. Jones

Purple Loosestrife

Purple loosestrife readily adapts to wetlands and quickly establishes and expands to form dense stands that restrict native wetland plant species and reduce wildlife habitat.

Native region: Europe and Asia

Introduction: First reported in New England in 1814

Spread: Produces vast quantities of seed; seeds are very small and disperse easily by water or as a hitchhiker in mud that adheres to wildlife, livestock, and people

Range: Wetlands throughout the U.S.



Eurasian Watermilfoil

Eurasian watermilfoil is a submersed aquatic plant that roots in sediment and grows through the water, forming dense canopies on the surface of lakes and rivers. It impedes boats and recreational activities, prevents sunlight from penetrating the water, and crowds out native species.

Native region: Europe and Asia

Introduction: Likely introduced to the U.S. in ship ballast or as aquarium and water garden plant

Spread: Extremely adaptable to a variety of conditions, it spreads by stem fragments produced naturally and as a result of breakage by boat motors or wave action; spreads to other water bodies by hitchhiking on boats and trailers

Range: Lakes and rivers throughout the U.S.



LEADING GAME PLAY

The trunk contains props for two game activities: *Memory: Meet the Invaders* and *Hitchhikers from Another Ecosystem*. The following outlines detail how you can lead the games.

Memory: Meet the Invaders

Objective | To encourage visitors/students to recognize invasive species.
| This game reinforces the characteristics of invasive species.

Target Group | Grades K – 3

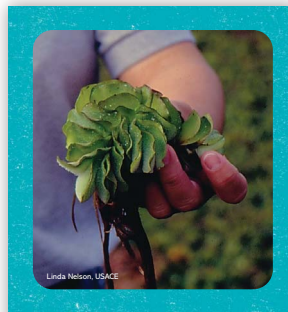
Props | 3 sets of color-coded game cards

- Play** |
1. Encourage students to explore the invasive species specimens.
 2. Provide an introduction that explains what invasive species are and how they harm the ecosystem.
 3. Explain the objective, which is to remember where matching sets of cards are located.
 4. Divide the group into three teams. Distribute one set of cards to each team.
 5. Instruct the teams to shuffle the cards and place all face down.
 6. Students take turns, in a clockwise fashion, at flipping two cards at a time.
 7. When a student reveals two cards showing the same invasive species, remove the cards from the play area. Unmatched cards are returned to their original face-down positions, and the next student picks two.
 8. Once all the cards are matched, the game is over.
 9. Following game play, reiterate what invasive species are and encourage students to name a few species and their threats.
 10. Potential follow-up questions:
 - What are some ways invasive species harm native species?
 - What facts about invasive species surprised you?
 - Do you think you have invasive species in your yard or community?

Memory: Meet the Invaders



Front of all cards



Linda Nelson, USACE

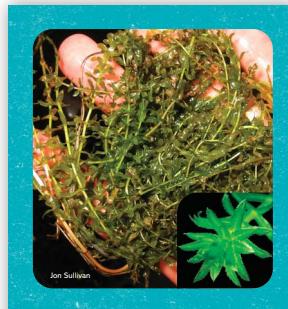
GIANT SALVINIA

- Escaped aquarium and water garden plant
- Invades lakes and ponds
- Populations can double in size in 9 days!



FERAL PIG

- Intentionally released or escaped fugitive from farms
- Roam in aggressive packs
- Destroys crops & lawns through digging



Jon Sullivan

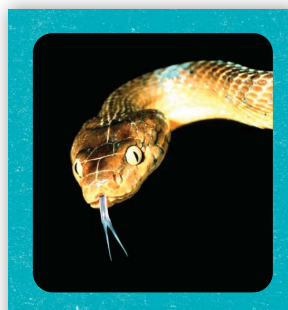
HYDRILLA

- Runaway aquarium plant
- Pieces of the plant hitchhike on boat motors and trailers
- Grows an inch a day!



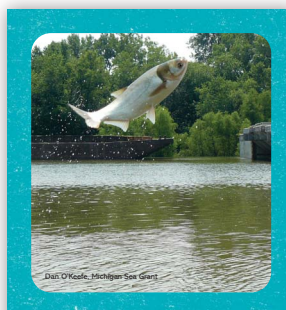
JAPANESE HONEYSUCKLE

- Runaway garden plant
- Smothers native plants
- Can grow up to 80 feet long!



BROWN TREE SNAKE

- Stowaway on cargo ships & airplanes
- Preys on native birds, reptiles, & bats
- Climbs utility poles and causes electrical power outages



Dan O'Keefe, Michigan Sea Grant

ASIAN CARP

- Fish farm escapee
- Competes with native fish for food
- Watch out boaters—these fish jump!

Memory: Meet the Invaders



Front of all cards



WATER HYACINTH

- Escaped water garden plant
- Blocks sunlight that native plants need
- Overgrows in lakes and waterways and stops boat traffic



BURMESE PYTHON

- Escaped or released overgrown pets
- Threatens mammals, birds, and other reptiles
- One of the world's largest snakes—up to 20 feet long!



YELLOW STAR THISTLE

- Hitchhiked in crop seed shipments
- Prevents recreational use, like walking & hiking, & chokes our native plants
- Fatally toxic to horses



COMMON BUCKTHORN

- Escaped garden plant
- Crowds out native plants
- Relies on birds and wildlife to spread seeds



SEA LAMPREY

- Invasive fish from North Atlantic Ocean
- Stalks the Great Lakes
- Sucks blood from other fish



EMERALD ASH BORER

- Hitchhikes on firewood and wood chips
- Threatens ash trees
- Eats its way through sapwood of trees

Memory: Meet the Invaders



Front of all cards



SALT CEDAR / TAMARISK

- Escaped garden plant
- Tremendous appetite for water
- Rides the wind and water to new ground



ZEBRA MUSSEL

- Stowaway in ballast water of ships
- Forms big colonies that clog pipes, encrust dams, & smother native mussels
- Adheres to boats, buoys, and everything else!



KUDZU

- Runaway garden plant
- Grows to 100 feet long
- Nicknamed the "vine that ate the South"



PURPLE LOOSESTRIFE

- Escaped from gardens
- Forms dense stands that keep native plants and wildlife out
- One plant produces 2 to 3 million seeds a year!



ASIAN LONG-HORNED BEETLE

- Stowaway on cargo ship pallets
- Hitchhiker on lumber and firewood
- Adults can fly up to 400 miles in search of a new tree



NUTRIA

- Escaped from fur farms
- Destroys earthen levees, dams, and wetlands by burrowing
- Feeds heartily on rice and sugarcane crops

Hitchhikers from Another Ecosystem

Objective | To encourage visitors/students to recognize how we humans help invasive species move into new ecosystems. This game reinforces the sources and pathways of invasive species and what you can do to prevent spread.

Target Group | Grades 3 – 12

Props | Laminated card for brainstorming
Dry erase markers
Invasive species transporters: fishing bobber, hiking boot, dirt bike tire section, tent stake, non-native seed packet, dog, boat, bulldozer, and piece of ash wood.

- Play**
1. Provide an introduction that explains what invasive species are, how they harm the ecosystem, and how humans—unwittingly or intentionally—help their spread.
 2. Explain the objective, which is to brainstorm how these common everyday items help invasive species get around.
 3. Divide the group into smaller groups. Up to 9 groups can be accommodated. Distribute one laminated card, one marker, and one invasive species transporter to each group. Consider using the fishing bobber, miniature hiking boot, dirt bike tire section, and stuffed dog for younger children. Add the tent stake, non-native seed packet, toy boat, toy bulldozer, and ash wood for older children.
 4. Instruct the groups to discuss each item, what it is and how it is used, and how it carries invasive species. Have them record their ideas on the card.
 5. Give the groups a couple of minutes for discussion, and then have them pass the transporter to the next group. Continue passing transporters until each group has brainstormed with each transporter.
 6. Ask groups to share their thoughts on each transporter.
 7. Following game play, reiterate what invasive species are and encourage students to name a few ways humans can slow and stop the spread of invasive species.

Pets can transport invasive species on their fur.
The stuffed dog represents pets.



Hitchhikers from Another Ecosystem

Play *(continued)*

8. Potential follow-up questions:
 - Do you think you've ever transported an invasive species?
 - What are some ways you can prevent the spread of invasive species?
9. Potential follow-up questions for older children:
 - Brainstorm how cargo ships, airplanes, and freight trains help transport invasive species.
 - Now that you know how invasive species move from place to place, what will you do about it?
 - Besides your own actions, who and in what way can we stop the spread of invasive species? Consumers? Local community groups? Government agencies?



Cargo ships carry goods around the world.