On The Lookout For Aquatic Invaders

Identification Guide for the Pacific Northwest

Sea Grant
Oregon

INTRODUCTION

Nonnative species are altering freshwater and marine ecosystems in the Pacific Northwest, and more species are introduced every year. This identification guide has been developed as a tool to help watershed councils and other community-based groups increase their understanding of aquatic invasive species (AIS), and to begin monitoring for species of particular concern to their watersheds. It provides background information and key identification characteristics of many aquatic invaders that are already established or likely to become established in the Pacific Northwest. Ultimately, greater awareness of the pathways that spread AIS to new regions can help prevent their introduction, and monitoring efforts can help identify and respond to new invasions before they become a problem.

Participants take caution:
Monitoring activities are a potential AIS pathway. Make sure to clean your gear and boots to prevent spreading aquatic invaders to new areas.

REPORT THIS SPECIES!

Please report sightings of AIS that pose a serious risk to aquatic ecosystems, as labeled in this booklet. This will allow authorities to rapidly respond to new aquatic invaders. Limited control options exist for some established species not labeled for reporting.

Developed by **Scott Wiedemer** and **Samuel Chan**

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PARTNERS IN THIS EFFORT:

Stop the invasion
Protect Oregon from Invasive Species

OISC
Oregon Invasive Species Council

United States Environmental Protection Agency

Oregon State Marine Board

Oregon Watershed Enhancement Board
OWEB

Washington Invasive Species Council

Let's Work Together

John Schaefers

Controlling Invasive Species

The Pacific Northwest is renowned for its natural environment. Diverse plant and animal communities thrive in our ecosystems. Unfortunately, these natural communities and systems are increasingly threatened by aquatic invasive species, a form of biological water pollution. Harmful nonnative plants and animals are moving into our coasts, waterways, and wetlands, degrading habitats, displacing desirable species, damaging infrastructure, contaminating water resources, and necessitating expensive control treatments.

Once established, invasive species spread relentlessly, each generation taking over more territory. Unlike other forms of water pollution such as oil spills, however, invasive species don't dissipate with time and they will permanently alter the environment. Awareness and early detection help us contain these threats and keep them from spreading and causing further damage to the environment and our quality of life.

This guide is an introduction to some of the more prominent and harmful aquatic, riparian, and wetland invasive species in our region. It is not too late to stop the spread and establishment of these species. You can make a difference in your community and watershed by

- staying informed and "connected." Learn about the species listed in this guide. Visit **OregonInvasivesHotline.org**, **oregoninvasivespecies.com,** or **anstaskforce.gov/campaigns.php** for more information on invasive species and access to other resources available on the Web. Contact the experts and agencies listed on the back of this publication.
- detecting and reporting these invasive species. Be vigilant and report sightings by calling **1-866-INVADER** or going to **OregonInvasivesHotline.org**.

Here's what you can do if you are an outdoor recreationist (boater, angler, gardener, hiker, hunter) or you work near waterways

Boaters and Anglers

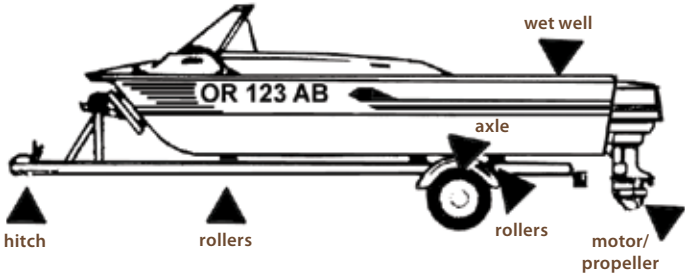
Aquatic invasive species can very easily spread between waterways by hitching a ride on boats and trailers. Some species can even cause expensive damage to your boat. Protect Oregon's waterways and never launch a dirty boat!

- Inspect hard-to-reach spots, damp areas, and other protected places on your boat. Harmful species can survive in such places for days. Feel for small

bumps, which could be attached organisms. Remove any plants and animals you find before leaving the water.

- Clean your boat and equipment with high-pressure hot water, or allow equipment and your boat to dry in sunny conditions for at least five days before entering new waters. For more information about clean boating activities, visit **anstaskforce.gov/campaigns.php** or contact the Oregon State Marine Board at **503-378-8587**.
- Drain and empty water entirely from the motor, wet well, and bilge on land, before leaving the water body.
- Remove any plants, dirt, and water from your gear and clothing.
- Dispose of bait properly. Empty your bait bucket on land in a trash container before leaving the water body. Never release live bait into the water or release aquatic animals from one water body into another.

Key places to check your boat for aquatic organisms



Gardeners, Hikers, and Watershed Stewards

- Learn about the prominent aquatic invasive species. Do not buy or share aquatic invasives.
- Inspect and clean your equipment, tools, and clothing of seeds, soil, and plant fragments before entering and after leaving natural areas and waterways.
- Do not dump pond plants or animals into natural areas.
- Inspect, decontaminate, rinse, and remove "hitchhiking" invasive plants and animals from purchased aquatic plants before setting them in your garden.
- Remove and properly dispose of aquatic invasive plants by drying them, away from natural areas. When possible, place them in a plastic bag for disposal in the trash.

Pets and aquariums:

- Don't dump your pets. If you have a pet that you can no longer care for, contact your local pet store, humane society, veterinarian, or other expert, for guidance on appropriate and humane options.
- Don't dump your aquarium water into natural habitats. Seal aquarium plants in plastic bags and place them in the trash.
- Make responsible pet and aquarium purchases. Check to see whether they are listed as invasive species by local agencies. Many pets may live longer, grow bigger, and take more care than you realize. Before choosing a pet, do some research and be sure you're ready to care for it long term.

Nutria (*Myocastor coypus*)

C.C. Lockwood, www.cclockwood.com

Species at a Glance

The nutria is a large, semi-aquatic rodent that lives in colonies along rivers, lakes, and wetlands. It often invades and damages ecologically sensitive areas by tunneling into riparian zones to create large burrows.

It is adaptable to a broad range of climatic conditions.

Historically, the nutria has been important to the international fur trade, which includes trapping and farming them for their high-quality fur.

Distribution

Native to South America, nutria have been introduced to Europe, Asia, North America, and Africa.

In the U.S., nutria populations are found in many states, often in coastal areas. Along the west coast, populations in Oregon and Washington are expanding.

Nutria are increasingly common in urban and suburban environments.

Samuel Chan, Oregon Sea Grant

Nutria burrows and shoreline erosion at Devil's Lake, Oregon

How this Species Spreads

Wild nutria populations have been established through accidental escapes from nutria farms and by intentional introduction for trapping.

Nutria damage in a Louisiana wetland

Louisiana Dept. of Wildlife and Fisheries, www.nutria.com

Aurelio Perrone, Applied Ecology Research Center, Turin, Italy

Environmental Impacts

Nutria are opportunistic feeders, consuming roughly 25 percent of their body weight in vegetation each day. Nutria feeding habits can dramatically alter the plant ecology of invaded ecosystems by depleting wetland vegetation.

Nutria burrowing and riparian grazing cause streambank instability and erosion. This behavior can alter the habitat and hydrology of rivers, lakes, wetlands, and coastal swamps.

Habitat

Nutria prefer lakes, rivers, streams, and wetlands. They often burrow into steeply incised banks of lakes and rivers.

Identification

Nutria are excellent swimmers with webbed hind feet and cylindrical, rat-like tails.

While swimming, they are often mistaken for beavers. Nutria have brown fur; the chin is typically covered by white hairs, and they have large, yellow-orange incisors (front teeth).

Nutria burrows often indicate their presence in an area.

Feral Swine (*Sus scrofa* spp.)

Bruce Coblentz

Male feral pig

Species at a Glance

Feral pigs cause extensive damage to riparian areas and wetlands, increasing soil erosion, compaction, and siltation and reducing water quality. They compete with native wildlife for resources and have been implicated in spreading disease to livestock and humans. These rapidly reproducing mammals reach sexual maturity at four to nine months and produce up to two litters of five to six offspring per year. Once established, feral pig populations are difficult to eradicate without sustained effort. In some cases, about 70 percent of the pig population must be eradicated to keep the population from growing. Preventing the introduction of feral pigs into new areas is the most effective form of management.

Distribution

Wild pigs *(Sus scrofa* ssp.*)* are native to the Old World, but with the advent of worldwide travel they have been introduced to all continents except Antarctica, and to many oceanic islands. Currently, feral pig populations exist throughout the southeastern and southwestern United States, plus Oregon and Hawaii.

In Oregon, feral pig populations are currently limited to small, isolated populations in the southern and central parts of the state. However, they have the potential to become widespread in western Oregon due to ideal habitat conditions (adequate water, forage, and cover).

Bruce Coblentz

Lacking sweat glands, feral pigs need moist habitats for thermoregulation.

How this Species Spreads

Pigs were first introduced by early explorers and were either released or escaped to form feral breeding populations. Existing feral populations were bolstered by accidental escapes, the use of free-ranging livestock practices, and the release of domestic pigs for hunting.

Back hairs are raised as an expression of fright or aggressiveness.

Bruce Coblentz

Feral pigs can "eat out" extensive areas of important riparian habitat. Pigs have eaten and rooted out most of the vegetation outside of this fenced exclosure.

Bruce Coblentz

Environmental Impacts

Rooting by feral pigs damages natural seedling regeneration, consumes native seeds, eliminates vegetation including roots, destabilizes soils, causes increased erosion and compaction, damages riparian habitat, and reduces water quality.

Rooting and grubbing activities cause extensive damage (called "eat outs") to the soil and facilitate the invasion of noxious weeds.

Feral pigs are pests to livestock, nursery production, and crops.

Habitat

Lacking sweat glands for thermoregulation of body temperature, pigs occupy areas that have readily accessible water and plenty of cover to keep cool.

They are often associated with riparian areas, bottomlands, and swamp-like habitats. Thus riparian areas, vegetative cover, wetlands/ponds, well-irrigated fields, plant nurseries, and even golf courses make good habitat for feral pigs.

Although feral pigs are omnivores, their main diet consists mainly of plant material. A single adult is capable of consuming 590 kg of tree mast per year.

Identification

Feral pigs are typically intermediate in size between domestic hogs and the European wild boar. Pigs tend to be dark, either black or brown in color, but mottling or spotting is not uncommon, and occasionally they will be white. They tend to have a lean, "gamey" look that is different from domestic hogs, with longer tusks and coarser coats. Their presence can be identified through their "wallows," which appear as distinct oval-shaped mud holes simulating the effect a rototilled soil.

REPORT THESE MUSSELS!

Zebra Mussel (*Dreissena polymorpha*)
Quagga Mussel (*Dreissena rostriformis bugensis*)

Randy Westbrooks, U.S. Geological Survey, www.invasive.org

Zebra mussels (actual size less than 5 mm) cover a larger native clam.

Species at a Glance

The zebra and quagga mussel are small (up to 20 cm), freshwater bivalves found in lakes, rivers, canals, and ponds. They have enormous impacts on the ecosystems they invade and often form large colonies, which can exceed 10,000 individuals per square meter.

The zebra mussel was introduced to the Great Lakes in 1988, and the slightly larger quagga mussel was detected there a year later.

Distribution

The zebra mussel is native to watersheds of the Black and Caspian seas.

The quagga mussel is native to Ukraine, in the Dneiper River drainage of the Black Sea.

Both mussels have spread throughout the Great Lakes region and across much of the Mississippi River watershed.

In January 2007, the quagga mussel was discovered in the Colorado River watershed—in Lake Mead, Nevada, and Lake Havasu and Lake Mohave along the California-Arizona border. Range expansion across the Colorado River watershed and other western U.S. watersheds is expected.

Samuel Chan, Oregon Sea Grant

Shoe encrusted with quagga mussels after just 3.5 months.

How these Species Spread

Zebra and quagga mussels were transported and introduced to the Great Lakes as planktonic larvae in the ballast water of commercial cargo ships traveling from Eastern Europe.

The primary vector for potential spread is overland transport on trailered boats. Other vectors include contaminated machinery, aquarium dumping, fish stocking, aquaculture, scientific sampling equipment, and scuba gear.

Passive downstream migration of the larval stage further expands their range.

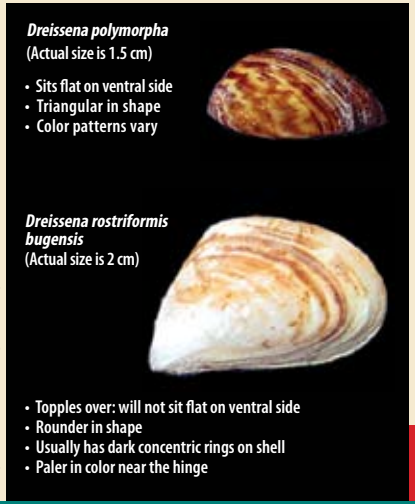
Environmental Impacts

Zebra and quagga mussels have had huge biological impacts on the Great Lakes ecosystem and surrounding watersheds. Rapid reproduction and a lack of competition or predation from native species allows them to form dense mats on hard structures, instigating large-scale environmental change.

They filter copious amounts of water while filter-feeding, causing bottom-up food-web effects that can alter plankton blooms, benthic community composition, biodiversity, and fish populations.

Zebra mussels cause hundreds of millions of dollars worth of economic damage annually by clogging industrial and residential water-intake pipes.

A zebra mussel (top) and quagga mussel (bottom) are shown for comparison.



Amy Benson, U.S. Geological Survey

Habitat

Zebra and quagga mussels are found attached to hard surfaces (rocks, logs, debris, boats, etc.) in shallow to deep water of lakes, rivers, and ponds. The quagga mussel may be found at depths greater than 120 m, and it is capable of colonizing areas with soft substrate. It is tolerant of a broad range of freshwater conditions, including degraded waters, and can withstand water-current speeds up to 2 meters per second.

Identification

The zebra mussel is up to 2 cm long and often occurs in large clusters. It is easily recognized by its triangular shape and one flat edge where byssal threads (used to attach to hard surfaces) emerge. It is usually striped with dark bands but can also be pure black or unpigmented. The quagga mussel is larger, up to 4 cm long, with a more-rounded shell.

It usually has dark, concentric rings on the shell that are paler near the hinge. There is a small groove near the hinge where byssal threads emerge.

REPORT THESE MUSSELS!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Asian Clam *(Corbicula fluminea)*

Noel M. Burkhead, U.S. Geological Survey, nas.er.usgs.gov

Species at a Glance

The Asian clam is a small, brown, freshwater mollusk found on or just beneath the sediment surface. It is generally smaller than 2.5 cm in length but is capable of reaching lengths over 5 cm.

It is tolerant of climates ranging from tropical to temperate and often becomes invasive when introduced to new regions. It is capable of rapid reproduction and high population density.

Distribution

The Asian clam is native to southeast Asia but has been introduced to North and South America, Australia, Europe, and Africa.

It is currently found in 43 states, is particularly prevalent across the eastern U.S., and its range continues to expand.

It is established in California, Oregon, and Washington.

Samuel Chan, Oregon Sea Grant

Asian clam with New Zealand mudsnails

How this Species Spreads

Historically, the Asian clam was intentionally introduced to many regions as a food source.

It is often introduced to new waterways by human activities, including the live bait trade, the aquarium trade, ballast water transfer, and transport with sand and gravel for construction.

Environmental Impacts

The Asian clam can reach densities greater than 10,000 per square meter.

It can alter aquatic habitat, outcompete and displace native species, and disrupt the food chain.

This clam also causes damage as a fouling organism that clogs industrial and residential water-intake pipes.

Jim Mason, Great Plains Nature Center, www.gpnc.org

Habitat

The Asian clam inhabits silt, sand, and gravel substrate in rivers, lakes, streams, canals, and reservoirs. It often prefers moving water with high levels of oxygen.

It is capable of surviving intertidal brackish water with moderate salinity.

It is intolerant of pollution and very cold water (near freezing).

Identification

As a bivalve species, the Asian clam has two shells that mirror each other.

They are light tan to dark brown in color, and they grow darker with age.

Shells are thick, with evenly spaced growth ridges. Near the hinge, shells often become worn, revealing white layers of the shell interior.

The Asian clam does not resemble any native freshwater species in the Pacific Northwest.

REPORT THIS SNAIL!

New Zealand Mudsnail (*Potamopyrgus antipodarum*)

Jane and Michael Liu, Oregon Sea Grant

Distribution

The mudsnail is native to New Zealand but has been introduced to Australia, Europe, and North America.

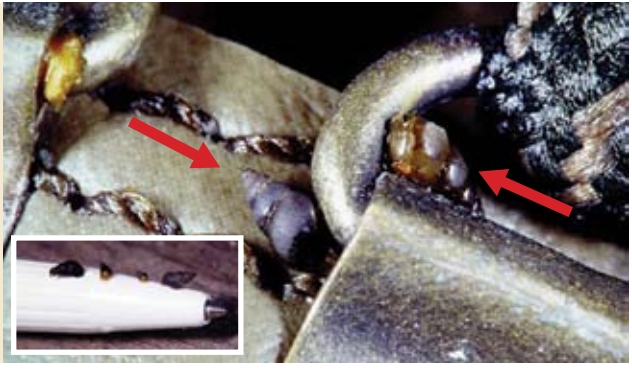
First discovered in the Snake River in Idaho in 1987, it has since spread to all western states except New Mexico.

Ballast water has introduced a separate population of New Zealand mudsnails to the Great Lakes.

Species at a Glance

The New Zealand mudsnail is a small, aquatic snail that is adaptable to diverse climatic and environmental conditions. It is found in freshwater and brackish environments.

It has spread rapidly across much of the western U.S. and is considered a top invasive threat to aquatic ecosystems.



Jane and Michael Liu, Oregon Sea Grant

Several New Zealand mudsnails attached to the laces of a hiking boot. A mature snail is usually less than 5 mm long. Inset: mudsnails on tip of pen.

How this Species Spreads

The New Zealand mudsnail is often introduced through ship ballast water and aquaculture operations.

Once introduced to a region, mudsnails can spread quickly by hitchhiking on the wading gear, boats, and trailers of fishermen, boaters, and watershed workers.

The problem with hitchhiking is magnified by the mudsnail's small size and its ability to survive extreme conditions and reproduce parthenogenetically (without fertilization).

Environmental Impacts

New Zealand mudsnails often dominate the benthic habitat where they are found. Population densities of 100,000 per square meter are common in some rivers, comprising up to 95 percent of the macroinvertebrate biomass.

They can outcompete and displace native macroinvertebrates that other species depend on for food.

Disruption of the food chain and nutrient cycling can lead to reduced growth rates and lower populations of fish species.

Shell is elongated and dextral (its whorls or spirals lean toward the right).

D. L. Gustafson, http://www.esg.montana.edu/aim/mollusca/nzms

Habitat

New Zealand mudsnails are found in lakes, rivers, streams, and estuaries on hard or woody debris, rock and gravel surfaces, and vegetation.

Identification

The mudsnail's shell is brown, with five to seven whorls. The shell is 5 to 6 mm in length.

The opening of the shell has a movable cover called the operculum, which allows a snail to seal itself inside.

REPORT THIS SNAIL!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Bullfrog (*Rana catesbeiana*)

Sandy Ridlington, Oregon Sea Grant

Distribution

Bullfrogs are native to the central and eastern U.S. and southern Quebec and Ontario.

Since the early 1900s, they have been introduced and spread to many areas in the western U.S.

Bullfrogs have also been introduced to Europe, South America, and Asia.

Species at a Glance

The American bullfrog is the largest frog in the U.S., weighing up to one pound. It has been cultivated globally for its edible legs and has been introduced to many regions around the globe as an aquarium pet.

The bullfrog is invasive in much of the western U.S. and several other continents. It is often a dominant species in new environments, due to a limited number of predators (for example, dragonfly larvae).

Ed Nied Jr.

How this Species Spreads

Bullfrogs have been widely distributed via aquaculture and the aquarium trade.

Juveniles can travel overland up to a mile during wet seasons, allowing them to colonize new ponds or other permanent water sources to expand their range. Tadpoles may take more than a year to molt.

Environmental Impacts

Adult bullfrogs eat anything they can catch and swallow, including birds, fish, crustaceans, bats, snakes, turtles, and other frogs.

In introduced ecosystems, their presence has been blamed for the serious decline of native frogs, snakes, and amphibians, whose young fall prey to adult bullfrogs.

A high reproduction rate and limited predation allow the bullfrog to quickly establish itself and proliferate in invaded areas.

Extraordinarily high densities of juvenile frogs are common.

Bullfrog tadpole

Gary Nafis, CaliforniaHerps.com

Habitat

Bullfrogs are found in or near marshes, ponds, lakes, and streams, in habitats ranging from Eastern swamps to desert oases. They prefer warm, slow water with thick aquatic vegetation.

Identification

Coloration varies from dull green or olive to brown, with dark blotches on the back and legs. The underbelly is cream or yellow colored.

A fold of skin extends from the eye to the ear.

In males, the eardrum is larger than the eye, whereas the female eardrum and eye are the same size.

Bullfrog tadpoles are large, reaching 15 cm in length.

REPORT THIS TURTLE!

Red-eared Slider (*Trachemys scripta elegans*)

Gary Nafis, CaliforniaHerps.com

Distribution

The red-eared slider is native to the south-central U.S., in much of the Mississippi River basin.

In North America, the red-eared slider has been introduced to new waterways across much of New England, the Great Lakes region, and along the west coast (including California, Oregon, and Washington).

This species has been introduced across much of the globe, including Europe, Asia, Australia, South Africa, the Caribbean, and the Middle East.

Species at a Glance

The red-eared slider is a medium-sized freshwater turtle native to the south-central U.S. This opportunistic forager consumes small fish, crayfish, aquatic plants, and aquatic invertebrates (including insects, worms, shrimp, snails, and amphibians). Its lifespan can exceed 20 years, and it can reach shell lengths of nearly 30 cm.

The attractive red-eared slider is the most extensively bred and distributed pet turtle species.

U.S. Geological Survey, nas.er.usgs.gov

How this Species Spreads

This turtle is generally introduced to new areas by pet owners "setting them free," which often occurs when the turtles outgrow their tanks or when owners grow tired of caring for them.

Environmental Impacts

When established outside of their native range, red-eared sliders compete with smaller native turtle species for nesting areas, basking sites, and food sources. Native turtle populations are often reduced in infested waterways.

Additionally, pet turtles often carry parasites or disease that can devastate native turtle populations. Parasites or disease can result from commercial breeding operations that take place in densely populated and unsanitary conditions.

Wayne Van Devender, Appalachian State University

REPORT THIS TURTLE!

Habitat

The red-eared slider prefers freshwater lakes and wetlands with abundant basking spaces (logs, rocks, bird nests, etc.).

Identification

The most noticeable feature of the red-eared slider is the red or orange stripe behind each eye.

The top of the shell is dark green, while the underbelly is bright yellow.

There are yellow stripes along the neck and legs.

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Rusty Crayfish (*Orconectes rusticus*)

Chris Lukhaup, www.cruста10.de

Species at a Glance

The rusty crayfish is a large crayfish species that has emerged as an invasive threat to aquatic ecosystems in many regions of the country.

This opportunistic feeder can exceed 10 cm in length, has strong claws, and aggressively displaces native crayfish species. It consumes aquatic plants, fish eggs, and invertebrates (including aquatic insects, clams, worms, leeches, and snails).

Distribution

The rusty crayfish is native to the Ohio River basin, including parts of Ohio, Kentucky, Tennessee, Illinois, and Indiana.

It has been introduced to new areas across much of the Great Lakes Region, New England, and parts of New Mexico.

Although several sightings have been reported, the rusty crayfish has not become established in the Pacific Northwest.

Brian Roth, University of Wisconsin

How this Species Spreads

Unsuspecting anglers have contributed to the spread of the rusty crayfish by using this popular bait species in waterways outside of its native range.

Due to its resilient nature, the rusty crayfish is often used in aquariums, particularly in classroom settings. Releasing aquarium species into new ecosystems provides another pathway for the rusty crayfish to spread.

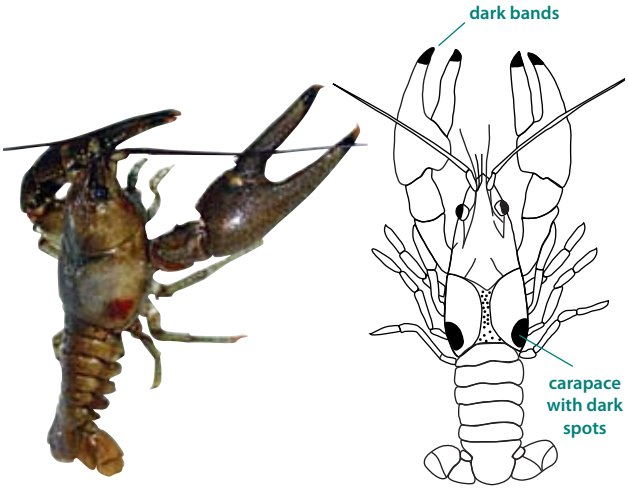


Photo: Myriah Richerson and Amy Benson, U.S. Geological Survey; sketch: Stefania Padalino, Oregon Sea Grant

Environmental Impacts

Rusty crayfish prey upon and cause significant damage to stands of aquatic plants, reducing food sources and aquatic habitat for aquatic invertebrates and fish.

Rusty crayfish often outcompete native crayfish species for food and habitat. They can have an adverse impact on fish populations through competition for food and predation on fish eggs.

With their strong claws and aggressive nature, rusty crayfish can also pose a menace to swimmers.

Habitat

The rusty crayfish inhabits freshwater lakes, rivers, and streams with substrate of rock, gravel, clay, or silt.

They are found in deep pools and fast currents. They prefer areas that offer shelter from predators, such as rocks, logs, and debris.

Identification

Rusty crayfish are most easily identified by large, rust-colored spots on either side of the carapace (shell).

They have large, grayish-green to reddish-brown claws with black bands at the tips. The claws leave an oval gap when closed.

REPORT THIS CRAYFISH!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Ringed Crayfish *(Orconectes neglectus)*
Virile Crayfish *(Orconectes virilis)*

Chris Lukhaup, www.crusta10.de

Distribution

The ringed crayfish is native to the central plains and Ozark regions of the Mississippi River drainage. Introduced populations have been found in New York, as well as in Oregon's Rogue, John Day, and Umpqua rivers.

The virile crayfish is native to central North America, including Canada and the U.S. It has been introduced to parts of the Southwest, Southeast, Northeast, and Mid-Atlantic regions.

Species at a Glance

The ringed crayfish is an attractive, medium-sized crayfish. When introduced to new regions, it poses a threat to native aquatic organisms.

The virile crayfish is a large crayfish, closely related to the lobster. This short-lived species (less than two years) can reproduce rapidly and compete with native crayfish when introduced.

Dr. Keith A. Crandall

Virile crayfish *(Oreconectes virilis)*

How this Species Spreads

Both the ringed crayfish and the virile crayfish can be introduced when used as fishing bait in bodies of water outside their native ranges.

Release from personal aquariums can also establish these species in new waterways.

Environmental Impacts

The impacts of ringed crayfish introductions are unknown. High-density populations have been observed in watersheds where it has become established. Competition with native crayfish and other aquatic species for habitat and forage is possible.

The virile crayfish has a high reproductive rate and is capable of competing with native aquatic organisms. Displacement of native crayfish has occurred where this species is introduced. Additionally, burrowing by the virile crayfish can cause extensive bank erosion or damage irrigation structures.

Ringed crayfish *(Orconectes neglectus)*

Tyler Strange and Jan Hoover, North American Native Fisheries Association

Habitat

The ringed crayfish is found in clear freshwater rivers and streams with significant current. During daylight hours, it burrows into gravel and beneath large rocks.

The virile crayfish is found in freshwater lakes, rivers, streams, and marshes. During daylight, it often finds shelter behind rocks, logs, or thick vegetation.

Identification

The ringed crayfish is medium-sized. Adults are 4–9 cm in length. It is olive-green to reddish-tan in color, with two dark (almost U-shaped) stripes cross the width of the central carapace. A pair of dark stripes runs lengthwise along the edge of its abdomen. Ringed crayfish claws are large and broad with black or brown rings around the orange-tipped pincers. They leave a large gap when closed.

The virile crayfish is large, reaching lengths of more than 12 cm. It is green to reddish-brown in color and without prominent markings. Lengthwise blotches occur in pairs on the abdomen. Virile crayfish pincers are greenish with orange tips and often have small white knobs.

Red Swamp Crayfish *(Procambarus clarkii)*

Chris Lukhaup, www.crusta10.de

Distribution

The red swamp crayfish is native to the coastal plains of the Gulf Coast, from Mexico to Florida, and in the Mississippi River drainage, as far north as Illinois.

It has been introduced in patchy populations across much of the western U.S. (including Oregon and Washington) and south Atlantic states.

It has also been introduced to Asia, Africa, Europe, and South America.

Species at a Glance

The red swamp crayfish is a large, aggressive, warm-water crayfish. It is prized as a food source and often raised in aquaculture operations.

It has been widely introduced as a food source outside its native range. When established in new areas, it often competes with native aquatic organisms, and its burrowing can cause streambank erosion.

George W. Robinson © California Academy of Sciences

Red swamp crayfish *(Procambarus clarkii)*

How this Species Spreads

The red swamp crayfish is a popular food that can be spread accidentally by aquaculture operations. Intentional introductions have also occurred to create a food source in regions outside its native range. It has also been introduced through the live seafood trade.

This species can also be introduced through release from personal aquariums or by use as fishing bait.

Environmental Impacts

The red swamp crayfish reproduces rapidly, often dominating invaded ecosystems. When introduced, it aggressively competes with native crayfish and other aquatic species for habitat and forage.

This crayfish can act as a host for parasites and diseases.

The red swamp crayfish is an agricultural pest in regions outside of its native range. Burrowing causes bank erosion and often damages irrigation structures and channels.

Red swamp crayfish *(Procambarus clarkii)*

Mike Murphy, Carnegie Mellon University

Habitat

This crayfish is often found in slow-moving or still water in swamps, wetlands, ditches, lakes, and rivers.

It prefers warm-water conditions and often burrows to avoid cold temperatures or drought. It is tolerant of low-salinity conditions in coastal areas.

Identification

The red swamp crayfish is large. Adults are 5.5 to 12 cm in length.

It is dark red in color—nearly black on the carapace—with a black stripe on the abdomen.

Its claws and carapace have spiky, reddish knobs, and the pincers are long and narrow.

Chinese Mitten Crab (*Eriocheir sinensis*)

Paul Heimowitz, U.S. Fish and Wildlife Service

Distribution

The Chinese mitten crab is native to China and Korea along the Yellow Sea.

This species is found throughout the San Francisco Bay watershed and has migrated as far inland as the Sierra Nevada foothills of California.

Range expansion along the west coast is expected.

Species at a Glance

The Chinese mitten crab is a burrowing crab that has a catadromous lifecycle. This means it spends the majority of its life in the freshwater reaches of coastal watersheds but reproduces and develops in brackish estuaries.

This crab causes significant damage to the aquatic ecosystems it invades. High-density populations are common and often disrupt the food chain and ecology.

Other species of mitten crab are also a concern, including the Japanese mitten crab *(Eriocheir japonica)*.

California Department of Fish and Game

Underside view of female (left) and male (right)

How this Species Spreads

The Chinese mitten crab was first identified in San Francisco Bay in 1992. It was introduced from ship ballast water or intentionally as a food source.

Ocean currents and ballast water are capable of spreading the planktonic larvae of this species to new coastal areas.

The Chinese mitten crab migrates upstream to freshwater areas as a juvenile and is able to traverse over land, allowing it to navigate around obstacles (such as dams).

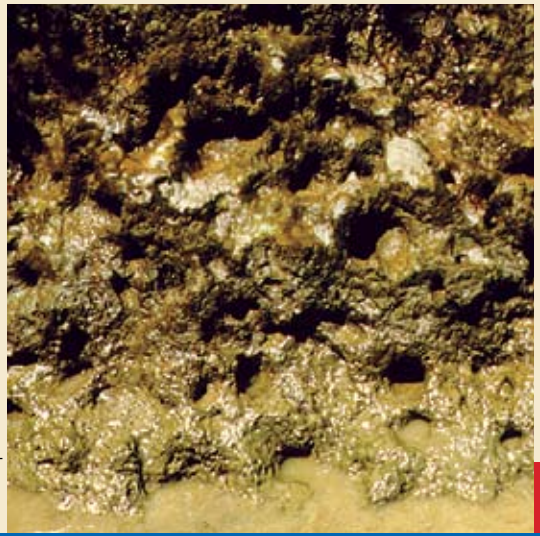
Environmental Impacts

The Chinese mitten crab is an opportunistic feeder that preys upon and competes with native flora and fauna for limited habitat and resources.

Burrowing causes significant erosion damage to levees, streambanks, and irrigation structures.

Massive hordes of mitten crabs migrate to the estuary for reproduction, causing an annual nuisance that disrupts industrial water intake and fish migration.

Mitten crab burrows leave this streambank susceptible to erosion.



California Department of Fish and Game

Habitat

The Chinese mitten crab inhabits riverbanks, levees, and estuaries of coastal watersheds.

The Chinese mitten crab reproduces and exists as a juvenile in saltwater estuaries, but spends most of its adult life in upland freshwater habitat, sometimes hundreds of miles from the sea.

Identification

The most identifiable feature is the dense patch of hair on its white-tipped claws.

The carapace (shell) width of adult crabs reaches about 4 to 8 cm, with a notch in the middle and four spines on each side.

Mitten crabs are light brown in color and their legs are long, more than twice the width of the carapace.

REPORT THIS CRAB!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

European Green Crab (*Carcinus maenas*)

Gary Weber, Oregon State University

Species at a Glance

The European green crab, also known as the European shore crab, is a small marine shore crab found in rocky intertidal and estuarine areas.

It is an opportunistic and voracious feeder that consumes a broad range of plants and animal species.

Distribution

The European green crab is native to Europe and North Africa.

It has been introduced to both coasts of North America, as well as Australia, South Africa, and Argentina.

First found on the west coast in San Francisco Bay in 1989, the European green crab has since been spread by currents to estuaries throughout the west coast, reaching as far north as Vancouver Island, BC. It is currently found in low-density populations in the Pacific Northwest.

Gary Weber, Oregon Sea Grant

The underside of male (left) and female (right) European green crabs.

How this Species Spreads

Multiple pathways can introduce the European green crab to new regions. These pathways include ocean currents, the aquarium or live seafood trade, hull fouling, ballast water, and aquaculture.

This crab was likely introduced to San Francisco Bay by ship ballast water. Northward range expansion was likely aided by strong El Niño currents that transported the planktonic larvae along the coast to new embayments and estuaries.

Environmental Impacts

Although currently found in low densities in the Pacific Northwest, the European green crab is a resilient species that threatens to displace native bird, crab, and fish species through competition and predation. Of particular concern is the commercially valuable Dungeness crab.

Now a dominant species along North America's Atlantic coast, the European green crab has dramatically altered species composition and decimated populations of Eastern soft-shell clams.

Tim Sullivan

Habitat

The European green crab is tolerant of diverse climatic conditions. It can inhabit shallow waters along the shores of diverse coastal areas, including estuaries, bays, and rocky intertidal areas. On the west coast, it is most frequently found on estuarine mudflats.

Identification

The most identifiable characteristic of the European green crab is the set of five triangular spines, evenly spaced on each side of its eyes. Additionally, there are three lobes between the eyes.

European green crabs are often multicolored and mottled, ranging in color from dark green to brown, with an underside of yellow, orange, red, or green.

The carapace of adult crabs is typically 5.5–8 cm in width.

Australasian Burrowing Isopod *(Sphaeroma quoianum)*

Tim Davidson, Oregon Institute of Marine Biology

Australasian burrowing isopods on sandstone in Coos Bay, Oregon

Species at a Glance

The Australasian burrowing isopod is a small, filter-feeding crustacean notorious for its burrowing activity. This marine species prefers intertidal estuarine conditions, where it burrows into sandstone, wood, mud, peat, and Styrofoam, creating interconnected systems of tunnels that result in severe erosion.

This isopod is frequently found in high densities, reaching 10,000 per square meter.

Distribution

The Australasian burrowing isopod is native to estuaries in New Zealand, Australia, and Tasmania.

This organism was first found in San Francisco Bay in the early 1900s and has gradually been introduced to new estuaries along the Pacific Coast, including Humboldt Bay, San Diego Bay, and Bajia San Quintin, Mexico.

In Oregon, this isopod was discovered in Coos Bay in 1995 and Yaquina Bay in 2005. Further range expansion is expected along the west coast.

Tim Davidson, Oregon Institute of Marine Biology

Erosion of sandstone, caused by the Australasian burrowing isopod, along the shoreline of Coos Bay estuary, Oregon

How this Species Spreads

The Australasian burrowing isopod was likely introduced to San Francisco Bay in wooden-hulled ships traveling from Australasia.

This species can spread to nearby areas by transport on floating debris.

Recreational and commercial traffic along the coast, or movement of infested substrate (including Styrofoam buoys or plant material), could facilitate introduction.

Environmental Impacts

Tunnels make banks susceptible to erosion from currents and waves. Erosion rates as high as 1 m per year have been measured along infested shorelines, often harming riparian vegetation and habitat.

Water turbidity (suspended sediment) is likely increased by burrowing activity and the resulting erosion.

Burrowing into Styrofoam dock floats releases tiny particles of toxic styrene into the surrounding estuary, while also destroying the floats.

Burrowing can weaken levees and other water-control structures.

Sphaeroma quoianum

Tim Davidson, Oregon Institute of Marine Biology

REPORT THIS ISOPOD!

Habitat

It prefers soft substrate (mud, sandstone, peat, wood, etc.) on the landward edges of intertidal mudflats and salt marshes.

It is tolerant of large variations in salinity and favors steep and undercut banks that are submersed only part of the day.

Identification

The Australasian burrowing isopod is most easily recognized by its extensive burrowing activity, which can transform the banks of coastal bays and estuaries to look like Swiss cheese.

Similar to many isopod species, these brown, 1 cm-long creatures roll into a ball when handled or disturbed.

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Marine Clams:

Amur River Clam (*Corbula amurensis*)
Eastern Softshell Clam (*Mya arenaria*)

Andrew Cohen, www.exoticsguide.org; right, U.S. Geological Survey

REPORT THIS SPECIES!

Amur River clam, *Corbula amurensis*

Species at a Glance and Distribution

The Amur River clam is a suspension feeder native to China, Korea, and Japan. Transported by ship ballast water, it was found in San Francisco Bay in 1986 and has since become a dominant species in the bay. It poses a significant risk of spreading along the Pacific Coast.

The eastern softshell clam, native to North America's east coast, was intentionally introduced as a food source along the Pacific Coast in the late 1800s. It now spans from central California to southern Alaska.

Manila Clam (*Venerupis philippinarum*)
Purple Varnish Clam (*Nuttallia obscurata*)

The Manila clam (also known as the Japanese littleneck clam), from eastern Asia, was accidentally introduced to Puget Sound in the 1930s. It is now found from southern California to central British Columbia and is a major component of recreational and commercial harvest. It often displaces the native littleneck clam, which it resembles.

The purple varnish clam, native to Japan, Korea, and China, was first found in British Columbia in the 1980s and has since spread along the Washington and Oregon coasts.

Sarah Dudas

Purple varnish clam, *Nuttallia obscurata*

How these Species Spread

Marine clams have often been intentionally released to new areas to provide a food source, while marine aquaculture operations and the live seafood trade have accidentally released nonnative clams.

The planktonic larvae of marine clams can be transported to new regions in ship ballast water.

Environmental Impacts

Nonnative marine clams can significantly alter estuarine ecosystems and food chains by outcompeting and displacing native clams and other marine organisms.

Habitat

The Amur River clam is tolerant of pollution, a wide range of temperatures, salt- and freshwater, and all sediment types. It is found partly buried in the intertidal zone and prefers mud and sand substrate.

The eastern softshell clam resides in the mid-intertidal zone, 20–35 cm deep in sand to mud substrate.

The Manila clam is found in the mid-low intertidal zone, buried near the surface of sand to mud substrate.

Purple varnish clams are found in the mid-high intertidal zone, 20–25 cm deep in cobble to mud substrate.

Mary Jo Adams

Mary Jo Adams

Identification

The Amur River clam is tan, white, or yellow, and one shell is slightly longer than the other. It has brown siphons and reaches lengths up to 2.5 cm.

The eastern softshell clam (at left, top) has a chalky white, slightly pointed, oval-shaped shell that shows concentric growth rings and reaches lengths up to 15 cm. The outer shell periphery is often brown, and the siphons are gray to brown.

The Manila clam (at left, bottom) is oval in shape and up to 6 cm in length. The shell is cream to gray in color, showing concentric growth rings, and straight ridges extend from the hinge. Brown to black patches and triangular markings can also be present. The interior of the shell is mostly white.

The purple varnish clam is relatively flat with a large external hinge and reaches over 7 cm in length. It has a thick shell with the appearance of brown varnish on the outside and a purple interior.

Shells on left: top, eastern softshell clam, *Mya arenaria;* bottom, Manila clam, *Venerupis philippinarum*

REPORT THESE SEA SQUIRTS!

Solitary Sea Squirts: Club Tunicate (*Styela clava*) Pacific Transparent Sea Squirt (*Ciona savignyi*)

Left: Janna Nichols; right: Tim Davidson

At left, club tunicates compete for space in Puget Sound, Washington. At right, a club tunicate is shown out of water.

Species at a Glance

Solitary sea squirts, also known as solitary tunicates, are invertebrate filter feeders that attach to hard substrate in marine environments. Unlike colonial sea squirts, solitary sea squirts are larger, stand-alone organisms, each with two siphons that allow seawater to flow through the body ("squirting" water).

In the Pacific Northwest, the club tunicate and the Pacific transparent sea squirt have invaded coastal areas, raising ecological concerns.

Distribution

The club tunicate is native to Asia but has been introduced to Europe, Australia, New Zealand, and both the Atlantic and Pacific coasts of North America. In the Pacific Northwest, it is found in Puget Sound; Coos Bay, Oregon; and along much of the California coast (including San Francisco Bay and Humboldt Bay).

The Pacific transparent sea squirt is native to Korea and Japan. It has been introduced to Puget Sound, where its range continues to expand, as well as San Francisco Bay and south along the California coast.

Georgia Arrow

The propeller of an unused sailboat is overcrowded with fouling organisms, including the club tunicate, *Styela clava*.

How these Species Spread

Solitary tunicates are often transported to new regions through aquaculture activities and through ship fouling and ballast water exchange. Recreational boating and local shipping activities can often help expand their range.

A group of Pacific transparent sea squirts, *Ciona savignyi*

Janna Nichols

A wolf eel den is crowded with *Ciona savignyi* in Puget Sound, Washington.

JD Rowe

Environmental Impacts

Solitary tunicates often displace or overgrow filter feeders (scallops, oysters, mussels) and other native organisms through competition for food and space on available substrate. This behavior can impact marine ecosystems by altering the food supply for species that depend on native prey and by changing the marine habitat.

The club tunicate often grows in high-density populations, reaching up to 1,500 individuals per square meter. Damage to shellfish aquaculture has occurred in some regions.

While the Pacific transparent sea squirt is often found in high-density populations, its environmental impacts are not well known.

Habitat and Identification

Both species are found in estuaries, harbors, and other sheltered, low-energy marine environments, attached to rocks, sea walls, and other hard substrate.

The club tunicate is yellowish-orange to brown in color with leathery and bumpy skin, reaching lengths up to 16 cm. The club-shaped body has two siphons and is attached to hard substrate by a narrow stalk. It is tolerant of fluctuations in salinity and temperature and is found in permanently submerged, shallow locations, including rocky and floating substrate (boat hulls and docks) to depths of at least 25 m.

The Pacific transparent sea squirt is whitish, transparent, and cylindrical-shaped, up to 16 cm in length. Its body is barrel-shaped and gelatinous, with two siphons. It is generally found at depths from 10 to 40 m.

REPORT THESE SEA SQUIRTS!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Didemnum *(Didemnum sp.)*

Gretchen Lambert, University of Washington Friday Harbor Labs

Didemnum attached to a rope in a branching colony in Sausalito, California

Species at a Glance

Didemnum, a type of colonial tunicate, is an aquatic, invertebrate, filter feeder found in marine environments. Many small individuals (called zooids) comprise colonies that are covered by a sheet-like matrix of cellulose.

It is invasive to many coastal regions and is known as a fouling organism for its ability to overgrow and foul vast areas of benthic surfaces such as boat hulls, propellers, or rocky shorelines.

Distribution

Didemnum is found in many bays and harbors on the Pacific and Atlantic coasts of North America, as well as in northern Europe, New Zealand, and Japan.

Didemnum first appeared on the west coast in San Francisco Bay in 1993. In 1998, it was found in the cooler waters of Puget Sound (Washington) and the Strait of Georgia (British Columbia).

The species of Didemnum found in the Pacific Northwest has not yet been positively identified, and therefore its native range is unknown. Some believe the species originated in Japan, while a close relative, *Didemnum lahillei*, is thought to be native to European coastal waters.

Andrew Cohen, Guide to the Exotic Species of San Francisco Bay, www.exoticsguide.org

How this Species Spreads

The free-swimming larvae are short-lived and locally dispersed by ocean currents before attaching to hard substrate to form new colonies.

Regional spread of Didemnum is aided by ship fouling, ballast water, and aquaculture operations.

Environmental Impacts

Colonies of Didemnum compete with native filter-feeders (scallops, oysters, mussels) for available substrate by blocking the settlement of larvae.

Didemnum spreads quickly, overgrowing and smothering other marine organisms. As Didemnum spreads, it can impact the ecosystem by altering the food supply for species that depend on native prey.

Didemnum hampers aquaculture operations by fouling aquaculture equipment and shellfish beds.

Loss of spawning beds, due to fouling, may harm productive fisheries.

A close-up view of a *Didemnum sp.* colony from San Francisco Bay

Luis A. Solórzano, www.californiabiota.com

REPORT THIS ANIMAL!

Habitat

Didemnum possesses broad environmental tolerances. It is found at depths ranging from intertidal to 65 m, and at temperatures from 2°C to 24°C.

It attaches to hard surfaces including rocks, boats, human-made structures, and even living organisms such as mussels.

Identification

Colonies of Didemnum are tan, yellow, or pale orange and take on a variety of irregular shapes (flat, bulbous, branching, mat-like, or cylindrical and rope-like) up to a meter in length.

Didemnum colonies often attach to ropes, docks, ships, or other hard substrate.

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Spartina:

Salt Meadow Cordgrass (*Spartina patens*)
Dense-flowered Cordgrass (*Spartina densiflora*)

USDA-NRCS PLANTS Database, http://plants.usda.gov

Smooth cordgrass (*Spartina alterniflora*)

Species at a Glance

There are 13 similar species of spartina or cordgrass, a group of deciduous, erect, marsh grasses that grow in salty to brackish water estuarine areas. Four spartina species have become aggressive invaders to the U.S. west coast, often transforming open estuaries into meadows that dramatically alter estuarine habitat and hydrology.

Eradication efforts in the Siuslaw estuary and Coos Bay aim to eliminate spartina from Oregon. Extensive eradication efforts are also occurring in Washington's Puget Sound and Willapa Bay.

Smooth Cordgrass (*Spartina alterniflora*)
English Cordgrass (*Spartina anglica*)

Distribution

Smooth cordgrass and salt meadow cordgrass naturally occur along the Atlantic coast, from Canada to the Caribbean and Central America. English cordgrass originated in England. Dense-flowered cordgrass is from South America.

These species have invaded multiple sites in California (predominantly in San Francisco Bay and Humboldt Bay) and Washington (including Willapa Bay, Gray's Harbor, and Puget Sound).

Samuel Chan, Oregon Sea Grant

Smooth cordgrass rhizome (*Spartina alterniflora*)

How these Species Spread

Spartina has been intentionally introduced to new regions for bank stabilization and marsh restoration.

Aquaculture operations, watercraft, and boat trailers can accidentally transport spartina to new areas.

Spartina spreads within an estuary via seeds and vegetative propagation. Ocean currents can potentially transport spartina along the coast to new estuaries.

Environmental Impacts

Spartina forms dense stands that cover large areas and trap sediment. Increased sedimentation dramatically alters estuarine habitat and hydrology by transforming mudflats to salt marsh, while channelizing water flow.

Dense spartina stands reduce biodiversity and habitat for native wetland birds, animals, and invertebrates.

Interference with oyster aquaculture has also occurred.

Spartina anglica in Puget Sound

Habitat

These species are found in the low to upper salt marsh and in mudflat habitat.

Identification

Leaf blades are green and hairless and have ridges on the upper surface. Leaf width and length vary widely between these species. The ligule, a thin membrane where the leaf blade meets the stem, consists of a row of fine hairs.

Flowering times vary from April to November for different species, with flowers found on two to several spikes that diverge from the stem.

Plants are 15 cm to 2.5 m tall and grow in dense, single-species stands.

Identification of spartina to the species level can be very difficult and may require an expert.

REPORT THIS PLANT!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Japanese Eelgrass (*Zostera japonica*)

Sylvia Yamada, Oregon State University

A patch of Japanese eelgrass in Yaquina Bay, Oregon

Species at a Glance

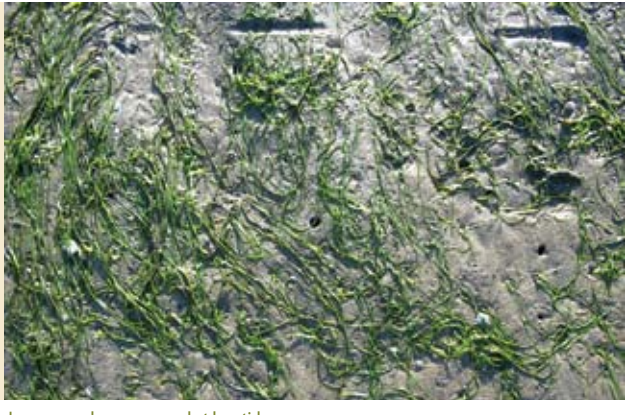
Japanese eelgrass (also known as dwarf eelgrass) is a submersed aquatic annual herb with green, grass-like blades. It can range from small patches to extensive meadows in shallow intertidal estuarine mudflats and other coastal marine areas.

An introduced species in the Pacific Northwest, Japanese eelgrass can alter habitat characteristics by colonizing historically unvegetated mudflats.

Distribution

Japanese eelgrass is native to Asia and can be found from Vietnam to Russia.

First introduced to Washington in the 1950s, Japanese eelgrass has spread to many estuaries in the Pacific Northwest.



Tim Davidson, Oregon Institute of Marine Biology

Japanese eelgrass exposed at low tide

How this Species Spreads

Japanese eelgrass was transported and introduced to Washington with shipments of Japanese oysters for aquaculture.

Locally, it spreads through seed dispersal and clonally by spreading its root-like rhizomes in mudflats.

Seeds are carried long distances by currents, introducing Japanese eelgrass to new locations along the coast. Seed transport can be aided by ship fouling, ballast water, and migratory birds.

Environmental Impacts

Japanese eelgrass often invades mudflats that are naturally devoid of vegetation, thereby altering intertidal habitat structure, water flow, and sedimentation.

Stabilization of mudflat sediment can result, possibly allowing other estuarine vegetation to become established.

Some organisms utilize the habitat and food provided by Japanese eelgrass establishment, while other organisms are displaced. Thus its net impacts on marine ecosystems are uncertain.

Two blades of Japanese eelgrass (*Zostera japonica*) are pictured with one blade of common eelgrass (*Zostera marina*).

Mary Jo Adams

Habitat

Japanese eelgrass is generally found in upper to mid-tidal areas of estuaries, in muddy to sandy substrate. It is also capable of occupying perpetually submersed, brackish, shallow lagoons.

This species tends to colonize higher levels of the estuary than native eelgrass *(Zostera marina)*.

Identification

Japanese eelgrass blades are 3–30 cm in length and 0.75–1.5 mm in width. Leaf blades are green and bendy, tending to flow with the water when submerged and lying flat at low tide.

Seeds are smooth, brown, oval-shaped, and about 2 mm long.

Japanese eelgrass has 3 parallel veins running down the length of each leaf, distinguishing it from the common eelgrass *(Zostera marina)*, which has 5 to 11 veins running down its wider and longer leaf blades.

Asian Kelp (*Undaria pinnatifida*)

National Introduced Marine Pest Information System, www.marine.csiro.au/crimp/nimpis

Distribution

Asian kelp is native to Japan, China, and Korea.

It has been introduced to Australia, New Zealand, Argentina, Western Europe, and the Mediterranean.

Asian kelp was first discovered in California waters in 2000 and is now found at sites from Los Angeles to Monterey Harbor. Suitable habitat conditions for Asian kelp extend from southern California to British Columbia.

Species at a Glance

Asian kelp is a type of brown seaweed (algae) found in nearshore coastal habitats. This opportunistic and fast-growing species can rapidly colonize new areas, forming dense stands in sheltered areas.

A popular aquaculture species, Asian kelp is commonly harvested for human consumption.

Simon Talbot, University of Tasmania

Asian kelp attached to the hull of a boat

How this Species Spreads

Asian kelp has been intentionally introduced to some regions as a harvestable food source.

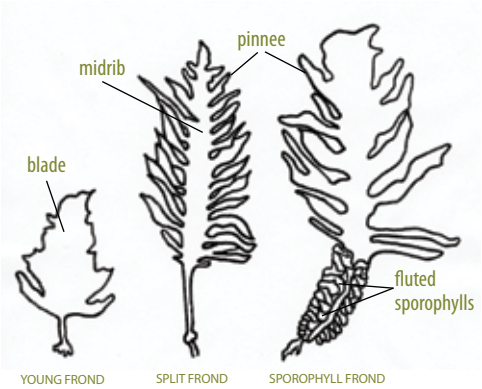
Accidental introductions can result from ship fouling or ballast water discharge, aquaculture operations, or the live seafood trade.

Regional range expansion mainly occurs reproductively through planktonic spore dispersal, but range expansion is often aided by human activities such as shipping.

Environmental Impacts

Asian kelp often grows in large, dense colonies that exclude native plants or occupy areas previously lacking seaweed. The introduction of Asian kelp can dramatically alter community composition and the structure of marine habitat.

This seaweed is a fouling organism that can interfere with aquaculture operations.



KEY FEATURES

- blade terminates well short of base
- sporophylls develop laterally along each edge of stipe, always in two discrete pieces
- 1–3 m in length
- blade dotted with white cryptostomata and dark gland cells

Sketch: J.C. Sanderson; photo: RIMP, CSIRO Marine Research, www.marine.csiro.au/crimp/nimpis

REPORT THIS SEAWEED!

Habitat

Asian kelp is found on marine substrate (rocks, shells, cobbles, etc.) and artificial structures (ropes, buoys, ships, etc.) in nearshore and estuarine habitats. It is frequently found at depths of 1–3 m but can occupy depths up to 15 m in clear water.

This seaweed is tolerant of a wide range of water temperatures and variable levels of sunlight exposure.

Identification

The fronds of Asian kelp are frilly and golden brown, 1–3 m in length, with a midrib running down the center.

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

HYDRILLA (*HYDRILLA VERTICILLATA*)

James R. Allison, Georgia Dept. of Natural Resources, www.invasive.org

Species at a Glance

Hydrilla is a submersed, rooted, freshwater aquatic plant, found in lakes, rivers, and streams.

When established, hydrilla often forms thick, intertwined stands that fill much of the water column, with dense mats forming at the water surface.

Distribution

Hydrilla is native to southern Asia, but it has been widely introduced across Europe, Australia, Africa, and North America.

In the 1950s, hydrilla was first introduced to the U.S. as an aquarium plant. It has spread throughout the south-eastern U.S. and the east coast.

Along the west coast, several watersheds in California have been infested.

Eradication efforts in Pipe and Lucerne lakes in Washington aim to eliminate hydrilla from the state.

Vic Ramey, Center for Aquatic and Invasive Plants, University of Florida

Hydrilla covers a lake in Florida.

How this Species Spreads

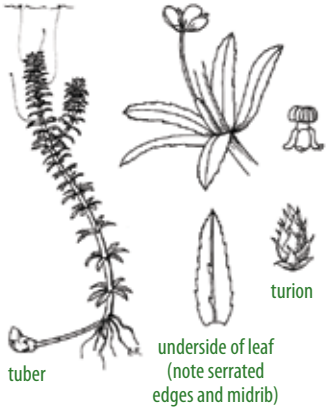
Hydrilla is a popular and hearty aquarium plant. The intentional dumping of personal aquariums has introduced hydrilla to aquatic systems throughout the world.

Boating, fishing, bait shipment, irrigation, and aquaculture are secondary pathways that spread hydrilla from initial areas of introduction.

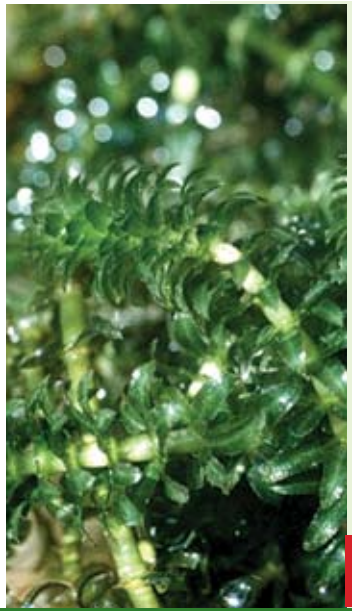
Environmental Impacts

Hydrilla produces dense mats and spreads rapidly, crowding out native vegetation, reducing water quality, and disrupting the food chain and ecology.

Dense stands impede navigation, dramatically reduce recreational opportunities and tourism, and can block irrigation canals.



Sketch: Center for Aquatic and Invasive Plants, University of Florida; photo: Colette Jacono, U.S. Geological Survey



REPORT THIS PLANT!

Habitat

Hydrilla prefers still or slow-moving water in lakes and rivers. It is often found in water depths of 0–8 m.

Identification

Look for small, potato-like tubers attached to the root.

Serrated, pointy, green leaves grow in whorls of five around the stem, and reddish leaf midribs often have small spines. Stems can reach 9 m in length.

Turions, scaly hard buds, are found along the leaf nodes.

Flowers are small, with transparent petals 1–5 cm in length.

It is a perennial plant that is most noticeable during the summer. It is often confused with Brazilian elodea.

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Brazilian Elodea (*Egeria densa*)

Toni Pennington, Portland State University Center for Lakes and Reservoirs

Brazilian elodea. Inset: submersed stems and flowers

Species at a Glance

Brazilian elodea is a rooted and submersed freshwater plant found in lakes and slow-moving rivers and streams.

This fast-growing perennial is adaptable to diverse climatic and chemical conditions, often forming dense, single-species patches when introduced to new regions.

Distribution

Brazilian elodea is native to South America.

It has been introduced to Asia, Australia, Africa, Europe, New Zealand, and North America.

In North America, Brazilian elodea appears in patches across the southeastern U.S. and along both coasts, including much of the Pacific Northwest.

Evelyn Paret, Oregon Sea Grant

How this Species Spreads

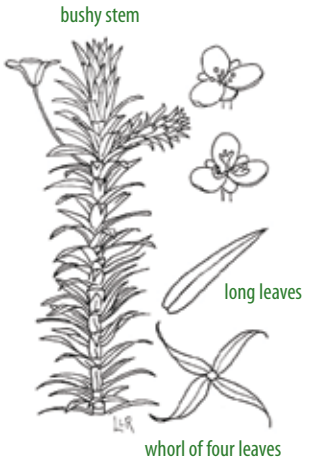
Widely introduced around the globe as a popular aquarium species, it becomes established when released from personal aquariums.

Range expansion occurs through plant fragmentation. Pieces of Brazilian elodea can be carried by water currents or become introduced to new waterways via attachment to boats, trailers, or fishing equipment.

Environmental Impacts

This plant often forms dense, single-species stands that outcompete and displace native vegetation and reduce the water quality of fish habitat and alter aquatic community composition.

Dense stands of Brazilian elodea increase sedimentation, decrease sunlight penetration and dissolved oxygen levels, and reduce navigation and recreational opportunities.



Sketch: Center for Aquatic and Invasive Plants, University of Florida: photo: Stefania Padalino, Oregon Sea Grant

Habitat

Found in temperate regions, in still or slow-moving freshwater environments, at water depths of 0–6 m.

Identification

Leaves and stems are bright green.

Stems are cylindrical, erect, and highly branched, reaching up to 6 m in length.

Leaves are 2–4 cm long and up to 0.5 cm wide with small, toothed edges, occurring in dense whorls of four to six around the upper stem.

Small, white, three-petal flowers float at the water surface, less than 1 cm in diameter.

Brazilian elodea closely resembles the native *Elodea canadensis*, which has smaller leaves in whorls of three, and smaller flowers. It is also often confused with hydrilla.

Milfoil: Eurasian Watermilfoil (*Myriophyllum spicatum*) Parrotfeather (*Myriophyllum aquaticum*)

Alison Fox, University of Florida, www.invasive.org

Eurasian watermilfoil

Species at a Glance

Eurasian watermilfoil and parrotfeather are green, perennial, submersed freshwater plants with finely dissected leaves.

Both of these species have been widely distributed around the globe as attractive aquarium and pond species, and both have emerged as top aquatic invasive threats to North America.

These species can be confused with similar-looking water milfoil species native to the Pacific Northwest. However, native varieties typically do not dominate the aquatic habitat where they are found.

Distribution

Eurasian watermilfoil is native to Europe, Asia, and North Africa. It has become established in patchy populations across North America.

Parrotfeather is indigenous to South America. It has been introduced to North America, Australia, and New Zealand. It is found in patchy distributions across the southern U.S. and along each coast.

Both species of milfoil are established in the Pacific Northwest. Eurasian watermilfoil is widespread, while parrotfeather occupies a more limited range in western sections of Oregon, Washington, and California.

Vic Ramey, Center for Aquatic and Invasive Plants, Univ. of Florida

Parrotfeather

How these Species Spread

Eurasian watermilfoil and parrotfeather were originally introduced to new regions through release from personal aquariums or escape from private ponds.

Range expansions occur by transport of plant fragments to new waterways via flowing water or human activities. Plant fragments can easily become attached to boat propellers or trailers, providing an easy mechanism for transport.

Environmental Impacts

When introduced, parrotfeather and Eurasian watermilfoil significantly alter aquatic ecosystems by forming dense stands that fill the water column, shade out native vegetation, and reduce habitat for native species.

Dense stands often diminish water quality, impede navigation, reduce recreational opportunities and tourism, and block irrigation canals.

Alison Fox, University of Florida, www.invasive.org

Parrotfeather covers a stream.

Habitat

Both species prefer shallow, nutrient-rich, and slow-moving waters of ponds, lakes, reservoirs, canals, wetlands, rivers, and streams. Parrotfeather is more common in very shallow water, while Eurasian watermilfoil can grow in depths up to 4 m.

Eurasian watermilfoil is moderately tolerant of salinity and colonizes tidally influenced, brackish coastal waterways.

Identification

Eurasian watermilfoil has submersed green leaves that become limp when removed from the water. They are usually arranged in whorls of four around each node of the stem. Each leaflet has 14–24 hairlike, paired divisions. The flower spike extends with reddish flowers up to 20 cm above the water surface. Stems are brownish-red to light green in color.

Parrotfeather has submersed leaves, as well as bright green emergent (above the water) leaves that extend up to 30 cm above the water surface. Leaves are usually arranged in whorls of five. Each submerged leaf is 1.5–3.5 cm long, with 20–30 hairlike, paired divisions, while the brighter green and stiffer emergent leaves are 2–5 cm in length with 6–18 divisions. Beneath the water surface, stems are brownish and often intertwined.

Giant Salvinia (*Salvinia molesta*)

Vic Ramey, Center for Aquatic and Invasive Plants, University of Florida

Species at a Glance

Giant salvinia is an aquatic, free-floating, freshwater fern.

Salvinia grows rapidly, forming tight chains of green leaves on the water surface. The huge, floating mats that can result alter the aquatic ecosystem and interfere with recreational opportunities and industrial water use.

Distribution

Giant salvinia is native to freshwater lakes and rivers of the southern Brazilian coast.

Giant salvinia has achieved widespread global distribution; it is especially prevalent in tropical and subtropical waters.

Since 1995, salvinia has spread across much of the southern and southeastern U.S., as well as areas in Arizona, southern California, Mexico, and Hawaii. Salvinia could potentially spread to coastal areas as far north as Maryland and Oregon.

Ted D. Center, USDA Agricultural Research Service, www.invasive.org

Giant salvinia covers a farm pond.

How this Species Spreads

The horticulture and aquarium plant industry has been the primary vector of introduction.

Reproduction occurs by fragmentation, and salvinia is often spread locally when plant fragments adhere to hard surfaces with which they come in contact, such as boats, trailers, and fishing gear.

Wind and water currents can also spread salvinia.

Environmental Impacts

Salvinia can alter aquatic ecosystems by excluding native species and by preventing light and oxygen from penetrating the surface, thus reducing habitat for fish and other animals.

Salvinia can also obstruct navigation, reduce recreational activities, clog irrigation ditches, and impede electricity generation.

This close-up picture of a giant salvinia leaf reveals hundreds of eggbeater-shaped tiny hairs.

Mic Julien, Commonwealth Scientific and Industrial Research Organization, www.invasive.org

Habitat

Found in slow-moving, warm, and nutrient-rich water in lakes, ponds, ditches, swamps, marshes, rice fields, reservoirs, and rivers.

Identification

Giant salvinia plants can range from less than a square inch to over an acre in size. Individual fronds are about the size of a nickel.

Horizontal stems float just beneath the surface, and nodes along the stem produce a pair of green, floating leaves and a highly divided, brown, submerged leaf. These submersed leaves are often mistaken as roots.

REPORT THIS PLANT!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

DIDYMO *(DIDYMOSPHENIA GEMINATA)*

Fish & Game New Zealand, www.fishandgame.org.nz

Enormous mats of didymo carpet a New Zealand river.

SPECIES AT A GLANCE

Didymo, also known as rock snot, is a single-celled freshwater diatom (a type of algae), often found in warm, pristine lakes and rivers at depths of 10 cm to 2 m.

Over the past several decades, this once-rare algae has begun to exhibit invasive characteristics both in its native range and when introduced to new regions. Seasonal algal blooms can form large, mat-like colonies that alter aquatic habitat by covering rocks and plants.

DISTRIBUTION

Didymo is native to northern Europe and western North America, where it has gradually increased its geographic range over the past several decades.

Didymo has been introduced to north and central Asia, as well as New Zealand.

Biosecurity New Zealand. www.biosecurity.govt.nz

How this Species Spreads

Didymo can be spread by human activities such as boating or fishing. It can be transported in water or attached to boats, wading gear, or fishing equipment.

It can also be dispersed locally by animals and possibly by wind.

Introduction of a single cell of this algae can lead to a viable population in new regions.

Environmental Impacts

Didymo can form large mats in rivers and streams. These mats can impact plant, invertebrate, and fish communities through displacement and alteration of aquatic habitat.

It has the potential to jeopardize salmon spawning beds and rearing grounds.

Large didymo colonies are unsightly, often with tail-like growths that flow in the water current and strongly resemble toilet paper. These colonies can also foul and impede water intakes.

People often complain of eye irritation when swimming in infested waters.

Didymo attached to a branch in a New Zealand river, forming long tails

Biosecurity New Zealand. www.biosecurity.govt.nz

Habitat

Didymo is mainly found in warm, pristine waters with abundant sunlight, low nutrients, and high oxygen levels.

Formation of large colonies is generally limited to streams and rivers with stable flow patterns, such as below dams. Swift currents appear to facilitate colony growth in shallow rivers, while these formations are extremely rare in lakes.

Identification

Didymo is pale yellowish-brown to white in color, and often looks like toilet paper trailing from rocks and aquatic plants in streams. Although it appears slimy, the texture is similar to damp wool. When water levels recede, dried mats of this dead algae can resemble dried tissue paper.

Didymo colonies tend to die back when water levels are low, or at the end of the summer as daylight hours diminish.

REPORT THIS PLANT!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Yellow Flag Iris (*Iris pseudacorus*)

Stefania Padalino, Oregon Sea Grant

Distribution

Yellow flag iris is native to Europe and the British Isles, Western Asia, North Africa, and the Mediterranean region.

It is now broadly distributed in temperate regions throughout the world. In the U.S., only the Rocky Mountains remain free from introduction.

In the Pacific Northwest, yellow flag iris occurs in many coastal brackish marshes.

Species at a Glance

Yellow flag iris often occurs in low-lying, nutrient-rich wetland communities, and its yellow flowers form carpets of color in wetlands and along lake margins during the spring and early summer.

Despite its invasiveness, it is still widely available for use in horticultural settings. The large, attractive flowers have made this plant an enormously popular ornamental for use in water gardens.

A. Murray, University Florida

Yellow flag iris, *Iris pseudacorus*

How this Species Spreads

Yellow flag iris has been introduced as an ornamental plant all over the world, and it often escapes to surrounding waterways.

It has also been intentionally introduced for erosion control and retention in sewage-treatment ponds.

Plant fragmentation spreads this species locally, while its seeds can be dispersed great distances by waterways.

Environmental Impacts

This plant modifies its environment by forming dense, horizontal rhizome mats that increase sedimentation and elevate wetland topography. This process reduces aquatic habitat and alters wetland hydrology.

Yellow flag iris outcompetes and displaces native aquatic plants.

Many native organisms consume yellow flag iris, but it contains a toxic sugar derivative and is thus avoided by vertebrates. The rhizomes are especially poisonous.

Sandy Ridlington, Oregon Sea Grant

Habitat

Yellow flag iris is found in nutrient-rich areas with full sun exposure, in wetlands, and along the banks of ponds, lakes, and slow-moving rivers.

Many wetlands, including brackish marshes, are susceptible to invasion, as this plant tolerates a range of soil acidity, water depths, and salinity.

Identification

It grows 0.4–1.5 m tall and has thick, fleshy rhizomes that form dense, horizontal mats. Each rhizome is 1–4 cm in diameter and extends vertical roots 10–20 cm deep.

Stiff, swordlike leaves originate at the base of the stem in a fan-like, overlapping arrangement.

Leaves are 50–100 cm long by 1–3 cm wide, covered with a whitish wax, and have raised mid-ribs.

It is the only yellow iris that occurs outside of cultivated areas (for example, wetlands), and its large, yellow flowers are 8–10 cm wide.

The three-sided fruit are shiny green and contain three densely packed vertical rows of seeds that are 2–5 mm in diameter, pale brown, and disk-shaped.

Reed Canarygrass *(Phalaris arundinacea)*

Stefania Padalino, Oregon Sea Grant

Distribution

Native to northern regions of North America and Eurasia.

Through interbreeding, invasive populations have developed in North America and Europe. Invasive strains have also been established in Australia, New Zealand, South Africa, Hawaii, and southern Asia.

In the Pacific Northwest, reed canarygrass prefers moist, low-elevation areas across Oregon, Washington, and California.

Species at a Glance

Reed canarygrass is a highly productive perennial wetland grass that reaches 1–2 m in height.

Vigorous European strains of reed canarygrass were bred and planted as a forage crop. In North America, several of these strains escaped to the natural environment and crossbred with native varieties, creating invasive populations.

Vic Ramey, Center for Aquatic and Invasive Plants, University of Florida

How this Species Spreads

In the 19th century, reed canarygrass was promoted nationwide as a forage crop.

Some varieties have been used as ornamentals and introduced to new regions by gardeners.

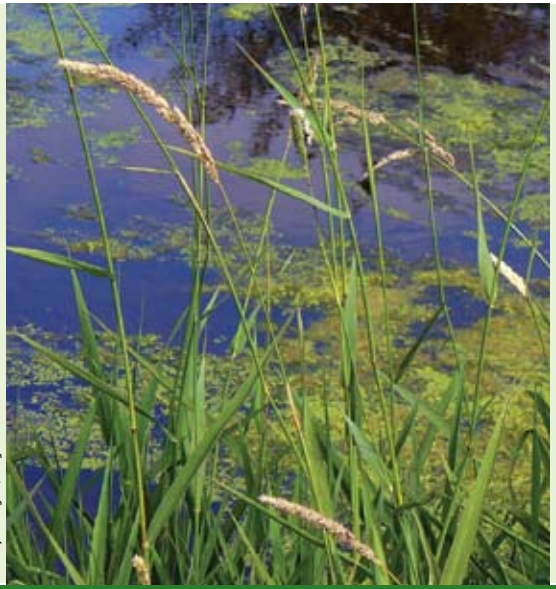
Reed canarygrass spreads by seed and through vegetative propagation. Seeds can be transported to new sites by flooding, animals, or the movement of soils.

Environmental Impacts

Reed canarygrass is capable of dramatically altering wetland ecosystems by creating dense stands that exclude native plant species with rapid growth and extensive rhizomes, thereby altering wetland habitat and hydrology.

Rare wetland plants and animals are particularly vulnerable to reed canarygrass competition.

This plant offers poor shelter for nesting birds, as stems are weak and tend to collapse.



Sandy Ridlington, Oregon Sea Grant

Habitat

It is usually found in wetlands, wet ditches, roadsides, and river floodplains disturbed by past grazing or soil movement. It can also flourish in dry soils.

Identification

Culms (stems) emerge in the first five to seven weeks of spring to form large clumps that peak in vegetative growth in mid-June. Culms reach heights of 0.6–2 m, and the flat leaf blades are 2–20 mm wide and up to 0.5 m long.

Flower formation occurs in mid-July. Flowers and grains are arranged in compact, branched panicles that reach 2–20 cm in length. They open upon flowering, then return to a tight spike formation, which often turns light purple in the late spring but fades to straw color during the summer.

A membranous auricle is found at the base of each leaf.

Purple Loosestrife *(Lythrum salicaria)*

Samuel Chan, Oregon Sea Grant

Distribution

Native to Europe and Asia, purple loosestrife has spread across much of the U.S. and southern Canada, and has been introduced in Ethiopia and Australia.

Species at a Glance

Purple loosestrife is a tall, perennial herb, easily recognized by its attractive spikes of purple flowers. This highly invasive plant jeopardizes wetland habitat by forming large, dense stands that alter wetland hydrology and exclude native species.

Since its horticultural introduction to the U.S. in the early 1900s, purple loosestrife has invaded prime wetland habitat.

Samuel Chan, Oregon Sea Grant

How this Species Spreads

Purple loosestrife is a popular ornamental plant, and garden horticulture has frequently introduced it to nearby natural areas.

It was likely introduced to the U.S. accidentally, from seeds transported with shipping freight or intentionally for beekeeping.

Reproduction and dissemination occur primarily by seed. Seeds are mainly spread by waterways but can also adhere to boots, machinery, and wetland fauna.

Environmental Impacts

High germination rates and dense seedling growth result in overcrowding of native plants and a reduction in wetland biodiversity.

Loosestrife leaves rapidly decompose in the fall, whereas native plants such as cattail decompose in the spring. This change in timing of nutrient release into wetland systems can jeopardize the survival of native organisms adapted to a spring nutrient flush.

Purple loosestrife encroachment in wetland habitat can alter wetland hydrology and eliminate open-water roosting space needed by migratory waterfowl.

Vic Ramney, Center for Aquatic and Invasive Plants, University of Florida

Habitat

Purple loosestrife is commonly found in disturbed wetlands, riparian zones, and roadside ditches.

Identification

Purple loosestrife grows in large stands. Individual vertical squared stems range from 1.5 to 3 m in height and can be smooth or hairy.

Lance-shaped leaves are 3–10 cm long and arranged oppositely or in whorls of three.

The top of the stem bears a large, vertical spike that holds many small flowers. Each flower has five or six pink-purple petals surrounding a small, yellow center.

Knotweed: Japanese Knotweed *(Fallopia japonica [formerly Polygonum cuspidatum])* Giant Knotweed *(Polygonum sachalinense)*

Samuel Chan, Oregon Sea Grant

Japanese knotweed in bloom

Species at a Glance

Japanese knotweed and giant knotweed are closely related plants with smooth, hollow stems and a bamboo-like appearance. These attractive perennials have been introduced as ornamental plants to many new regions, where they often become invasive.

Japanese and giant knotweed are able to interbreed, creating the invasive hybrid known as Bohemian knotweed *(Fallopia x bohemicum)*. A fourth, but less common, knotweed species introduced to the Pacific Northwest is Himalayan knotweed *(Fallopia polystachyum)*.

Distribution

Japanese knotweed is native to Japan and northern China; giant knotweed is native to Japan and the Sakhalin Islands.

Knotweed species are invasive across northern and central Europe, most of North America, and areas of New Zealand and Australia.

Japanese and giant knotweed are currently expanding their range in coastal areas of Washington and Oregon.

Tom Heutte, USDA Forest Service, www.invasive.org

Giant knotweed towers over a woman in Alaska.

How these Species Spread

Knotweed species have long been popular among gardeners, and the horticulture trade has distributed them globally.

Knotweed generally spreads by vegetative fragmentation. Pieces of knotweed stem as small as 1 cm can become new plants, which grow rapidly. Removal efforts can result in fragmentation, which further spreads this invasive plant when fragments are transported by humans or animals.

Flood events aid dispersal by transporting plant fragments downstream to new sites.

Environmental Impacts

Knotweed often forms dense stands that suppress and exclude native vegetation, primarily through shading. This situation is especially problematic in riparian habitats, where species diversity can be dramatically reduced.

Knotweed leaf litter has limited nutrient value, and this may negatively impact aquatic macroinvertebrate communities that feed on leaf litter.

Habitat

Knotweed primarily inhabits moist, sunny sites such as river banks, wetlands, roadways, and disturbed meadows or fields.

At left, giant knotweed is compared alongside the smaller leaf of Japanese knotweed. At right, a stem and leaves of giant knotweed are shown.

Sandy Ridlington, Oregon Sea Grant

Identification

Stands of knotweed range in height, from up to 4.5 m (giant) to 3 m (Japanese) to 2 m (Himalayan).

Knotweed leaves are 15 cm (Japanese) to 30 cm (giant) long, 5–12 cm broad, and sit on a 1–3 cm stalk. They are rounded, flat, or cordate (heart-shaped) at the base, and taper to a point toward the end.

Greenish-white flowers (2.5–3 mm long) are arranged in drooping clusters.

Knotweed stems are mottled green and magenta in color.

The hybrid Bohemian knotweed exhibits intermediate characteristics between giant and Japanese knotweed.

Asian (Leaping) Carp: Bighead Carp (*Aristichthys nobilis*) Silver Carp (*Hypophthalmichthys molitrix*)

David Riecks, University of Illinois, Illinois-Indiana Sea Grant, sgnis.org

Bighead carp

Species at a Glance

Silver and bighead carp are large, fast-growing, freshwater fish that can exceed 25 kg in weight. These two carp species have been introduced around the world for aquaculture production, often becoming established in new regions.

Silver and bighead carp are well known for their leaping prowess. They tend to reside in surface water and leap out of the water (up to 2 m high) when disturbed, causing boaters a serious safety risk.

Distribution

Silver and bighead carp are native to Eastern Asia and parts of China and Russia.

They have been introduced outside of their native range into Africa, Australia, North America, and South America.

In the U.S., their range has expanded to include much of the Mississippi River basin, including the Missouri, Illinois, and Ohio rivers.

David Riecks, University of Illinois, Illinois-Indiana Sea Grant, sgnis.org

Silver carp

How these Species Spread

Silver and bighead carp have been introduced to new regions by accidental release from aquaculture facilities, as well as by intentional introductions to create a food source and to control phytoplankton blooms in eutrophic waters.

Bait-bucket transfers can introduce these species to new waterways.

Environmental Impacts

Silver and bighead carp are often found in high densities in the waterways they invade, becoming the dominant fish species in many areas.

They filter-feed on phytoplankton and zooplankton and graze on aquatic vegetation. This behavior can put significant pressure on the base of the food chain and dramatically alter aquatic ecosystems.

Competition with native fish species can diminish recreational fisheries.

They can potentially carry and transmit new diseases to invaded ecosystems.

Duane Chapman, U.S. Geological Survey

Habitat

Bighead and silver carp are generally found in calm, slow-moving waters, such as lakes and backwaters of large rivers.

Identification

Silver carp are bright silver in color, with small scales. They have a large, toothless, upturned mouth, and their eyes are set far forward along the midline of the body. The dorsal fin has 8 rays, while the anal fin has 12–13 rays. Silver carp can reach 1 m in length and weigh up to 27 kg.

Bighead carp have a protruding lower jaw, forward-set downturned eyes, and a large head. They are deep-bodied, silver to gray in color, often with irregular dark blotches along the back and sides. The dorsal fin has 8–9 rays; the anal fin has 13–14. Bighead carp can reach lengths of 1.4 m and weigh up to 40 kg.

Bighead and silver carp can hybridize in the wild, making identification difficult in regions where they coexist.

REPORT THESE FISH!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Atlantic Salmon (*Salmo salar*)

Quebec Ministry of Tourism

A wild Atlantic salmon caught in northern Quebec

Species at a Glance

Atlantic salmon is the lone salmon species native to the Atlantic Ocean.

Atlantic salmon aquaculture, or "farming," has become an enormous global industry. Expansion of this industry to the Pacific has created a threat of establishment from escaped fish.

Distribution

Their native range spans the North Atlantic and Baltic Sea.

Atlantic salmon aquaculture developed in the North Atlantic, but it has expanded to the Pacific Ocean. It is an important industry in the Pacific Northwest, ranging from northern California to British Columbia. Chile, New Zealand, and Australia also produce Atlantic salmon as part of an international and growing industry.

While self-sustaining populations of Atlantic salmon in the Pacific Ocean have not been documented, hundreds of thousands have escaped over the past decade, and some are known to have successfully reproduced in British Columbia streams.

Fisheries and Oceans Canada, www.pac.dfo-mpo.gc.ca

Salmon aquaculture operations in British Columbia, Canada

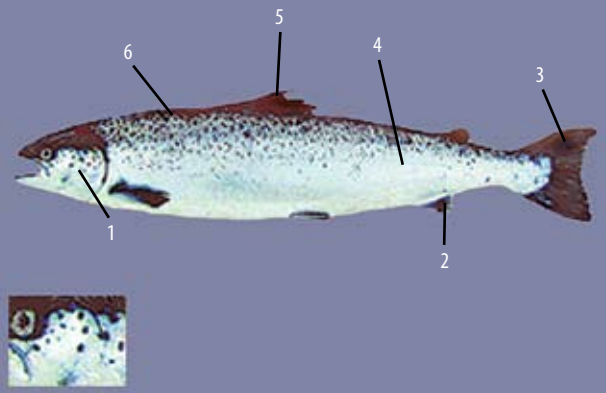
How this Species Spreads

Adult Atlantic salmon frequently escape from aquaculture facilities damaged by storms and other causes.

Environmental Impacts

Introduced Atlantic salmon populations could compete with native salmon species, altering the community structure of the ecosystem and damaging valuable fisheries.

The confined environment of salmon aquaculture pens can lead to outbreaks of parasites and disease, which may be transmitted to native fish populations by proximity to aquaculture or by interaction with escaped fish.



1 Large black spots on gill cover
2 8–11 anal fin rays
3 No spots on tail
4 Large scales
5 Worn fins/tail from net pens
6 Large black spots on back

Alaska Department of Fish & Game

Habitat

Similar to Pacific salmon species, the Atlantic salmon is anadramous, reproducing and rearing as juveniles in freshwater rivers and developing to adulthood in the open ocean.

Identification

Adult Atlantic salmon typically range in size from 3 to 10 kg and have a silver belly with a darker back of various shades of blue, brown, or green.

They are covered with many black spots that taper out toward the belly. They have a relatively large mouth, and large black spots on the gill cover, but no spots on the tail.

The anal fin has 8–11 rays, differentiating Atlantic salmon from Pacific salmon species, which have 13 or more rays on the anal fin.

REPORT THIS FISH!

In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In other states, contact the National Invasive Species Hotline: 1-877-STOP-ANS

Other Nonnative Fish

Species at a Glance

Nonnative fish are often introduced to areas outside their native range. This often impacts native fish populations and aquatic habitat. In the Pacific Northwest, most invasive fish originate from other regions of North America.

How Fish Are Introduced

Accidental fish introductions can occur from personal aquarium dumping, escape from aquaculture pens, bait bucket release, the live seafood trade, ship ballast water dumping, and other activities.

Occasionally, nonnative fish are introduced for biocontrol purposes, to help control invasive plants, insects, or other nonnative fish populations.

Fish species are usually introduced intentionally to create a food source, or for recreational sportfishing.

Environmental Impacts

The impact of nonnative fish on invaded ecosystems varies substantially and generally depends upon the life history traits of each nonnative fish species and their interaction with native species in new environments.

Introduced fish often alter aquatic ecosystems through competition with and predation upon native species. This can decrease populations of native fish and other aquatic organisms.

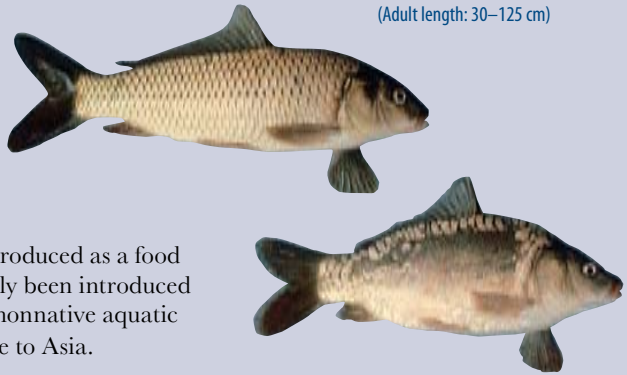
Nonnative fish that feed on and remove aquatic plants can alter aquatic habitat in lakes, rivers, and streams.

Grass carp *(Ctenopharyngodon idella)*
(Adult length: 45–125 cm)

USDA Archives, www.invasive.org

Nonnative carp

The common carp was widely introduced as a food fish. Grass carp have more recently been introduced in some locations to help control nonnative aquatic vegetation. Both species are native to Asia.



Common carp *(Cyprinus carpio)*
(Adult length: 30–125 cm)

Leonard L. Lovshin, Dept. of Fisheries and Allied Aquacultures, Auburn University

Nonnative Panfish

A wide variety of small panfish have been introduced to provide recreation and food. They often flourish in waterways that are now too warm to support healthy trout populations.

Black crappie *(Pomoxis nigromaculatus)*
(Adult length: 15–40 cm)

Bluegill *(Lepomis macrochirus)*
(Adult length: 15–25 cm)

Rock bass *(Ambloplites rupestris)*
(Adult length: 12–30 cm)

Pumpkinseed *(Lepomis gibbosus)*
(Adult length: 12–25 cm)

Yellow perch *(Perca flavescen)*
(Adult length: 15–30 cm)

Images provided by the New York State Dept. of Environmental Conservation

Nonnative Gamefish

These aggressive gamefish have been introduced across much of the Pacific Northwest. They can reduce populations of native trout, salmon, and other native species through predation and competition.

Muskellunge *(Esox masquinongy)*
(Adult length: 30–125 cm)

Northern pike *(Esox lucius)*
(Adult length: 30–100 cm)

Images provided by the New York State Dept. of Environmental Conservation

Walleye *(Stizostedion vitreum)*
(Adult length: 25–60 cm)

Smallmouth bass *(Micropterus dolomieu)*
(Adult length: 20–50 cm)

Largemouth bass *(Micropterus salmoides)*
(Adult length: 20–60 cm)

Nonnative Trout

Nonnative trout species were introduced to develop recreational fisheries. They often displace native trout populations through competition and predation. Lake trout and brook trout are native to eastern North America, while brown trout is a European species.

Alaska Dept. Fish & Game

Lake trout *(Salvelinus namaycush)* (Adult length: 35–75 cm)

Brown trout *(Salmo trutta)*
(Adult length: 20–60 cm)

Brook trout *(Salvelinus fontinalis)*
(Adult length: 15–45 cm)

Images provided by the New York State Dept. of Environmental Conservation

Nonnative Anadromous Fish

Anadromous fish live in the ocean but migrate to freshwater to breed. American shad and striped bass are anadromous species, native to the Atlantic coast of North America, that have been introduced to the Pacific Northwest for sportfishing and food. American shad annually migrate up coastal watersheds in large numbers across much of the region, while striped bass have more limited distribution and populations.

Striped bass *(Morone saxatilis)*
(Adult length: 45–120 cm)

New York State Dept. of Environmental Conservation

American shad *(Alosa sapidissima)*
(Adult length: 30–60 cm)

Maryland Dept. of Natural Resources

Nonnative Catfish

Catfish have been introduced to the Pacific Northwest for food and recreational fishing. These are three of the most common nonnative catfish species now found in the region.

Brown bullhead *(Ameiurus nebulosus)*
(Adult length: 20–40 cm)

Channel catfish *(Ictalurus punctatus)*
(Adult length: 30–100 cm)

Black bullhead *(Ameiurus melas)*
(Adult length: 15–30 cm)

Images provided by the New York State Dept. of Environmental Conservation

Nonnative Aquarium and Ornamental Fish

Aquarium fish are often released by their owners into local waterways, and ornamental pond fish can often escape into the surrounding watershed. Goldfish and the Oriental weatherfish are examples of aquarium species now established in the Pacific Northwest. Possible impacts include competition with native species, predation, and disease transmission.

Goldfish *(Carassius auratus)* (Adult length: 3–30 cm)

M.E. Brown, U.S. Geological Survey

Noel M. Burkhead, U.S. Geological Survey

Oriental weatherfish *(Misgurnus anguillicaudatus)*
(Adult length: 12–25 cm)

More Nonnative Fish

Mosquitofish are small, aggressive fish, native to the southern U.S., that have been introduced globally for mosquito control. They are fiercely predatory and territorial, at times attacking native fish. They compete with native fish by consuming native macroinvertebrates in addition to mosquito larvae.

Mosquitofish *(Gambusia affinis)* (Adult length: 2–7 cm)

Samuel Chan, Oregon Sea Grant

Although native to many waterways in the Pacific Northwest, the tui chub has emerged as an invasive species when introduced as bait to waterways outside of its native range. Tui chub consumption of zooplankton led to blue-green algae blooms in Diamond Lake, Oregon, that hampered recreational fishing and decreased water quality. Multiple attempts have been made to eradicate the tui chub (by poisoning the lake with piscicides) and restore recreational fishing.

Tui chub *(Gila bicolor)* (Adult length: 15–35 cm)

Oregon Dept. of Fish & Wildlife

The northern snakehead is not established in the Pacific Northwest. Native to China and Korea, it has been found in five eastern states. This species is imported for food and was likely released intentionally. As a voracious predator that reproduces rapidly, this species poses a significant threat to aquatic ecosystems.

Northern snakehead *(Channa argus)* (Adult length: 30–100 cm)

USDA Archives, www.invasive.org

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To report sightings of aquatic invasive species: In Oregon, call 1-866-INVADER or go to OregonInvasivesHotline.org
In Washington, call 1-360-902-2700. In other states, call the National Invasive Species Hotline: 1-877-STOP-ANS.

Giant salvinia (Scott Bauer, USDA Agricultural Research Service, www.invasive.org)

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