On the Lookout for Aquatic Invaders

Identification Guide for the West

Sea Grant
Oregon

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Partners in This Effort

Stop the invasion — Protect Oregon from Invasive Species

OISC — Oregon Invasive Species Council

Washington State Recreation and Conservation Office — Washington Invasive Species Council

The Western Regional Panel on Aquatic Nuisance Species

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Introduction

Nonnative species are altering freshwater and marine ecosystems in the western United States, 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 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 are likely to become established in the coastal-influenced states of the West. 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.

Charlene Simpson

Participants, Use Caution

Monitoring activities are a potential AIS pathway. Be sure to clean and dry 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 respond rapidly to new aquatic invaders. Limited control options exist for some established species not labeled for reporting.

Economic Costs of Aquatic Invasive Species

Invasive species were introduced to the West as a result of trade, commerce, and the fulfillment of cultural and recreational needs. Aquatic invasive species may incur a wide spectrum of social costs, resulting from direct and indirect damages to ecosystems and human activities. Management of invasive species often results in high and recurring management costs.

Total direct- and indirect-use impacts of invasive species are estimated at over $143 billion per year in the U.S. A reported 138 nonnative fish species and 88 nonnative mollusks have been introduced to the U.S., and the fish alone cause an estimated economic loss of $5.4 billion a year. Although the aggregated economic damages and management costs of invasive mollusks have not been studied, estimations of individual species' costs are available.

Duane Fagergren, Washington Dept. of Fish and Wildlife

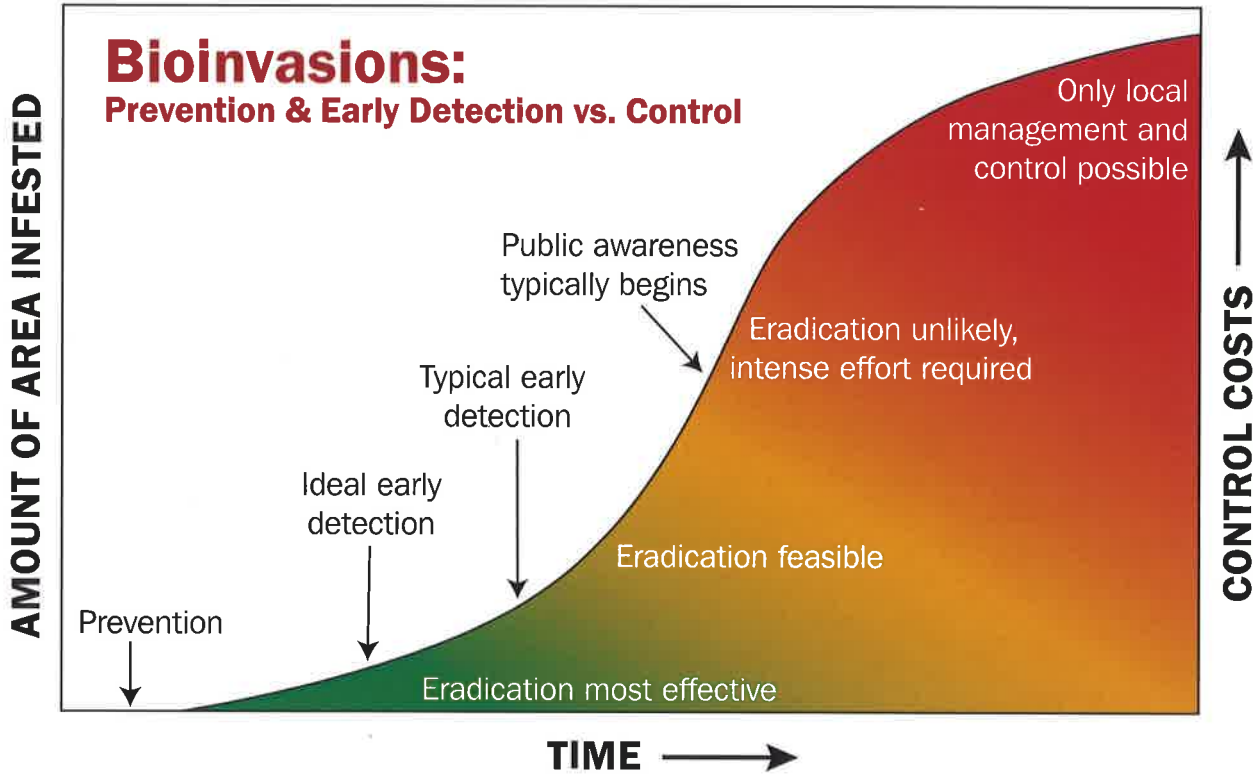
For example, zebra mussels negatively impact hydropower plants, drinking-water facilities, golf courses, and recreational activities. Some researchers estimated that zebra mussels caused over $3 billion in damages to electricity generation and water treatment facilities of North America during the years 1989–2004. Currently, $30 million is spent annually to decontaminate quagga mussels from the water infrastructures of the Southern California Metropolitan Water Authority.

Invasive species can lead to large changes in the natural, built, and managed environment and may result in changes to or closure of popular waterways for recreation, transportation, and natural resources. Prevention, early detection, and rapid response (EDRR) are among the most cost-effective and efficient ways of reducing the costs of invasive species, because once an invader becomes widespread and well established in a biological system, eradication success is minimal. In Oregon, every dollar invested in prevention and early detection yielded $34 in benefits.

Apart from the economic costs, biological invasions pose the second-greatest threat to global biodiversity next to habitat destruction. Invaders are driving unprecedented species loss worldwide and have profound ecological impacts. Nearly 20 percent of the world's endangered vertebrate species are thought to be threatened by invasive species. Thus, predictive information about the characteristics of potentially harmful invaders and the systems prone to invasion can provide valuable information to guide control efforts and reduce monetary costs.

This guide enables you to recognize and report some of the greatest invasive species threats to the West. By doing so, you are contributing to preventing the spread and harmful effects of invasive species.

Economic Costs of Aquatic Invasive Species *continued*



Let's Work Together

Controlling Invasive Species

The West 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 often will permanently transform the environment. Awareness and early detection help us contain these threats and prevent 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, and contribute to saving millions of dollars in damage and management costs, by:

- **Staying informed and "connected."** Learn about the species listed in this guide. Visit **nas.er.usgs.gov/**, **anstaskforce.gov/campaigns.php**, and **www.youtube.com/watch?v=4uLKK09TljI** 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 the appropriate agency in your state, listed on page 87 of this publication, and the national invasive species reporting site, **nas.er.usgs.gov/SightingReport.aspx**.

John Schaefers

Here's what you can do when working or recreating in or near waterways:

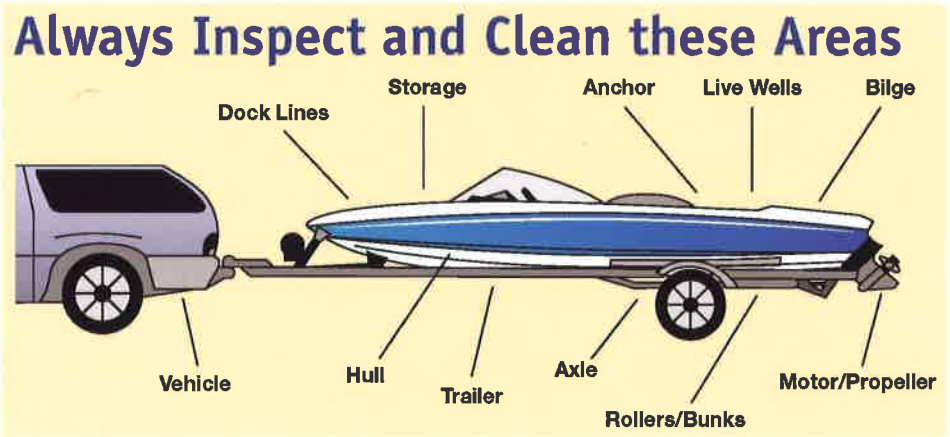
Boaters and Anglers

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

Before you transport your boat or equipment

www.100thmeridian.org/



- 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**, **www.youtube.com/watch?v=JX8TmwTx-tU**, and **www.aquaticnuisance.org/video**, or contact your state agency listed on page 87.
- 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.

Gardeners, Hikers, Watershed Stewards, Maintenance Workers, Resource Managers, Educators, and Researchers

- Learn about the prominent aquatic invasive species. Do not buy or share aquatic invasive species.
- Inspect, clean, and dry your equipment and tools of sediments and "hitchhiking" plants and animals 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" plants and animals from purchased aquatic plants before setting them in your garden.

Guadalupe Diaz

- 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.
- Don't let animals and plants loose into the wild.

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.

Amanda Slade

Don't Let It Loose! Dispose of plants and animals properly!

Tsunami Marine Debris: A Potential Invasive Species Pathway in the Modern Era

The March 11, 2011, tsunami off the coast of Japan sent an estimated five million tons of debris into the ocean. Numerous types of marine debris (boats, docks, buoys, construction timbers, etc.) from the tsunami have been found containing nearshore species of Japanese/western Pacific origin, including live fish. The arrival of more than 100 nearshore species on Japanese tsunami debris—after at least 15 months in the open ocean—spotlights an invasive species pathway driven by natural disasters in the modern era. Organisms attached to such debris often scrape off onto the shore as they beach, before they can be contained and removed. Given the nature and history of biological invasions, it may be years, even decades, after the major tsunami debris fields dissipate before we can detect the establishment of colonies of these organisms. Listed below are four known, potentially invasive species from Japan to watch for (early detection). As of the date of this publication (February 2014), these species have been found on large structures of marine origin (floating docks) that have washed onto North American shores from the 2011 Japanese tsunami. For additional information about tsunami marine debris invasives and what you can do about them, see the Oregon Sea Grant publication *Japanese Tsunami Marine Debris: Key Aquatic Invasive Species Watch* (http://seagrant.oregonstate.edu/sgpubs/g13002).

OSU Hatfield Marine Science Center

Floating dock from Japanese tsunami in Agate Beach, Oregon.

Washington Dept. of Ecology

Japanese tsunami marine debris skiff washed ashore onto Long Beach, Washington, with live striped beakfish.

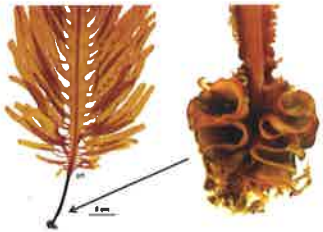
Washington Dept. of Ecology

Live striped beakfish (*Oplegnathus fasciatus*) found living in a water-filled compartment of a skiff that beached at Long Beach, Washington, nearly 24 months after being washed away from a port in northern Japan by the March 2011 tsunami. The fish, which are native to the western Pacific, are not known to occur in the eastern Pacific.

Wakame Kelp *(Undaria pinnatifida)*
Skeleton Shrimp *(Caprella cristibrachium)*
Asian/Japanese Shore Crab *(Hemisgraspus sanguinus)*
Northern Pacific Seastar *(Asterias amurensis)*

Asian/Japanese shore crab.

Pat Kight, Oregon Sea Grant



Gayle Hanson, OSU

-Undaria pinnatifida- Young and without sporophylls

-Undaria base- Mature and with ruffled sporophylls

An edible kelp species native to Japan, *U. pinnatifida* can be highly invasive and disruptive to native kelp ecosystems. In addition to its occurrence on larger tsunami debris, it may recruit in the natural environment on existing docks, pier pilings, or rock in newly disturbed areas. *Undaria* has lobes or finger-like projections from its blade margin and two highly ruffled sporophylls at its base.

Caprellids, or **skeleton shrimp**, are a family of amphipods found worldwide in intertidal or subtidal waters. They have a highly modified body (up to 3 cm) with elongated appendages and a small head. The abdomen is small, rendering the animal similar to a stick figure. They are found on upright structures and other marine organisms, such as bryozoans and hydroids.

John Chapman, OSU

Skeleton shrimp.

The **Asian/Japanese shore crab** has a square-shaped shell with three spines on each side of the carapace, ranging in colors from green to purple to orange-brown to red. It has light and dark bands along its legs and red spots on its claws. This species is small, with adults ranging from 35 mm (1.5 in) to 42 mm (1.65) in carapace width. This versatile crab inhabits any shallow, hard-bottom intertidal or sometimes subtidal habitat.

The **Northern Pacific seastar** is predominantly yellow in color and often seen with purple or red detail on its upper surface. There are numerous small spines with sharp edges on the upper body surface. On the underside of the body, these spines line the groove in which the tube feet lie, and join up at the mouth in a fan-like shape. The underside is a uniform yellow in color. Fully grown individuals can reach 40–50 cm in diameter. It is normally found in shallow water but can be found from the intertidal area through to the subtidal, as deep as 200 m.

OSU, Hatfield Marine Science Center

Northern Pacific seastar.

NUTRIA (*MYOCASTOR COYPUS*)

C.C. Lockwood, www.cclockwood.com

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. In the western U.S., populations in Colorado, New Mexico, Oregon, and Washington are expanding.

Nutria are increasingly common in urban and suburban environments.

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 has adapted 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. Furthermore, nutria have been introduced as a form of weed control.

Samuel Chan, Oregon Sea Grant

Nutria burrows and shoreline erosion at Devils 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.

© Milos Andera / USGS

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 by 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 4 to 12 months and produce up to two litters of 4 to 12 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. Feral pig populations exist throughout the southeastern, southwestern, and midwestern United States, with the largest populations in Florida, California, Hawaii, and Texas. They are also found in Oregon, Arizona, New Mexico and experts anticipate they will spread into more western states. See National Feral Swine Mapping System http://128.192.20.53/nfsms/.

Bruce Coblentz

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

How this Species Spreads

Pigs were first introduced by early settlers 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 and Eurasian wild boars for hunting. Feral pigs continue to spread from natural expansion, accidental release of domestic pigs, and illegal movement by hunters.

Feral pigs range from black to brown, but can also be light with spots.

Bruce Coblentz

Feral pigs can damage 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 carry many diseases and 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.

Feral pigs are omnivores. They eat mostly plant material and can damage crops and forests, but they also prey on small mammals and young livestock.

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, although distinguishing between feral pigs and domestic pigs can be difficult by appearance alone. Their presence can be identified through their "wallows," which appear as distinct oval-shaped mud holes simulating rototilled soil.

REPORT THESE MUSSELS IMMEDIATELY!

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

Zebra and quagga mussels 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 likely introduced through ship ballast water 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, Caspian, and Azov 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 the West, the Quagga mussel has been discovered in portions of the Colorado River watershed, including Lake Mead and Lake Powell, and also in southeastern California, southern Nevada, and western Arizona. To date, the western states have one infestation of zebra mussels, located in central California. Range expansion across the Colorado River watershed and other western U.S. watersheds is expected, but its spread can be prevented or delayed through prevention and early detection.

Samuel Chan, Oregon Sea Grant

Shoe encrusted with quagga mussels after just 3 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 trans-port 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.

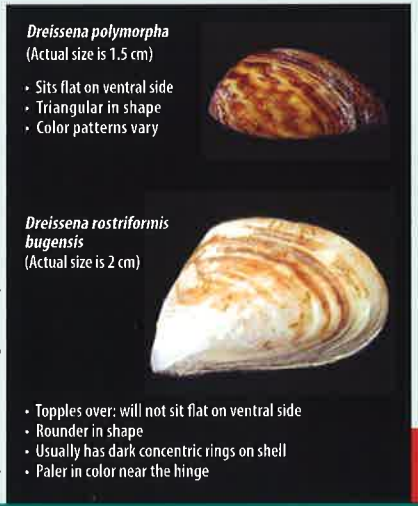
Environmental Impacts

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

REPORT THESE MUSSELS!

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 immediately to your state contact. See back cover.

ASIAN CLAM *(CORBICULA FLUMINEA)*

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

DISTRIBUTION

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

It is widespread throughout freshwater and estuarine areas, particularly across the eastern U.S., and its range continues to expand.

It is established in California, Oregon, Washington, Idaho, Utah, Arizona, and Colorado.

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.

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.

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

Environmental Impacts

Asian clams can displace native species, reduce biodiversity, alter the food chain, and damage equipment (including boat motors, intake pipes, diving gear, and commercial water systems.

Asian clams can clog intake pipes, causing boat engines to overheat and power-plant cooling system to fail, resulting in millions of dollars of damage each year.

Asian clams are efficient filter feeders that consume microscopic plants and animals from the base of the food chain, and their intensive filtering activity can drastically decrease the quantity of food available in the water body. Many juvenile fish species require a source of microscopic plants and animals to eat in order to survive and must compete with the Asian clams for food. A decrease in the survival rate of juvenile fish can impact the entire fish population in future years.

Asian clams form dense clusters, often more than 6,000 animals per square meter. The heavy clusters occasionally cover the benthic area of a water body, destroy historic underwater sites, and alter the benthic community.

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 West.

REPORT THIS SNAIL!

New Zealand Mudsnail (*Potamopyrgus antipodarum*)

Jane and Michael Liu, Oregon Sea Grant

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.

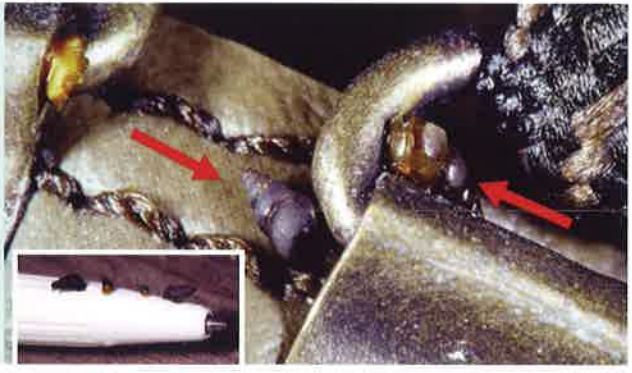
It has spread rapidly across much of the western U.S. and is considered a top invasive threat to aquatic ecosystems.

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.



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. For example, population densities of over 200,000 per square meter were reported in the Columbia River Estuary and have been known to reach densities of 800,000 per square meter, 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

REPORT THIS SNAIL!

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.

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

AMERICAN BULLFROG (*LITHOBATES CATESBEIANUS*)

Ed Nied Jr.

SPECIES AT A GLANCE

The American bullfrog is the largest frog in North America, weighing up to 3.3 lbs (1.5 kg). It has been cultivated globally for its edible legs and has been introduced to many regions as an aquarium pet.

The bullfrog is invasive in much of the western U.S. and several other continents. It is often an ecologically dominant species in new environments, due to a lack of predators and the possession of competitively advantageous traits such as high fecundity, tolerance to human-modified habitats, and a generalist diet.

DISTRIBUTION

Bullfrogs are native to the central and eastern U.S., extending into southern Quebec to Nova Scotia.

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

The bullfrog's invasive range encompasses more than 40 countries, spanning Europe, South America, and Asia.

Jennifer Rowe, OSU

How this Species Spreads

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

Juveniles and adults are capable of dispersing over land for a distance of 3.2 km during wet seasons, allowing them to colonize new permanent water sources to expand their range. Tadpoles often take two years to metamorphose into the terrestrial form, so large-bodied overwintered larvae have a competitive advantage over many native frog species. Where co-evolved, nonnative centrarchid fish co-occur with bullfrongs, fish may facilitate bullfrogs by limiting densities of macroinvertebrate predators.

Bullfrog tadpole.

Gary Nafis, Californiaherps.com

Environmental Impacts

Adult bullfrogs are gape-limited predators that eat anything they can catch and swallow, including birds, fish, crustaceans, bats, snakes, turtles, and other frogs.

In introduced ecosystems, their presence has been implicated in the decline of native amphibians, fish, and reptiles of conservation concern. Bullfrogs also act as an unaffected carrier of the emerging infectious disease chytridiomycosis, which has led to global amphibian population declines and extinctions.

A high reproductive rate allows the bullfrog to quickly establish itself and proliferate in invaded areas.

Extraordinarily high densities of juvenile frogs are common.

Habitat

Bullfrogs are found in or near marshes, ponds, lakes, and streams; they are even common in human-modified habitats, such as irrigation ditches. Bullfrogs are highly aquatic and prefer permanent, slow-moving bodies of warm water. However, they are increasingly prevalent in ephemeral wetlands within their invasive range.

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 (tympanic membrane) is larger than the eye, whereas the female eardrum and eye are the same size. Bullfrog tadpoles are large, reaching 15 cm in total length.

RED-EARED SLIDER (*TRACHEMYS SCRIPTA ELEGANS*)

Gary Nafis, CaliforniaHerps.com

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.

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.

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

How this Species Spreads

This turtle is generally introduced to new areas by pet owners 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

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.

REPORT THIS TURTLE!

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

REPORT THIS CRAYFISH!

RUSTY CRAYFISH (*ORCONECTES RUSTICUS*)

Chris Lukhaup, www.crusta10.de

DISTRIBUTION

The rusty crayfish is native to the Ohio, Tennessee, and Cumberland drainages (part of the Ohio River basin, but not all tributaries), 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 and the Mid-Atlantic.

Apart from a confirmed population in the John Day River of Oregon, the rusty crayfish has failed to become established in much of the Pacific Northwest.

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).

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 and releasing unused bait.

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.

Environmental Impacts

Rusty crayfish prey upon and cause significant damage to native populations of aquatic plants, reducing food sources and aquatic habitat for aquatic invertebrates and fish and facilitating invasive plants and algae to occupy waters inhabited by native species.

Rusty crayfish often outcompete native crayfish species for food and habitat. Native crayfish are exposed to increased predation because rusty crayfish often take the best hiding spots. They can have an adverse impact on fish populations through competition for food and predation on fish eggs. Rusty crayfish consume up to twice as much as native crayfish.

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

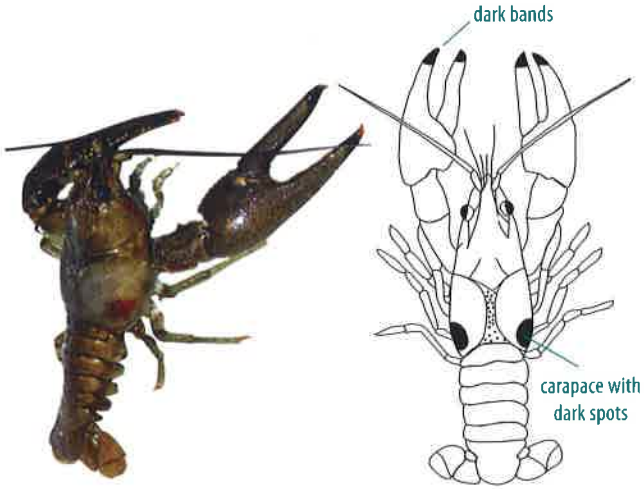


Photo: Myriah Richerson and Amy Benson, U.S. Geological Survey; sketch: Stefania Padalino, Oregon Sea Grant

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.cnusta10.de

Ringed crayfish *(Orconectes neglectus)*.

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 that can compete with native crayfish when introduced.

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 and Umpqua Rivers.

The virile crayfish is native to central North America, including Canada and the U.S. In the U.S. it is native to the Missouri, upper Mississippi, lower Ohio, and Great Lakes drainages. It has been introduced to parts of the Southwest, Southeast, Northeast, Pacific Northwest, and Mid-Atlantic regions, as well as Idaho and northeast Nevada.

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 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)*.

Brome McCreary

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. The pincers 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 often have dark specks and orange or reddish tips.

Red Swamp Crayfish *(Procambarus clarkii)*

Chris Lukhaup, www.cruste10.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, Washington, Utah, Idaho, Arizona, New Mexico, and much of California) as well as south Atlantic states, Hawaii, and southern Alaska.

It has also been introduced in 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.

REPORT THIS CRAB!

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, the Great Lakes region, and Chesapeake Bay, and has migrated as far inland as the Sierra Nevada foothills of California. It has been collected in the Columbia River Estuary in Washington. 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

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.

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.

Gary Weber, Oregon Sea Grant

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

How this Species Spreads

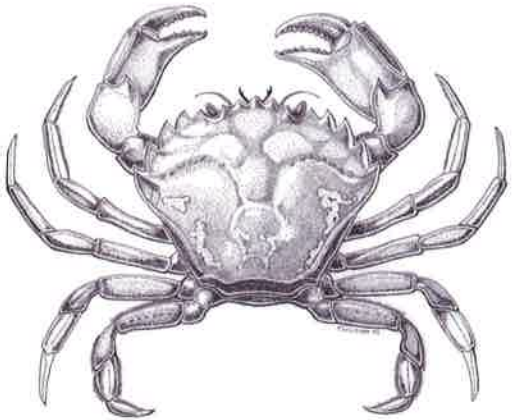
Multiple pathways can introduce the European green crab to new regions. These pathways include ocean currents, the aquarium or live seafood trade, hull fouling, ballast water, movement of aquatic vegetation for coastal zone management initiatives, drifting seaweed "rafts," and aquaculture.

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. It is one of the most voracious clam predators known.



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 claws have small black spots.

The carapace of adult crabs is typically 6–10 cm in width.

REPORT THIS ISOPOD!

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 North America 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 meter per year have been measured along infested shorelines, often harming riparian vegetation and habitat.

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.

The Australasian isopod burrows may facilitate habitat for other nonnative species.

Sphaeroma quoianum.

Tim Davidson, Oregon Institute of Marine Biology

REPORT THIS ISOPOD!

Habitat

The isopod will colonize a wide variety of soft substrate (mud, sandstone, peat, wood, etc.) in intertidal mudflats and salt marshes but also has a clear preference for decaying wood.

It is tolerant of large variations in salinity and favors steep and undercut banks in the intertidal zone.

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.

These isopods are grey/brown and can grow to 15 mm in length. They have powerful mandibles, making it possible for them to burrow.

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 1990s 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. Often more than half of its shell is left above the sediment to feed.

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. Its brown siphons can reach lengths of up to 2.5 cm. Unequally sized shell halves give this marine clam an "overbite" appearance.

The eastern softshell clam (at left, top) has a chalky white, slightly pointed, oval-shaped shell that shows concentric growth rings and reaches lengths of 10–15 cm and widths of 8–19 cm. The outer shell periphery is often brown, and the siphons are gray to brown. The shell is thin and fragile.

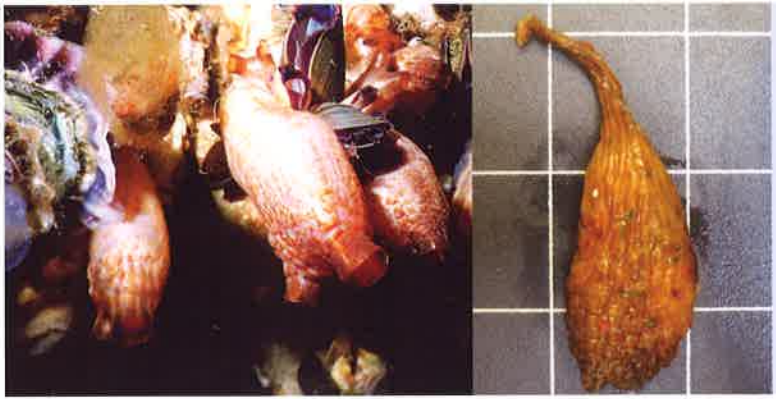
The Manila clam (at left, bottom) is oval in shape and up to 6 cm in length. The shell is cream to gray in color, showing concentric growth rings, and straight ridges extend from the hinge. Brown to black patches and triangular markings can also be present.

The purple varnish clam is relatively flat, with a large external hinge, and can reach over 7 cm in length. It has a thick shell with the appearance of brown varnish on the outside and a purple interior. The body, mantle, and siphons are white.

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 of 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

REPORT THIS ANIMAL!

DIDEMNUM *(DIDEMNUM VEXILLUM)*

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 or rocky shorelines, and for covering boat hulls, engines, nets, equipment, pump intakes, marinas, and piers.

DISTRIBUTION

The origin of *Didemnum vexillum* has not been identified conclusively, but it presumably originates from Japanese waters. It is now 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 *Didemnum vexillum* species is established along the west coast in the San Francisco Bay area, Coos Bay and Winchester Bay in Oregon, the Puget Sound area, and Sitka, Alaska.

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

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 they 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.

REPORT THIS ANIMAL!

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 Marsh Snail (AP) (*Assiminea parasitologica*)

James Lean

A close-up view of Asian marsh snails (AP).

Species at a Glance

Assiminea parasitologica (AP) is a very small, intertidal, estuarine snail. It resembles a peppercorn with a distinctive yellow band. It is found in high concentrations in the upper reaches of estuaries in the saltmarsh. In its native country (Japan), it is the intermediate host to a lung fluke that has detrimental effects on humans. As of early 2014, the parasite has not been found with the AP snail in Oregon.

Distribution

Assiminea parasitologica is native to Japan and was first documented in Oregon's Coos Bay Estuary in 2007. AP can now be found in the Alsea, Coquille, Coos, Smith, Umpqua, and Yaquina estuaries in Oregon. As of early 2014, it had not been documented in Washington or California.

Sam Chan, Oregon Sea Grant

Asian marsh snails (AP) blending in with the estuary mudflat.

How this Species Spreads

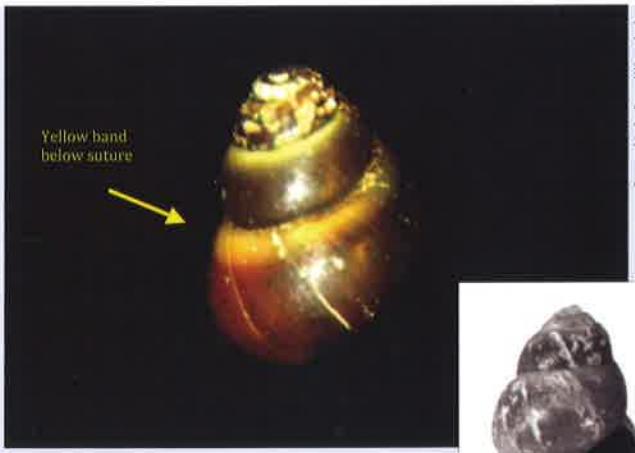
AP is thought to be introduced to the Coos Bay Estuary as larvae via ship ballast water. AP was present in three estuaries in 2008 and found in five in 2009. The newly invaded estuaries—the Coquille, Smith, and Alsea—are rather small waterways that do not experience large shipping traffic. These waterways do, however, experience large numbers of recreational fishermen and boaters.

Once introduced to an estuary, AP can spread quickly by hitchhiking on the wading gear, boats, and trailers of fishermen, boaters, birders, and scientists. The problem with hitchhiking is magnified by AP's small size and its ability to survive dessication and a wide range of salinities.

Environmental Impacts

AP often dominates the benthic habitat where it is found. For example, its population density was reported to be over 6,000 per square meter in the Coos Bay estuary.

The new arrival of *A. parasitologica* may pose ecological problems, as the snails develop interactions with the existing community of mesogastropods in the salt marshes and other intertidal habitats of Coos Bay. They have the potential to outcompete and displace native macroinvertebrates that other species depend on for food.



A close up of Assiminea parasitological snail, showing detail of whorls and yellow band below suture.

Habitat

AP is found in the upper mesohaline reaches of the estuary in mixed habitats. High concentrations of AP can be found in the salt marshes, rip-rap, on hard or woody debris, and on rock and gravel surfaces.

Identification

AP's shell is rather globose (roughly spherical) in shape, with five whorls and a flattened spire. AP possesses a distinctive yellow band below the suture. The shell is 4 to 7 mm in length.

REPORT THIS PLANT!

SPARTINA:

SALT MEADOW CORDGRASS (*SPARTINA PATENS*)
DENSE-FLOWERED CORDGRASS (*SPARTINA DENSIFLORA*)
SMOOTH CORDGRASS (*SPARTINA ALTERNIFLORA*)
ENGLISH CORDGRASS (*SPARTINA ANGLICA*)

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

Smooth cordgrass (*Spartina alterniflora*).

SPECIES AT A GLANCE

There are 15 similar species of *Spartina* or cordgrass, a group of deciduous, erect, marsh grasses that grow in salty to brackish 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 have been, and are continuously being, implemeneed in bays and estuaries in Oregon, Washington, and California.

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 native to South America.

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

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 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 forms vast meadows that dramatically alter 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, mammals, and invertebrates.

Interference with oyster aquaculture has also occurred.

Spartina anglica in Puget Sound.

REPORT THIS PLANT!

Habitat

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

Identification

Leaf blades are green and hairless, and width/length varies between 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 can range from a few centimeters to 2.5 m tall and grow in dense, single-species stands.

Invasive *Spartina* can be easily confused with the California native cordgrass (*Spartina foliosa*) and other species such as rushes, sedges, and round stems.

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.

In its invasive range in the Pacific Northwest, Japanese eelgrass can alter habitat characteristics by colonizing historically un-vegetated 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 on the west coast of the U.S. Populations have established themselves in Washington and Oregon.

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 the transport of equipment and recreational gear.

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 tidal zone levels of the estuary than native eelgrass *(Zostera marina)*.

Identification

Japanese eelgrass blades are 3–30 cm in length and 1–1.5 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.

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 southeastern U.S. and the east coast.

Along the west coast, several watersheds in California have been infested. Hydrilla also occurs in Idaho and Colorado.

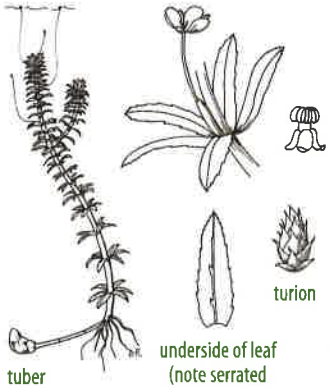
Vic Ramey, Center for Aquatic and Invasive Plants, University of Florida

Hydrilla covers a lake in Florida.

How this Species Spreads

Hydrilla is a popular and hardy 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.



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

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.

Habitat

Hydrilla tolerates a wide range of growing conditions, including low light and warm temperatures. It is generally found rooted to the bottom of 0–8 m deep, slow-moving or still lakes, ponds, reservoirs, and rivers.

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.

Tiny 1–5 cm female flowers are transparent white, located in leaf axis, and have 6 petals on long, threadlike stalks. Male flowers are green with an inverted bell shape. Turions (scaly hard buds) are found along the leaf nodes.

It is often confused with Brazilian elodea.

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

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 in lakes and ponds across the southeastern U.S. and along both coasts, including much of the West (Washington, Oregon, California, Idaho, Arizona, New Mexico, and Colorado).

Evelyn Paret, Oregon Sea Grant

How this Species Spreads

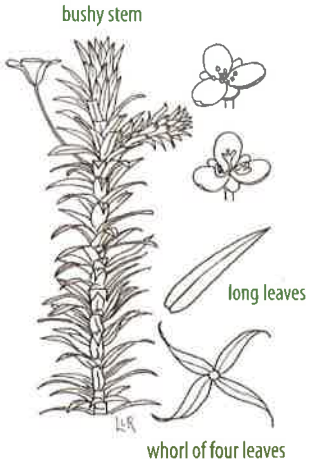
Widely introduced around the globe as a popular aquarium species, it becomes established when released from personal aquariums.

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 1–4 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 plants, 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. states west of the continental divide (excluding Nevada and Utah).

Both species of milfoil are established in the West: Idaho, Montana, New Mexico, Arizona, and Texas.

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. Same-day transport of plant fragments allows a significantly high risk of establishment.

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 can 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 and northern Argentina.

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.

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.

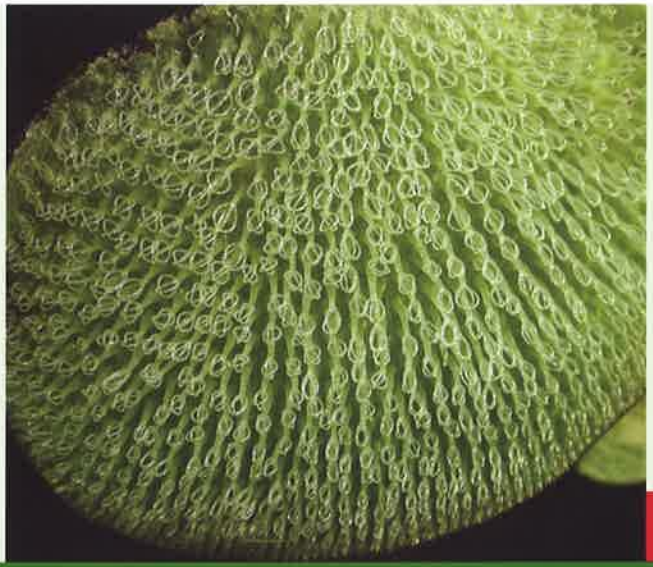
Wind and water currents can also spread salvinia.

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 but can grow to up to 6 cm.

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 for 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

REPORT THIS PLANT!

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 northern North America (Vancouver Island), 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. It is currently found in scattered populations in Washington, California, Idaho, Montana, Wyoming, Colorado, and Utah.

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*)

Samuel Chan, Oregon Sea Grant

Yellow flag iris forms dense islands that trap sediments and alter the flow of streams.

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.

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.

It was first found in the western U.S. in the 1950s, in California and western Montana.

Tania Siemens, Oregon Sea Grant

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.

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 and can survive in prolonged anoxic or drought conditions. The rhizome mats can prevent the germination and growth of other plants.

Many native organisms consume yellow flag iris, but it contains a toxic sugar derivative, thus vertebrates avoid it—especially its poisonous rhizomes.

USGS

Samuel Chan, 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 are 50–100 cm long by 1–3 cm wide, covered with a whitish wax, have raised mid-ribs, and have a fan-like, overlapping arrangement from the base.

Flowering typically occurs from April to June. It is the only yellow iris that occurs outside of cultivated areas (for example, wetlands), and its large, pale yellow to almost orange 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

Species at a Glance

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

Vigorous European cultivars of reed canarygrass were bred and planted for livestock forage and erosion control. In North America, several of these strains escaped to the natural environment and crossbred with native varieties, creating highly aggressive invasive populations.

Distribution

Although there is some disagreement as to the status of reed canarygrass in many parts of its range, it is considered 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, Argentina, Puerto Rico, Hawaii, and southern Asia.

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 (rhizomatic) 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. This highly productive plant commonly forms dense monotypic stands that exclude native plant species through rapid growth and extensive creeping rhizomes. During floods, mats of rhizomes (up to 2 ft thick) are carried downstream, where they invade new sites. Reed canarygrass can alter wetland function and hydrology by impeding drainages and increasing evapotranspiration rates.

Rare wetland plants are particularly vulnerable to reed canarygrass competition.

This plant offers minimal nutritional value for wildlife. It also provides 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, riparian areas, wet ditches, roadsides, and river floodplains disturbed by past grazing or soil movement. It can also flourish in dry soils, but it is especially prevalent in moist, low-elevation areas.

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 and then return to a tight spike formation, which often turns light purple in the late spring but fades to straw-colored 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 West 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.

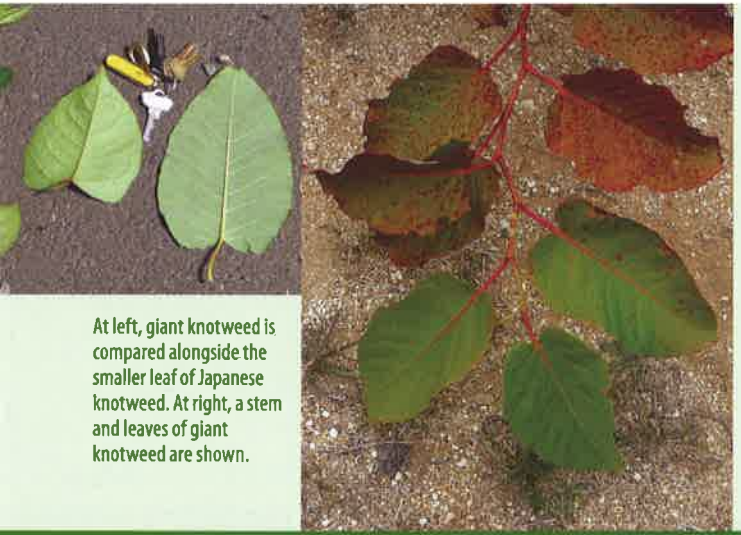
Knotweed generally spreads by vegetative fragmentation. Pieces of knotweed stem as small as 1 cm can become new plants, which grow rapidly. Removal efforts can result in fragmentation, which further spreads this invasive plant when fragments are transported by humans or animals. Cutting knotweed stimulates growth, and pulling may stimulate further sprouting in the potentially very large (up to 45 feet) root system.

Flood events aid dispersal by transporting plant fragments downstream to new sites and by disturbing habitat that knotweed can rapidly colonize.

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-disturbed riparian areas have been shown to degrade native salmon-spawning grounds.

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



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

Habitat

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

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 to reddish-brown in color.

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

YELLOW FLOATING HEART *(NYMPHOIDES PELTATA)*

Barbara Mumblo, Siskiyou Mountain Ranger District

SPECIES AT A GLANCE

Yellow floating heart is a water lily-like aquatic perennial plant used in water gardens that can aggressively cover lakes, ponds, and perennial wetlands by forming dense mats of foliage, stolons (horizontal stems capable of forming at the nodes), and rhizomes (root-like stems).

Yellow floating heart rapidly and easily spreads from one body of water to another through fragments and seeds flowing through waterways and attached to boats, boat trailers, recreational equipment, and waterfowl.

Yellow floating heart still has a limited distribution in the West; therefore, it is important to prevent its further establishment by cleaning equipment and reporting new infestations.

DISTRIBUTION

Yellow floating heart is a native of Eurasia and the Mediterranean area, as well as Japan, China, and India.

It is currently restricted to several sites in Oregon, Washington, California, and the midwestern and northeastern United States and Canada.

Barbara Mumblo, Siskiyou Mountain Ranger District

How This Species Spreads

Yellow floating heart was introduced as an ornamental plant and is spread as it escapes water gardens, is discarded into a waterway, or is moved by floodwaters.

Seeds, tubers, and plant fragments can rapidly disperse through interconnected water bodies and are also transported through recreation and waterfowl.

Habitat

Yellow floating heart inhabits the margins of slow-moving fresh water such as rivers, lakes, reservoirs, ponds, and wetlands. It grows rooted to the bottom in water depths of 2–13 feet and overwinters as dormant tubers.

Environmental Impacts

Yellow floating heart aggressively forms dense mats on the surface of the water, excluding native vegetation, trapping sediments, creating stagnant areas with reduced oxygen that can harm native plants, fish, and other aquatic life.

The dense mats also interfere with recreation and can create hazardous entanglement. Imagine trying to kayak, swim, or waterski in the stinky mat of yellow floating heart.

Recreation in pristine, isolated, mountain lakes with gear contaminated with yellow floating heart and other aquatic invasive species puts these delicate habitats in danger of infestation and impact.

Barbara Mumblo, Siskiyou Mountain Ranger District

Identification

Yellow floating heart can be distinguished by its small yellow flowers (3–4 cm in diameter) that are visible all summer from May to September. Flowers have 5 petals that are fringed and arranged like spokes on a wheel.

Shiny, heart-shaped floating leaves are 3–10 cm across and are purplish underneath. Flat and oval seeds are hairy along the edges and about 2–3 cm long. The seeds are produced abundantly and germinate readily.

Don't confuse yellow floating heart with the native yellow pond lily, spatterdock (also called pond lily or cow lily), which has yellow, ball-shaped flowers and large elephant ear-shaped leaves. Another native look-alike is water-shield, which has small, floating leaves with the underside often coated in a gelatinous slime.

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

Asian (Leaping/Jumping) Carp

Bighead Carp (*Aristichthys nobilis*)
Silver Carp (*Hypophthalmichthys molitrix*)

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

Bighead carp (*Aristichthys nobilis*) (Adult length: 66–91 cm).

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 are filter feeders that have been introduced around the world for controlling algae in aquaculture production, and by becoming established in new regions through flooding and releases.

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, from Russia to China. Bighead carp are native to southern and central China.

They have been introduced outside of their native range into Africa, Asia, 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. Silver carp have also been found in small populations in Colorado and Nevada. Bighead carp have been found in small populations in California, Wyoming, Arizona, New Mexico, and Texas.

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

Silver carp (*Hypophthalmichthys molitrix*) (Adult length: 61–81 cm).

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.

Since juvenile silver and bighead carp often resemble baitfish, bait-bucket transfers can introduce these species to new waterways.

Contaminated stocks of grass carp, introduced for plant control, have resulted in the spread of silver carp.

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 consume large amounts of phytoplankton and zooplankton and graze on aquatic vegetation, causing severe reductions in available food for native species. This behavior can put significant pressure on the base of the food chain and dramatically alter aquatic 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.

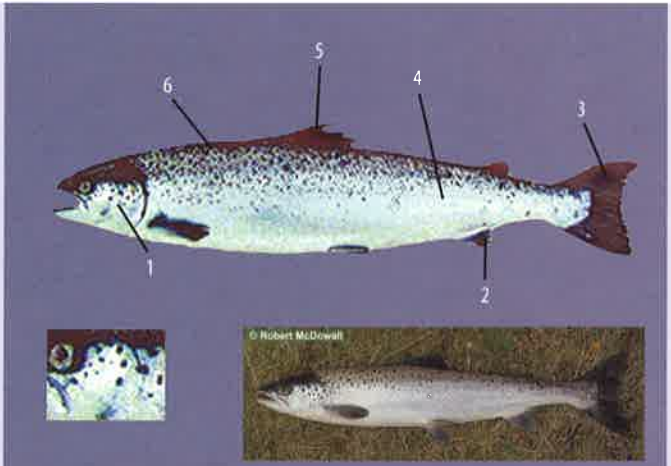
How this Species Spreads

Adult Atlantic salmon frequently escape from aquaculture facilities damaged by storms and other causes. The highly migratory nature of the fish enables populations to move great distances upon escape, and large numbers have been found in Alaskan waters. The species has also been intentionally introduced to increase fishing opportunities.

Environmental Impacts

Introduced Atlantic salmon populations could compete and possibly hybridize 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, such as viral hemorrhagic septicemia (VHS).



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

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 typically has 8–12 rays, differentiating Atlantic salmon from Pacific salmon species, which have 11–13 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

NONNATIVE CARP: GRASS CARP (*ARISTICHTHYS NOBILIS*) COMMON CARP (*CYPRINUS CARPIO*)

SPECIES AT A GLANCE

The common carp was widely introduced from Europe in the late 1800s as a food fish. Grass carp have more recently been introduced in some locations to help control nonnative aquatic vegetation. Its effectiveness at eliminating plant material has resulted in its introduction into all but five states in the U.S.

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

USDA Archives, www.invasive.org

HOW THESE SPECIES SPREAD

The grass carp was first introduced to aquaculture facilities in Alabama and Arkansas in 1963. Since then, it has often been introduced to control aquatic weeds. The carp has spread further through escapement from ponds and aquaculture facilities.

Although there is some discussion about the first introduction of the common carp to U.S. waters, it is largely accepted that it was first introduced in the late 1800s as a cultured food fish. Carp in farm ponds frequently escaped to open water through flood events or dam breaks; more recently, juvenile common carp used as bait fish have increased population growth and dispersal.

DISTRIBUTION

The grass carp is native to eastern Asia, from Russia to southern China. It has been introduced throughout the U.S. and is absent only from Alaska, Montana, Maine, Rhode Island, and Vermont.

The common carp is native to Eurasia. It evolved in the Caspian Sea, and migrated naturally to the Black and Aral Seas, east to eastern mainland Asia, and west as far as the Danube River. It has been introduced and recorded in every state of the U.S. except Alaska and Maine.

Environmental Impacts

Grass carp are filter feeders, and compete with many native species. Furthermore, the increased predation on plant material significantly alters the community structure, eliminating refuge for many juvenile fish. The presence of grass carp often increases the chances of algal blooms because of their digestive process.

The common carp is regarded as a pest fish because of its widespread abundance and its tendency to destroy vegetation and increase water turbidity by dislodging plants and rooting around in the substrate, causing deterioration of habitat for species requiring vegetation and clean water.

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

René Reyes, U.S. Dept. of the Interior, Bureau of Reclamation

Identification of Nonnative Carp

Grass carp are dark gray or silver to olive in color, with a long, slender body. They have a wide, scale-less head and a wide mouth. Their dorsal fin typically has 7–8 rays and their anal fin has 7–11 rays. They can reach lengths of over a meter and weigh up to 50 kg.

Carp hatch from tiny eggs, less than 0.4 inches (1 mm) in diameter, and grow to a weight of 33 pounds (15 kg) and a length of 40 inches (1 m) in 5 to 6 years. They can live for over 20 years. Carp have stocky bodies and large scales, and range in color from dark olive bronze on the top of the back to lighter silvery yellow on the belly. The color intensity varies to blend with the color of the water or the habitat background. The tail is forked with rounded lobes. The dorsal and ventral fins have stiff-barbed spine at the front followed by soft flexible rays.

Habitat

Grass carp tend to live in calm bodies of water such as ponds and lakes. They tolerate low salinity levels and have been found in brackish water. Furthermore, they have a fairly wide temperature range; reportedly they can survive for five months under ice cover.

Common carp generally inhabit lakes, ponds, and the lower sections of rivers, but they are also known to inhabit brackish estuaries, backwaters, and bays.

Nonnative Panfish

Pumpkinseed Sunfish (*Lepomis gibbosus*)
Bluegill (*Lepomis macrochirus*)
Yellow Perch (*Perca flavescens*)
Black Crappie (*Pomoxis nigromaculatus*)
Rock Bass (*Ambloplites rupestris*)

Species at a Glance

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 native trout populations.

Distribution

The pumpkinseed sunfish is native to the Atlantic Slope drainage in South Carolina, states that border the Great Lakes, Hudson Bay, and the Mississippi basin. It is also native to the states from Canada to North Dakota, Georgia to Kentucky, and Missouri and Maine.

Bluegill are native to most states that border the St. Lawrence River, the Great Lakes, and from the Mississipp River basins east. They are also native to Texas, Oklahoma, New York to Minnesota, northern Mexico, Missouri, south to the Gulf of Mexico, the Atlantic and Gulf Slope drainages from Virginia to Texas, New Mexico, and Wyoming.

Yellow perch are native from Maine to Georgia. They are also native to the Atlantic, Arctic, states that border the Great Lakes, Mississippi River basins from Quebec to Ohio, Illinois, the Dakotas, Missouri, Nebraska, and in the southern part of the Atlantic drainages from South Carolina to Georgia.

Black crappie are native to most states that border the Atlantic Slope, Mississippi River basins from Quebec to the Gulf, Texas, Oklahoma, and parts of Mexico and Canada.

Rock bass are native to the St. Lawrence River, states that border the Great Lakes, Hudson Bay, some of the states that border the Mississippi River basins from Quebec south, the Savannah River drainage, Georgia, northern Alabama, and Missouri.

All of these species have been introduced throughout the continental U.S. and are found in all of the western states.

How these Species Spread

These species have been introduced for recreational fishing. They have been able to spread further due to connecting water systems.

Sam Chan, Oregon Sea Grant

Environmental Impacts

Pumpkinseed sunfish can hybridize with other sunfish, often resulting in a large, sterile male. Furthermore, pumpkinseed sunfish compete with native species and can decimate macroinvertebrate populations, altering the community structure of the ecosystem.

Bluegill are aggressive fish that outcompete native species. In California, bluegill chase the native Sacramento perch from spawning grounds and other favorable habitat, leaving the perch more vulnerable to predation.

Yellow perch often compete with native species such as trout and may prey on the juveniles.

Black crappie are known to prey on the juveniles of endangered native species, most notably salmonids in the Pacific Northwest.

Rock bass affect populations of native species through competition and hybridization.

Habitat

Panfish live in water bodies that have little to no current. They tend to live around areas that provide debris they can use for cover.

These nonnative panfish often flourish in waterways that are now too warm to support healthy trout populations, but they can also survive in cooler waters where juvenile salmon and trout can survive as well.

Identification of Nonnative Panfish

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

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

Pumpkinseed sunfish are colorful, round fish. They have brown spots and orange bellies, with a characteristic red-orange spot behind the gill slit.

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

Bluegill are distinguishable from other sunfish by the dark spots at the base of the dorsal fin and the bars on their sides.

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

Yellow perch are yellowish with dark bands that run vertically on their sides. Their average length is about six inches and their weight about 1/3 pound.

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

Black crappie resemble white crappie but have subtle differences. The black crappie is silvery-green in color and has dark blotches instead of vertical bars on its sides.

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

Rock bass have a dorsal fin that is divided into two portions: spiny and soft-rayed sections. They are capable of changing the shade of their body from light to dark, so coloration is not the most reliable means of identification. They have red eyes and a large mouth compared to their body size.

Nonnative Gamefish

Smallmouth Bass (*Micropterus dolomieu*)
Largemouth Bass (*Micropterus salmoides*)
Walleye (*Stizostedion vitreum*)
Northern Pike (*Esox lucius*)
Muskellunge (*Esox masquinongy*)

Species at a Glance

These aggressive gamefish have been introduced across much of the Pacific Northwest and throughout the U.S. due to their popularity with recreational fishermen. They can reduce populations of native trout, salmon, and other native species through predation and competition.

Distribution

Smallmouth bass are native to the St. Lawrence River, the Great Lakes, Hudson Bay, and states that border the Mississippi River basins from southern Quebec to North Dakota and south to Alabama and Oklahoma, and the Atlantic and Gulf Slope drainages from Virginia to Texas, except for Louisiana. They are also native to Vermont, New York, Michigan, and the Dakotas.

Largemouth bass are native to the St. Lawrence River, the Great Lakes, Hudson Bay, and states that border the Mississippi River basins from southern Quebec to Minnesota and south to the Gulf of Mexico, the Atlantic Slope drainages from North Carolina to Missouri. They are also native to Texas, Nebraska, Kansas, Alabama, Georgia, and Florida, and to the Gulf Slope drainages from southern Florida to northern Mexico.

Walleye are native to the St. Lawrence River, states that border the Great Lakes, the Arctic, and states that border the Mississippi River basins from Quebec to Alabama and Arkansas. They are also native to the Dakotas, Oklahoma, Kansas, and Nebraska.

Northern pike are native to the Atlantic, Arctic, Pacific, states that border the Great Lakes, and Mississippi River basins from Labrador to Alaska and south to Pennsylvania, Missouri, and Nebraska. They are also native to the South Saskatchewan River drainage, and are found in Montana, parts of the Dakotas, Nebraska, Iowa, and Missouri.

Muskellunge are native to the St. Lawrence River, states that border the Great Lakes, Hudson Bay, Kentucky, the Carolinas, Mississippi River basins from Quebec to Manitoba, the Appalachians to parts of Georgia, and in Iowa.

These species have been introduced throughout the U.S. and are found throughout the western region. However, northern pike are not as widespread as the other species.

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

NONNATIVE GAMEFISH *CONTINUED*

HOW THESE SPECIES SPREAD

These species have been and continue to be introduced for recreational fishing. Northern pike have also been introduced to control other species such as shad and carp.

Abby Mertz

ENVIRONMENTAL IMPACTS

Smallmouth and largemouth bass often feed on native species. Smallmouth bass have been known to feed on juvenile salmonids on the Pacific coast, particularly in the Columbia River. They have also hybridized with Guadalupe bass in Texas, compromising the genetic makeup of the native species.

Walleye are voracious predators and often reduce the populations of native species through predation. Most notably, they feed on the smolt of Pacific salmonids, significantly increasing the predation pressure on the fragile stocks.

Much like walleye, northern pike consume large amounts of prey. They have eliminated populations of native species and alter community structures. Northern pike have also been known to hybridize with native muskellunge, creating sterile males.

Much like the other gamefish, muskellunge reduce the population of smaller fish.

HABITAT

Smallmouth bass prefer clear lakes or rivers. They tend to live in cooler water.

Largemouth bass are often found in calm, clear water. They also tend to live around structure such as docks, logs, and rocks.

Northern pike and walleye need clean water with adequate structure. Furthermore, they need wetlands and marshes to provide spawning habitat.

Muskellunge are typically found in calm waters with heavy vegetation and structure.

Identification of Nonnative Gamefish

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

Smallmouth bass are generally green with vertical bars on their sides. There are 13 to 15 rays on their dorsal fin. Smallmouth bass are often smaller than largemouth bass, with large fish being in the eight-pound range. Also, as their name suggests, they have smaller mouths than largemouth bass.

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

Largemouth bass are often dark green with blotches that form a horizontal line down the middle of the body. Their belly is light in color and they have a dorsal fin that is essentially divided into two parts.

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

Walleye have two distinct dorsal fins: a spiny fin and a soft-rayed one. They have white edges on their caudal and anal fins. Lastly, they have a distinctive, cloudy appearance to their eyes.

Northern pike are long, slender fish, with a matching mouth. They are olive green in color and have lighter spots throughout their body.

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

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

Muskellunge resemble northern pike in size and shape, but muskellunge are lighter green in color, with dark spots and vertical bars.

Nonnative Trout

Rainbow Trout (*Oncorhynchus mykiss*)
Brown Trout (*Salmo trutta*)
Brook Trout (*Salvelinus fontinalis*)
Lake Trout (*Salvelinus namaycush*)

Species at a Glance

Nonnative trout species were introduced to develop recreational fisheries. They often displace native trout populations through competition and predation. There have also been recordings of these species hybridizing with native species.

Alaska Dept. Fish & Game

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

Distribution

Rainbow trout are native to the Pacific Slope from Alaska to Baja California, the Mackenzie River drainage in Alberta and British Columbia, and in the river basins of states that border the Pacific Ocean and Idaho.

Brown trout are native to Europe, northern Africa, and western Asia, and were first introduced in the late 1800s.

Brook trout are native to most of eastern Canada, Newfoundland, Maine, Hudson Bay, North Carolina; and in the Atlantic, Great Lakes, and Mississippi River basins from Tennessee southward. They are also native to Michigan, Wisconsin, Minnesota to northern Georgia, and Iowa.

Lake trout are native to northern Canada, Alaska, New England, and the Great Lakes basin. They are also native to Waterton Lake, Glenns Lake, Cosley Lake, and St. Mary Lake in northeastern Montana, and to Elk Lake and Twin Lake in southwestern Montana.

These species have been introduced throughout the U.S.

How these Species Spread

These species have been and currently are stocked to promote recreational fishing.

Habitat

Trout tend to thrive in cool, clear water. Due to stocking, they can be found in a number of water bodies, ranging from ponds to rivers.

Environmental Impacts

Rainbow trout often hybridize with native species, affecting their genetics. The stocking of rainbow trout has introduced diseases to several water bodies, which can also be detrimental to native species. Rainbow trout compete with some native species and consume others.

Brown trout displace native species through competition and predation.

Brook trout have replaced several native trout species, including the greenback cutthroat trout in Black Hallow Creek in Colorado. Furthermore, there have been records of brook trout displacing golden trout, the former state fish of California.

Lake trout have eliminated native trout species through competition and predation. In Lake Tahoe, the native Lahontan cutthroat species went extinct after the introduction of lake trout.

Identification of Nonnative Trout

Rainbow trout *(Oncorhynchus mykiss)*
(Adult length: 51–58 cm).

Rainbow trout have a distinctive color scheme with green on the top, pink in the middle, and white on the bottom. They also have dark spots throughout the upper half of their bodies.

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

Brown trout gradually transition from brown on the top to silver on the belly. They have dark spots on the top of their sides and red spots in the middle.

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

Brook trout are distinguishable from other trout species by the white edges on the caudal, pectoral, and anal fins. They are dark brown to olive on the top and silvery-white on their bellies. Furthermore, they have yellow to red spots covering their sides.

Lake trout *(Salvelinus fontinalis)*
(Adult length: 46–61 cm).

Lake trout often have dark green sides with a light yellow belly. They also have light-colored spots throughout their bodies.

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

Nonnative Anadromous Fish

Striped Bass (*Morone saxatilis*)
American Shad (*Alosa sapidissima*)

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

Maryland Dept. of Natural Resources

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

New York State Dept. of Environmental Conservation

Species at a Glance

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.

Distribution

Striped bass are native to states that border the Atlantic drainages from the St. Lawrence River to the Florida Ocean, and the Gulf Slope drainage from Louisiana to Florida.

American shad are native to the states that border the Atlantic coast from Labrador to Florida.

Striped bass have been introduced throughout the continental U.S., and the American shad has been introduced to Alaska.

How these Species Spread

Striped bass have been introduced for recreational fishing. After introduction, striped bass can spread further by utilizing connecting waterways.

American shad have been introduced for recreational fishing, as well as for food and forage. The species was originally introduced to California in the 1800s, but then spread to Oregon, Washington, and Alaska.

Tor Benson

Environmental Impacts

Striped bass often prey upon native species, increasing the predation pressure on these species.

American shad provide competition for the juvenile stages of many native species, including the Pacific salmonids. Furthermore, they may transmit parasites to native species, as well as to humans who consume the fish.

Habitat

Striped bass and American shad usually do not venture more than a few miles from the coast. They are often caught in the mouths of rivers and estuaries. Their migration into rivers is usually for reproduction. They are found in freshwater lakes because they were intentionally stocked.

Identification

Striped bass are most notable for their silvery body with dark horizontal stripes that run along the sides. They have two spines on the gill covers, and their dorsal fin is divided and resembles two separate fins.

American shad have a dark green-blue back with a silver side. They have a distinctive line of black spots that run from the back of the gill slits to the dorsal fin.

NONNATIVE CATFISH

CHANNEL CATFISH (*ICTALURUS PUNCTATUS*)
BLACK BULLHEAD (*AMEIURUS MELAS*)
BROWN BULLHEAD (*AMEIURUS NEBULOSUS*)

SPECIES AT A GLANCE

Catfish have been introduced to the western U.S. for food and recreational fishing. They grow to large sizes and are capable of surviving in a variety of water bodies, which makes them popular for recreational fishing. These are three of the most common nonnative catfish species now found in the region.

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

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

DISTRIBUTION

Channel catfish are native to the Great Lakes, the Hudson Bay, the Missouri-Mississippi River basins from Canada to the Gulf of Mexico, and from Montana to New York and south.

Brown bullhead are native to states that border the Atlantic and Gulf Slope drainages from Nova Scotia to Alabama, ocean states that border the St. Lawrence, the Great Lakes, Hudson Bay, and states that border the Mississippi River basins from Quebec to Louisiana.

Black bullhead are native to the Great Lakes, Hudson Bay, the Mississippi River basins from Montana to New York to Montana, and south to the Gulf of Mexico. They are also native to the Gulf Slope drainages from Georgia and Alabama to northern Mexico, except for Florida, Massachusetts, South Carolina, Delaware, and New Jersey.

These species have both been introduced to the entire continental U.S. The black bullhead has not been introduced as densely as the other species.

How these Species Spread

All of these species are introduced for food and recreational fishing. The channel catfish was first introduced into the Colorado basin in the early 1900s. Black bullhead may have also been introduced through stock contamination when other catfish species were introduced.

Environmental Impacts

Channel catfish often prey upon smaller fish. This has resulted in the reduction in many species, including several endangered species such as the Colorado squawfish and the humpback chub.

The impacts of introduced brown bullhead are unknown at present.

Black bullhead consume native species such as the endangered humpback chub in the Little Colorado River. They also compete with native species for the best habitats.

Habitat

Channel catfish are often found in water bodies with slow currents. These are also often water bodies that are stocked for recreational fishing.

Black bullhead live in water bodies that contain structures where they can hide and reproduce.

Brown bullhead can live in both fresh and brackish water, thus making it a very hardy fish.

Identification

Channel catfish are easily distinguishable from all other catfish, except blue catfish, by their forked tail. One difference between the channel catfish and blue catfish is that channel catfish have up to 29 rays in their anal fin, whereas blue catfish often have 30 or more rays. They are olive-brown to blue in color, with a white belly.

Black bullhead are greenish-black to black on the top and white on their belly. Their anal fin has between 17 and 21 rays, and their barbels are dark.

Brown bullhead are dark brown on top and offwhite on the belly. They are scaleless and have a sharp spine at the base of the dorsal and pectoral fins.

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

All catfish images provided by the New York State Dept. of Environmental Conservation

Nonnative Aquarium and Ornamental Fish

Goldfish (*Carassius auratus*)
Oriental Weatherfish (*Misgurnus anguillicaudatus*)

Species at a Glance

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.

Distribution

Goldfish are native to eastern Asia and possibly Europe, and Oriental weatherfish are native to eastern Asia.

These species have been introduced into every state except Alaska.

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

Charlene Simpson

Environmental Impacts

Goldfish are capable of reproducing very quickly, resulting in large numbers that compete with native species for food and space. The Sacramento sucker is one species that has suffered from the introduction of goldfish.

Oriental weatherfish compete with native fish species for food, often significantly reducing the insect population.

Tommy McDonald

Habitat

Goldfish are typically found in calm waters with vegetation that can be used for cover. They are capable of surviving in a range of water conditions, allowing them to thrive in a variety of water bodies.

Oriental weatherfish are often found in the muddy bottom of shallow water. They tend to stay where there is vegetation to hide in.

Identification

Although goldfish are known for their golden-orange coloration, they are not always that color. They can range from olive green to off-white. They have a long dorsal fin with 15 to 21 rays, and a spine at the base of the dorsal and anal fins.

Weatherfish have eel-like bodies, and are brown with greenish grey-brown marble markings dorsally and a pale silver belly. The mouth is small and narrow with thick, fleshy lips and surrounded by six barbels. They have a stout spine on their pectoral fin and 9 dorsal rays, 6 to 7 pelvic rays, and 7 to 8 anal rays.

M.E. Brown (USGS)

B. Albert (USGS)

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

How these Species Spread

Originally, goldfish were released to increase the amount of fish in North America. Currently this species spreads through the release of unwanted aquarium pets.

Oriental weatherfish have been released as unwanted aquarium pets, by escaping from private ponds, and possibly to serve as a source of food.

More Nonnative Fish

Mosquitofish (*Gambusia affinis*)

Mosquitofish (*Gambusia affinis*) 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.

Robert McDowall

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

Tui Chub (*Gila bicolor*)

Although native to many waterways in the Pacific Northwest, the tui chub (*Gila bicolor*) 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.

Oregon Dept. of Fish & Wildlife

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

Northern Snakehead (*Channa argus*)

The northern snakehead (*Channa argus*) 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.

USDA Archives, www.invasive.org

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

AIS Report Contacts

(all URLs last accessed 13 December 2013)

ORGANIZATION	Contact
ANS Task Force	www.anstaskforce.gov
Center for Invasive Species and Ecosystem Health	www.invasive.org
Stop Aquatic Hitchhikers	www.protectyourwaters.net
U.S. Fish and Wildlife Service Invasive Species	www.fws.gov/invasives
U.S. Geological Survey Nonindigenous Aquatic Species	http://nas.er.usgs.gov
Aquatic Nuisance Species Project	www.aquaticnuisance.org

Nancy Leeper

STATE	Contact
Alaska	1-877-INVASIV (1-877-468-2748)
Arizona	AISComments@azgfd.gov
California	www.dfg.ca.gov/invasives/inv_reporting/sightingReport.html; *California Invasive Species Program:* 1-866-440-9530
Colorado	ReportANS@state.co.us; 1-303-291-7362
Idaho	1-877-336-8676
Kansas	http://kdwpt.state.ks.us/Fishing/Aquatic-Nuisance-Species/Report-an-Aquatic-Nuisance-Species
Montana	fwp.mt.gov/fishAndWildlife/species/ais/inspectCleanDry.html; 1-406-444-2449
Nebraska	http://snr.unl.edu/invasives/hotline.htm; 1-402-472-3133
Nevada	1-775-688-1314
New Mexico	*Public Information/Outreach:* 1-505-476-8000 *Operation Game Thief:* 1-800-432-4263
North Dakota	*North Dakota Game and Fish Department:* ndgf@nd.gov; 701-328-6300; fryckman@nd.gov.
Oregon	OregonInvasivesHotline.org; 1-866-INVADER (877-468-2337)
South Dakota	http://gfp.sd.gov/wildlife/nuisance/aquatic/report-ANS.aspx
Texas	www.texasinvasives.org/action/report.php
Utah	http://wildlife.utah.gov/dwr; 1-800-662-3337
Washington	http://wdfw.wa.gov/ais/reporting/; 1-877-9-INFEST (877-946-3378)
Wyoming	http://wgfd.wyo.gov/web2011/fishing-1000206.aspx; 1-877-WGFD-AIS (1-877-943-3247)
British Columbia	*Invasive Species Council of BC:* 1-888-933-3722 *BC Ministry of Environment:* 250-387-9500

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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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