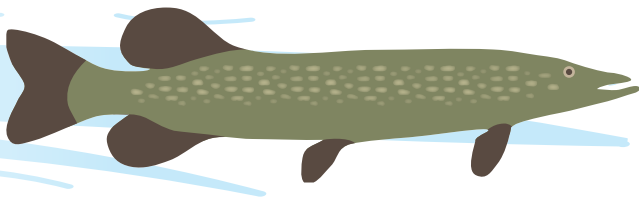


Impacts of Aquatic Invasive Species on Salmon

What is an invasive species?

A species of plant, animal or insect that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Aquatic invasive species primarily live in water. Invasive species are most often spread through deliberate or accidental human transport.

Two invasive species immediately threaten salmon and fisheries in the Mat-Su



► Northern pike (*Esox lucius*)

- A fish that is native to most of Alaska within the area north and west of the Alaska Range. Pike were intentionally introduced in Southcentral Alaska and have become an invasive species in the Mat-Su Basin, due to their preference for habitat similar to that of juvenile salmon (particularly coho, sockeye, and Chinook salmon, and also rainbow trout) and the lack of natural predators in the region.
- Voracious predator of juvenile salmon and native resident fish
- Invade vast systems of streams and lakes
- How they spread:
 - » Deliberate and illegal transport and release of live fish
 - » Natural mechanisms such as lake flooding and movement via interconnected waterways
 - » By law, live specimens cannot be transported, possessed, exported, or released into state waters without a permit

Keep Alaska wild and free of invasive species

Individuals are affected by invasive species' impacts on boat and floatplane operation, other water recreation activities, and recreational fisheries. Property values can also be affected.

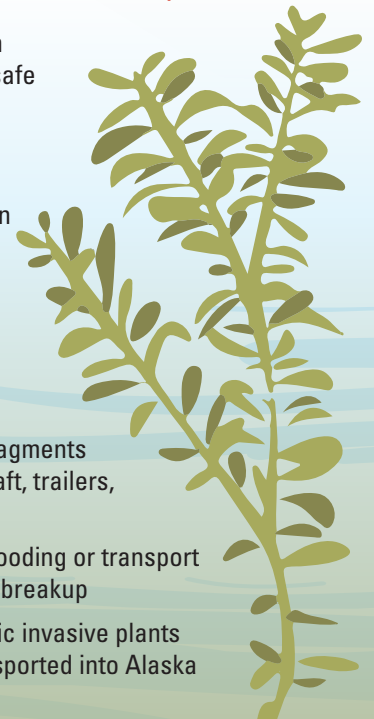
Businesses and local economies rely on fisheries, boating, and floatplane opportunities that are impacted by invasive species.

The **State of Alaska** and the **Matanuska-Susitna Borough** spend money and staff resources on invasive species management and eradication.

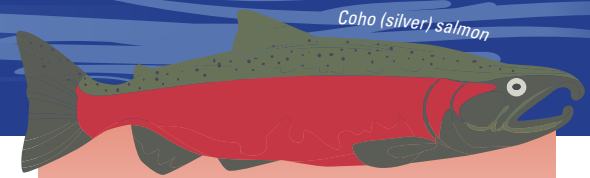


► Elodea (*Elodea canadensis* and *Elodea nuttallii*)

- An invasive aquatic plant that can grow in thick mats, endangering safe boat and floatplane operation and reducing recreation opportunities
- Displaces native plants and when in high density, can reduce oxygen levels, degrading salmon habitat
- How it spreads:
 - » Deliberate human actions such as illegal release of aquariums into waterbodies
 - » Accidental activities such as fragments caught on floatplanes, watercraft, trailers, or gear used in infested waters
 - » Natural mechanisms such as flooding or transport on ice in flowing waters during breakup
 - » By law, Elodea and other aquatic invasive plants cannot be bought, sold, or transported into Alaska



Why are Aquatic Invasive Species a Problem?



Salmon are a critical economic and cultural resource for communities across the state. In Southcentral Alaska, wholesale values of salmon were \$445 million in 2018.²

Economic and cultural impacts

In Alaska, invasive species threaten natural resources, such as salmon, transportation infrastructure, such as boating and floatplane use, and the economic and cultural benefits they provide.

Management costs

- Preventing the introduction of invasive species is the most cost-effective approach and saves money in the long term
- Once invasive species are introduced and establish themselves, they are very expensive to continually manage
- Source for new infestations if unmanaged
 - » Lakes infested with Elodea will be a source for new infestations across the state, threatening salmon habitat and increasing future management costs

Fisheries and tourism

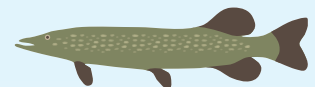
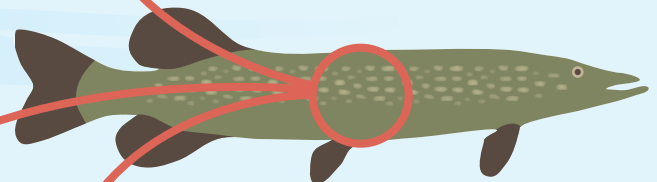
- Pike are currently causing declines in highly productive salmon fisheries, such as Alexander Creek¹
 - » Healthy native fish stocks are essential for tourism services, including sportfish guides, lodges, and commercial air service to fishing areas
- Elodea could cost Cook Inlet commercial sockeye fisheries \$23 million annually³
- Elodea may negatively impact subsistence fisheries for Chinook salmon throughout Alaska⁴

Ecological impacts

Invasive species impact ecosystems by altering habitats, competing with native species for food and territory, and changing existing predator-prey relationships.

Reduced salmon populations

- Pike consume large numbers of stocked and migrating salmon fry/juvenile salmon, reducing the populations of salmon in Mat-Su waterbodies where habitats overlap
 - » Pike prefer the same type of habitat (shallow, low flow, vegetated waters) as Chinook and coho salmon juveniles, increasing the threat to these two salmon species
 - » Pink and chum salmon are least affected because juvenile time in freshwater is limited
 - » Most juvenile sockeye salmon rear in locations not preferred by pike, but can be particularly vulnerable to predation during their outmigration or when they occur in shallow lakes
- Pike may displace salmon
 - » Several waterbodies in the Mat-Su Basin that once contained resident fish now contain only pike
 - » Collapse of salmon populations is possible and has occurred in some cases
- Elodea is predicted to have negative long-term effects on salmon populations



“Invasive species are one of the most significant drivers of environmental degradation and species extinction worldwide and are generally considered the primary cause of biodiversity loss in freshwater and island ecosystems.”

- Safeguarding America’s Lands and Waters from Invasive Species: A National Framework for Early Detection and Rapid Response



Where has Elodea invaded?

▶ In the Mat-Su, Elodea has impacted Alexander, Sucker, and Big Lakes



▶ Elodea has been successfully eradicated with herbicides from lakes in Anchorage and the Kenai Peninsula

Boating and floatplane activities, property value

- Elodea poses safety hazard for floatplanes, boats, and paddling
- Recreational floatplanes
 - » Impedes floatplane launching and fouls rudders
- Boating activities
 - » Makes boat travel difficult by fouling propellers and reduces recreation opportunities
 - » Impedes boat launching, navigation, and fishing
- Waterfront property value and business
 - » Reduces value of waterfront property and may financially impact businesses associated with water-related activities



Degraded salmon habitat and improved pike habitat⁵⁻⁸

- Elodea degrades salmon rearing, spawning, and foraging habitat
 - » Decreases water flow and increases sedimentation
 - » Impedes nutrient availability
 - » Lowers levels of dissolved oxygen when large mats are decaying at the same time
- Elodea displaces native flora and fauna
 - » Could displace salmon altogether
- Improves and creates additional spawning and rearing habitat for northern pike, and when very dense may push adult pike out of lakes downstream, exacerbating the impacts of pike predation on juvenile salmon



Ecosystem impacts

- Pike decrease biodiversity where there is not a variety of habitats where other species can avoid predation
- Removes salmon as a food source for predators like bears and eagles
- Pike predation on salmon deprives the surrounding ecosystem of nutrients from decaying salmon carcasses

“Salmon play a crucial part in sustaining watersheds, adding nutrients to aquatic systems, and are an important food for bears, eagles, and other wildlife.”

- Union of Concerned Scientists Invasive Species: Alaska

Best Practices

“If actions are not taken to control and/or eradicate northern pike in waters outside their native range, continued adverse impacts to Alaska’s environment and economy are certain.”

-ADF&G Management Plan for Invasive Northern Pike in Alaska

Leadership, initiative, cooperation, funding, and fast action are all needed to solve this growing problem.⁹ Below are the most effective and efficient control methods and best management practices for invasive species.

GOAL: No new aquatic invasive species

Action: Prevent and limit the introduction and spread of aquatic invasive species

<ul style="list-style-type: none"> • Current regulations <ul style="list-style-type: none"> » It is illegal to buy, sell, or transport Elodea and other aquatic invasive plants within Alaska, and these plants are prohibited from entering state boundaries. » It is illegal to transport, possess, export, or release live fish or fish eggs into state waters. 	<ul style="list-style-type: none"> • Individual actions <ul style="list-style-type: none"> » Outreach and education » Never release plants, water, fish, or animals into a body of water unless they came from that water body. 	<ul style="list-style-type: none"> » CLEAN: Remove visible plants, mud, and animals from equipment » DRAIN: Drain water from equipment » DRY: Dry anything that came in contact with water » Learn more at www.stopaquaticchitchhikers.org » To report Elodea, pike, or any other invasive species, contact the Invasive Species hotline: 1-877-INVASIV (1-877-468-2748)
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GOAL: Manage existing populations

The best method for managing invasive species populations is often a combination of cultural/individual, chemical, and physical control strategies that are most appropriate for a particular waterbody and infestation level and that will have the least impacts on the surrounding ecosystem and human health. Agency, landowner, and citizen coordination is key to successful containment and eradication. Currently, there is an Integrated Pest Management strategy for Elodea and a management plan for invasive northern pike in Alaska.

Action: Contain, suppress, and eradicate

<ul style="list-style-type: none"> • Physical actions (northern pike) <ul style="list-style-type: none"> » Physical removal of fish from waterbodies via netting – labor intensive and must be repeated regularly. Does not completely remove pike, but drives down populations which reduces predation on native fish. » Draining all the water – completely removes pike and other fish but challenging to do and may not be realistic for many waterbodies. Requires draining infrastructure to be in place. 	<ul style="list-style-type: none"> • Chemical actions (northern pike) <ul style="list-style-type: none"> » Rotenone: a naturally-derived (from plant roots) fish pesticide used since the 1930s and registered by the Environmental Protection Agency – completely removes pike and “does not negatively affect human health or the environment in the concentrations used for fisheries management.”¹⁰ <ul style="list-style-type: none"> – Removes all fish from the waterbody. Native resident fish need to be reintroduced after pike are eradicated. – In most cases, chemical treatment is more effective and practical than draining. – Breaks down within a few weeks to months after treatment. No impacts to surrounding water systems or drinking water have been documented. 	<ul style="list-style-type: none"> • Chemical actions (Elodea) <ul style="list-style-type: none"> » Fluridone: herbicide applied to all or part of a waterbody that selectively kills Elodea with little impact on native aquatic plants – most effective management option. <ul style="list-style-type: none"> – Native plants are minimally affected by fluridone at target concentrations for Elodea, and if affected tend to re-establish naturally. – Requires multiple treatments during growing season. – Does not impact fish in concentrations used for treatment. » Diquat: herbicide applied to a specific area that kills all aquatic plants on contact, but does not typically kill rooted vegetation. <ul style="list-style-type: none"> – Effective but may require restoration of native plant populations in the targeted area. – Binds to sediment but is not biologically available to plants or microorganisms. – Does not impact fish in concentrations used for treatment. » Both herbicides break down within a few days to months after treatment, depending on conditions. No impacts to surrounding water systems or drinking water have been documented.
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Action: Champion and financially support management policies and rapid response

<ul style="list-style-type: none"> • Champion and financially support control and eradication efforts statewide for Elodea. 	<ul style="list-style-type: none"> • Rapid Response Funding <ul style="list-style-type: none"> » Support the establishment of a statewide rapid response fund to ensure adequate resources are available to quickly respond to new infestations of aquatic invasive species. 	<ul style="list-style-type: none"> • Invest early in managing aquatic invasive species to save communities and the state millions of dollars in the long term. 	<ul style="list-style-type: none"> • Ensure lead agencies (DNR and ADF&G) addressing aquatic invasive species in Alaska are adequately staffed and have resources to address and manage current and emerging invasive species issues.
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