



AQUATIC

Invasive Species Water Steward Handbook

SECOND EDITION



ONTARIO'S
**INVADING
SPECIES**
AWARENESS PROGRAM

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Grow Grant Program.



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INVASIVE SPECIES WHAT ARE THEY?

The term “invasive species” refers to a plant, animal, or micro-organism that has been introduced into an area outside of its natural range and has the potential to cause harm to the surrounding environment, economy, or society, including human health.

While these species are naturally controlled by predators, parasites, pathogens, and competing species within their native range, once they have been introduced to our environments, they often lack these natural controls. As a result, invasive species have a competitive advantage over our native organisms and often outcompete, overcrowd, and otherwise kill-off native species. This disruption can lead to a severe ecological unbalance, as well as extensive economic losses to industries, such as tourism, recreation, and fisheries.

With over 250,000 lakes and over 100,000 km of rivers, Ontario has experienced significant impacts from unintentional introduction of aquatic invasive species (AIS). For example, the spread of zebra mussels throughout much of southern Ontario has resulted in dramatic changes to our waterways, such as: increased water clarity, decreased food stores for our juvenile fish species, fouling of recreational watercraft and docks, cutting of swimmers’ feet, as well as the near extirpation of our native clam species.



*Photo credit: Randy Westbrooks,
Invasive Plant Control, Inc., Bugwood.org*

GREAT LAKES AIS LANDING BLITZ

In 2019, Great Lakes States and Provincial natural resource agencies, in cooperation with key partners (e.g., Sea Grant network) implemented a regional Great Lakes AIS outreach event called the Great Lakes Regional AIS “Landing Blitz”. The focus of this initiative is to educate recreational boaters and anglers about invasive species, and the need to Clean, Drain, Dry their boats, by engaging with them at boat-launches across the Great Lakes.

In its first year, the Great Lakes AIS Landing Blitz held events at over 440 locations in the US and Canada.

THE WATER STEWARD PROGRAM

With funding from the Ontario Trillium Foundation's Grow Grant program, the OFAH has brought the spirit and message of the Landing Blitz further inland to ensure that we continue to protect all of Ontario's valuable water resources.

Like the Great Lakes AIS Landing Blitz, the Water Steward Program focuses on having volunteer-run boater-engagement events at boat launch locations, where volunteers and ISAP staff can educate boaters and anglers on AIS prevention, species information, and more.

BEING AN AIS WATER STEWARD

This AIS Water Steward Handbook outlines the standards, procedures, and background information required to effectively engage the public on the issue of AIS. As a volunteer AIS Water Steward, your role will be to:

- **Educate recreational boaters on the pathways, impacts, and identification of AIS;**
- **Promote preventative behaviours among recreational boaters; and**
- **Encourage and train recreational boaters to actively reduce the spread of AIS through voluntary AIS-checks.**

KEY MESSAGES

There are three key messages to convey to boaters while in the field:

1 PREVENTING THE SPREAD OF AIS TO PROTECT RECREATION

Although the influence of AIS is far reaching, recreationalists, like boaters, are some of the most directly affected by their spread. A survey

conducted by the Ontario Federation of Anglers and Hunters (OFAH) in 2018 found that boaters and anglers were most willing to take action against AIS for the following three reasons:



Photo credit: 'Photo 28529966' by Jonathan Gagnon, CC BY NC 4.0, at <https://www.inaturalist.org/photos/28529966>

• **The introduction of AIS into a waterway can have significant negative impacts on populations of native fish and wildlife species.** For example, researchers believe that spiny waterfleas are the greatest threat to the biodiversity and structure of native zooplankton communities in the Canadian Shield since acid rain. These AIS reduce native zooplankton populations by an average of 30 to 40% per lake, depleting a vital food source for young sportfish. A study published in January, 2020, found that juvenile walleye grow 12 to 14% slower in lakes where both spiny waterflea and zebra mussels exist (such as Lake of the Woods) than they do in waterbodies without¹.



Photo credit: Nathan Robbins

- **AIS compromise the natural beauty of our waterways.** Many species of invasive aquatic plants, such as Eurasian water-milfoil, water soldier, and curly-leaved pondweed form dense mats of vegetation, which smother native plant species and spread across large swaths of water. These monocultures often clog up travel corridors and make recreational use of the waterway extremely difficult. Some of these plants, such as Eurasian water-milfoil, can increase the likelihood of algal blooms due to large-scale decomposition.
- **AIS cause damage to both human health and equipment.** For example, in addition to their ecological impacts, zebra mussels are well known for fouling motors, boat hulls, docks, as well as being a hazard to swimmers, due to their razor-like shells.

¹ Hansen, G.J.A., Ahrenstorff, T.D., Bethke, B.J. et al. "Walleye growth declines following zebra mussel and Bythotrephes invasion." *Biol Invasions* no.22 (2020): 1489, <https://doi.org/10.1007/s10530-020-02198-5>

Note: Anglers should consider the additional step of “**dispose**”. Proper disposal of bait is crucial to reducing the spread of AIS. Instruct anglers to dump unused bait and explain that it is illegal to dump the contents of a bait bucket or live or dead bait either directly into the water or within 30 metres of it. This is important

for preventing the spread of species such as Round Goby and the pathogen, viral hemorrhagic septicemia (VHS). Encourage anglers to always source their bait locally.



*A Round Goby is caught in a minnow trap.
Photo credit: "Photo 100557773" by Inland Seas Education Association, CC BY-NC 4.0 at <https://www.inaturalist.org/photos/100557773>*

2 CLEAN, DRAIN, DRY: EVERY LAKE - EVERY TIME

The Clean, Drain, Dry message should be central to your interactions with boaters. Be sure to highlight which parts of your AIS-check are required by law (**Clean** and **Drain**) and why the additional step of **drying** is important.

✓ **CLEAN** the boat and all related equipment before leaving the waterbody and ensure it is clean before entering a new one. Look for any mud, vegetation, mussels, or other suspicious debris stuck in or on the vessel and its equipment.

✓ **DRAIN** before leaving a waterbody. Drain all standing water by pulling the transom plug, draining the live-well, lowering the motor, and draining all other water-containing devices on the vessel. Draining helps to eliminate small organisms, such as spiny waterfleas and zebra mussel larvae from the vessel.

✓ **DRY** or disinfect. Some aquatic invasive species can survive up to two weeks out of water, and not every invader can be seen with the naked eye. To remove undetected AIS, encourage boaters to dry their vessel for at least five days in direct sunlight. Alternatively, boaters can clean every part of the vessel that came in contact with the water using hot water over 50°C, or by using a pressure washer with between 2,500 and 3,000 psi (most modern electric or gas-powered pressure washers can achieve this psi level).

3 AIS REGULATIONS

In order to reduce the spread of AIS, a number of federal and provincial regulations have been developed that place restrictions on the movement of watercraft, and the movement and possession of non-native organisms.

BOATERS SHOULD KNOW...

According to the Ontario's Invasive Species Act, 2015: before transporting a boat or boat equipment overland [boaters must]:

- remove or open drain plugs to allow water to drain from the boat or boat equipment
- take reasonable precautions to remove all aquatic plants (weeds), animals and algae from any boat, boat equipment, vehicle or trailer

Before reaching a launch site or placing a watercraft in any body of water in Ontario, boaters are required to ensure their boat, boating equipment, vehicles or trailers are free of all:

- aquatic plants
- animals
- algae

In Ontario, "it is illegal to import, possess, deposit, release, transport, breed/grow, buy, sell, lease or trade **prohibited** invasive species." This includes²:

- Snakeheads (Each member of the family Channidae)
- Stone Moroko (*Pseudorasbora parva*)
- Wels Catfish (*Silurus glanis*)
- Zander (*Sander lucioperca*)
- Golden mussel (*Limnoperna fortunei*)
- Killer shrimp (*Dikerogammarus villosus*)
- Common yabby (*Cherax destructor*)
- Brazilian waterweed (*Egeria densa*)
- European water chestnut (*Trapa natans*)
- Hydrilla (*Hydrilla verticillata*)
- Parrot feather (*Myriophyllum aquaticum*)
- Marbled crayfish (*Procambarus virginalis*)
- Red Swamp crayfish (*Procambarus clarkia*)
- New Zealand mud snail (*Potamopyrgus antipodarum*)
- Tench (*Tinca tinca*)
- Prussian carp (*Carassius gibelio*)
- Mountain pine beetle (*Dendroctonus ponderosae*)

² "Managing invasive species in Ontario," Wildlife and Nature, Province of Ontario, accessed January 22, 2021, <https://www.ontario.ca/page/managing-invasive-species-ontario>

If you are boating in a waterbody where European water chestnut or water soldier are found, you must:

- Avoid boating in the infested area;
- Take reasonable steps to avoid spreading these plants to another part of the waterbody;
- Remove the plants from your boat, motor and trailer before traveling over land; and
- Dispose of the plants so they don't end up back in the waterbody.

In Ontario, "it is illegal to import, deposit, release, breed/grow, buy, sell, lease or trade **restricted** invasive species."³ This includes:

- Dog-strangling vine (*Vincetoxicum rossicum*)
- Japanese knotweed (*Reynoutria japonica*)
- Invasive phragmites (*Phragmites australis*)
- Yellow floating heart (*Nymphoides peltata*)
- Carolina Fanwort (*Cabomba caroliniana*)
- European frogbit (*Hydrocharis morsus-ranae*)
- Bohemian knotweed (*Reynoutria xbohemica*)
- Giant knotweed (*Reynoutria sachalinensis*)
- Himalayan knotweed (*Koenigia polystachya*)
- Pig (*Sus scrofa*)

In addition to the above, boaters and anglers should be aware of the following regulations:

- It is **illegal** to (or attempt to) deposit or release live or dead bait or baitfish (including fish eggs, gametes or parts) into or within 30 m of any waters, or the water, soil or other materials used to hold any of these items. This does not apply to plant-based bait or to water being dumped back into the waters from which it was taken;
- It is **illegal** to transport live fish over land, other than baitfish (unless specifically licensed to do so);
- It is **illegal** to transport any species of crayfish, alive or dead, over land. Crayfish can only be used for bait in the waterbody in which they are caught. You are only allowed to possess 36 crayfish at any one time for the purposes of angling;
- It is **illegal** to transport Bighead Carp, Silver Carp, Grass Carp, Black Carp, or any member of the snakehead family, except if the fish is dead and has been eviscerated (gutted);
- It is illegal to possess, transport or release Round Goby, Tubenose Goby, Rudd or Ruffe

³ Province of Ontario, "Managing invasive species in Ontario"

unless they are dead, or to use any of these fish as bait, even if they are dead; and

- It is illegal to introduce an aquatic species to areas where it is not naturally found.

To find out what AIS might be in your area, visit www.EDDMapS.org.

SAFETY NOTE

Your safety is always the number one priority. Ensure that all vehicles are put in park before interacting with boaters. Pay close attention to potential pinch points such as around the trailer hitch while looking over a watercraft, as well as to sharp objects which may be on the watercraft and trailer.

Occasionally, a boater may be resistant or even hostile towards your efforts. Do not interact with these people, the first priority is to disengage and de-escalate. If a member of the public is breaking the law, record whatever identification information you can and contact the local authorities.

The NDMNRF TIPS line for natural resources violations is **1-877-847-7667**.

To report a non-natural resource related crime, contact crime stoppers by calling **1-800-222-8477** or by using their website: www.canadiancrimestoppers.org/tips

HELPFUL EQUIPMENT

- Emergency contact lists
- Cell phone
- Hand sanitizer
- Drinking water
- First aid kit
- Bug spray
- Sunscreen
- Uniform and identification items
- Chair and table
- Clipboard and notebook
- Pens/pencils
- Paper towels/ rags/ chamois
- Information pamphlets
- Needle-nose pliers or crescent wrench for boat plugs
- Putty knife
- Flashlight
- Extendable mirror
- Magnifying glass
- Garbage bag
- 5-gallon bucket
- Overhead tent

Note: At the end of each day of boater engagement, please have one representative from your volunteer group complete the AIS Boater Engagement Survey available on our website.

DID YOU KNOW?

Zebra mussels and other invasive species can attach to aquatic plants, so be sure to remove all plants from the watercraft, regardless of species.

CONDUCTING A VOLUNTARY AIS-CHECK

All watercraft should be checked, regardless of whether they are leaving or entering a waterbody. Use the “AIS Water Steward Survey” (included in your Water Steward Toolkit) to track the number of boaters engaged each day.

Before engaging with a boater, ensure that you are wearing some kind of identification. Approach vehicles in the staging area rather than on the boat ramp itself (the staging area is wherever vehicles pull off to wait their turn at the launch). A pre-emptive visit to the launch the day before is a good idea to get a sense of where you should set up in order to reduce any likelihood of causing a traffic jam. Most AIS-checks should generally be quite short, ideally around three minutes.

ENGAGING A WATERCRAFT USER

Follow these steps:

Greet a boater and identify yourself by name, as well as the organization you represent (if applicable). Briefly explain the purpose of this stop, for example:

“Hi there, my name is Matt. I’m with (name of your organization) and we are here working with boaters to stop the spread of aquatic invasive species such as (locally relevant AIS; see www.EDDMapS.org for more info). Harmful invasive species often hitch a ride from one waterbody to the next by attaching to boats, trailers, and other equipment unnoticed. May I have a few minutes of your time to show you how to Clean, Drain, Dry your boat to prevent the spread of AIS?”

If the boater refuses, offer an informative resource. If they say yes, ask them to activate the vehicle’s parking brake, turn off the engine, and to step outside with you.



CLEAN

Begin your walk-through at the driver's side trailer winch and work your way around the watercraft from there. Be sure to fully involve the boater in the process, having them check visually and by touch. Focus on the following key areas, using the Watercraft Checklist (included in your Water Steward Toolkit) to keep track.

The Hull: Look closely at the main hull of the watercraft, where small organisms like snails and mussels often attach themselves. Instruct the boater to feel around the ridges, seams, and recessed bolts of the vessel, as bumps or a sandpaper-like texture may indicate the presence of young zebra mussels, known as veligers.

Below the water line: It is important to pay close attention to all areas below the waterline. Feel along the lower main hull with your hand and use a mirror to check hard to reach places like trailer rollers, rails, and pads.

Transom area: Look for fragments of vegetation which can be caught in the propellor and transducer. Closely examine both upper and lower portions of the motor, including trim tabs, as well as any boat plugs and water intake.

Rear trailer: Trailers are especially prone to picking up fragments of aquatic plants, such as Eurasian water-milfoil or fanwort. Examine the trailer axle, carefully using a mirror and flashlight. Look for AIS around the trailer lights, electrical wires, pads, and licence plate.



Watercraft interior: Ask about gear inside of the vessel that may have been submerged, such as anchors, buoys, and hunting decoys. Instruct the boater on inspecting lines, chains, and fishing tackle, and explain how organisms like spiny waterfleas will commonly attach to these items.

Be sure to explain why these areas deserve special attention and to provide examples of AIS the boaters may encounter on their watercraft.



Photo credit: Andrea Miehlis

DRAIN

Ensure that the transom plug has been pulled and ask the boater about other potential sources of standing water in the vessel:

- Has the motor been lowered to release excess water?
- Has the live-well been drained?
- What other water holding devices does their vessel contain (e.g., ballast tanks) and have they been properly drained?



Photo credit: Andrea Miehlis



Explain that small organisms like spiny waterfleas and microscopic zebra mussel veligers can survive in standing water for long periods of time. If an incoming vessel has not been properly drained, ask the boater to take it to a dry location away from the water to do so. If the vessel is just coming off the water, ensure that it is properly drained before leaving the launch.

DRY



Finally, instruct the boater on drying or disinfecting the watercraft. Encourage them to dry their vessel for at least five days in direct sunlight before their next launch. If this is not possible, or if they wish to go above and beyond, urge the boater to disinfect their watercraft by washing it with hot water over 50°C, or by using a pressure washer with between 2,500 and 3,000 psi.

UNIQUE WATERCRAFT

Some vessels have unique designs that allow invasive hitchhikers to hide more easily.

JET BOATS AND PERSONAL WATERCRAFT (PWCS):



Photo credit: 'Yamaha 232 Limited' by Yamaha Watercraft, CC BY 2.0, at <https://flic.kr/p/7yuWED>

These watercrafts use water intake as a means of propulsion. Once the watercraft is out of the water, ask boaters to run the engine for 5-10 seconds to expel any leftover water and vegetation from these systems.

WAKEBOARD BOATS:



Photo credit: 'JET SKI Sea Doo' by late Clube Guaiba ICG, CC BY 2.0, at <https://flic.kr/p/dkjWGV>

Some jet boats are specifically designed to create extra wake for water sports. These wakeboard boats contain one to three ballast tanks which can easily hide AIS species, such as zebra mussel veligers or spiny waterfleas. Ensure that these tanks are fully drained before entering and after exiting a waterbody, in addition to clearing out the water



Photo credit: '2013-08-01 09:59:17' by Bob Linder, CC BY-ND 2.0, at <https://flic.kr/p/kc5bg9>

DEALING WITH POTENTIAL AIS

It is important to remember that boaters should remove all aquatic organisms, living or dead, that are found on or in the watercraft, regardless of whether they are positively identifiable as AIS. In many cases, such as with large aquatic plants, this can be done manually. For some invertebrates, such as mussels and snails, a putty knife can be used to remove them from equipment, but this may leave scratches on a boat. If the boater does not want to remove them manually, instruct them to use a pressure washer, available for use at their local carwash, to clean the watercraft with hot water above 50°C, or to dry their vessel in the sun for at least five days before launching their vessel into any waterbody.

If you encounter an aquatic organism that you suspect to be an AIS, we encourage you to take a clear photograph, mark your location, and report your sighting.



DID YOU KNOW?

A small fragment of Eurasian water-milfoil, around six inches in length without roots, can survive several days out of water and infest a new waterway.

REPORTING AN AIS

Report any potential AIS using the EDDMapS webpage or mobile app (Android & iPhone). Users simply **take a picture**, **note their location** with their mobile device, and **submit** a report to the **Invading Species Awareness Program** at the information provided below.

VISIT

www.EDDMapS.org

to register and report your sighting.

Sightings may also be reported to

www.iNaturalist.ca

or to the

Invading Species Hotline at **1-800-563-7711**

or by email info@invadingspecies.com

TIPS FOR PHOTOGRAPHING AN INVASIVE SPECIES

How to Photograph Invasive Fish



Photograph entire fish on its side with something for scale



Accurately capture the shape of the dorsal fin



Photograph the mouth of the fish



Take a photo of the underside of the fish

Photos: Asian Carp Regional Coordinating Committee

Note: Please ensure compliance with all relevant fishing regulations

DID YOU KNOW?

Spiny and fishhook waterfleas can both reproduce asexually, making a single individual capable of infesting a new waterbody.

HOW TO PHOTOGRAPH AQUATIC INVASIVE PLANTS



Capture the view of the entire infestation;

Physically remove a plant from the water or from equipment, and capture a photo of the entire plant, laid flat. Use a ruler or a common object for scale;



Photograph the leaf shape and arrangement along the stem; and

Capture any flowers, seeds, or other reproductive organs on the plant clearly.



Note: Be careful to avoid spreading potential AIS through fragmentation! Do not disturb more plants than is necessary and be sure to dispose of your specimen in the trash when you are finished photographing it.

Photo 1: Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org

Photo 2: '47760085' by slammy199, CC-BY-NC 4.0, at <https://www.inaturalist.org/photos/47760085>

Photo 3: Rebekah D. Wallace, University of Georgia, Bugwood.org

Photo 4: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

HOW TO PHOTOGRAPH INVASIVE INVERTEBRATES



Place a ruler or common item beside the invertebrate for scale;

Capture both top and bottom of the organism;



For snails, photograph the opening/ underside of the snail; and

Place the snail upright to capture an image of the specimen from above, making sure to capture the whorls clearly.



Photo 1: Shawn Liston, Audubon of Florida, Bugwood.org
 Photo 2: California Department of Fish and Game, CDFG, Bugwood.org
 Photos 3 and 4: Brook Schryer

COMMON BOATER QUESTIONS/ COMMENTS AND ANSWERS:

ISN'T THE SPREAD OF AQUATIC INVASIVE SPECIES INEVITABLE?

There are many AIS established in Ontario; however, it is important that boaters take deliberate actions to prevent the spread of these species to new areas and/or prevent the introduction of new species to Ontario's waters. For example, it's always important to **Clean, Drain, Dry** your boat or recreational watercraft when leaving a waterbody to ensure you've done your part to prevent the spread of species, such as zebra mussels, Eurasian water-milfoil, spiny waterfleas, etc. There are a number of AIS that are not found, nor established in Ontario, and if we each do our part to act as Water Stewards – we can reduce the risk of new species being introduced to the waterbodies and ecosystems that we inherently treasure.

WON'T AIS SPREAD FROM NON-HUMAN PATHWAYS?

Once introduced to a waterbody, a species will begin to establish itself and, over time, begin to colonize other areas within the waterbody and connected waterbodies. This is why we focus the majority of our efforts on prevention as opposed to management/control. If we are able to stop a species from being introduced in the first place, then we can prevent any further impacts that are associated with the establishment of an invasive species, such as natural spread via reproduction and colonization. Otherwise, there are only a handful of documented examples and scientific literature studies that suggest species can be moved via other natural pathways, such as birds. The real culprit for the introduction and spread of invasive species is humans, with the majority of invasive species being intentionally or unintentionally introduced anthropogenically.

DON'T SOME AIS, LIKE ZEBRA MUSSELS OR ROUND GOBY, IMPROVE FISHING AND WATER QUALITY?

Yes and no. Zebra mussels filter out essential building blocks for our food webs by consuming plankton, which is necessary for our native fishes while they're in their juvenile life stages. Without a natural abundance of plankton, our fisheries begin to suffer. Moreover, through their constant filtering behaviour, zebra mussels eventually cause an increase in water clarity. This clearer water allows

greater sunlight penetration into deeper water columns, encouraging plant growth to an excessive extent and negatively affecting our cool-water species, such as Walleye. If your preference is clear water for a short duration of time, then yes, zebra mussels have benefits; however, if we analyze this in a cost versus benefit way, then zebra mussels are never a good thing for any waterbody in Ontario.

Round Gobies, in contrast, have been proven to be a desired prey species for many of our predatory fish species here in Ontario (e.g. Smallmouth Bass, Largemouth Bass, Yellow Perch, and even deeper water species such as Walleye and Lake Trout). In some cases, the spread of Round Gobies has increased the overall size of our native fish species through the presence of an abundant and easily predated food source. However, these AIS also predate heavily on the younger life stages of our native species (i.e., eggs & fry), thus reducing the overall recruitment and retention of future generations of native species, such as the Smallmouth Bass.

FOLLOW UP QUESTION: BUT WON'T THE PREDATION OF THE ROUND GOBY KEEP IT IN CHECK, THUS REDUCING THE IMPACTS TO THE YOUNG OF OUR NATIVE SPECIES?

No; the Round Goby reproduces at a rate that is not checked by the predation by our native species. Unlike our natives, it has an extended reproductive season and can spawn several times in any given season with peaks in April and July.

IS IT REALISTIC TO THINK THAT WE CAN ERADICATE ESTABLISHED AIS?

The science and research of invasion biology changes each and every day. Though it's a challenge to imagine a silver bullet for each species, this does not mean that someday they may not exist or be discovered. That being said, the goal of government and NGOs is to prevent a species from arriving and establishing in the first place, because once they have, the cost of management and control becomes extensive. Science has shown that a small investment up front to prevent the eventual establishment of a species (e.g. Asian carps) is much better, economically, than allowing them to establish and then trying to mitigate impacts.

IF WE DID NOTHING ABOUT INVASIVE SPECIES, WOULDN'T THEY EVENTUALLY NATURALIZE?

It is difficult to predict what any invasive species' impact will be on the watershed. Letting the natural systems deal with invasive species unchecked is not a productive way to solve invasive species problems. Additionally, the definition of 'naturalization' is contested, for example, a species may appear to be naturalized in one waterbody, but may have invasive tendencies if introduced to another, un-infested waterbody.

ARE ASIAN CARPS ESTABLISHED IN THE GREAT LAKES?

No; Asian carps are not currently established in the Great Lakes; however, there have been a number of Grass Carp (*Ctenopharyngodon Idella*) captured and/or found dead within Ontario's waters. For an up-to-date distribution of Grass Carp, please visit www.EDDMapS.org.

SHOULD I STOP BOATING IN LAKES THAT HAVE AIS?

No; aquatic invasive species have been in Ontario for hundreds of years and though they continue to negatively impact our recreation in a number of ways, we should not allow AIS to prevent us from enjoying our natural resources. However, we each need to be mindful of the potential for spread via our boats and other recreational watercrafts when leaving the water. In order to prevent the spread of an AIS from one waterbody to another, it's important that boaters and recreationists **Clean, Drain, Dry** their vessels to reduce the likelihood that they may unknowingly spread an AIS.

I ALREADY KNOW ABOUT AIS AND I DON'T HAVE TIME FOR THIS!

Thank you for your time and your dedication to the health of our natural resources! Have a great day.

ISN'T THIS JUST AN EXCUSE TO LOOK IN MY LIVE-WELL?

No. Water Stewards are not law enforcement. We are only here to stop invasive species from spreading and to educate people on the deliberate actions they can take to prevent the introduction and/or spread of invasive species.

WHAT IS THE OFAH DOING TO PREVENT THE INTRODUCTION OF AIS INTO OUR WATERS?

Since 1992, the OFAH, in partnership with the Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNR), has delivered Ontario's Invading Species Awareness Program. This program is focused on increasing awareness of invasive species, addressing key pathways contributing to introductions/ spread, and facilitating the provincial reporting tools to monitor and track invasive species in Ontario.

HOW DO I REPORT A SIGHTING OF AN INVASIVE SPECIES?

We have an invasive species tracking system, including a mobile app for android and apple devices! EDDMapS is a fast and easy way to report and map invasive species without any technical expertise. Users simply take a picture with their mobile device and report from where they are standing using the EDDMapS app. Alternatively, you can visit www.EDDMapS.org. Sightings may also still be reported to the: Invading Species Hotline at **1-800-563-7711** or by email: **info@invadingspecies.com**.

AIS IDENTIFICATION AND GENERAL INFORMATION

This section is intended to help you become familiar with some of the key invasive threats to Ontario's waters today. In addition to this list, it is important to familiarize yourself with any invasive threats and outbreaks that are specific to your area. You can use the EDDMapS webpage to download lists of AIS that are specific to your home waterbodies.

INVASIVE INVERTEBRATES

WHERE TO LOOK:

For molluscs, such as snails and mussels, examine the watercraft hull and trailer, as well as any exterior equipment (e.g., the motor) feeling carefully along ridges, seams, and recessed bolts. Keep in mind that small bumps or a sandpaper-texture could indicate the presence of juvenile mussels.

For crustaceans, such as crayfish and waterfleas, focus on standing water (i.e., bait bucket, live-well, etc.), as well as fishing and boating equipment like ropes, chains, and fishing line.

SPINY WATERFLEA AND FISHHOOK WATERFLEA

(*Bythotrephes longimanus* and *Cercopagis pengoi*)

Spiny waterfleas and fishhook waterfleas are small aquatic predators native to Eurasia. Both waterfleas are species of zooplankton – small animals that rely on water currents and wind to move long distances. Spiny and fishhook waterfleas prefer large, deep, clear lakes, but can also be found in shallower waters. Eggs can be transported long distances on boats or equipment if they stay moist. The main diet of spiny and fishhook waterfleas is other zooplankton.



Photo credit: Andrew Barcham, OPP

RANGE

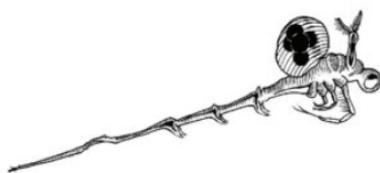
The spiny waterflea has been found in each of the Great Lakes and in more than 100 inland lakes in Ontario, as well as some parts of Manitoba and the United States. The fishhook waterflea is established in lakes Ontario, Erie and Michigan, as well as some inland lakes in upstate New York.

IMPACTS

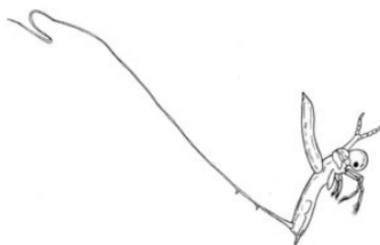
- Researchers believe that spiny waterfleas are the greatest threat to the biodiversity and structure of native zooplankton communities in the Canadian Shield since acid rain;
- Spiny waterflea introductions result in an average 30 to 40 % decline in native populations of zooplankton;
- Because their main diet is zooplankton, they reduce food supplies for small fish and the young of sport fish such as bass, Walleye, and Yellow Perch;
- Due to their spines, spiny and fishhook waterfleas are difficult for many juvenile fish to consume;
- A few animals can quickly multiply into a large population;
- They are easily spread between waterbodies on angling equipment and in bait buckets, live-wells, and bilge waters; and
- Spiny and fishhook waterfleas can affect recreational angling and commercial fishing. Their tail spines catch on fishing equipment, making it difficult to reel in lines, and clogging commercial nets and trawl lines.

HOW TO IDENTIFY SPINY AND FISHHOOK WATERFLEAS

- Both species have a single dark eye, four pair of legs and branched antennae that are used for swimming;
- The tail of spiny waterflea makes up 60% of its total length, while the tail of fishhook waterflea makes up 80% of its total length; and
- You would need a microscope to identify key characteristics of each species.



Spiny waterflea illustration: © OFAH



Fishhook waterflea illustration: © OFAH

ZEBRA AND QUAGGA MUSSELS

(*Dreissena polymorpha* and *Dreissena bugensis*)

Zebra and quagga mussels are freshwater bivalves native to the Black Sea region of Eurasia. Zebra and quagga mussels are capable of heavily colonizing hard and soft surfaces, including, docks, boats, break walls and beaches. These colonies are responsible for clogging intake structures in power stations, and water treatment plants.

RANGE

Zebra mussels are found throughout each of the Great Lakes, Lake St. Clair, other connecting waterways, as well as in a number of southern Ontario inland lakes and rivers. They also exist throughout several US states.

Unlike the zebra mussel, quagga mussels are found to be limited to the southern Great Lakes; Lake Ontario, Lake Michigan, Lake Huron, and Lake Erie. They also exist in Lake St. Clair and Lake Simcoe, the St. Clair River, the Rideau River, the Detroit River, and the St. Lawrence River, as well as several US states.

IMPACTS

- Zebra and quagga mussels filter water to the point where food sources such as plankton are removed, altering food webs. This also causes clearer water, allowing sunlight to penetrate deeper, increasing growth of aquatic vegetation;
- Impact fish and wildlife by increasing toxic algal blooms and competing for food sources;
- Large colonies affect spawning areas, potentially impacting the survival of fish eggs; and
- Affects recreational activities by cutting swimmers' feet as a result of their sharp shell.

HOW TO IDENTIFY ZEBRA MUSSELS



Zebra mussel (top) and Quagga mussel (bottom)
photo Credit: Amy Benson, U.S. Geological Survey
Bugwood.org

- Average 2-2.5 cm, reaching up to 4 cm long;
- Sits flat on its underside;
- Triangular in shape;
- Black or brown with white to yellow zigzagged patterns; and
- Color patterns can vary.

HOW TO IDENTIFY QUAGGA MUSSELS

- Average 2 cm, reaching up to 3 cm long;
- Doesn't sit flat;
- Round in shape;
- Dark concentric rings on shell; and
- Pale cream color near hinge.

CHINESE AND BANDED MYSTERYSNAILS

(*Cipangopaludina chinensis* and *Viviparus georgianus*)

The banded mysterysnail, native to the southeastern United States, and the Chinese mysterysnail, native to Asia, were both likely released as a result of the aquarium trade or the live food trade. These snails can survive out of water for days at a time and reproduce very quickly.

RANGE

Outside of their native distribution, both snails currently exist in the Niagara River, Lake Ontario, Lake Erie, and a number of inland waterways throughout south central Ontario, including the Kawartha Lakes and the Haliburton region.

IMPACTS

- May prey on fish eggs and reduce survival rates;
- Out-compete for food and habitat and effect the abundance of native snails;
- Chinese mysterysnails have been reported to clog water intake pipes; and
- Carry parasites and trematodes that kill waterfowl.

HOW TO IDENTIFY CHINESE MYSTERYSNAIL

- 6.5 cm or less;
- Spherical shoulder whorls separated by prominent sutures;
- Brownish to olive-green;
- Posses an operculum (trap door for shell opening) that is oblong with concentric growth lines.



Photo credit: Robert T. Dillon, Jr., College of Charleston, Bugwood.org



Photo credit: Bernard Sietman, Bugwood.org

HOW TO IDENTIFY BANDED MYSTERYSNAIL

- 3.5 cm or less;
- Spherical with whorls separated by deep sutures;
- Yellow to greenish brown with 3-4 dark reddish-brown spiral bands; and
- Posses an operculum (trap door for shell opening) that is ear-shaped with concentric growth lines.

NEW ZEALAND MUDSNAIL

(*Potamopyrgus antipodarum*) **PROHIBITED SPECIES**

These tiny snails, which are native to New Zealand, spread easily in live-wells, bilge water, bait buckets, and other watercraft equipment. They are capable of surviving several days out of water and, due to their ability to reproduce asexually, a single female snail can lead to an established population in a new waterbody.



Photo credit: Mohammed El Damir, Bugwood.org

RANGE

In Ontario, this snail exists in the St. Lawrence River, in Lake Ontario near Kingston and in the Niagara region, and in Lake Superior near Thunder Bay. It is also known to exist on the US side of Lake Erie and Lake Ontario, as well as Lake Michigan and inland waters of a number of states.

IMPACTS

- Reach extremely high densities; and
- Can dominate and suppress other benthic invertebrate populations, which has the potential to have adverse effects on the food web.

HOW TO IDENTIFY NEW ZEALAND MUDSNAIL

- 8 mm or less;
- Cone-shaped and slender with pointed whorls;
- Variable, range from light to dark brown; and
- Possess an operculum (trap door for shell opening) that is ear-shaped with off-centre nucleus.



Photo credit: Robert T. Dillon, Jr., College of Charleston, Bugwood.org

INVASIVE FISH

WHERE TO LOOK:

Focus primarily on live-wells and bait buckets, ensuring that all standing water is drained from the vessel.

ROUND GOBY (*Neogobius melanostomus*)



Photo credit: C. Thom Foster

The Round Goby is a small, bottom-dwelling invasive fish, native to the Black and Caspian seas in eastern Europe. In less than a decade, the Round Goby successfully spread through all five Great Lakes and has begun to invade

inland waters. In some areas, the fish has reached densities of more than 100 fish per square metre of lake bottom nearshore. Round Goby feed aggressively on insects and other small organisms found on lake and river bottoms.

The Ontario government has banned the possession of live Round Goby and the use of Round Goby as baitfish. According to the Ontario Sport Fishing Regulations, 2021, “if you catch a Round Goby (or any invasive species) it should be destroyed as it cannot be released live into any waters.”⁴

RANGE

Outside of its native range, the Round Goby has been found in all five Great Lakes and many of their tributaries. Round Goby are also found in some inland waters in southern Ontario, such as Lake Simcoe, Lake Couchiching, the Trent River, Rice Lake, and parts of the Otonabee River.

IMPACTS

- Compete with, and prey on, native bottom-dwelling fish and freshwater mussels;

⁴ Province of Ontario, Ministry of Natural Resources and Forestry, Fish and Wildlife Service Branch “2021 Fishing Ontario, Recreational Fishing Regulation Summary,” (2021), accessed January 25, 2021 <https://www.ontario.ca/document/ontario-fishing-regulations-summary>

- They reduce populations of sport fish by eating their eggs, their young, and competing for food sources; and
- Researchers believe the Round Goby is linked to outbreaks of botulism type-E in Great Lakes' fish and fish-eating birds. The disease is caused by a toxin that is passed from zebra mussels to goby, to birds, resulting in large die-offs of fish and birds.

HOW TO IDENTIFY ROUND GOBY



Photo credit: John Lyons

- Adults are 6 to 16 cm long;
- Body is brownish or olive in colour, with dark brown spots. Reproducing males are almost completely black;
- Possess a prominent black spot on their first dorsal fin;
- Possess a fused pelvic fin (underside—see image), that they use to suction cup to rocks;
- Nostril tubes do not reach the upper lip;
- Fully scaled body; and
- Looks similar to several species of fish found in the Ontario, including the invasive Tubenose Goby and native sculpins.

DID YOU KNOW?

Native to Ontario does not mean non-invasive! Popular sport fish like Northern Pike, Black Crappie, and Yellow Perch can have devastating affects on ecosystems where they do not naturally occur, even if they exist in another lake close by. Never transport live fish, it's against the law!

WHERE TO LOOK:

Focus on exterior portions of the watercraft, such as the motor, water intakes, and transducers, as well as all along the trailer. Use a mirror and flashlight to check hard-to-reach places, like rollers and trailer axle. Don't overlook equipment which is periodically used outside of the vessel, including anchors, bow lines, and fishing equipment.

EURASIAN WATER-MILFOIL

(Myriophyllum spicatum)



Photo credit: Andrea Hicks

Eurasian water-milfoil is an invasive aquatic plant native to Europe, Asia, and northern Africa. Introduced to North America in the 19th century, it is now one of the most widely distributed invasive aquatic plants on the continent. Eurasian

water-milfoil prefers shallow water 1-3 m deep, but can root in up to 10 m of water. Because tiny plant pieces can develop into new plants, Eurasian water-milfoil is easily spread when water currents, boat propellers, trailers, or fishing gear carry plant fragments to new areas.

RANGE

Eurasian water-milfoil was first discovered in Canada in Lake Erie in 1961. Since then, it has spread to each of the Great Lakes, the St. Lawrence River, many inland lakes throughout southern and central Ontario, and much of the United States. Outside its native range, the plant has spread across every continent, except Antarctica.

IMPACTS

- The plant reduces biodiversity by competing aggressively with native plants;
- Reduces oxygen levels in the water, caused by decomposing plants, which can lead to fish die-offs;
- Thick mats of Eurasian water-milfoil can hinder recreational activities such as swimming, boating, and fishing; and
- Dense stands can create stagnant water, which is an ideal habitat for mosquitoes.

HOW TO IDENTIFY EURASIAN WATER-MILFOIL

- The plant is a perennial that grows under the water surface;
- Feather-like green leaves circle the stem in groups of four or five on each side of an individual leaf;
- Tiny, reddish flowers grow on emergent terminal spikes 5 to 20 cm long that rise above the water towards late summer (August-September); and
- Eurasian water-milfoil looks similar to the native northern water-milfoil (*Myriophyllum sibiricum*), native Coontails (*Ceratophyllum demersum*, *C. echinatum*), and the invasive parrot feather.



Photo credit: Andrea Hicks

WATER SOLDIER (*Stratiotes aloides*)

PROHIBITED SPECIES



Photo credit: '93926406' by Alexis, CC BY 2.0, at <https://www.inaturalist.org/photos/93926406>

Water soldier is an invasive aquatic perennial plant that is native to Europe and northwest Asia. Prior to being regulated as a **prohibited** invasive species under Ontario's *Invasive Species Act*, water soldier was sold for use as an

ornamental plant in water gardens, which is the most likely source of its introduction to the wild.

RANGE

Although a small population of water soldier was detected within the Black River in 2015, control measures have been taken and no sightings have occurred there since 2016. The only known populations in Ontario are currently in the Trent-Severn Waterway, Red Horse Lake, southeast of Lyndhurst, Ontario and the recently discovered population in the Bay of Quinte.

IMPACTS

- Forms dense mats of floating vegetation, creating stagnant waters;
- Crowds out native vegetation, resulting in decreased plant biodiversity;
- Has the potential to alter surrounding water chemistry, which may harm phytoplankton and other important aquatic organisms;
- Dense floating mats of water soldier can hinder recreational activities, such as boating, angling, and swimming; and
- Sharp serrated leaf edges can cut swimmers and individuals who handle water soldier plants. Caution should be taken if you come in contact with the plant.

HOW TO IDENTIFY WATER SOLDIER

- Leaves can reach up to 40 cm long, are sword-shaped, bright green, with sharp spines, and form a large 'rosette' or group of leaves arranged in a circle. Water soldier is similar in appearance to an aloe plant, household spider plant, or the top of a pineapple;
- Flowers, if present, are white with three petals. Flowering of water soldier is exceptionally rare in Ontario, so this should not be used as a main identification characteristic; and
- Mature water soldier plants produce offsets or clones, which are similar to those produced by the household spider plant.



Photo credit: Shaun Winterton, *Aquarium and Pond Plants of the World*, Edition 3, USDA APHIS PPQ, Bugwood.org

FANWORT (*Cabomba caroliniana*) **RESTRICTED SPECIES**

Fanwort is an invasive aquatic plant native to the southeastern United States and parts of South America. Since fanwort is a popular aquarium plant, it may have been introduced to Ontario by someone emptying the contents of an aquarium into a waterway, or boats may have carried plant fragments from an infested area outside the province. Fanwort grows and spreads aggressively, forming dense mats under or at the surface of the water. Ontario has regulated fanwort as **restricted** under the *Invasive Species Act*.



Photo credit: Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org

RANGE

In Ontario, fanwort was first found in Kasshabog Lake, part of the Crowe River watershed northeast of the City of Peterborough. Since its discovery in 1991, it has spread within the watershed to North River, South Lake, and Big Mountain Lake. Fanwort has also been introduced in Australia, India, Japan, Malaysia, and the northeast and northwest United States.

IMPACTS

- If fanwort spreads outside of the Crowe River watershed, it could disrupt the plant and animal life in other waterways and interfere with recreation;
- It is a fast-growing plant, that forms thick mats that crowd out native plants, block sunlight to submerged plants, disrupt fish communities, and clog drainage canals and streams;
- Dense stands of fanwort can hinder swimmers and boaters and prevent other recreational uses of waterways; and
- Because fanwort thrives in acidic water, it could spread to lakes on the Canadian Shield, which tend to be acidic.

HOW TO IDENTIFY FANWORT



Photo credit: Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org

- Under the water, pairs of finely divided fan-shaped leaves grow on opposite sides of the main stem, creating a feathery effect.
- The plants also have small, floating oblong leaves up to 3 cm long.
- Fanwort flowers from late spring to early fall. The flowers usually rise above the surface of the water. They are 0.6 to 1.5 cm wide and white to pale yellow, sometimes with a purple or pink tinge.
- Resemblance to native coontail (*Ceratophyllum demersum*)

BRAZILIAN ELODEA (*Egeria densa*)

PROHIBITED SPECIES

Brazilian elodea, also known as Brazilian waterweed, is a submerged aquatic plant native to South America. This species can reproduce via fragmentation, making boats and trailers ideal vectors for its spread.



Photo credit: Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org

Brazilian elodea has become a popular aquarium and water garden plant, often sold under the alias *Anacharis*. Ontario has regulated Brazilian elodea as **prohibited** under the *Invasive Species Act*.

RANGE

This plant is not yet documented in Ontario, but has established populations in the Great Lakes basin, including in Illinois, Indiana, New York, and Pennsylvania, in addition to 30 other non-Great Lakes States.

IMPACTS

- It rapidly forms dense mats on the surface of the water that can restrict water movement, increase sedimentation, affect water quality, and crowd out native plant species;
- Changes water quality, such as lowering water temperature and reducing oxygen concentrations, reducing nutrient availability while growing, as well as eutrophication (nutrient overloading) when the plant decomposes;
- Ecosystem impacts include the smothering of native plant seeds through sedimentation and changes to native fish populations through reduced habitat quality; and
- Thick mats of Brazilian elodea can also impede several recreational activities, such as boating, fishing, and swimming and can even clog infrastructure and water supply intakes.

HOW TO IDENTIFY BRAZILIAN ELODEA



Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

- Often confused with Hydrilla, another prohibited AIS, and with the native Canada Waterweed (*Elodea canadensis*);
- Plant grows submerged in depths ranging from 1 to 2 m, but can grow in depths up to 6 m;
- Stems are thin (1 to 3 mm in diameter) upright, cylindrical, simple or branched, and grow to the surface of the water forming dense mats;
- Leaves are 1 to 3 cm long, up to 5 mm broad, and found in whorls of 4 to 8;
- Leaves and stems are generally bright green and the short internodes (i.e. the length of stem between sets of leaves) give it a very leafy appearance;
- Brazilian elodea has small flowers with three white petals that stick out approximately 2 cm above the surface of the water, once they open.

EUROPEAN WATER CHESTNUT

(*Trapa natans*) **PROHIBITED SPECIES**



Photo credit: OFAH

European water chestnut is an invasive aquatic plant native to Europe, Asia, and Africa. Although it is not certain how the plants arrived in Ontario, it was most likely introduced through the improper release of water garden plants.

To prevent the further spread and introduction of this unwanted invader in the province, Ontario has regulated European water chestnut as **prohibited** in Ontario under the *Invasive Species Act*, with additional rules regarding boating in infested areas.

RANGE

Within Ontario, this AIS has been detected in eastern Lake Ontario, the Ottawa River, the St. Lawrence River, the Rideau River, the Greater Cataraqui River, and in the Welland River.

IMPACTS

- Forms extremely dense floating mats of vegetation that shade out native vegetation, decreasing plant biodiversity and making recreational activities like swimming, angling, and boating almost impossible in the infested areas;
- Their hard, woody nuts possess sharp, barbed spines and can accumulate on shorelines, causing injury when stepped on; and
- Reduces light penetration and plant growth beneath the European water chestnut canopy, combined with a large amount of decomposing vegetation below, can lead to decreased dissolved oxygen levels, which can impact native species and cause fish deaths.

HOW TO IDENTIFY EUROPEAN WATER CHESTNUT

- Floating, diamond shaped, green leaves with serrated margins, which grow up to 5 cm wide;
- Leaves form a densely crowded rosette up to 30 cm in diameter;
- Leaf stems are up to 15 cm long, with a spongy swollen section;
- Underwater leaves are feather-like with finely dissected leaf segments;
- Flowers are very small (8 mm long), white, and have four petals;



Photo credit: - Leslie J. Mehrhoff, University of Connecticut, Bugwood.org



Photo credit: - Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

- Produces a hard “woody” nut (seed), 3 to 4 cm wide with sharp barbed spines. Nuts are green when viable, black when not viable; and
- Nuts bear no resemblance to the “water chestnut” used in cooking, nor are they edible.

HYDRILLA (*Hydrilla verticillata*) PROHIBITED SPECIES

Hydrilla is an aquatic plant whose native range is scientifically contested. Because tiny plant pieces can develop into new plants (fragmentation), hydrilla is easily spread when water currents, boat propellers, trailers, fishing gear, or people carry plants or plant fragments to new areas. Hydrilla is classified as a **prohibited** species in Ontario under the *Invasive Species Act*.

RANGE

Hydrilla has not been detected in Canada, but it has been found in neighboring American states. In the United States, it has spread across the southern states from Florida to California, along the west coast in California and Washington, along the entire Atlantic seaboard, and inland through Pennsylvania, Indiana, Wisconsin, New York, and several other states. Hydrilla populations can now be found on every continent except Antarctica.



Photo credit: Chris Evans, River to River CWMA, Bugwood.org

IMPACTS

- Once established, hydrilla is able to grow aggressively, outcompeting native plants;
- It forms dense mats that block sunlight from reaching other submerged plants;
- The plant degrades water quality by raising pH levels, decreasing oxygen, and increasing water temperature;
- It can hinder the flow of water, as well as recreational activities such as swimming, fishing, and boating; and
- By causing stagnant water, hydrilla may provide habitat that allows mosquitoes to breed.

HOW TO IDENTIFY HYDRILLA

- The plant is a perennial that grows underwater;
- Stems are rooted, erect, either branched or unbranched, and grow up to 7.5 m long;
- Leaves are green, attached to the stem and arranged in whorls of 3 to 8. They have visibly saw-toothed edges, and sometimes have prickles on the underside;
- Flowers are small, with petals 2 to 4 mm wide, and are white to reddish or white to light green with red stripes. When open they float on the surface of the water.



Photo credit: David Fenwick

PARROT FEATHER *(Myriophyllum aquaticum)*

PROHIBITED SPECIES



Photo credit: Graves Lovell, Alabama Department of Conservation and Natural Resources, Bugwood.org

Parrot feather is an invasive perennial aquatic plant native to South America. It was introduced to North America around 1890 as an aquarium and aquatic garden plant. Due to intentional and accidental releases, it was able to escape into waterways

and spread by plant fragments. This AIS has been classified as **prohibited** in Ontario under the *Invasive Species Act*.

RANGE

In Ontario, parrot feather populations have been detected in Midhurst, Mallorytown, and northwest of Hamilton. The populations in Midhurst and Mallorytown have been successfully eradicated.

IMPACTS

- Clogs waterways and displaces native vegetation;
- Negatively affects recreational activities such as boating, swimming, and fishing; and
- Creates stagnant waters, increasing breeding grounds for mosquitoes.

HOW TO IDENTIFY PARROT FEATHER

- Herbaceous, submerged aquatic plant reaching depths of 2 to 5 m;
- Leaves are whorled and feather-like with 20 to 30 segments per leaf;
- Submerged leaves are 1.5 to 3.5 cm long and emergent leaves are 2 to 5 cm long and much greener;
- Flowers in axils of emergent leaves, forming a terminal spike above water;



Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

- May be mis-identified as the invasive Eurasian water-milfoil, or the native northern milfoil; and
- Only female white flowers are known to occur in North America.

PHRAGMITES *OR* EUROPEAN COMMON REED

(*Phragmites australis australis*) **RESTRICTED SPECIES**

Invasive phragmites is a perennial grass, native to Eurasia, that has been damaging Ontario's ecosystems for decades. While it prefers areas of standing water, its roots can grow to extreme lengths, allowing it to survive in relatively dry areas. Today, it can be found in each continent, besides Antarctica. This plant is listed as a **restricted species** in Ontario under the *Invasive Species Act*.

RANGE

Phragmites is currently prevalent across southern Ontario, with especially large pockets around Lake St. Clair, as well as Long Point, Rondeau, and Turkey Point Provincial Parks. This AIS also exists in British Columbia, Manitoba, Quebec, Newfoundland, New Brunswick, Nova Scotia, and throughout much of the United States.

IMPACTS

- Crowds out native vegetation, thus resulting in decreased plant biodiversity.
- Generally provides poor habitat and food supplies for wildlife, including several species at risk;
- It releases toxins from its roots into the soil to hinder the growth of and kill surrounding plants;
- Grows very quickly thereby causing lower water levels as water is transpired faster than it would be with native vegetation;
- Increases fire hazards as stands are composed of a high percentage of dead stalks; and
- Can affect agriculture, create road safety hazards and impact recreational activities such as swimming, boating and angling.

HOW TO IDENTIFY INVASIVE PHRAGMITES

One factor making the identification of invasive phragmites difficult is the existence of a closely related native subspecies. The following information can help in identifying invasive phragmites.

INVASIVE PHRAGMITES:



Photo credit: Rob Routledge, Sault College, Bugwood.org

- Grows in stands that can be extremely dense with as many as 200 stems per square metre;
- Can reach heights of up to 5 metres (15 feet); and
- Has stems that are tan or beige in colour with blue-green leaves and large, dense seedheads.

NATIVE PHRAGMITES (*Phragmites americanus*):

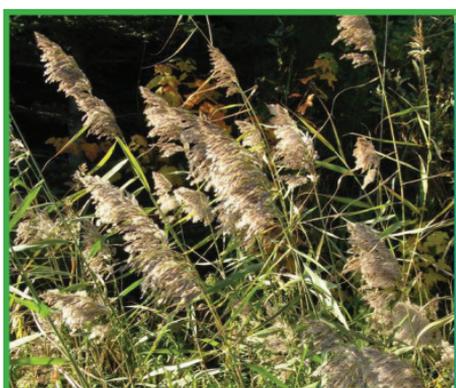


Photo credit: Caleb Slemmons, National Ecological Observatory Network, Bugwood.org

- Grows in stands that are usually not as dense as the invasive plant;
- Well-established stands are frequently mixed with other plant; and
- Usually has more reddish-brown stems, yellow-green leaves and smaller, sparser seedheads.



Photo credit Colin Chapman-Lam, CC BY-NC 4.0, at <https://www.inaturalist.org/photos/159021215>

YELLOW FLOATING-HEART

(*Nymphoides peltata*) **RESTRICTED SPECIES**

Yellow floating-heart is a perennial aquatic plant native to Asia and Europe. Yellow floating-heart is most commonly found in slow moving waters, about 0.5 to 4 m deep, such as rivers, lakes, or ponds. Its ability to reproduce by broken stems and seeds

as well as its availability to be purchased online makes it a species that can be easily introduced. Ontario has regulated yellow floating-heart as **restricted** under the *Invasive Species Act*.



Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

RANGE

Yellow floating-heart ranges throughout several U.S. states and Canadian provinces. It has been reported in Ontario, Quebec, and Nova Scotia. In Ontario, it was found in a pond that is connected to the Rideau River, in the Royal Botanical Gardens Nature Sanctuaries near Burlington, and areas near Georgetown and Erin.

IMPACTS

- Blocks sunlight from reaching native aquatic plants;
- Degrades fish and wildlife habitats;
- Decreases the level of oxygen, creating stagnant water environments which are ideal habitats for mosquitoes to breed; and
- Makes it difficult to enjoy recreational activities such as boating, fishing, and swimming.

HOW TO IDENTIFY YELLOW FLOATING-HEART

- Aquatic, bottom-rooted perennial plant;
- Stems are long and branched, reaching up to 1 m or more, located below the surface of the water;
- Leaves are circular or heart shaped and about 3 to 10 cm;



Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

- Flowers consist of five bright yellow petals;
- Seed capsules contain numerous flat, oval seeds; and
- This species may be mis-identified as the native yellow pond lily (*Nuphar lutea*).

CURLY-LEAVED PONDWEED

(*Potamogeton crispus*)



Photo credit: Chris Evans, University of Illinois, Bugwood.org

Curly-leaved pondweed is a perennial, submerged plant native to Eurasia. This plant was intentionally introduced as an attempt to improve habitat for waterfowl and other wildlife. Curly-leaved

pondweed can be spread via fragmentation. It grows quite early in the season and dies back around the same time that many other plants, such as Eurasian water-milfoil, become noticeable.

RANGE

Within Ontario, this AIS exists across southern Ontario, the Georgian Bay-Trent Severn system, and across the Canadian Shield. Curly-leaved pondweed has populations in most states and provinces.

IMPACTS

- Grows in dense mats, which smother native plants;
- Restricts water flow, creating stagnant water;
- Impedes recreational water activities like swimming and boating; and
- Mass decomposition increases algal blooms.

HOW TO IDENTIFY CURLY-LEAVED PONDWEED

- Submerged aquatic plant.
- Stem is slightly flattened and multi-branched;
- Leaves are long and wavy, red-green in colour with sharp teeth and a waxy texture;
- Flowers are small, red-brown and emerge out of water; and
- Produces small, curved fruit.



Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

EUROPEAN FROG-BIT

(*Hydrocharis morsus-ranae*) **RESTRICTED SPECIES**

European frog-bit is an invasive aquatic plant native to Europe and parts of Asia and Africa. It can be found in slow-moving waters, such as sheltered inlets, ponds, slow-running rivers, and ditches. New plants can grow from stem fragments, seeds,

and winter buds known as turions that can be spread to new waters by boats and wildlife. Ontario has regulated European frog-bit as **restricted** under the *Invasive Species Act*.



Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

RANGE

Outside its native range, European frog-bit is found in the Rideau and Ottawa river systems, the St. Lawrence River, Lake Ontario, Lake Erie, the Kawartha Lakes, and other lakes and rivers in south central and south western Ontario. The plant has also been introduced to some American states, including New York, Vermont, Michigan, and Washington.

IMPACTS

- This fast-growing plant forms thick mats that reduce biodiversity by crowding out native plants and preventing sunlight from reaching submerged plants;
- When a large colony of the plant dies and decomposes, it removes oxygen from the water, which can affect fish communities and other aquatic life; and
- Dense masses of European frog-bit can hinder swimmers and boaters, prevent other recreational uses of waterways, and clog drainage canals and streams.

HOW TO IDENTIFY EUROPEAN FROG-BIT

- The plant can float freely or put down roots up to 50 cm long in shallow water;
- It produces a single white flower up to 2 cm wide with three rounded petals and a yellow centre;
- Leaves are 2.5 to 5 cm wide (about the size of a Canadian one-dollar coin), are round to heart-shaped, and form a rosette.
- The leaf bottom is purple-red with a spongy coating along the middle vein of the leaf that allows it to float on the water;
- European frog-bit will always be found alongside our native duckweed (Family *Lemnaceae*); and
- Can be mis-identified as native lily-pad species such as yellow-pond lily or white-water lily (*Nymphaea odorata*).



Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

INVASIVE ALGAE

STARRY STONEWORT (*Nitellopsis obtusa*)

Starry stonewort is an invasive macroalga (like seaweed) which is native to Eurasia. It spreads easily and aggressively through fragmentation and the movement of its small bulbils, making it critical that boaters avoid infested areas.

RANGE

In Ontario, starry stonewort has been recorded all along the Trent-Severn Waterway, from Lake Ontario to Georgian Bay/Lake Huron, and several non-connected lakes and stormwater basins.

It is also present in the St. Lawrence River, the Detroit River system, and several other US waterways.

IMPACTS

- Starry stonewort reduces biodiversity by forming dense mats (sometimes referred to as “pillows”) and competes aggressively with native plants as well as important food sources (e.g. phytoplankton, zooplankton, and invertebrates) for native fish and terrestrial species;
- Dense mats of starry stonewort can impede movement of fish, spawning activity, water flow, and recreational activities such as swimming, boating, and fishing; and
- Once introduced to a new area, starry stonewort can establish and spread very quickly.

HOW TO IDENTIFY STARRY STONEWORT

- It is a macroalga that resembles true plants with a singular stem with branchlets, which are sometimes extremely thick, but can also, in some instances, be similar to fishing line;



'22353441' by Marcus Rosten, CC BY 2.0, at <https://www.inaturalist.org/photos/22353441>

- Whorls of 4-6 branchlets coming off the main shoots, with blunt tips;
- White, star-shaped bulbils, which give the species its name, are produced at the nodes, generally 3-6 mm wide;



Photo credit: Photo credit: Minnesota Department of Natural Resources, Bugwood.org

- Can form dense mats up to 3 m thick; and
- Can be mis-identified as native muskgrass or chara (Family *Characeae*)
- No odour, with irregular branching, and the branchlets do not fork at the end.

INVASIVE PATHOGENS

WHERE TO LOOK:

Invasive pathogens are found within standing water (i.e., bait bucket or live-well). Ensure the boater/angler has conducted the 'Drain' step in Clean, Drain, Dry protocol to avoid the spread of any invasive pathogen. To disinfect their live-well, encourage anglers to have a spray bottle with a 10% household bleach solution (i.e., 100 ml of bleach to 900 ml of water). They should then spray the inside of their live-well and then rinse out the live-well with clean water at least 30 metres away from the waterbody. This is especially important if they are travelling into or out of a VHS management zone.

VHS

Viral hemorrhagic septicemia (VHS) is a multi-strain infectious disease that effects both fresh and saltwater fish. This disease can infect an extremely wide range of fish species and has been present in the Great Lakes since 2005. To reduce the spread of this disease, the NDMNRF has created two distinct VHS management zones for Ontario.

To find out which zone you are in, visit <https://www.ontario.ca/page/viral-hemorrhagic-septicemia-vhs>

RANGE

In Ontario, VHS has been detected throughout the Great Lakes, as well as in Lake Simcoe, Lake St. Clair, the St. Lawrence, and the Lower Thames River. Several US states have detected VHS and it exists in saltwater fisheries on the east and west coast.

IMPACTS

- VHS has caused significant sport fish die-off events throughout the Great Lakes;
- VHS can affect a wide range of sport and baitfish species, resulting in wide ranging effects to the larger ecosystem; and
- Due to impacts and die-offs to fish, VHS can negatively impact biodiversity.

HOW TO IDENTIFY VHS

Fish with VHS may, but will not always, display the following symptoms:

- Pale gills/organs;
- Bulging eyes;
- Bloated abdomen;
- Hemorrhaging (bleeding) on body and organs; and
- Abnormally dark body colour.



Photo credit: Dr. P. R. Bowser, Cornell University

AIS RESOURCES

For a more detailed list of invasive species currently threatening Ontario's ecosystems, visit www.invadingspecies.com

For information on AIS reported in a specific waterbody, visit www.EDDMapS.org.

LEGISLATIVE RESOURCES

Federal invasive species regulations can be found in sections 6, 7, 8, 9 and 10 of the Aquatic Invasive Species Regulations, under the *Fisheries Act*. These sections outline the list of federally **prohibited species** in Canada, rules and restrictions surrounding these species, and regulatory exemptions.

Regulations regarding disposal and transportation of baitfish, as well as transportation of non-baitfish species, can be found in sections 3 and 28 of the Ontario Fishery Regulations, 2007, under the Fisheries Act.

The management of invasive species in Ontario, specifically, is defined under the provincial *Invasive Species Act*, which contains a list of provincially **prohibited** and **restricted** species, rules and regulations surrounding these species, and exemptions.

For more information on the rules surrounding invasive species in Canada and Ontario, visit...

<https://www.ontario.ca/laws/statute/s15022>

<https://laws-lois.justice.gc.ca/eng/regulations/SOR-2007-237/page-1.html#h-735511>

<https://laws-lois.justice.gc.ca/eng/regulations/SOR-2007-237/page-3.html#h-735674>

<https://laws-lois.justice.gc.ca/eng/regulations/sor-2015-121/FullText.html>

REFERENCES

Hansen, G.J.A., Ahrenstorff, T.D., Bethke, B.J., Dumke, J.D., Hirsch, J., Kovalenko, K.E., LeDuc, J.F., Maki, R.P., Rantala, H.M., & Wagner, T. "Walleye growth declines following zebra mussel and Bythotrephes invasion." *Biol Invasions* no.22 (2020): 1481-1495, <https://doi.org/10.1007/s10530-020-02198-5>

"Managing invasive species in Ontario," Wildlife and Nature, Province of Ontario, accessed January 22, 2021, <https://www.ontario.ca/page/managing-invasive-species-ontario>

"Observations," iNaturalist, accessed January 24, 2021, <https://www.inaturalist.org/observations>

"Photos," Flickr, accessed January 22, 2021, <https://www.flickr.com/search/?text=&license=2%2C3%2C4%2C5%2C6%2C9&advanced=1>

Province of Ontario, Ministry of Natural Resources and Forestry, Fish and Wildlife Service Branch "2021 Fishing Ontario, Recreational Fishing Regulation Summary," (2021), accessed January 25, 2021, <https://www.ontario.ca/document/ontario-fishing-regulations-summary>

University of Georgia "Invasive and Exotic Species of North America," Bugwood, accessed January 25, 2021, <https://www.invasive.org/index.cfm>

