

# AQUATIC INVASIVE SPECIES Identification Guide for Minnesota

Aquatic & Wetland Plants • Invertebrates • Fish







# AIS Identification Guide

Third edition



## AIS DETECTORS

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UNIVERSITY OF MINNESOTA

**Driven to Discover®**

The AIS Detectors program is jointly supported by the Minnesota Aquatic Invasive Species Research Center and University of Minnesota Extension. Funding for the development of this book is provided in part by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources, the Clean Water Fund, the State of Minnesota, and private donations.

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# How to use this book

This ID book contains tips for identifying a number of aquatic invasive species (AIS) that are considered high-risk to Minnesota waters, as well as some common native lookalike species.

As you look at identifying characteristics and descriptions in the pages that follow, bear in mind that colors and sizes can be variable. These are general guidelines, not definitive taxonomic identification characteristics. Whenever possible, we highlighted key or unusual characteristics about a species, but specimens can often look very similar. They may also sometimes be found outside of the suggested habitats. If you are in doubt as to whether you have found an AIS, be sure to submit a report to the DNR through the EDDMapS website ([z.umn.edu/EDDMapS](http://z.umn.edu/EDDMapS)), the EDDMapS app, or by contacting a DNR AIS Specialist.

You will notice two different styles of maps in this book: for native species, we use watershed maps to highlight where species are generally found. Again, this can vary — these maps are a guideline. For invasive species, we use county maps to provide more localized distribution information. Maps are current using available data as of March 2020.

For more information on this book and AIS research, please visit [www.maisrc.umn.edu](http://www.maisrc.umn.edu).





# If you find an AIS

If you find an aquatic invasive species occurrence, follow these steps:

## 1. Use EDDMapS to submit the report.

You can do this using the EDDMapS app on your mobile device or on the EDDMapS website at [z.umn.edu/EDDMapS](http://z.umn.edu/EDDMapS). You should include:

- The date and time you made the observation.
- The species you believe you have found.
- The location you made the observation. Be specific.
- Photographs of the specimens.

## 2. Take photos of the AIS.

You should take multiple photos, including:

- Photos of the entire plant or animal (or as much as can clearly be captured in the frame).
- Close-ups of identifying features (such as leaves, fins, shape, colors, etc.).
- A photo that has an object in it for scale (such as a coin or a ruler).
- One photo of the general area where the AIS was found.

## 3. Collect a sample of the AIS.

- For animals such as invertebrates and fish, collect the entire animal.
- For smaller animals such as zebra mussels or spiny waterflea, you may want to include a few animals.
- For plants, you want to include as much of the plant as you reasonably can. Try to collect portions of the stem with leaves attached, any flowering structures if present, reproductive parts such as flowers or fruits, and organs such as tubers, turions, roots and rhizomes.
- Place the collected sample in a sealed container, something as simple as a Ziploc bag will do. If you have a large animal, like a carp, put it on ice in a cooler. You may also choose to wrap the plant or animal in a damp paper towel or newspaper prior to putting it into its container.
- Put a piece of paper with the location the sample was collected, the date of collection, and your name and contact information on it in the container with your sample. Be sure to write in pencil so that it doesn't bleed or run when wet.

## 4. Contact your local AIS specialist.

- Inform them that you have a sample of a suspected AIS and ask for further direction on what they would like you to do with it.
- The contact information for AIS Specialists is on the DNR's website: [www.dnr.state.mn.us/invasives/ais/contacts.html](http://www.dnr.state.mn.us/invasives/ais/contacts.html)

## 5. If you are using the EDDMapS app, be sure to upload your report from the queue.

The DNR is responsible for confirming and communicating new AIS occurrences. If your report is accurate, DNR will verify your report and it will become publicly viewable on the EDDMapS distribution maps.

If you are interested in learning more about AIS identification and citizen science, consider becoming an AIS Detector. Visit [www.aisdetectors.org](http://www.aisdetectors.org) for more information.

# Acknowledgements

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## For reviews and contributions, we thank:

Przemek Bajer	Wes Glisson	Tim Plude	Paul Skawinski
Eleanor Burkett	Gary Montz	Amy Rager	Chris Taylor
Nick Frohnauer	Becca Nash	Faye Sleeper	Mike Verhoeven
Susan Galatowitsch	Nick Phelps	Andrew Simons	

Minnesota Aquatic Invasive Species Research Center  
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Minnesota Department of Natural Resources





# Quick reference guide

## Eurasian watermilfoil

	Eurasian watermilfoil	Northern watermilfoil	Hybrid watermilfoil	Coontail	Water marigold	White water crowfoot	Bladderworts
Leaves alternate						x	x
Bladders present on leaves							x
Leaves whorled	x	x	x	x	x		
Leaflets on a central axis	x	x	x				
Leaves with <12 leaflets (4-11)		x					
Leaves with ≥12 leaflets (12-20)	x		x				

## Hydrilla

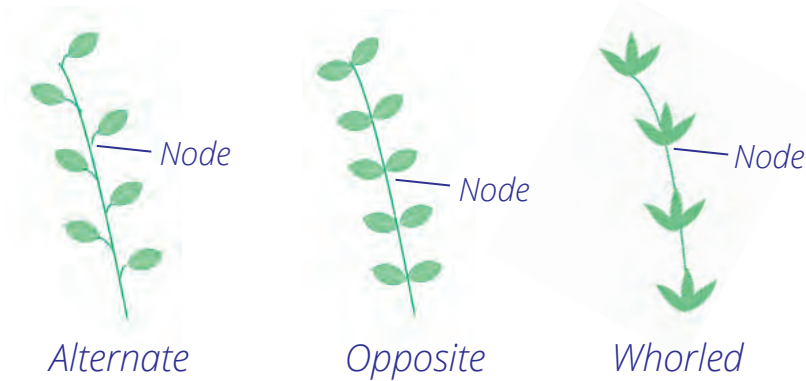
	Hydrilla	Brazilian waterweed	Elodea (waterweed)
≤ 3 leaves in a whorl			x
≥ 3 leaves in a whorl	x (usually 5)	x (usually 4)	
Showy white flowers		x	
Serrated leaf margins	x	x (under magnification)	
Produces tubers and turions	x		

## Starry stonewort

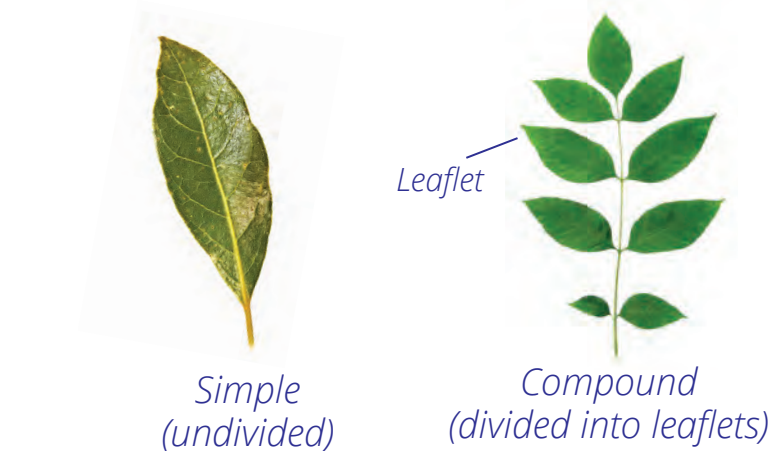
	Starry stonewort	<i>Chara spp.</i>	<i>Nitella spp.</i>	Sago pondweed	Water stargrass
Alternate, flat leaves					x
Branching needle-like leaves				x	
Whorled branchlets, like stem	x	x	x		
Strong odor		Some species			
Rough stems		x			
Forked branchlets	x		x		
Forked tips symmetrical			x		
Stays rigid out of water	x				
Star-shaped bulbils	x				

# Introduction to aquatic plants

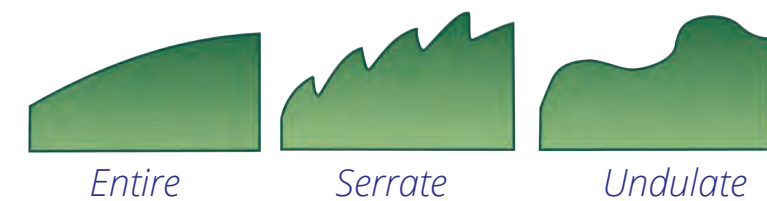
## Leaf arrangements



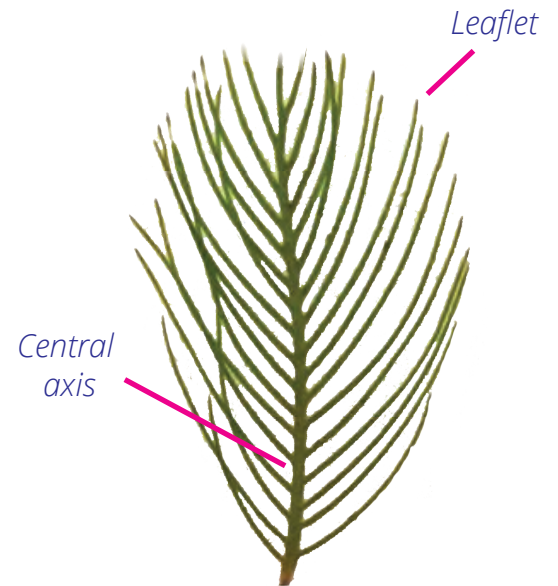
## Leaf types



## Leaf margins



## Whorled leaf





# INVASIVE

## Eurasian watermilfoil

*Myriophyllum spicatum*

### KEYS TO ID

- Feathery looking with four leaves per whorl
- Leaves have central axis with 12 – 20 leaflet pairs
- Can grow up to 10 feet long
- Produces pink and white flowers on spike above surface
- Leaves become limp when taken out of water

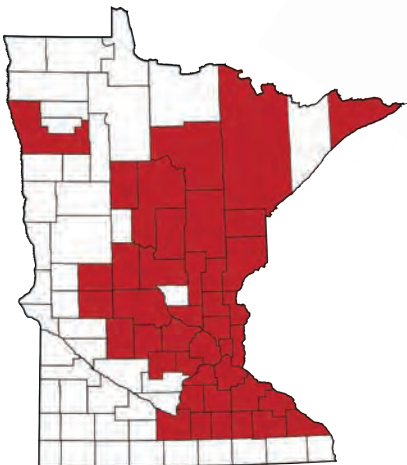
### LOOKS SIMILAR TO

- Northern watermilfoil (native)
- Coontail (native)
- Bladderworts (native)
- White water crowfoot (native)
- Water marigold (native)

### WHERE TO LOOK

- In lakes, ponds, and slow-moving areas of rivers or streams
- Grows best in depths of 3 – 15 feet

### CURRENTLY FOUND



*Note: Eurasian watermilfoil is known to hybridize with northern watermilfoil.*

*Hybrid watermilfoil is also considered invasive and should be reported.*

*Above-surface flowers*



*Four leaves per whorl with 12 – 20 leaflet pairs per leaf*



# NATIVE

## Northern watermilfoil

*Myriophyllum sibiricum*

### KEYS TO ID

- Four leaves per whorl
- Each leaf has between 4 – 11 leaflet pairs
- Leaves have a central axis and are rigid when taken out of water

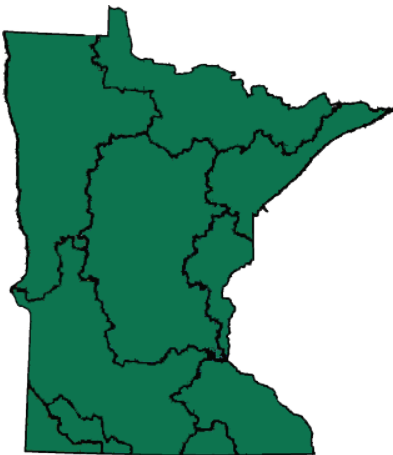
### LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Coontail (native)
- Bladderworts (native)
- Water marigold (native)
- White water crowfoot (native)
- Minnesota has six native milfoil species; this is the most common

### WHERE TO LOOK

- In depths of up to 20 feet

### CURRENTLY FOUND



*Four leaves per whorl with  
4 – 11 leaflet pairs per leaf*





# NATIVE

## Coontail

*Ceratophyllum demersum*

### KEYS TO ID

- Leaves have no central axis and are branching
- Can grow up to six feet long
- Often free-floating

### LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Water marigold (native)
- Northern watermilfoil (native)
- Bladderworts (native)
- White water crowfoot (native)

### WHERE TO LOOK

- In water up to 20 feet deep
- Upper leaves may reach surface and form dense patches
- Can become highly abundant and form “oil slicks” when it dies back

### CURRENTLY FOUND



# NATIVE

## Bladderworts

*Utricularia* spp.

### KEYS TO ID

- Thin leaves branching and zig-zagging can give a “fractal” appearance
- Leaves are highly dissected and have no central axis
- Has bladders, some of which may be filled with invertebrate victims of these carnivorous plants
- Has snapdragon-like flowers

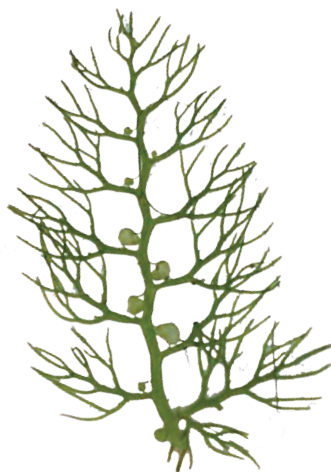
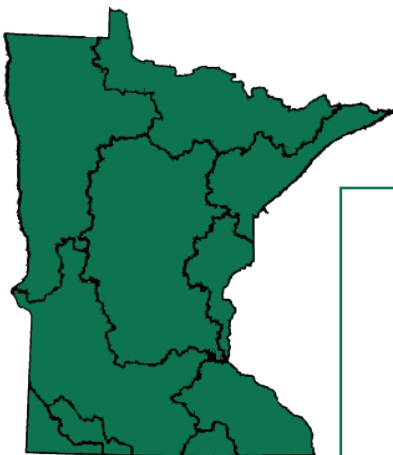
### LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Northern watermilfoil (native)
- Coontail (native)
- Water marigold (native)
- White water crowfoot (native)
- Minnesota has eight bladderwort species

### WHERE TO LOOK

- Usually found in shallow waters
- Can be either free-floating or buried in the sediment

### CURRENTLY FOUND



*Branching*



# NATIVE

## White water crowfoot

*Ranunculus aquatilis*

### KEYS TO ID

- Grows in mats on the water's surface
- Alternating leaves are highly dissected
- Produces flowers with yellow centers and five white petals
- Often has modified leaves at surface

### LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Water marigold (native)
- Northern watermilfoil (native)
- Bladderworts (native)
- Coontail (native)

### WHERE TO LOOK

- In ponds, slow-moving streams, and marshes
- Can grow up to 1 to 6 inches above water's surface

### CURRENTLY FOUND



# NATIVE

## Water marigold

*Bidens beckii* (formerly *Megalodonta beckii*)

### KEYS TO ID

- Opposite to whorled, highly dissected leaves that are variable along stems
- Leaves do not have a central axis
- Produces yellow buttercup flowers with more than five petals in mid- to late-summer
- Has two simple emergent leaves under the flower that are serrated

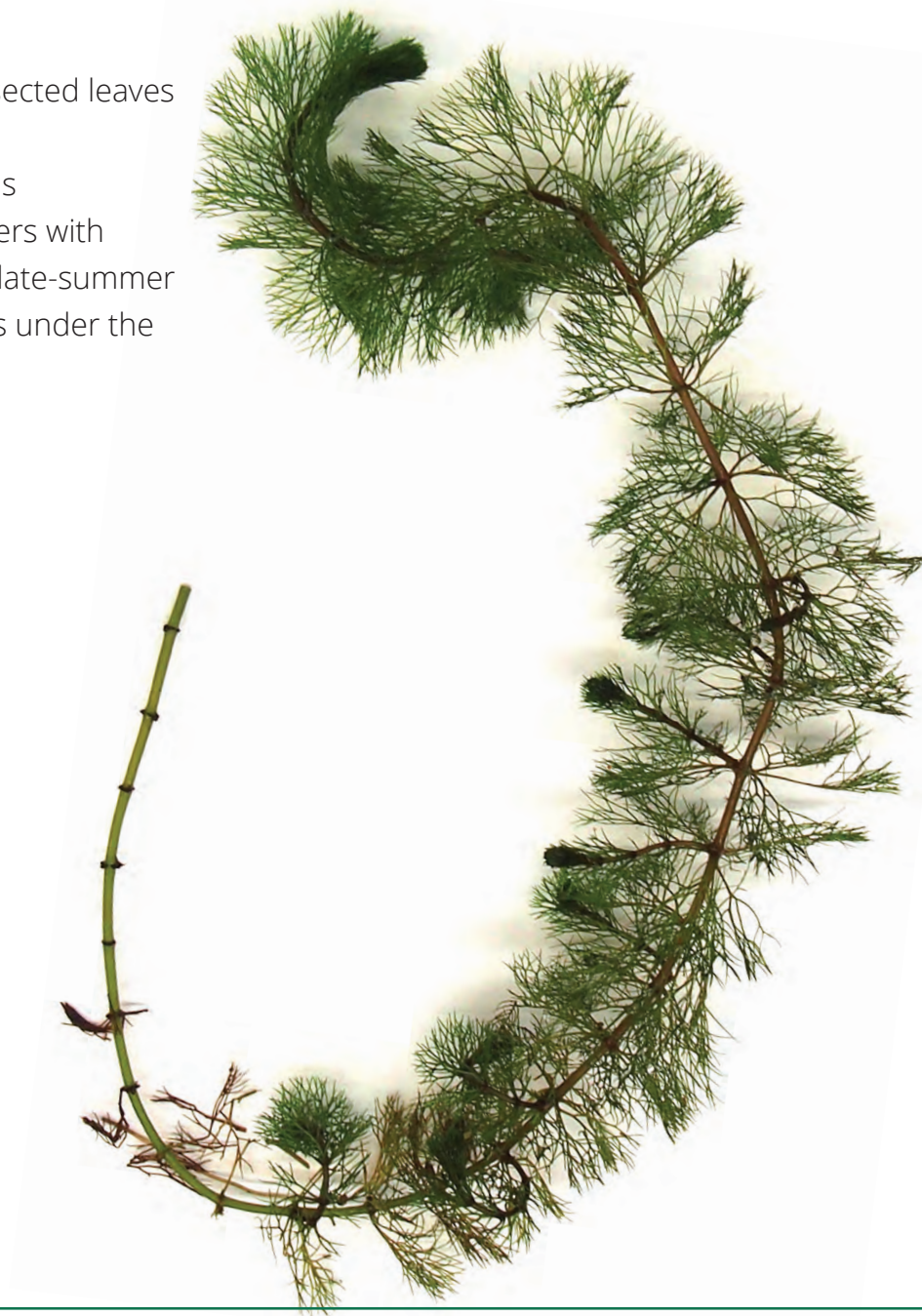
### LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Coontail (native)
- Northern watermilfoil (native)
- Bladderworts (native)
- White water crowfoot (native)

### WHERE TO LOOK

- In water up to 12 feet deep
- Flowers are above water

### CURRENTLY FOUND





# INVASIVE

## Hydrilla

*Hydrilla verticillata*

### KEYS TO ID

- Submersed plant that grows into thick mats
- Leaves are bright green with a midvein down the center and are between  $\frac{1}{8}$  and  $\frac{3}{4}$  inches long
- Leaves directly attached to stem (stalkless) in whorls of 3 – 10; often 5
- Ascending stems can grow up to 30 feet long
- Tubers or turions may be present
- Leaves have sharply toothed serrated edges that may require a hand lens to see



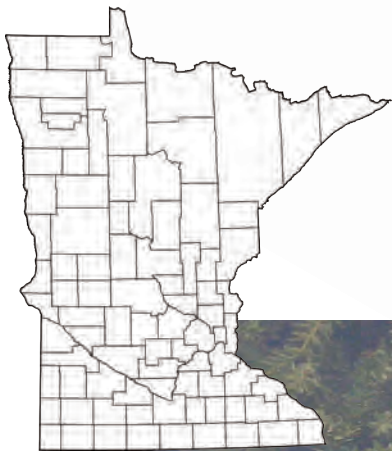
### LOOKS SIMILAR TO

- *Elodea* (native)
- Brazilian waterweed (invasive)

### WHERE TO LOOK

- Streams, lakes, and ponds
- In shallow or deep waters
- May invade deep waters where native plants can't grow
- Has not been found in Minnesota

### CURRENTLY FOUND



Dense mat

# NATIVE

## Common waterweed

*Elodea canadensis*

### KEYS TO ID

- Whorls of 3 oval-shaped leaves; whorls of 4 may occur
- Can grow up to three feet tall
- Leaves have smooth edges and are between  $\frac{1}{4}$  and  $\frac{3}{8}$  inches long
- Small white flowers visible above water in the summer



Three leaves per whorl

### LOOKS SIMILAR TO

- Hydrilla (invasive)
- Brazilian waterweed (invasive)
- Minnesota has three native *Elodea* species

### WHERE TO LOOK

- In water up to 10 feet deep
- Near stream inlets
- May be free-floating

### CURRENTLY FOUND





# INVASIVE

## Brazilian waterweed

*Egeria densa*

### KEYS TO ID

- Leaves in whorls of 4 to 6
- Leaves are between  $\frac{3}{8}$  and 1.5 inches long
- Small white flowers with 3 petals may be visible
- Can form dense mats that look bushy
- Serrated leaf margins may be visible under magnification

### LOOKS SIMILAR TO

- *Elodea* (native)
- *Hydrilla* (invasive)

### WHERE TO LOOK

- Submersed; can be free-floating or rooted
- Commonly used in home aquaria
- No established populations in Minnesota



# INVASIVE

## Starry stonewort

*Nitellopsis obtusa*

### KEYS TO ID

- Long, smooth branchlets are attached in whorls of 5 – 8 and branch asymmetrically at tips
- Stems are smooth
- Small, star-shaped bulbils form on clear threads at base of plant and may be found above or below the sediment surface
- Small, orange spheres called antheridia may be visible, these are male reproductive structures
- Branchlets typically several inches long, longer than *Chara* or *Nitella*
- Can fill water column and form surface mats

### LOOKS SIMILAR TO

- Native *Chara* (native)
- Native *Nitella* (native)
- Sago pondweed (native)
- Water stargrass (native)

### WHERE TO LOOK

- In shallow, still water and near accesses

### CURRENTLY FOUND



Actual size of bulbils

Below: orange antheridia





# NATIVE

## Muskgrasses

*Chara spp.*

### KEYS TO ID

- Stems are typically rough and crunchy
- Thin branchlets form whorls around thin stems
- Branchlets are not forked at tips
- May produce bulbils, but not star-shaped
- May have musky odor



*Whorled branchlets*

### LOOKS SIMILAR TO

- Starry stonewort (invasive)
- Native *Nitella* (native)
- Sago pondweed (native)
- Water stargrass (native)
- Minnesota has nine *Chara* species

### WHERE TO LOOK

- Fully submerged
- Along lake bottoms forming patches called meadows

### CURRENTLY FOUND



# NATIVE

## Stoneworts

*Nitella spp.*

### KEYS TO ID

- Stems are smooth
- Branchlets fork into two or three tips at end
- Unlike starry stonewort, forked tips are of equal length
- Typical branchlets are around an inch in length; much shorter than starry stonewort
- Becomes limp when out of water

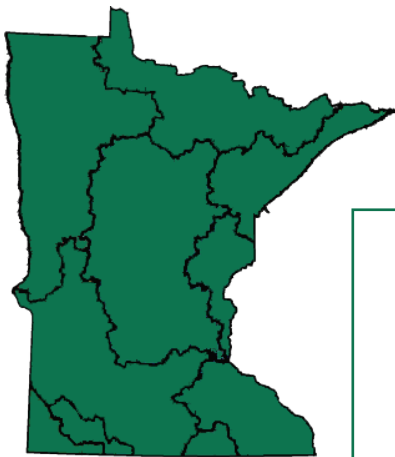
### LOOKS SIMILAR TO

- Starry stonewort (invasive)
- Native *Chara* (native)
- Sago pondweed (native)
- Water stargrass (native)

### WHERE TO LOOK

- Often in deeper zones of lake
- At depths up to 30 feet

### CURRENTLY FOUND





# NATIVE

## Sago pondweed

*Stuckenia pectinata*

### KEYS TO ID

- Has narrow, stiff leaves alternating off the slender stem
- The base of leaves are tightly attached to stem for about 1/4 of an inch before coming off the stem
- Produces clusters of egg-shaped fruits
- Leaves are very fine and almost look like pine needles
- Grows up to three feet tall

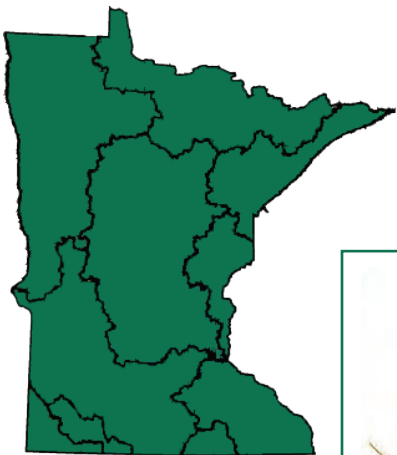
### LOOKS SIMILAR TO

- Starry stonewort (invasive)
- Native *Chara* (native)
- Native *Nitella* (native)
- Water stargrass (native)

### WHERE TO LOOK

- Usually in shallow waters up to six feet
- Entirely submersed in water

### CURRENTLY FOUND



# NATIVE

## Water stargrass

*Heteranthera dubia*

### KEYS TO ID

- Small yellow flowers visible above water in mid- to late-summer
- Leaves lack a visible midvein
- Slender and branching stems with alternating leaves
- Leaves are narrow and flat
- May create dense mats

### LOOKS SIMILAR TO

- Starry stonewort (invasive)
- Native *Chara* (native)
- Sago pondweed (native)
- Native *Nitella* (native)

### WHERE TO LOOK

- Mostly in shallow waters and near stream banks
- On sandy or muddy bottoms

### CURRENTLY FOUND



Yellow flowers





# INVASIVE

## Curly-leaf pondweed

*Potamogeton crispus*

### KEYS TO ID

- Thin, submerged leaves have distinct “teeth” and wavy edges
- Produces turions that look like small, greenish-brown pinecones
- Generally the first pondweed to come up in the spring; dies back in midsummer
- Leaves do not clasp around stem where they connect

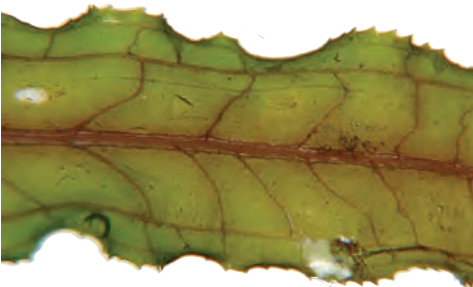
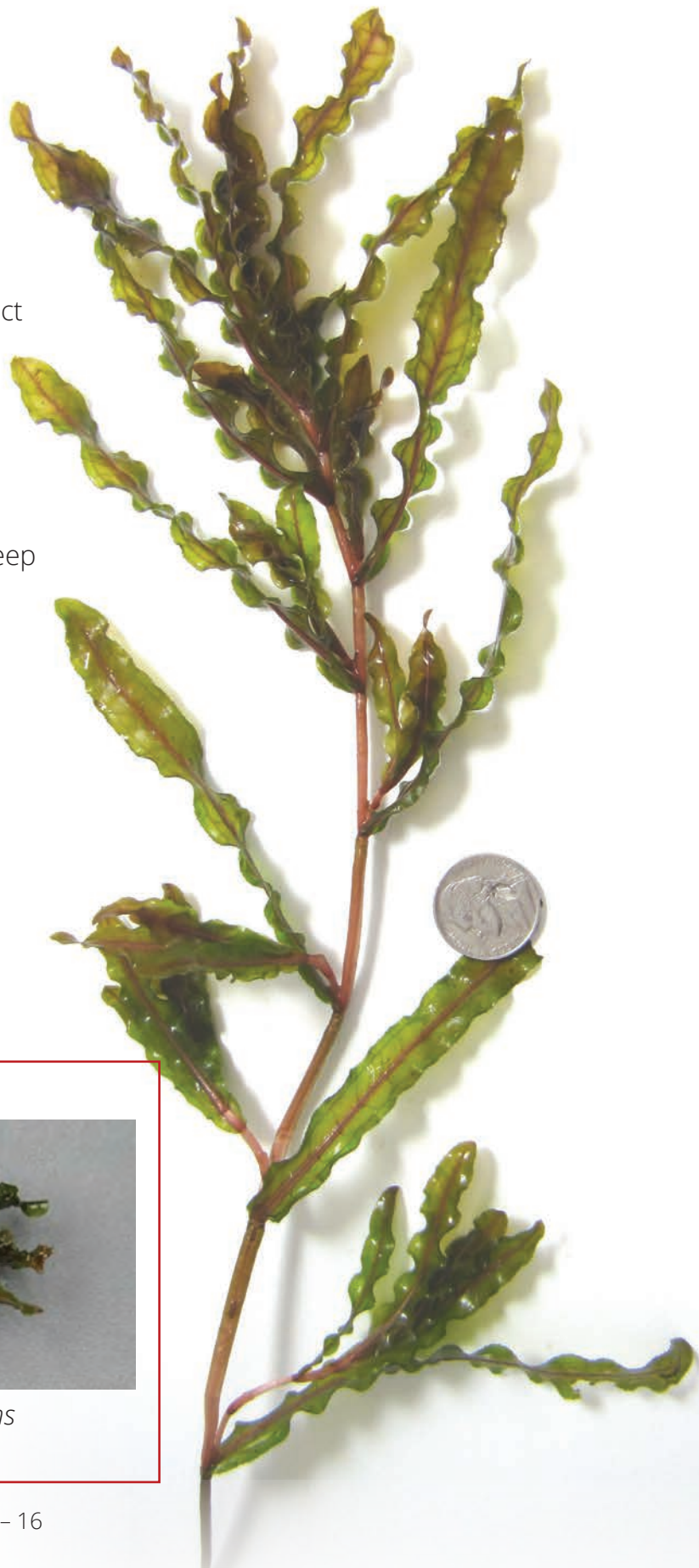
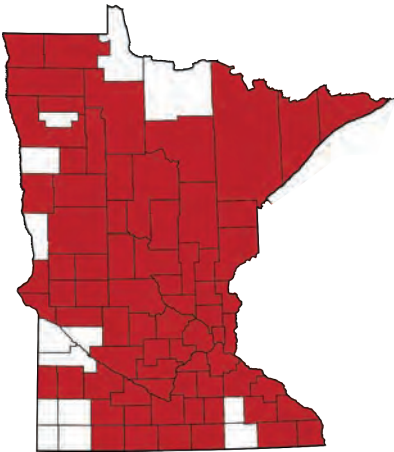
### LOOKS SIMILAR TO

- Clasping-leaf pondweed (native)

### WHERE TO LOOK

- Lakes, rivers, and streams in waters up to 15 feet deep

### CURRENTLY FOUND



Teeth on edges



Turions

# NATIVE

## Clasping-leaf pondweed

*Potamogeton richardsonii*

### KEYS TO ID

- Leaves alternate along the stem
- Leaves are wide and wavy, but don't have "teeth" like curly-leaf pondweed
- Leaves clasp around stem

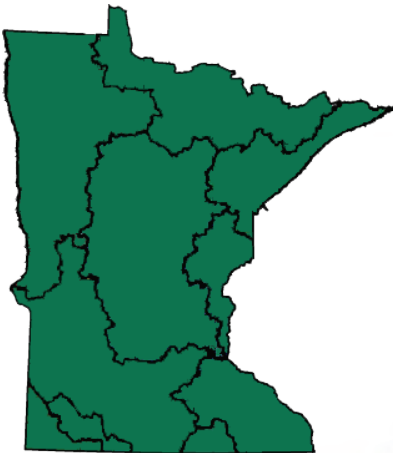
### LOOKS SIMILAR TO

- Curly-leaf pondweed (invasive)
- Also called Richardson's pondweed

### WHERE TO LOOK

- Fully submersed
- In water up to 12 feet

### CURRENTLY FOUND



*Leaves clasping stems*





# Quick reference guide

## Purple Loosestrife

	Purple loosestrife	Blue vervain	Joe pye-weed	Fireweed
Smooth leaf margins	x			x, sometimes wavy
Stem shape	Square to 6-sided	Square	Round	Round
Flowers grow in vertical clusters	x	x		x
Leaf arrangement	Opposite or whorled	Opposite	Whorled	Alternate
Single ring of flowers in bloom at a time		x		

## Hybrid cattail

	Hybrid cattail	Narrow-leaf cattail	Broadleaf cattail	Yellow iris	Blue flag iris
Leaf width	¼" - ½"	¼" - ½"	> ½"	~1"	~1"
Distance between male and female inflorescence	< 1"	> 1"	No gap	n/a	n/a
Dominant flower color	Tan-brown	Tan-brown	Tan-brown	Yellow	Blue-purple and white
Ridge-like thickening in center of leaf				x	
Leaf arrangement at base	Stacked	Stacked	Stacked	Fan-like	Fan-like

## Phragmites

	Invasive <i>Phragmites</i>	Native <i>Phragmites</i>	Reed canary grass	Miscanthus
Height	8 – 20 feet	8 – 15 feet	2 – 6 feet	4 – 8 feet
Inflorescence	Silver to purple, up to 20" tall	Silver to tan, 10 – 15" tall	Purple to tan, 6" tall	Finger-like silvery spikes
Flowering seasons	Late Aug. – Oct.	August	May – June	August – October
Leaves	1" wide, sheath tightly wraps stem	½ – 1" wide, sheath loosely wraps stem	½ – ¾" wide, rough texture	¼ – 1" wide, with prominent white midvein
Ligule	<1 mm, fuzzy	>1 mm, fuzzy	4 – 9 mm, transparent	1-2 mm, hairy
Stem color	Green to tan	Red to gold	Green to tan	Green to bronze

# Introduction to wetland plants

## Leaf arrangements



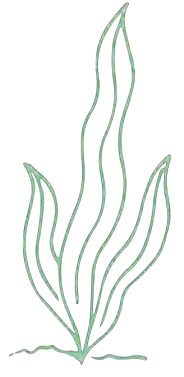
*Alternate*



*Opposite*



*Whorled*

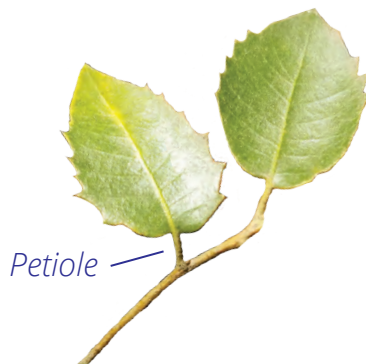


*Basal*

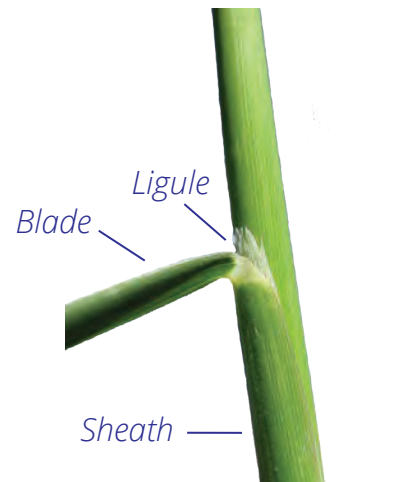
## Leaf attachments



*Sessile*

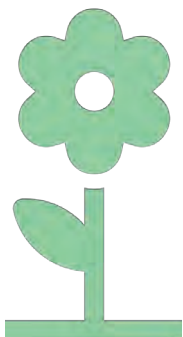


*Petiolate*

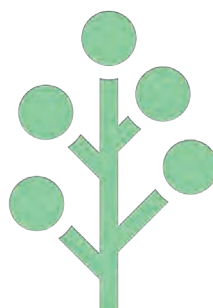


*Sheathing*

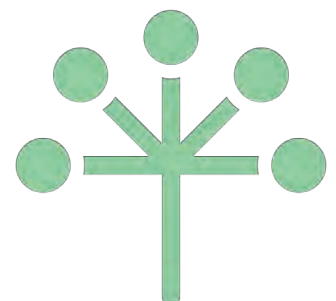
## Flower arrangements



*Single*



*Spike*



*Umbel*



# INVASIVE

## Purple loosestrife

*Lythrum salicaria*

### KEYS TO ID

- Grows 3 – 7 feet tall
- Purple-pink flowers grow on tall spikes
- Multiple rings of flowers bloom at the same time from the bottom of the spike up
- Leaves are opposite or whorled with smooth edges
- Stems are typically square but can be up to 6-sided

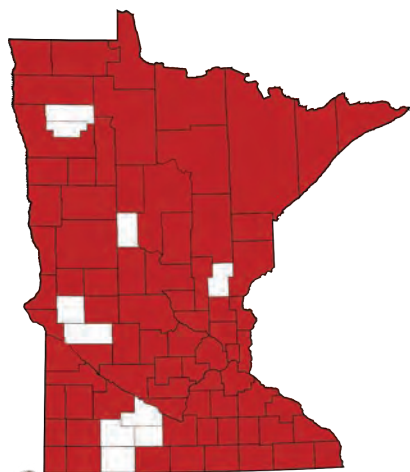
### LOOKS SIMILAR TO

- Blue vervain (native)
- Fireweed (native)
- Joe-pye weed (native)

### WHERE TO LOOK

- Wetland areas including wet meadows, stream banks, pond or lake edges, and ditches

### CURRENTLY FOUND



*Square stems and leaves with smooth edges*



# NATIVE

## Blue vervain

*Verbena hastata*

### KEYS TO ID

- Grows 1– 6 feet tall
- Blue-violet flowers grow on densely packed spikes and have five petals each
- Flowers bloom in a single, tight ring
- Leaves have sharply toothed edges and have opposite arrangement
- Stems are square and somewhat hairy

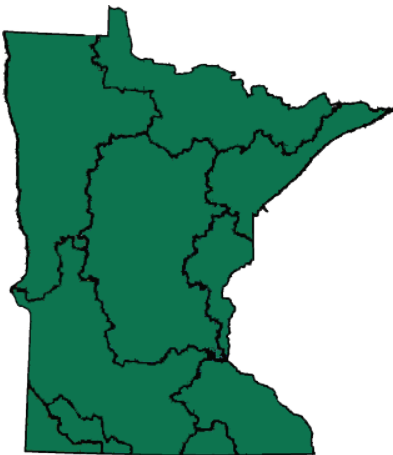
### LOOKS SIMILAR TO

- Purple loosestrife (invasive)
- Fireweed (native)
- Joe-pye weed (native)

### WHERE TO LOOK

- Shore areas, moist fields, and ditches
- Prefers sunny areas

### CURRENTLY FOUND



*Opposite leaves with sharply toothed edges (above)*  
*Flowers have spikes (below)*





# NATIVE

## Joe-pye weed

*Eutrochium spp.*

### KEYS TO ID

- Grows 2 – 10 feet tall
- Purplish flowers grow in clusters and have a fuzzy appearance
- Leaves are whorled with toothed margins
- Round stems may have hairs present

### LOOKS SIMILAR TO

- Purple loosestrife (invasive)
- Blue vervain (native)
- Fireweed (native)
- There are two native joe-pye weeds in Minnesota: Spotted joe-pye weed and Sweet joe-pye weed

### WHERE TO LOOK

- Wetlands, wet meadows, and shorelines

### CURRENTLY FOUND



*Whorled leaves with toothed margins*



# NATIVE

## Fireweed

*Chamaenerion angustifolium*

### KEYS TO ID

- Grows 3 – 7 feet tall
- Purple flowers grow on spikes and have four paddle-shaped petals alternating with four darker lance-shaped sepals
- Leaves are alternate with a white midrib and sometimes wavy edges
- Stems are round

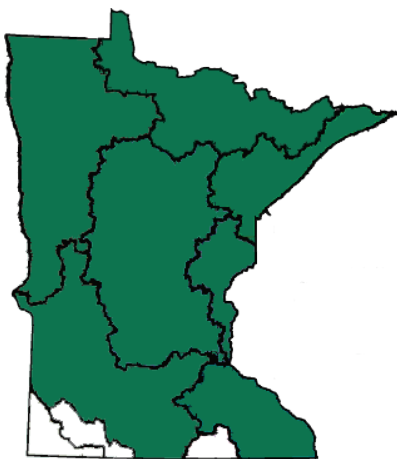
### LOOKS SIMILAR TO

- Purple loosestrife (invasive)
- Blue vervain (native)
- Joe-pye weed (native)

### WHERE TO LOOK

- Moist soils
- Woodland edges
- Shorelines

### CURRENTLY FOUND



*Alternating leaves with a white midrib (left)*  
*Alternating petals and sepals (right)*





# INVASIVE

## Hybrid cattail

*Typha × glauca*

### KEYS TO ID

- Leaf width is between  $\frac{1}{4}$  –  $\frac{1}{2}$  inch
- Gap between bottom, velvety-brown female flower and top, soft, tan-yellow male flower is between  $\frac{1}{4}$  – 1 inch
- Pollen shed as single grains or clusters of 2, 3, or 4 grains

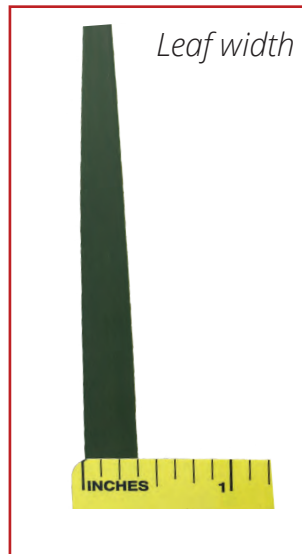
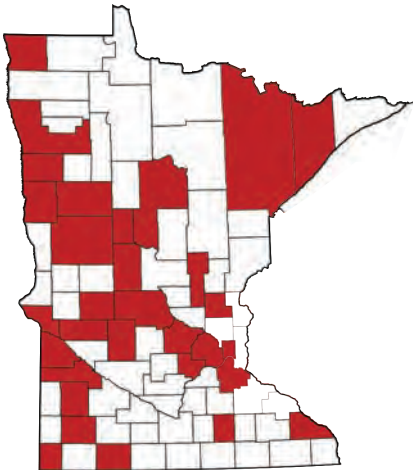
### LOOKS SIMILAR TO

- Narrow-leaf cattail (invasive)
- Broadleaf cattail (native)
- Yellow iris (invasive)
- Blue flag iris (native)

### WHERE TO LOOK

- Wetlands, ditches, edges of lakes, ponds, and streams

### CURRENTLY FOUND



Gap between flowers can range from absent to large; often intermediate



# INVASIVE

## Narrow-leaf cattail

*Typha angustifolia*

### KEYS TO ID

- Leaf width is between  $\frac{1}{4}$  –  $\frac{1}{2}$  inch
- Gap between bottom, velvety-brown female flower and top, soft, tan-yellow male flower is 1 inch or more
- Pollen shed as single grains

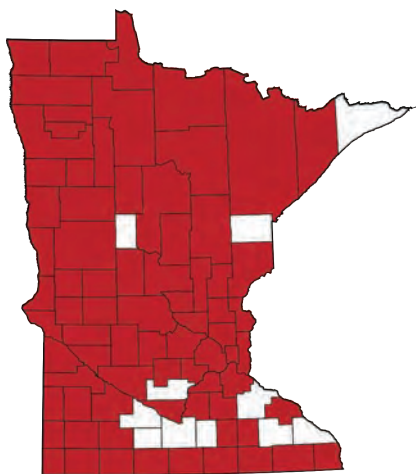
### LOOKS SIMILAR TO

- Hybrid cattail (invasive)
- Broadleaf cattail (native)
- Yellow iris (invasive)
- Blue flag iris (native)

### WHERE TO LOOK

- Wetlands, ditches, edges of lakes, ponds, and streams

### CURRENTLY FOUND



*Cattail seeds are spread by wind on dandelion-like fluff*

*Large gap between female and male flowers*





# NATIVE

## Broadleaf cattail

*Typha latifolia*

### KEYS TO ID

- Leaf width is greater than ½ inch
- No gap between bottom, velvety brown female flower and top, soft, tan-yellow male flower
- Pollen shed in clusters of four grains

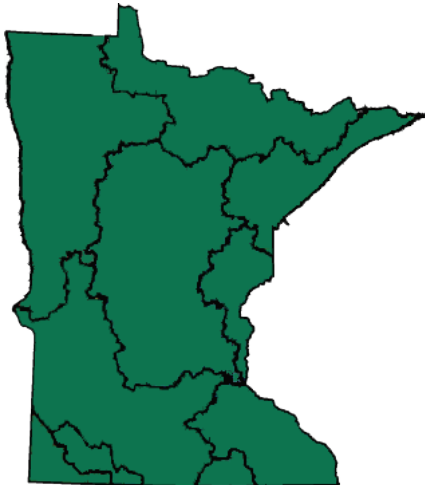
### LOOKS SIMILAR TO

- Narrow-leaf cattail (invasive)
- Hybrid cattail (invasive)
- Yellow iris (invasive)
- Blue flag iris (native)

### WHERE TO LOOK

- Wetlands, ditches, edges of lakes, ponds, and streams

### CURRENTLY FOUND



*Wider leaves*

*No gap between  
female and  
male flowers*



# INVASIVE

## Yellow iris

*Iris pseudacorus*

### KEYS TO ID

- Sword-like leaves form in flattened, fan-like clusters
- Center of leaf thickens sharply into a ridge
- Bright, yellow flowers usually grow with 2-3 on a stalk

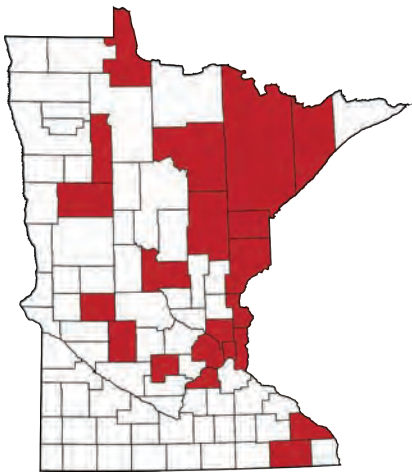
### LOOKS SIMILAR TO

- Hybrid cattail (invasive)
- Narrow-leaf cattail (invasive)
- Broadleaf cattail (native)
- Blue flag iris (native)

### WHERE TO LOOK

- Shorelines, shallow water, and ditches

### CURRENTLY FOUND



*Leaves make a fan-like pattern at the base;  
note thickening/ridge along centers of leaves  
(noted with arrow)*



# NATIVE

## Blue flag iris

*Iris virginica*, *Iris versicolor*

### KEYS TO ID

- Sword-like leaves form in flattened, fan-like clusters
- Center of leaf thickens gradually
- Blue-violet flowers with yellow and white markings

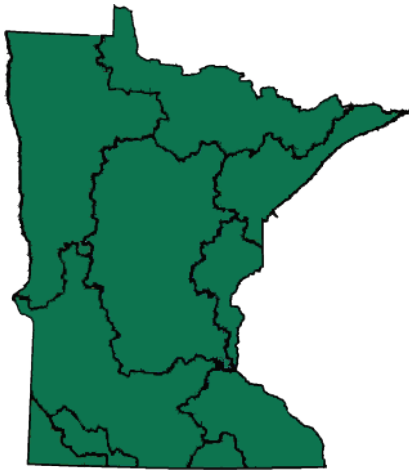
### LOOKS SIMILAR TO

- Narrow-leaf cattail (invasive)
- Hybrid cattail (invasive)
- Broadleaf cattail (native)
- Yellow iris (invasive)

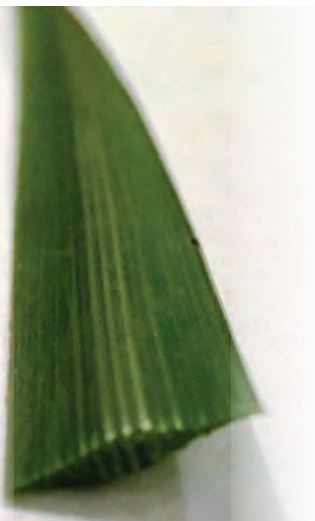
### WHERE TO LOOK

- Shorelines, shallow water, wetlands, and ditches

### CURRENTLY FOUND



Leaf thickens  
gradually



2 – 10

Leaves make a fan-like pattern at the base



# INVASIVE

## Invasive Phragmites

*Phragmites australis*

### KEYS TO ID

- Tall; up to 20 feet
- Full, showy seed heads that are silver to purple in color
- Leaf sheaths wrap tightly around stem with narrow ligule (< 1mm)
- Green stems that may feel ridged

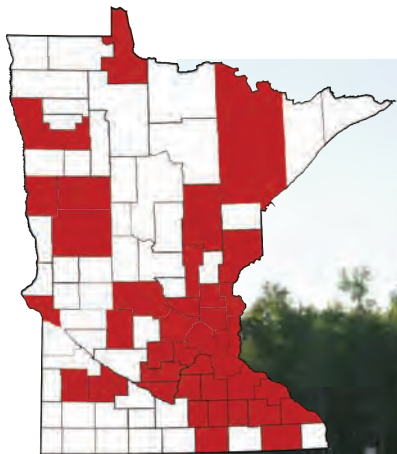
### LOOKS SIMILAR TO

- Native *Phragmites* (native)
- Reed canary grass (invasive)
- Silvergrass (invasive)

### WHERE TO LOOK

- Wetlands, ditches, edges of lakes, ponds, and streams

### CURRENTLY FOUND



Leaf sheaths wrap tightly around stem (left)  
Ligule is a thin, discrete brown line (right)





# NATIVE

## Native Phragmites

*Phragmites australis ssp. americanus*

### KEYS TO ID

- Tall; up to 15 feet
- Wispy seed heads that are silver to tan in color
- Leaf sheaths wrap loosely around stem with >1mm ligule
- Smooth stems golden to red in color

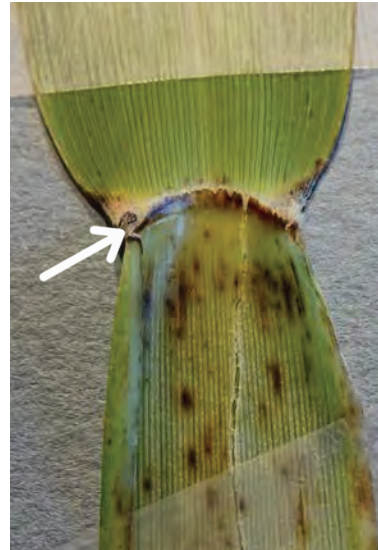
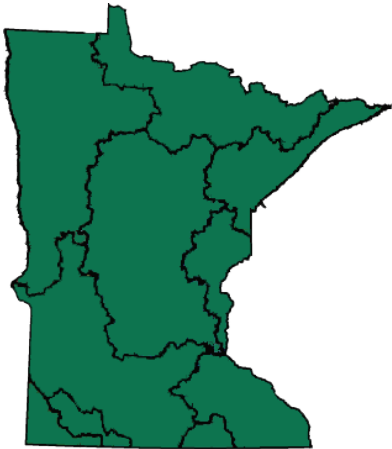
### LOOKS SIMILAR TO

- Invasive *Phragmites* (invasive)
- Reed canary grass (invasive)
- Silvergrass (invasive)

### WHERE TO LOOK

- Wetlands, ditches, edges of lakes, ponds, and streams

### CURRENTLY FOUND



Leaf sheaths wrap loosely around stem (left)  
Ligule is a thick, smudgy line (right)





# INVASIVE

## Reed canary grass

*Phalaris arundinacea*

### KEYS TO ID

- Leaves are  $\frac{1}{4}$  -  $\frac{3}{4}$  inch wide with a rough texture and up to 10 inches long
- Transparent ligule
- Hairless, hollow, smooth stems
- Seed heads about 6 inches tall and are green to purple to tan, blooming May to mid-June

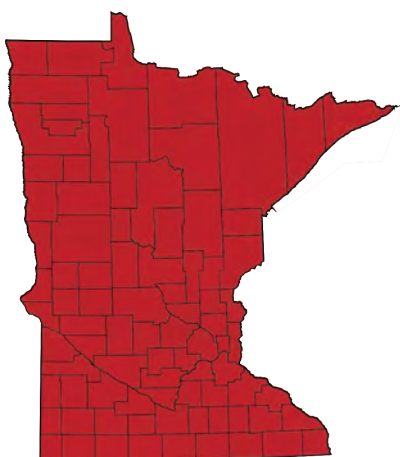
### LOOKS SIMILAR TO

- Invasive *Phragmites* (invasive)
- Native *Phragmites* (native)
- Silvergrass (invasive)

### WHERE TO LOOK

- Ditches, stream banks, wetlands
- May also be found in upland areas

### CURRENTLY FOUND



Translucent ligule (left)  
Seed heads can be purple (right)





# INVASIVE

## Silvergrass

*Miscanthus spp.*

### KEYS TO ID

- Grows 4 – 8 feet tall
- Seed heads resemble corn tassels, but are more dense and arch to one side of the stalk
- Long arching leaves, less than 1 inch wide, with a distinct, whitish midrib

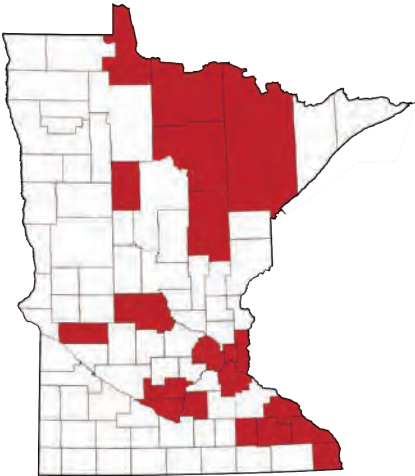
### LOOKS SIMILAR TO

- Invasive *Phragmites* (invasive)
- Native *Phragmites* (native)
- Reed canary grass (invasive)

### WHERE TO LOOK

- Sunny to semi-shaded areas along roads, ditches, woodland edges, and clearings
- Common in ornamental plantings

### CURRENTLY FOUND



*Long arching leaves with a white midrib*



# Quick reference guide

## Rusty crayfish

	Rusty crayfish	Clearwater crayfish	Calico crayfish	Virile crayfish
Red spot on carapace	x			
Black band on pincers	x	x		
Dark v-shaped mark on abdomen		x		
Notched gap in pincers			x	
Orange tip on pincers	x	x	x	x
Blue tint & white bumps on claws				x
Oval gap when pincers closed	x	x		

## Zebra and quagga mussels

	Zebra mussels	Quagga mussels	Native mussels	Freshwater golden clam	Snails
Adults attach to hard surfaces	x	x			x
Two shells	x	x	x	x	
Symmetric shape				x	
Ridges on shell			Some species	x	
Spiral-shaped shell					x
Striped pattern	Zig-zags	Rings	Some species		
Flattened ventral edge	x		Some species		
Curved line where shells meet		x	Some species		
Coloration lightens toward hinge		x	Some species		

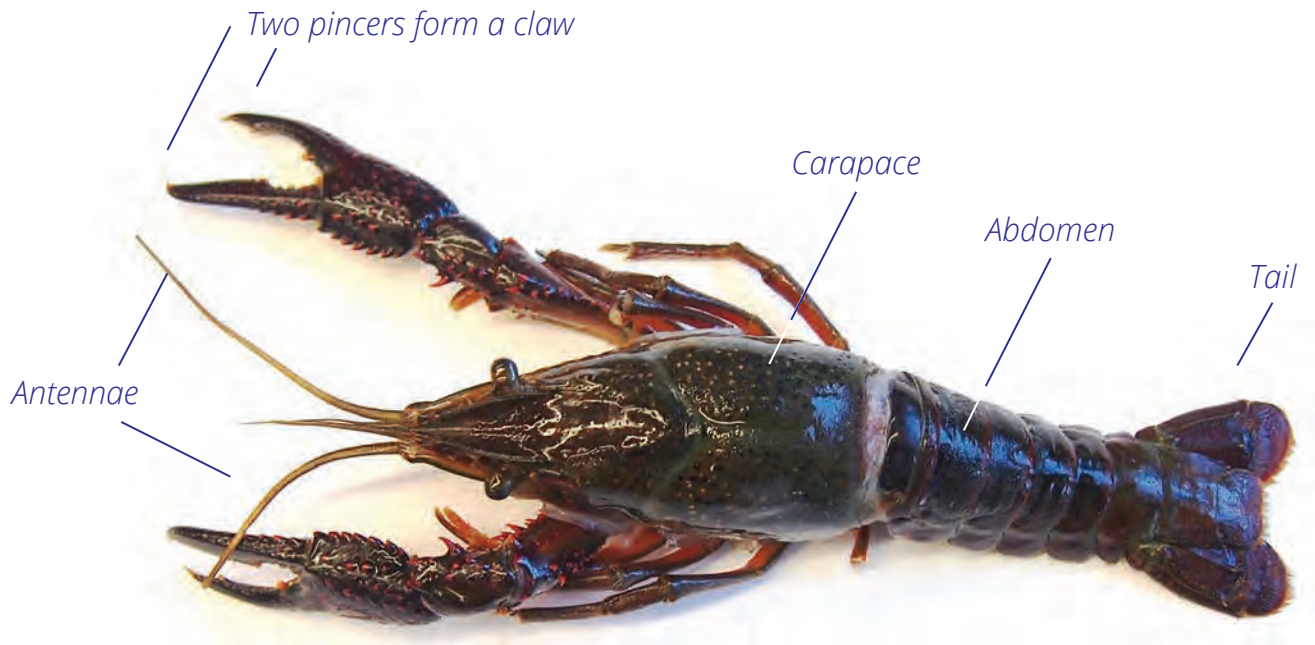
## Spiny waterflea

	Spiny waterflea	Fishhook waterflea	Other zooplankton
Long, spine-like tail	x	x	
Barbs on tail	x	x	
Black eyespot(s)	x	x	x
Egg sac (on females)	Round, bulbous	Long, pointed	
Hook at end of tail		x	
Can clump on angling gear	x	x	x

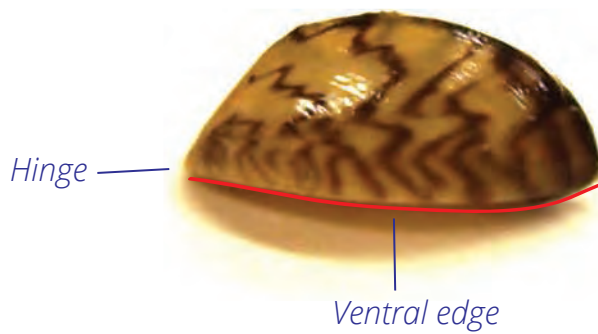


# Introduction to invertebrates

Crayfish



Mussels and clams



Snails



# INVASIVE

## Rusty crayfish

*Orconectes rusticus* (syn. *Faxonius rusticus*)

### KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- Red spots on the sides of carapace
- Small black bands at the tip of each pincer on claws
- When claws close, there is an oval-shaped gap
- Can grow up to 5 inches long

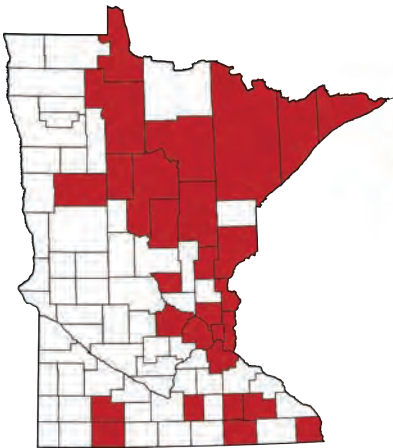
### LOOKS SIMILAR TO

- Red swamp crayfish (invasive)
- Northern clearwater crayfish (native)
- Calico crayfish (native)
- Virile crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

### WHERE TO LOOK

- Often found in shallow water up to three feet deep
- On a wide variety of bottom types

### CURRENTLY FOUND



Oval-shaped gap and black bands





# INVASIVE

## Red swamp crayfish

*Procambarus clarkii*

### KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- Can grow up to 5 inches
- Red bumps on claws
- Black wedge-shaped stripe on top of abdomen

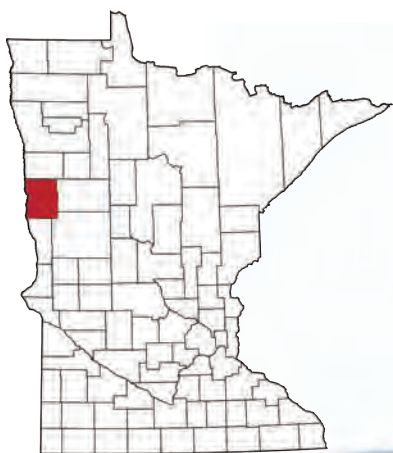
### LOOKS SIMILAR TO

- Rusty crayfish (invasive)
- Northern clearwater crayfish (native)
- Calico crayfish (native)
- Virile crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

### WHERE TO LOOK

- All types of freshwater
- Burrowed into bottoms of lakes, rivers, and ponds

### CURRENTLY FOUND



# NATIVE

## Northern clearwater crayfish

*Orconectes propinquus* (syn. *Faxonius propinquus*)

### KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- No red spot on side of carapace
- Claws are similar to rusty crayfish with black band at the tip
- Dark wedge-shaped marking down abdomen
- Can grow up to 4.5 inches

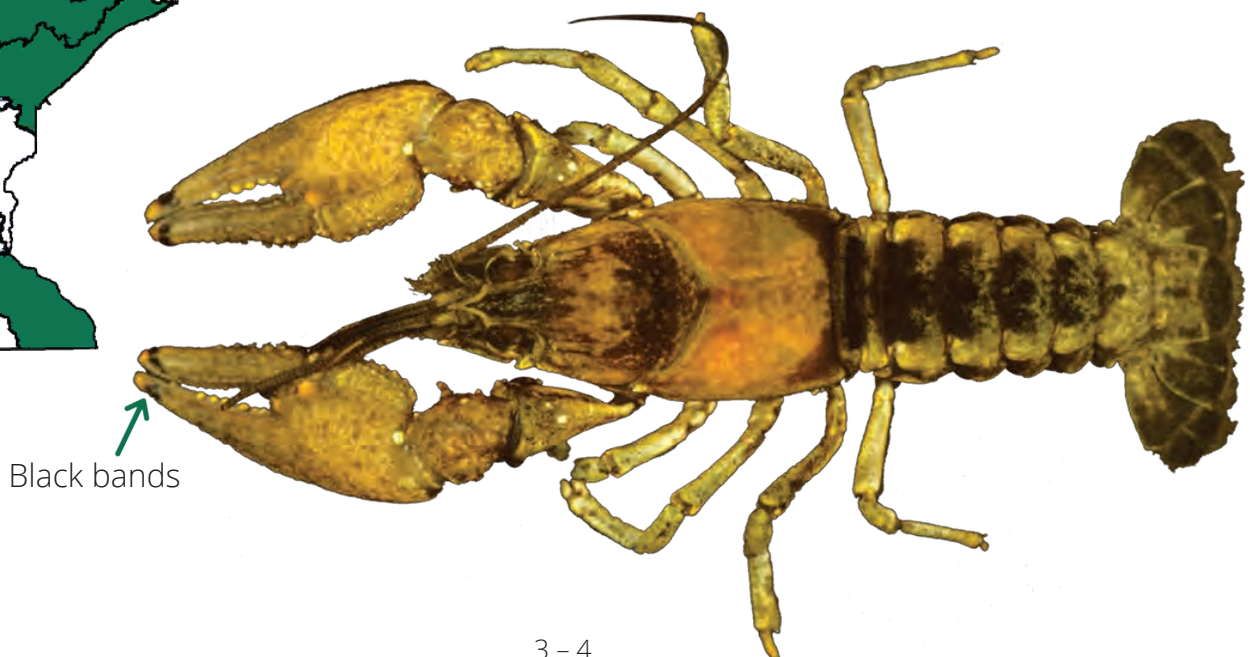
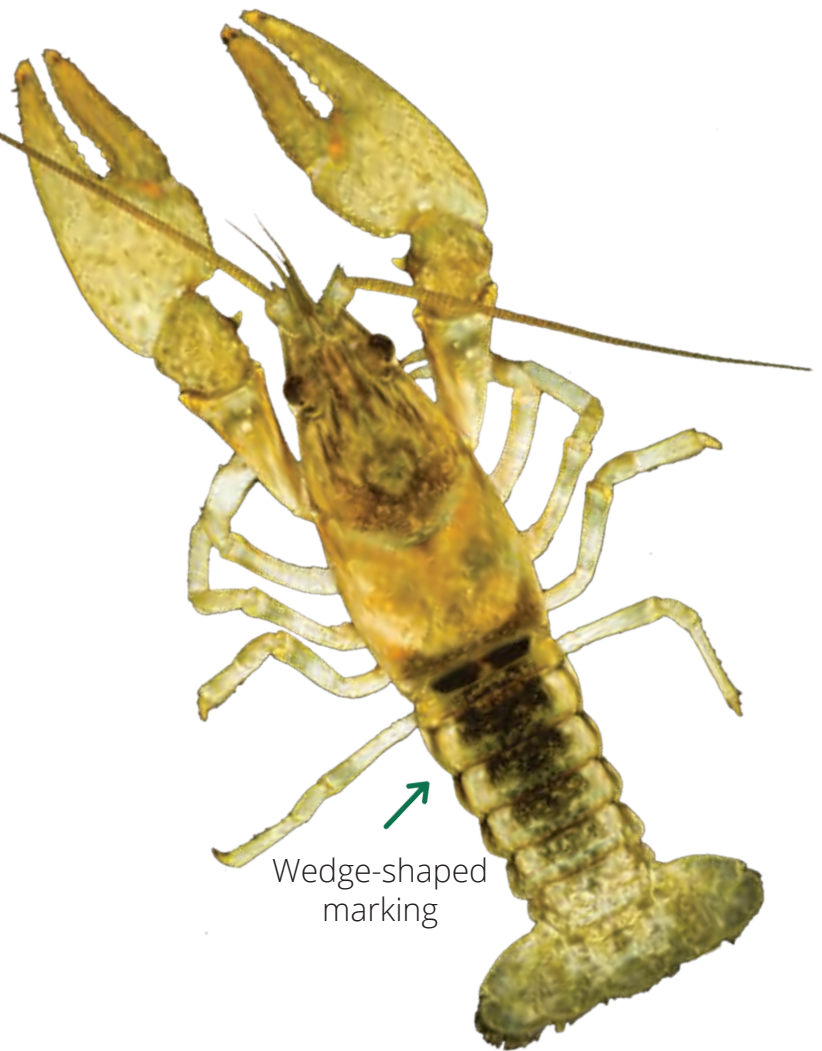
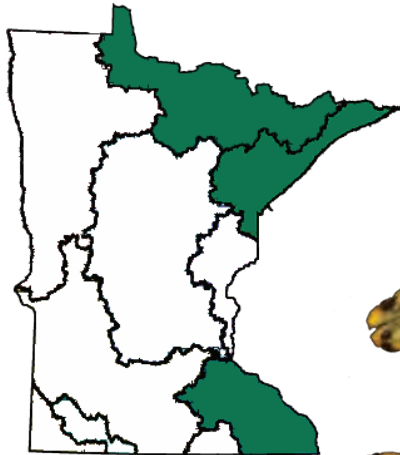
### LOOKS SIMILAR TO

- Rusty crayfish (invasive)
- Red swamp crayfish (invasive)
- Calico crayfish (native)
- Virile crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

### WHERE TO LOOK

- In clear, rocky streams and rocky lake shores

### CURRENTLY FOUND





# NATIVE

## Calico crayfish

*Orconectes immunis* (syn. *Faxonius immunis*)

### KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- No red spot on carapace
- Distinctive notch in the pincers of their claws
- Can grow up to 3.5 inches

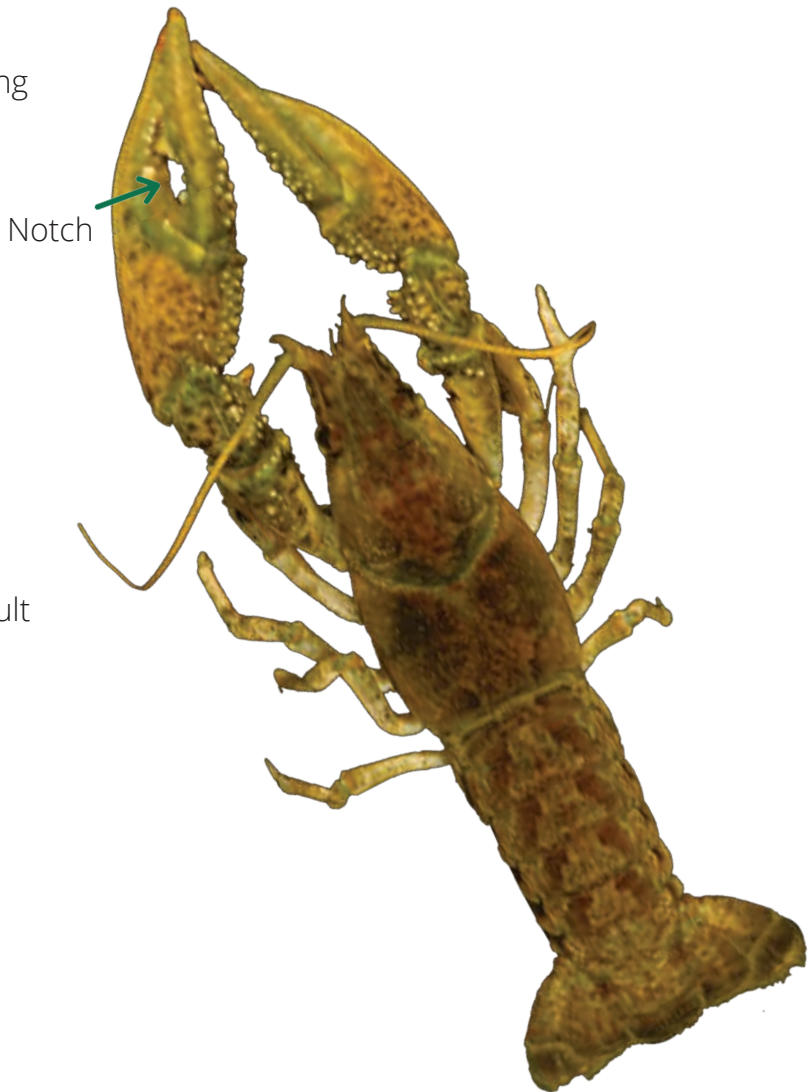
### LOOKS SIMILAR TO

- Rusty crayfish (invasive)
- Red swamp crayfish (invasive)
- Virile crayfish (native)
- Northern clearwater crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

### WHERE TO LOOK

- In shallow waters under plants for cover
- Will burrow in muddy bottoms of ponds

### CURRENTLY FOUND



# NATIVE

## Virile crayfish

*Orconectes virilis* (syn. *Faxonius virilis*)

### KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- No red spot on side of carapace
- Narrow claws with no black band
- Claws may have a blue tint with small white bumps
- Can grow up to 5 inches

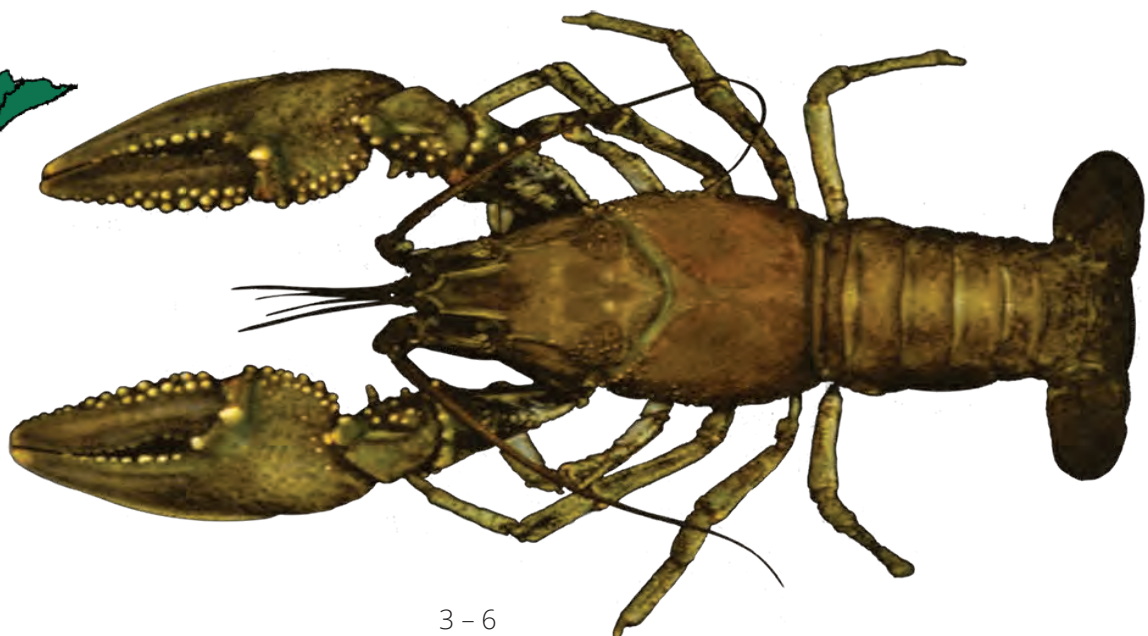
### LOOKS SIMILAR TO

- Rusty crayfish (invasive)
- Red swamp crayfish (invasive)
- Calico crayfish (native)
- Northern clearwater crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

### WHERE TO LOOK

- In a wide variety of habitats
- Under stones in lakes, streams, and wetlands
- Not found in swift-moving waters

### CURRENTLY FOUND





# INVASIVE

## Zebra mussels

*Dreissena polymorpha*

### KEYS TO ID

- Stripes are generally in zigzag pattern
- Pattern is variable; some may lack striping altogether and can be solid tan or brown
- Have a flat edge and won't topple over when set on it
- Shells form straight line when closed
- Range from  $\frac{1}{8}$  of an inch to 2 inches

### LOOKS SIMILAR TO

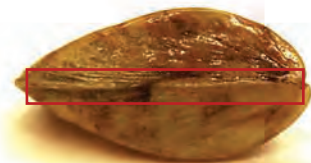
- Quagga mussels (invasive)
- Freshwater golden clam (invasive)
- Chinese mystery snail (invasive)
- Native snails (native)
- Native mussels (native)



*Stripes are zigzag*



*Byssal threads*

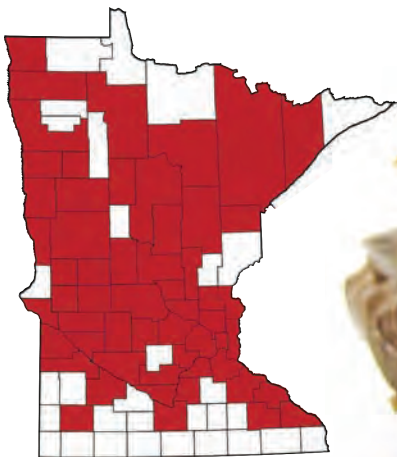


*Straight line*

### WHERE TO LOOK

- Often found attached to submerged objects (such as boats and docks as well as plants and rocks)
- May leave behind byssal threads when removed
- Newly settled mussels are usually in shallow areas; adults are common in depths of 10 to 20 feet

### CURRENTLY FOUND



*Zebra mussels covering native mussel*

# INVASIVE

## Quagga mussels

*Dreissena rostriformis "bugensis"*

### KEYS TO ID

- Stripes are in rings
- Wide range of coloration – some may appear to have almost no striping
- Will topple over when placed on ventral edge
- Shells form S-shape when closed
- Range from  $\frac{1}{8}$  of an inch to 2 inches

S-shape



### LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Chinese mystery snail (invasive)
- Freshwater golden clam (invasive)
- Native mussels (native)
- Native snails (native)



### WHERE TO LOOK

- Often found attached to submerged objects (such as boats and docks as well as plants and rocks)
- May leave behind byssal threads when removed
- May inhabit softer substrates (such as silt) and deeper water than zebra mussels



### CURRENTLY FOUND





# INVASIVE

## Freshwater golden clam

*Corbicula fluminea*

### KEYS TO ID

- Bivalve that ranges from light to dark in color
- Symmetric shape; rounder than zebra mussels
- Shells have rigid concentric rings
- Can grow up to 2 inches

### LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Quagga mussels (invasive)
- Chinese mystery snail (invasive)
- Native snails (native)
- Native mussels (native)

### WHERE TO LOOK

- In soft substrates like sand or mud

### CURRENTLY FOUND





## KEYS TO ID

- Have two shells (bivalves) with an asymmetrical shell shape
- Grow significantly larger than zebra mussels, quagga mussels, and freshwater golden clam
- 48 different species live in Minnesota
- Often called clams

## LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Chinese mystery snail (invasive)
- Freshwater golden clam (invasive)
- Quagga mussels (invasive)
- Native snails (native)
- Collectively called “unionids”

## WHERE TO LOOK

- Embedded in the bottom of lakes and rivers throughout Minnesota

## CURRENTLY FOUND



*Top: Native mussel on its own.*

*Bottom: Native mussel being smothered by zebra mussels. The uncovered part of this mussel was buried in the river bottom.*





# INVASIVE

## Chinese mystery snail

*Cipangopaludina chinensis*

### KEYS TO ID

- Grow up to 2 inches long
- Light to dark brown
- Have an operculum ("trapdoor") covering opening which is missing when dead

### LOOKS SIMILAR TO

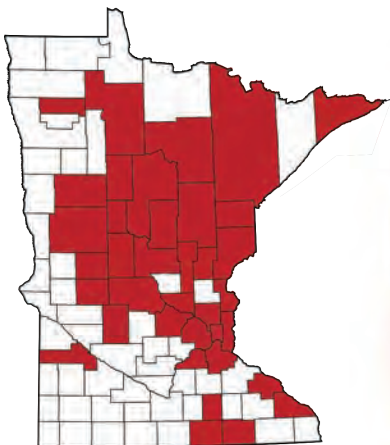
- Zebra mussels (invasive)
- Quagga mussels (invasive)
- Freshwater golden clam (invasive)
- Native mussels (native)
- Native snails (native)



### WHERE TO LOOK

- In lakes and slow-moving rivers

### CURRENTLY FOUND



# NATIVE

# Snails

## KEYS TO ID

- Single shell with spirals
- Generally under 2 to 3 inches

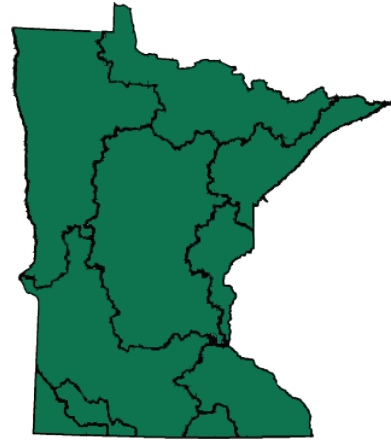
## LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Quagga mussels (invasive)
- Chinese mystery snail (invasive)
- Freshwater golden clam (invasive)
- Native mussels (native)

## WHERE TO LOOK

- Most aquatic habitats (from woodland pools to streams, rivers, wetlands, ponds, and lakes) throughout the state

## CURRENTLY FOUND



## Pond snail



## Ramshorn snail



## Limpet snail

Limpet snails are native to Minnesota but do not have the typical spiraled shell, and can be found attached to other animals or objects — often leading to confusion with zebra or quagga mussels.





# INVASIVE

## Spiny waterflea

*Bythotrephes longimanus*

### KEYS TO ID

- Range from  $\frac{1}{4}$  to  $\frac{5}{8}$  of an inch
- Have long, spiny tails with 1 – 4 pairs of barbs
- Have distinctive black eyespots
- Females may have bulbous brood chamber on back
- Most abundant during late summer and autumn

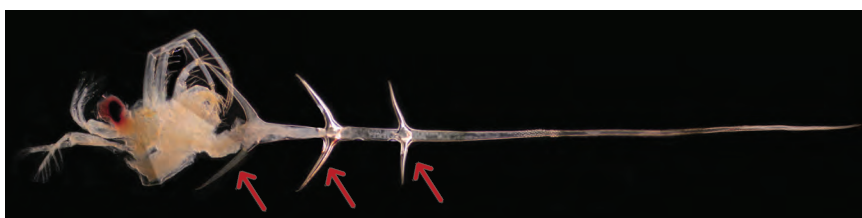
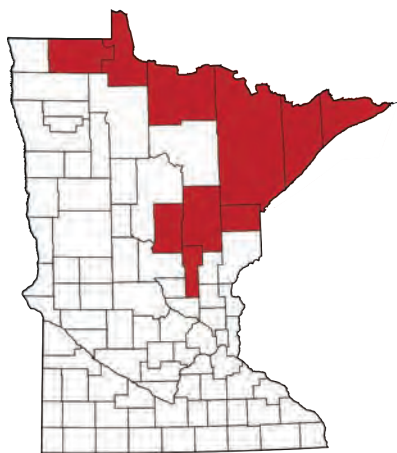
### LOOKS SIMILAR TO

- Fishhook waterflea (invasive)
- *Leptodora* (native)
- *Chaoborus* (native)

### WHERE TO LOOK

- Most often found on fishing line or other equipment in clumps that resemble a gelatinous blob
- Usually found in deep lakes but can establish in shallow lakes and rivers
- Suspended in water column

### CURRENTLY FOUND



Spiny waterflea with three pairs of barbs

# INVASIVE

## Fishhook waterflea

*Cercopagis pengoi*

### KEYS TO ID

- Range from about ¼ to ½ inch
- Have long tail with up to three pairs of barbs and a characteristic “hook” near the end
- Have distinctive eyespot
- Females may have pointed brood chamber on back

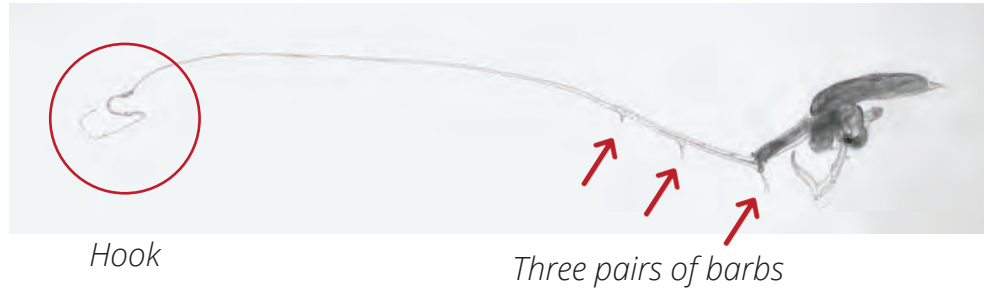
### LOOKS SIMILAR TO

- Spiny waterflea (invasive)
- *Leptodora* (native)
- *Chaoborus* (native)

### WHERE TO LOOK

- Clogged on nets or other fishing gear
- Brackish and freshwater lakes
- Has not been found in Minnesota

### CURRENTLY FOUND



Hook

Three pairs of barbs





# NATIVE

## Predatory zooplankton

*Leptodora sp.* and larval *Chaoborus sp.*

### KEYS TO ID

- No long, spine-like tail
- *Leptodora* grow up to 0.8 inches long with two antennae and one eye
- *Chaoborus* have two small eyes at the front of their bodies, lack spines on their tail, and also lack long antennae
- Both are almost entirely transparent

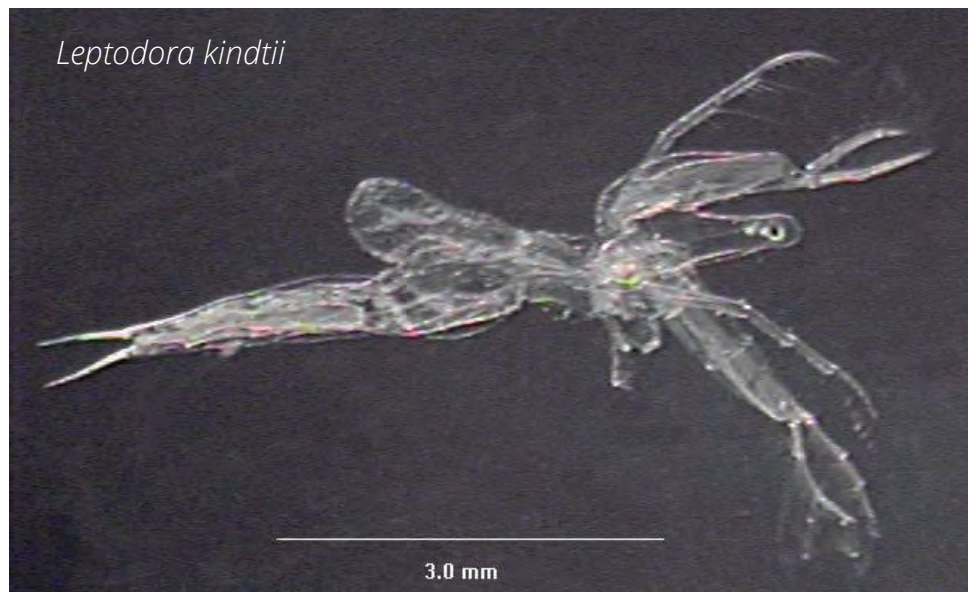
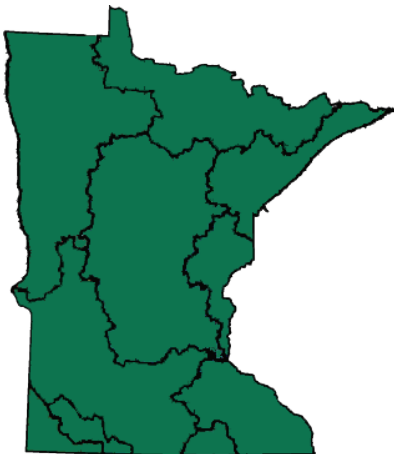
### LOOKS SIMILAR TO

- Spiny waterflea (invasive)
- Fishhook waterflea (invasive)

### WHERE TO LOOK

- Collected on fishing line
- Very widespread throughout Minnesota

### CURRENTLY FOUND



# Quick reference guide

## Bighead and silver carp

	Bighead carp	Silver carp	Gizzard shad	Mooneye	Shiners
Color	Gray with dark patches; silvery white underside	Silver; sometimes with a green hue	Silver-white	Silver	Varies
Eye location	Center below midline	Center below midline	Center above midline	Center above midline	Center above midline
Keel	Short	Long	Long	Short	
Shoulder spot			X		
Teeth				X	
Long final ray of dorsal fin			X		

## Round goby

	Round goby	Tubenose goby	Sculpins
Color	Mottled browns, blacks, grays, and olives — white or cream underside	Mottled brown on light brown, olive, or tan — white or cream underside	Variable brown markings
Black spot on first dorsal fin	X		
Separated 1st and 2nd dorsal fins	X	X	
Fused pelvic fins	X	X	

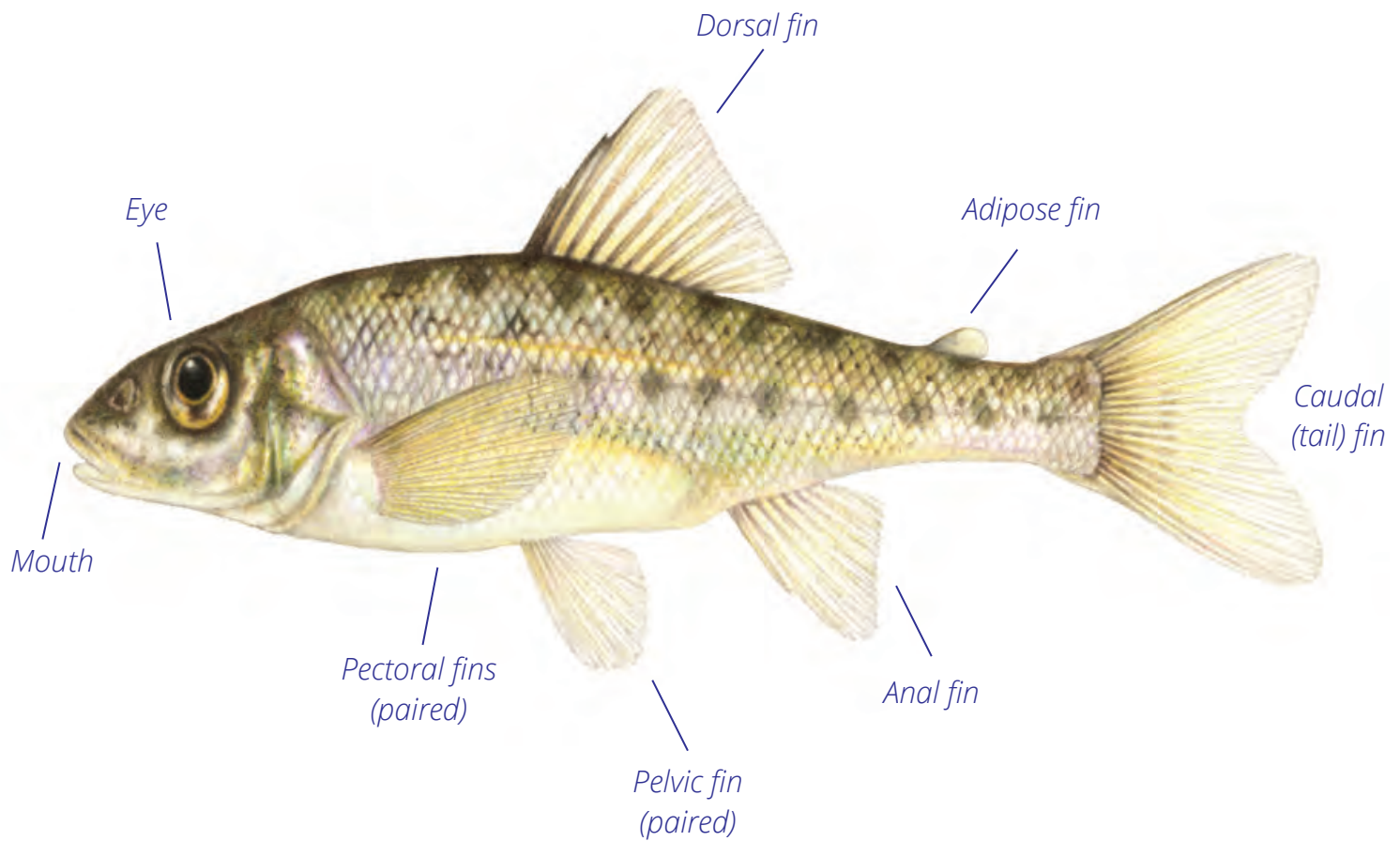
## Ruffe

	Ruffe	Walleye	Yellow perch	Sauger
Color	Tans, grays, olive, and silvers with irregular dark blotches; white-cream	Brown/olive with mottling, white-cream underside	Brownish-green with dark vertical bars, white-cream underside	Brown/gray with mottling, white-cream underside
Mouth extends past front of eye		X	X	X
White tip at base of caudal fin		X		
Fused 1st and 2nd dorsal fins	X			

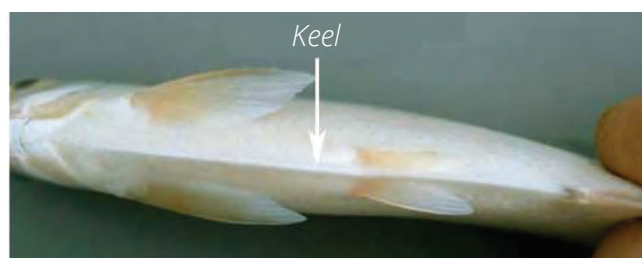
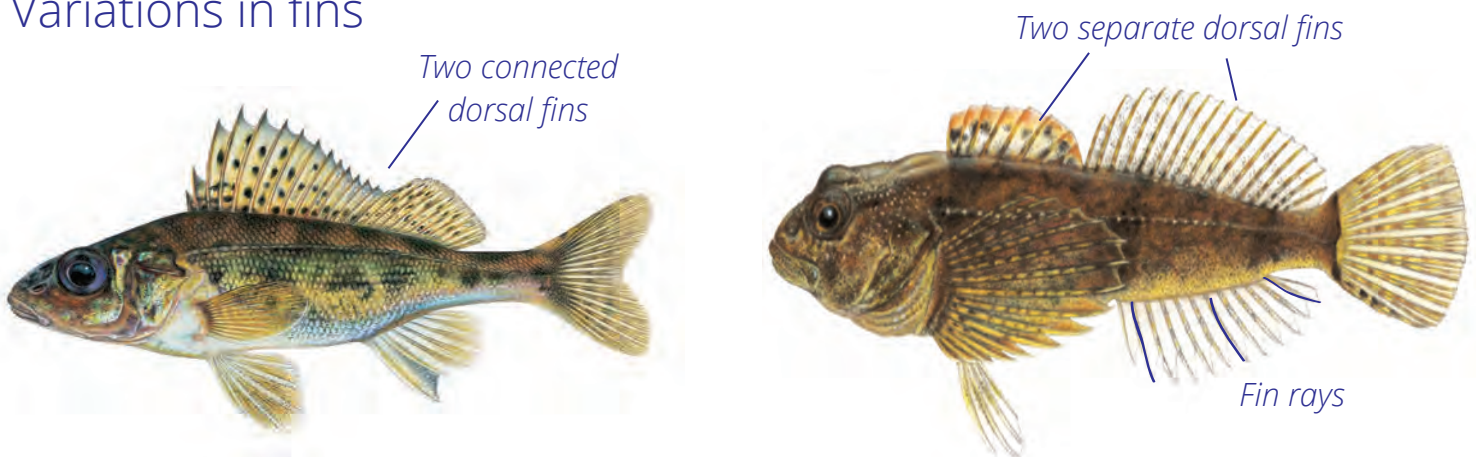


# Introduction to fish

## Fish characteristics



## Variations in fins



# INVASIVE

## Bighead carp

*Hypophthalmichthys nobilis*

### KEYS TO ID

- Dark gray with black blotches on back and sides
- Eyes point downward; center of the eye is even with or below the midline
- No teeth in upper or lower jaw
- Short keel between pelvic and anal fins
- Average size of Bighead carp caught in Minnesota is nearly 40 inches; early life stage could be confused with minnows

### LOOKS SIMILAR TO

- Silver carp (invasive)
- Gizzard shad (native)
- Mooneye (native)
- Emerald shiner (native)

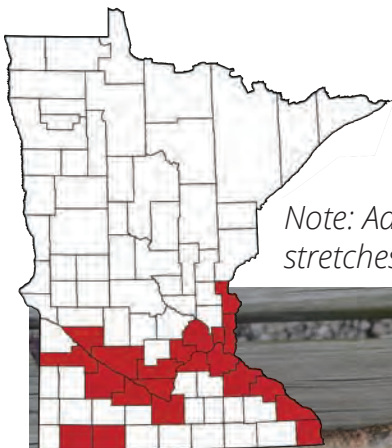
### WHERE TO LOOK

- Prefer turbulent, nutrient-rich rivers
- Need flowing water to reproduce; will use backwaters and slow areas other times of the year
- No known established populations in Minnesota; individuals have been caught intermittently



Juvenile

### CURRENTLY FOUND



Note: Adult bighead carp have been found in (or would have had to pass through) stretches of the Minnesota, Mississippi, and St. Croix Rivers in highlighted counties.





# INVASIVE

## Silver carp

*Hypophthalmichthys molitrix*

### KEYS TO ID

- Silver in color; can be greenish on back
- Eyes point downward
- Center of the eye is even with or below the midline
- No teeth in upper or lower jaw
- Long keel that extends in front and behind pelvic fins
- Average size of Silver carp caught in Minnesota is nearly 33 inches; early life stage could be confused with minnows

### LOOKS SIMILAR TO

- Bighead carp (invasive)
- Gizzard shad (native)
- Mooneye (native)
- Emerald shiner (native)

### WHERE TO LOOK

- Can jump up to ten feet in the air
- Prefer turbulent, nutrient-rich rivers; can tolerate a wide range of temperatures
- Need flowing water to reproduce; will use backwaters and slow areas other times of the year
- No known established populations in Minnesota; individuals have been caught intermittently



Fry (top)  
Adult (middle)  
Juvenile (bottom)

### CURRENTLY FOUND



*Note: Adult silver carp have been found in (or would have had to pass through) stretches of the Mississippi, St. Croix, and Ojibwa Rivers in highlighted counties.*

# NATIVE

## Gizzard shad

*Dorosoma cepedianum*

### KEYS TO ID

- Silver to white with a distinguishing shoulder spot
- Last ray on dorsal fin much longer than the others
- Upper edge of the eye located above the tip of the upper lip
- No teeth in upper or lower jaw
- Generally grow about 8 – 12 inches

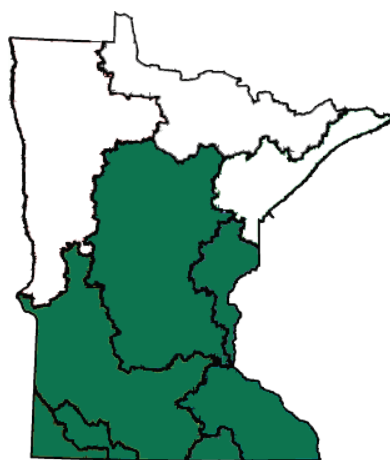
### LOOKS SIMILAR TO

- Bighead carp (invasive)
- Silver carp (invasive)
- Mooneye (native)
- Emerald shiner (native)

### WHERE TO LOOK

- Prefer shallow waters with soft, muddy bottoms
- Also found in slow-moving areas of rivers

### CURRENTLY FOUND





# NATIVE

## Mooneye

*Hiodon tergisus*

### KEYS TO ID

- Silver in color
- Keel extends from anal to pelvic fin
- Upper edge of the eye is located above the tip of the upper jaw
- Has teeth on both jaws and roof of mouth
- Grow up to 15 inches long

### LOOKS SIMILAR TO

- Bighead carp (invasive)
- Silver carp (invasive)
- Gizzard shad (native)
- Emerald shiner (native)

### WHERE TO LOOK

- Prefer large, clear lakes and rivers

### CURRENTLY FOUND





# NATIVE

## Emerald shiner

*Notropis atherinoides*

### KEYS TO ID

- Emerald-silver color on its sides
- Upper edge of the eye is located above the tip of the upper jaw
- No teeth on upper or lower jaw
- Generally grow about 3 – 4 inches

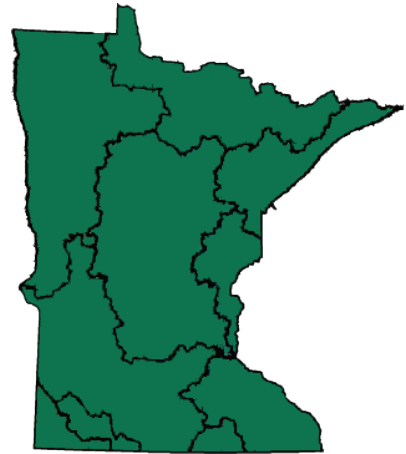
### LOOKS SIMILAR TO

- Bighead carp (invasive)
- Silver carp (invasive)
- Mooneye (native)
- Gizzard shad (native)

### WHERE TO LOOK

- Tend to school in large groups near surface of the water at dusk to feed

### CURRENTLY FOUND





# INVASIVE

## Round goby

*Neogobius melanostomus*

### KEYS TO ID

- Young gobies are solid gray; older fish are light gray with dark blotches
- Fused pelvic fin – which no native fish have – can resemble a suction cup
- First and second dorsal fins are separate
- Prominent black spot on first dorsal fin
- Has fine scales on body
- Usually less than 6 inches

### LOOKS SIMILAR TO

- Tubenose goby (invasive)
- Native Sculpins including mottled, slimy, spoonhead, and deepwater (native)

### WHERE TO LOOK

- Lakes and slow-moving rivers
- Areas with vegetation cover and rocky bottoms
- Found in Lake Superior but not yet in inland lakes

### CURRENTLY FOUND



Above: Fused pelvic fin  
Below: Dark spot on dorsal fin



# INVASIVE

## Tubenose goby

*Proterorhinus semilunaris*

### KEYS TO ID

- Has fused pelvic fins, which no native fish have
- Does not have black spot on dorsal fin
- First and second dorsal fins are separate
- Nostril extends beyond lower lip
- Has fine scales on body and grows to about 4 inches

### LOOKS SIMILAR TO

- Round goby (invasive)
- Native Sculpins including mottled, slimy, spoonhead, and deepwater (native)

### CURRENTLY FOUND



### WHERE TO LOOK

- In slow-moving, shallow water less than 15 feet with lots of plant cover
- Found in Lake Superior but not in inland lakes



*Note nostril extending beyond bottom lip and lack of black spot on dorsal fin.*





# NATIVE

## Sculpins

*Cottus spp.*

### KEYS TO ID

- Vary from light tan to dark brown with mottled blotches
- Fused first and second dorsal fin
- Scaleless body
- Have two separated pelvic fins
- Grow between 4.5 and 6 inches long

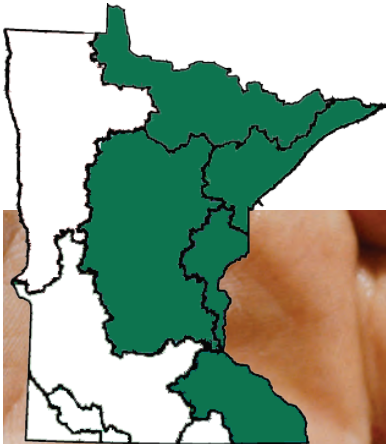
### LOOKS SIMILAR TO

- Round goby (invasive)
- Tubenose goby (invasive)
- Includes mottled, slimy, spoonhead, and deepwater sculpins

### WHERE TO LOOK

- Usually found in rocky areas
- Sometimes found in headwaters of creeks or small rivers

### CURRENTLY FOUND



*Lateral view of a Mottled sculpin showing coloring (below)*



*Underside of a Slimy sculpin with separated pelvic fins (right)*



# INVASIVE

## Ruffe

*Gymnocephalus cernuus*

### KEYS TO ID

- Olive- to gold-brown on its back with yellow-white underside
- Fused dorsal fins with dark spots
- Small, downturned mouth that does not expand past the front of the eye
- Sharp spines on gill cover
- Generally less than 6 inches long

### LOOKS SIMILAR TO

- Walleye (native)
- Sauger (native)
- Yellow perch (native)

### WHERE TO LOOK

- Prefer cooler waters
- Often in deep, offshore areas
- Lakes, reservoirs, and slow-moving rivers
- Found in Lake Superior but not in inland lakes



### CURRENTLY FOUND





# NATIVE

## Walleye

*Sander vitreus*

### KEYS TO ID

- Golden-brown to yellow in color; dorsal fin has dark blotches
- Separated first and second dorsal fins
- White spot on tip of tail
- Mouth extends past the eye
- Eyes point outward
- Grows larger than ruffe

### LOOKS SIMILAR TO

- Ruffe (invasive)
- Sauger (native)
- Yellow perch (native)

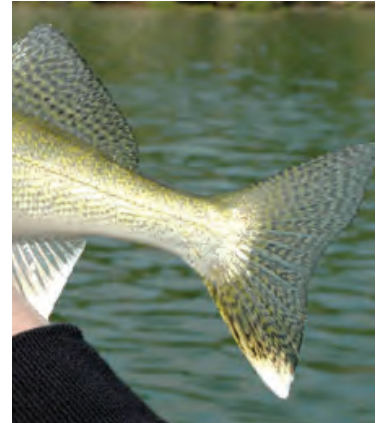
### WHERE TO LOOK

- In the shelter of aquatic vegetation

### CURRENTLY FOUND



*Juvenile (left)*



*White spot on tip of tail (right)*



# NATIVE

## Sauger

*Sander canadensis*

### KEYS TO ID

- Sandy to dark brown with 3 – 4 dark patches along back and sides
- Dorsal fins are separated and have rows of dark spots
- Mouth extends past the eye
- Grows larger than ruffe

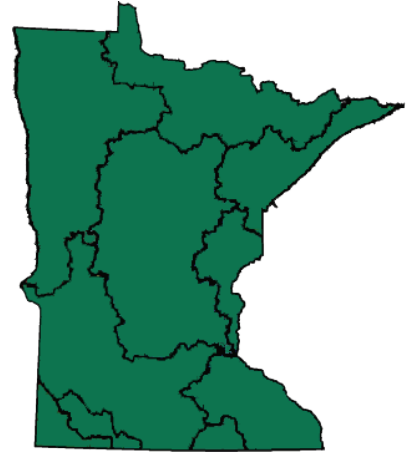
### LOOKS SIMILAR TO

- Ruffe (invasive)
- Yellow perch (native)
- Walleye (native)

### WHERE TO LOOK

- Likely to be found in deep pools
- Areas of high turbidity, low stream velocity, and deep water

### CURRENTLY FOUND





# NATIVE

## Yellow perch

*Perca flavescens*

### KEYS TO ID

- Green on top with 6 to 9 stripes down yellow sides
- Separated dorsal fins
- No distinct spots
- Grows larger than ruffe

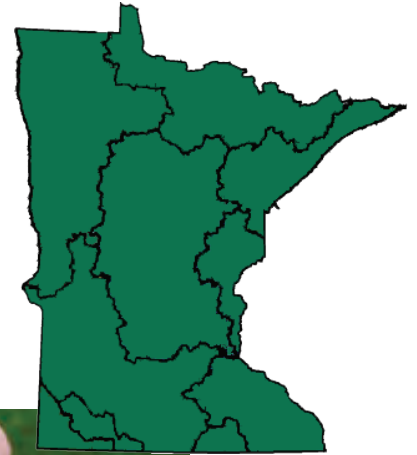
### LOOKS SIMILAR TO

- Ruffe (invasive)
- Sauger (native)
- Walleye (native)

### WHERE TO LOOK

- Abundant in lakes and backwaters of large rivers
- Prefer to be near vegetation

### CURRENTLY FOUND



# Glossary

**Adipose fin:** Located between the dorsal fin and caudal fin; have no spines or rays and are soft

**Alternate leaves:** Leaves are attached to the stem singly and on alternate sides

**Anal fin:** Located on the underside of a fish between the tail and pelvic fins, near the anus

**Antheridia:** Male reproductive structures that are small and orange to red on starry stonewort

**Ascending stem:** A stem growing upward

**Axis:** The main stem about which plant parts such as branches are arranged

**Basal:** A leaf arrangement where all the leaves emerge from a central point at the base of the plant

**Bivalve:** A mollusc that has two shells that meet at a hinge

**Branchlet:** A small branch or a subdivision of a branch

**Bulbil:** Asexual reproductive structure found on some charophytes. Bulbils of starry stonewort are white and star-shaped

**Byssal threads:** A mass of strong, silky filaments which mussels use to attach to surfaces

**Carapace:** A hard shell on the backs of crayfish

**Dissected:** Leaves that are deeply or repeatedly divided

**Dorsal fin:** Located on the top of a fish, it may be a single fin, with or without spines, or consist of two connected or unconnected parts — a sharp-spined part and a soft-rayed part

**Fry:** Immature fish from the time they hatch to the time they become fingerlings

**Gill cover:** A flap of skin protecting a fish's gills

**Invasive species:** Species that are not native to a given ecosystem, and cause (or have high potential to cause) harm, whether economic, environmental, or harm to human health

**Invertebrate:** An animal that lacks a spine

**Keel:** A ridge on the belly of the fish which is present only in some species

**Leaflet:** A part or division of a compound leaf

**Ligule:** A membrane near where the leaf blade meets the leaf sheath and wraps around the stem

**Midvein:** The vein in the center of a leaf

**Node:** The place on the stem where a leaf or branch is attached (or has been attached)

**Pectoral fins:** Located on both sides of the fish near the gill; help with balance, steering, and controlling depth

**Pelvic fins:** Located on the bottom of the fish in front of the anal fin; help balance the fish and keep it level

**Petiole:** A slender stalk that attaches a leaf to the stem of a plant

**Serrated:** Having a saw-toothed edge or margin notched with toothlike projections

**Sessile:** A type of leaf attachment where the leaf attaches directly to the stem

**Sheath:** A structure at the base of a leaf that wraps around the stem

**Spike:** A flower arrangement where many flowers are arranged vertically along the flower stalk

**Submersed/submerged:** Submersed plants are usually found entirely underwater, but the flowers and fruits may rise above the water surface. They are rooted in the sediment and have underwater leaves

**Substrate:** The surface on which an organism lives, grows, or obtains its nourishment

**Tubers:** A short, thick stem that grows underground and can produce a new plant

**Turbidity:** A measure that provides an estimate of the cloudiness of water due to silt, organic and inorganic matter, plankton, and microscopic organisms

**Turions:** A vegetative bud that detaches from a parent plant and can produce new plants via asexual reproduction

**Umbel:** A flower arrangement where many flowers form a cluster on a series of approximately equal-length stalks originating from a common center point

**Ventral edge:** On a bivalve, the surface opposite the hinge

**Whorl:** A ring of 3 or more similar structures radiating from a common point



# Photo credits

April Wolfson (cover); Abigail Neimann (page i); Cory Ryan (page ii); Shelly Binsfield (page iv)

## AQUATIC PLANTS

Introduction: Cayte (leaf arrangements); Benjamint444 (simple leaf); Evelyn Fitzgerald (compound leaves); Debivort (leaf margins); Christian Fischer (midvein); Megan M. Weber (axis and leaflet); Christine Lee (node and stem)  
Eurasian watermilfoil: Megan M. Weber; Paul Skawinski, UW-Extension Lakes | Northern watermilfoil: Megan M. Weber  
Coontail: Christine Lee | Bladderwort: Megan M. Weber; Veledan; Christa Rittberg  
White water crowfoot: Christine Lee; Trish Steel | Water marigold: Christine Lee; Peter Dziuk  
Hydrilla: Michael J. Grodowitz, U.S. Army Engineer Research and Development Center; Tim Krynak; J.M.Garg  
Common waterweed: Christine Lee; Minnehaha Creek Watershed District  
Brazilian waterweed: David Liu, Minnehaha Creek Watershed District; Lamiot; Lara Gudmundsdottir  
Starry stonewort: Dave Hansen; Christine Lee; Paul Skawinski, Aquatic Plants of the Upper Midwest  
Muskgrasses: Christian Fischer; Megan Weber  
Stoneworts: Kristian Peters; Paul Skawinski, Aquatic Plants of the Upper Midwest  
Sago pondweed: Christine Lee; Christian Fischer | Water stargrass: Paul Skawinski, Aquatic Plants of the Upper Midwest  
Curlyleaf pondweed: Paul Skawinski, UW-Extension Lakes; Leslie J. Mehrhoff  
Clasping leaf pondweed: Paul Skawinski, Aquatic Plants of the Upper Midwest

## WETLAND PLANTS

Introduction: Cayte (leaf arrangements); Alpsdake (sessile); Rod Belshee (petiolate); Harry Rose (sheathing)  
Purple loosestrife: Liz Shlapack; Earl Woolsey  
Blue vervain: Judy Gallagher; Ann C. McKenzie; Aaron Carlson  
Joe-pye weed: Sue Wetmore; Sara Hollerich Giles  
Fireweed: Christine Hanrahan; Elizabeth T. Knuth; Jeffrey Lee  
Hybrid cattail: Ryan Hodnett; Jerry Cannon; Megan M. Weber  
Narrowleaf cattail: Radio Tonreg; Svetlana Nesterova; Hank Fabian  
Broadleaf cattail: Patrick Leary; Damon Tighe; Jeffrey Lee  
Yellow iris: Shirley Zundell; Damon Tighe  
Blue flag iris: Megan M. Weber; Sandra Wolkenberg  
Invasive Phragmites: Andy Fyon; Julia Bohnen  
Native Phragmites: Michael Hough; Julia Bohnen  
Reed canary grass: Megan M. Weber; spacecowboy; Ron Halvorson  
Silvergrass: Stephen; Marcel Kettern

## INVERTEBRATES

Rusty crayfish: Jeff Gunderson | Red swamp crayfish: Christine Lee  
Northern clearwater crayfish, Calico crayfish, Virile crayfish: Chris Taylor  
Zebra mussels: Christine Lee | Quagga mussels: Megan M. Weber; Christine Lee  
Freshwater golden clam: Minnehaha Creek Watershed District; Böhringer Friedrich  
Freshwater mussels: Christine Lee; U.S. Fish and Wildlife Service  
Chinese mystery snails: Christine Lee  
Snails: Christine Lee; Alfredo Eloisa (limpet snail)  
Spiny waterflea: Donn Branstrator; Jeff Gunderson; Minnehaha Creek Watershed District  
Fishhook waterflea: J. Liebig, NOAA GLERL; Mart Simm  
Predatory zooplankton: Piet Spaans (*Chaoborus*); Great Lakes Environmental Research Laboratory (*Leptodora*)

## FISH

Introduction: Joseph Tomelleri (illustrations); John Lyons (keel)  
Bighead carp: Asian Carp Regional Coordinating Committee  
Silver carp: Michigan Sea Grant; Asian Carp Regional Coordinating Committee; Christine Lee  
Gizzard shad: Brian Gratwicke; Chad Thomas  
Mooneye: Konrad Schmidt | Emerald shiner: Andrew Kornacki; Konrad Schmidt  
Round goby: Peter van der Sluijs | Tubenose goby: John Lyons; Harka Ákos | Sculpins: John Lyons  
Ruffe: Tiit Hunt; USGS | Walleye: Dan Walchak; John Lyons; USFWS | Sauger: Konrad Schmidt  
Yellow perch: USFWS; John Lyons



ISBN 978-0-692-90536-4 \$45.00  
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