AQUATIC INVADERS

What is an invasive species?

- Native Species
  - An indigenous species historically found in an ecosystem.
- Non-native Species
  - A species that has moved, or has been moved, outside of its natural geographic range.
- Aquatic Invasive Species
  - An aquatic, non-native species that causes economic and/or environmental harm.
    - An introduced but non-invasive species is a non-native species that is restricted to its introduced range and does not cause economic and/or environmental harm.

What is an adaptation?

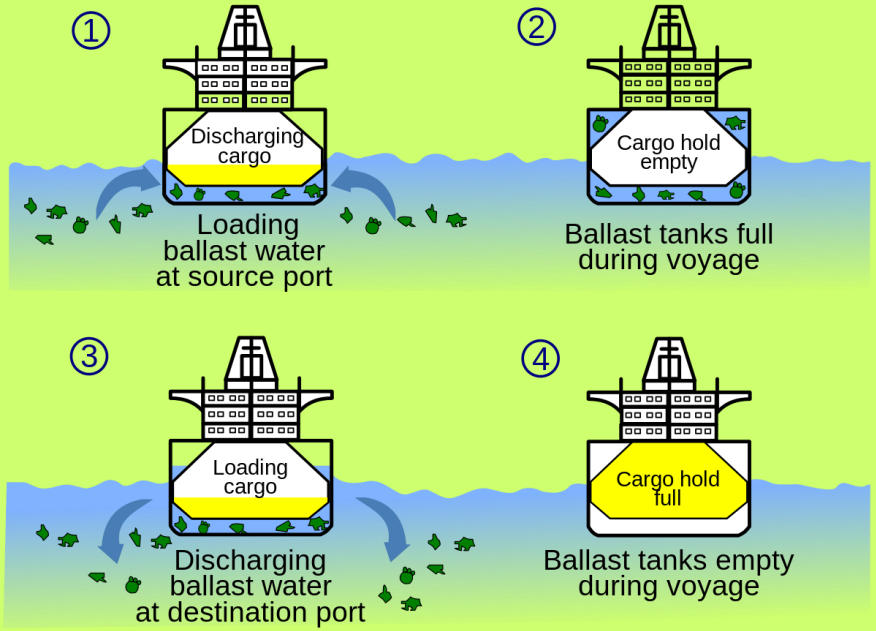
- An adaptation is the adjustment of organisms to their environment to improve their chances at survival in that environment.
  - Adaptations are the result of natural selection acting upon heritable variation.
- Natural Selection: organisms best fit for their environment tend to survive and reproduce.
- Physical adaptation: a physical change that helps a species survive.
- Behavioral adaptation: change behavior to better fit their environment.

Invasive Species Adaptations:

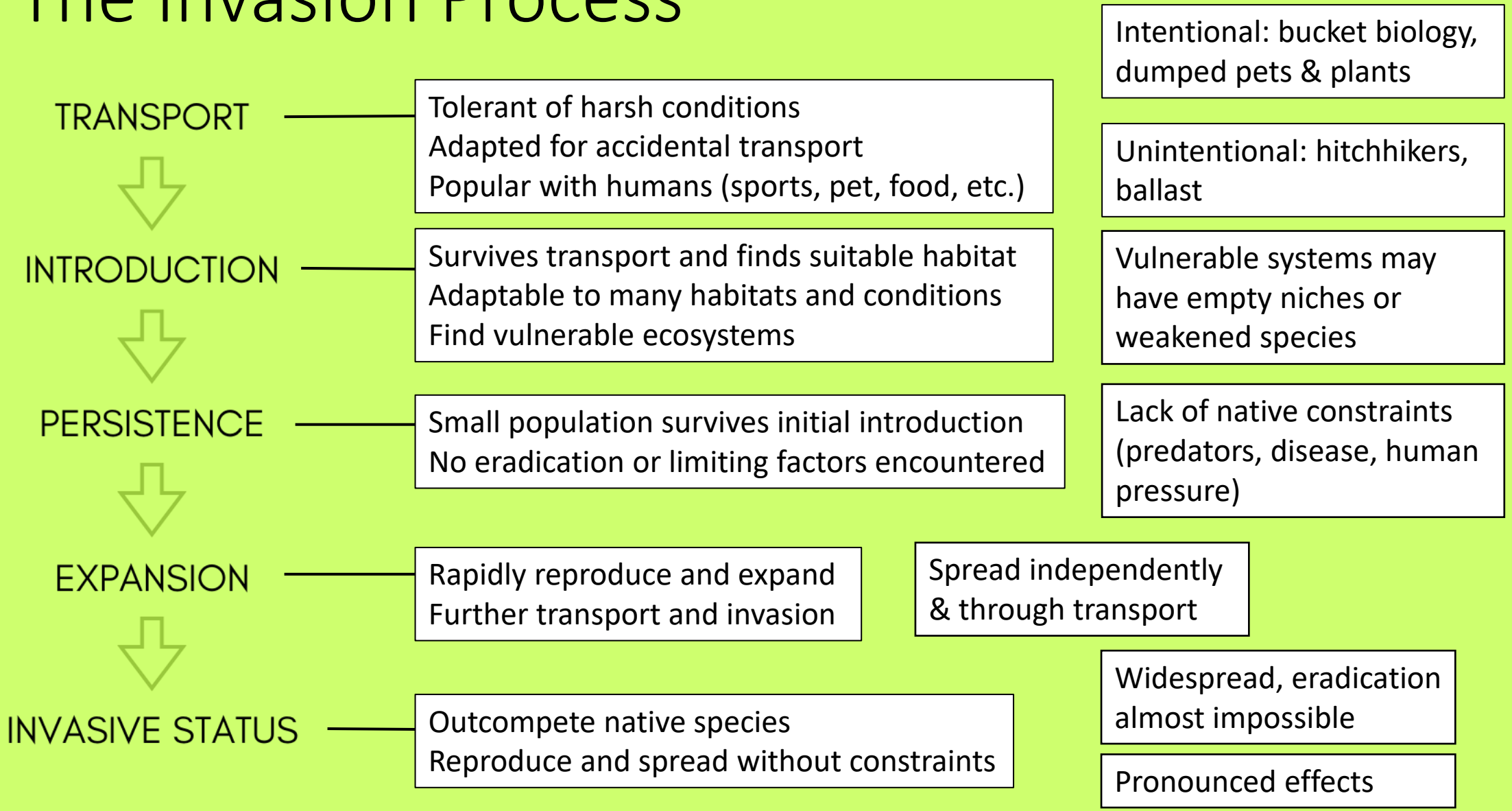
1. Grow fast
2. Reproduce Quickly
3. Spread easily
4. Tolerant of many different environments
5. Outcompete other species

How do they get here?

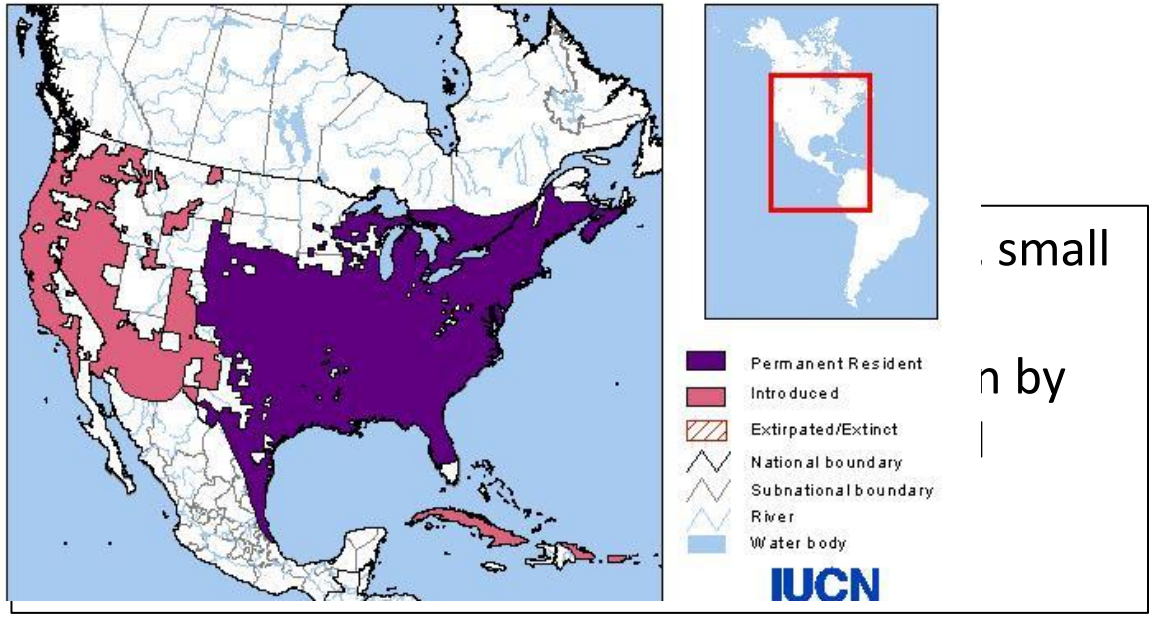
- Human transport
  - Intentional: illegal fish introduction, aquarium dumping, live bait
  - Unintentional: ballast water, dirty watercraft, hitchhikers
- Non-human transport
  - Waterfowl
  - Ingestion of seeds by animals (aquatic and terrestrial)
  - Overland travel



The Invasion Process



Native, introduced, or



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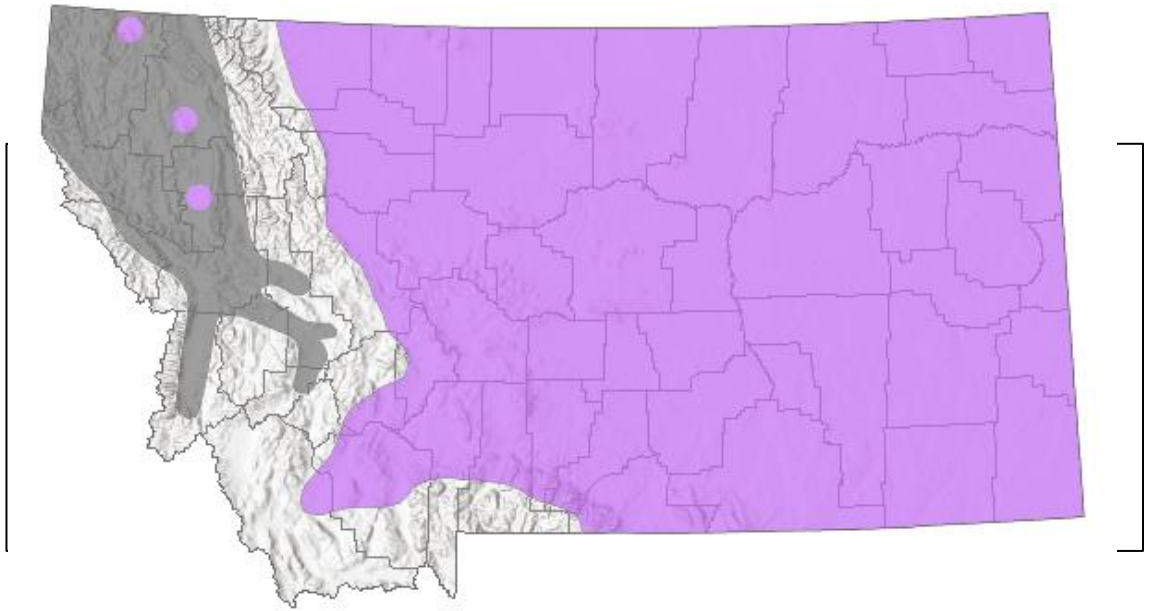


s	**Western Pearlshell Mussels**
	Continues to grow over lifespan. Average lifespan 60-70 years.
ach ion/	
	Byssal thread attachments Desiccation-resistant
Tolerant	Can withstand high pollution level
Outcompete Natives	Attaches to native invertebrate spe Outcompetes native mussels

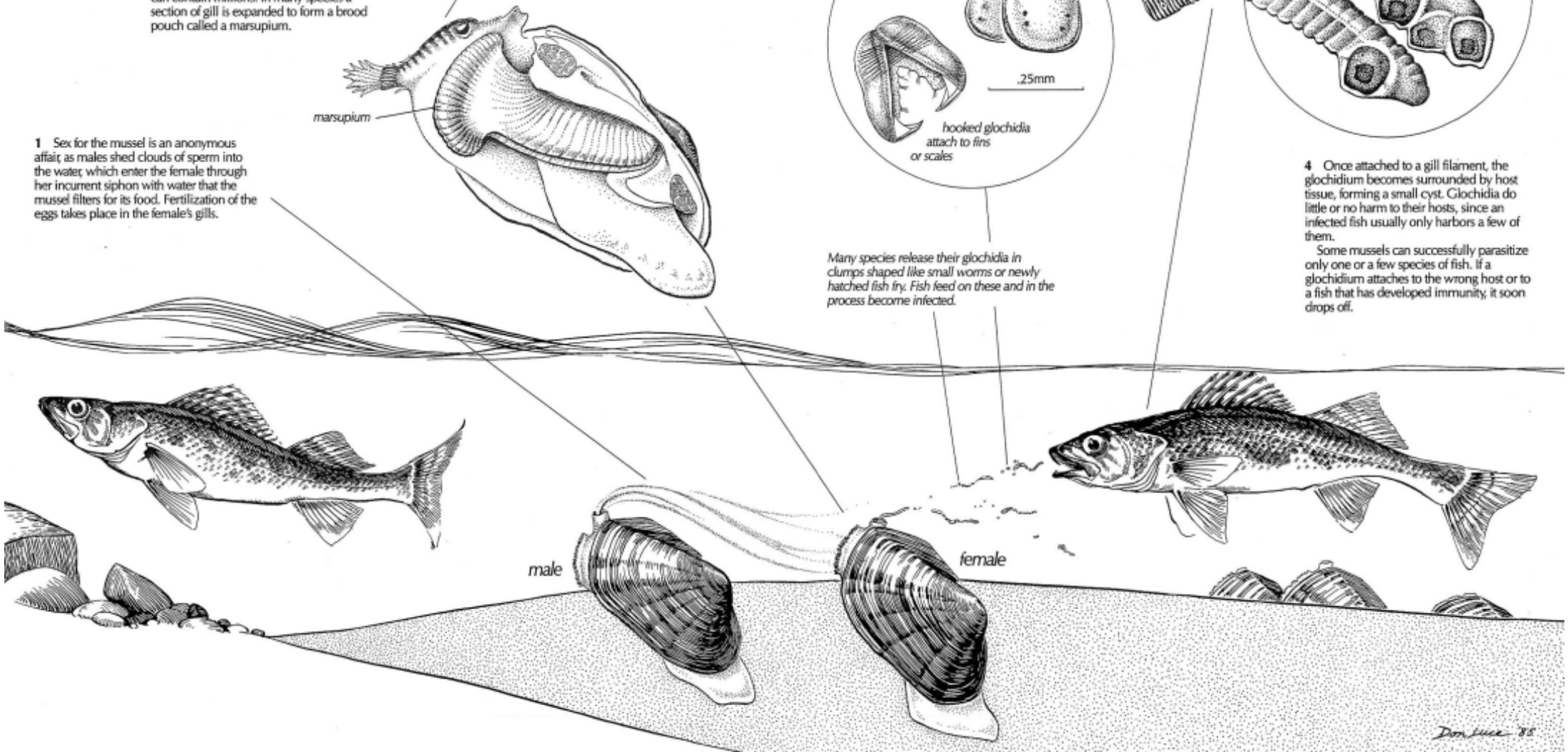
Mussel Life Cycle

1 Sex for the mussel is an anonymous affair, as males shed clouds of sperm into the water, which enter the female through her incurrent siphon with water that the mussel filters for its food. Fertilization of the eggs takes place in the female's gills.

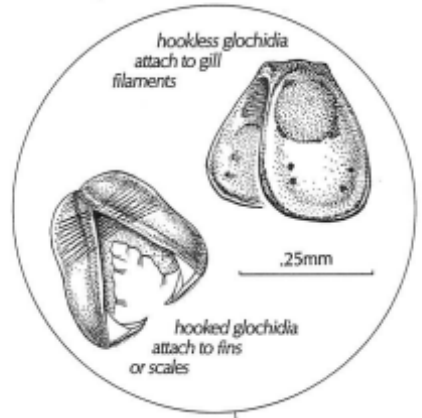
2 The fertilized eggs are retained within the gills of the female while they develop into specialized larvae known as glochidia. A small mussel may harbor several thousand embryos, whereas larger mussels can contain millions. In many species a section of gill is expanded to form a brood pouch called a marsupium.

Some mussels have a feature that improves the odds of infecting fish with their glochidia. Flaps of mantle extrude beyond the edge of their shells and look, flapping in the current, like tiny, tasty fishes. When larger fish strike at this lure, the mussel closes its shell and squirts a stream of glochidia into the fish's mouth.

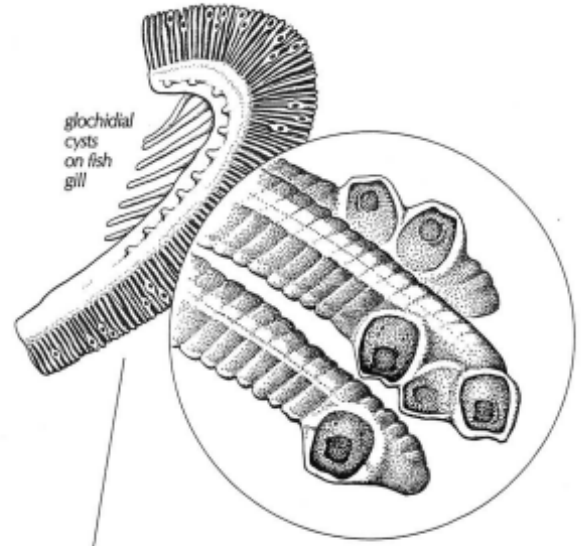
marsupium



3 The microscopic glochidia are the parasitic stage of the mussel life cycle. Though shaped like adults, with two valves, their internal structure is very different. When they contact the tissue of a fish, the two valves clamp shut and hang on.



Many species release their glochidia in clumps shaped like small worms or newly hatched fish fry. Fish feed on these and in the process become infected.



4 Once attached to a gill filament, the glochidium becomes surrounded by host tissue, forming a small cyst. Glochidia do little or no harm to their hosts, since an infected fish usually only harbors a few of them.

Some mussels can successfully parasitize only one or a few species of fish. If a glochidium attaches to the wrong host or to a fish that has developed immunity, it soon drops off.

Don Luce '88

Invasive Zebra and Quagga Mussels

Life Cycle of Dreissenid Mussels

Zebra and quagga mussels are an **aquatic invasive species** that can be found growing in freshwater lakes, ponds, rivers, streams, and wetlands. As adults, these fast growing **bivalves** filter their food out of the surrounding water. One adult zebra mussel can filter up to 1 liter of water each day. By doing so, they can quickly strip the water of the phytoplankton, bacteria, and organic detritus that serves as the base of most aquatic food webs.

Zebra and quagga mussels have a life span of three to nine years. They typically spawn from May to October when the water temperatures are warmer (12°C or higher). Males and female become mature and able to reproduce at ~8-9 mm in size.

Unlike most native North American freshwater mussels, dreissenid mussels do not need a fish host for reproduction and dispersal. Instead, they use external fertilization and water currents to spread their planktonic larvae.

During each spawning cycle, adult females can release up to 40,000 eggs. They can potentially go through 20 spawning cycles each year, so one female could release up to 1 million eggs per year. One male can release up to 200,000,000 sperm each year.

BENTHIC JUVENILE
~0.25mm to 8mm

PLANKTONIC POSTVELIGER
~150-200µm (0.15-0.2 mm)

4. The larvae drift as plankton for up to one month. During this time it eats, builds a shell, and develops internal organs.

5. After one month, the juvenile mussel has developed all of its internal organs. At this time, it sinks and settles on the bottom or to a nearby structure. The juvenile mussel uses its muscular foot to move along the benthic (bottom) substrate to find a suitable habitat. It then attaches to the substrate with its strong byssal threads.

PLANKTONIC VELIGER
~100-150µm (0.1-0.15 mm)

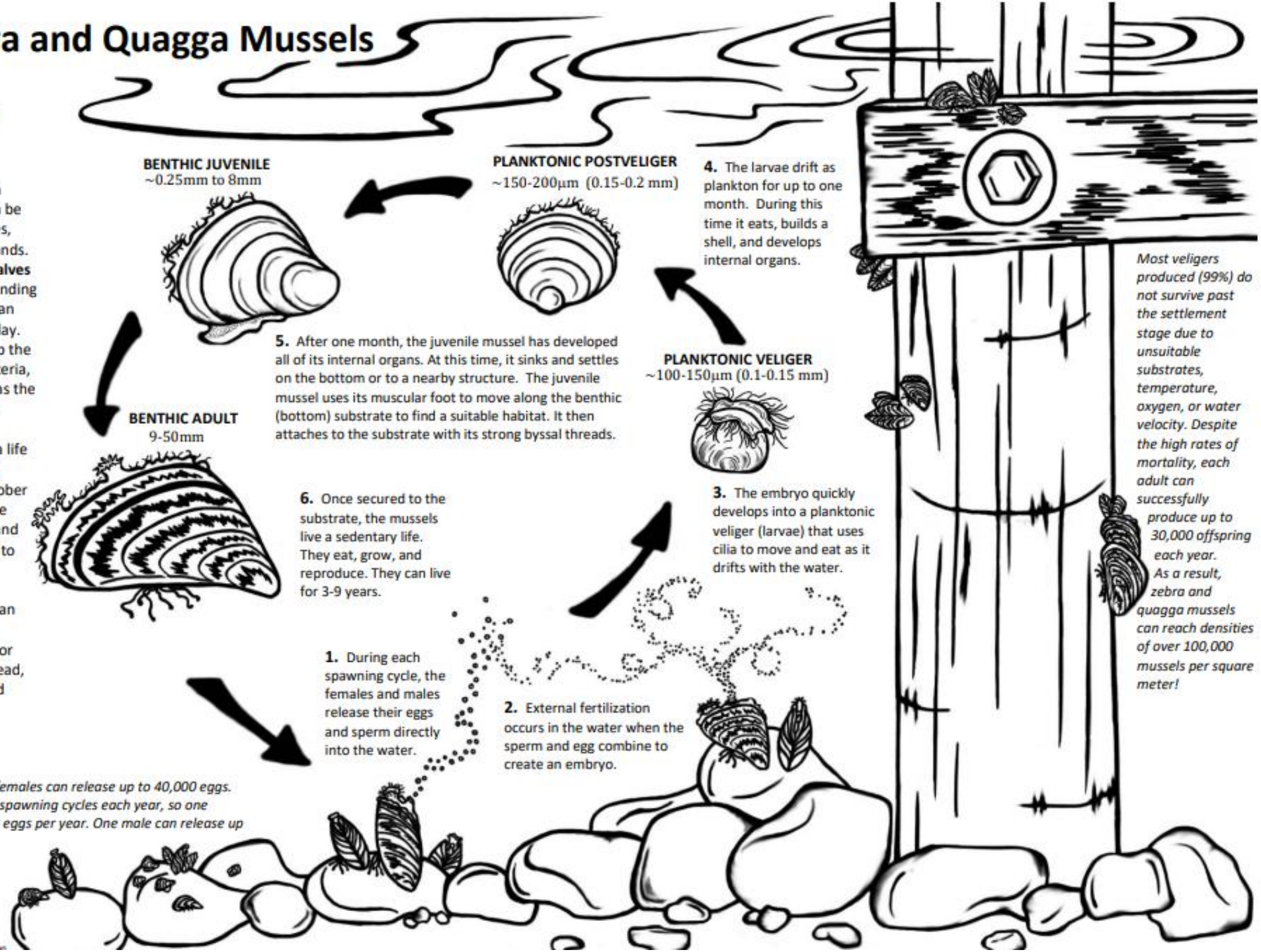
BENTHIC ADULT
9-50mm

6. Once secured to the substrate, the mussels live a sedentary life. They eat, grow, and reproduce. They can live for 3-9 years.

3. The embryo quickly develops into a planktonic veliger (larvae) that uses cilia to move and eat as it drifts with the water.

1. During each spawning cycle, the females and males release their eggs and sperm directly into the water.

2. External fertilization occurs in the water when the sperm and egg combine to create an embryo.

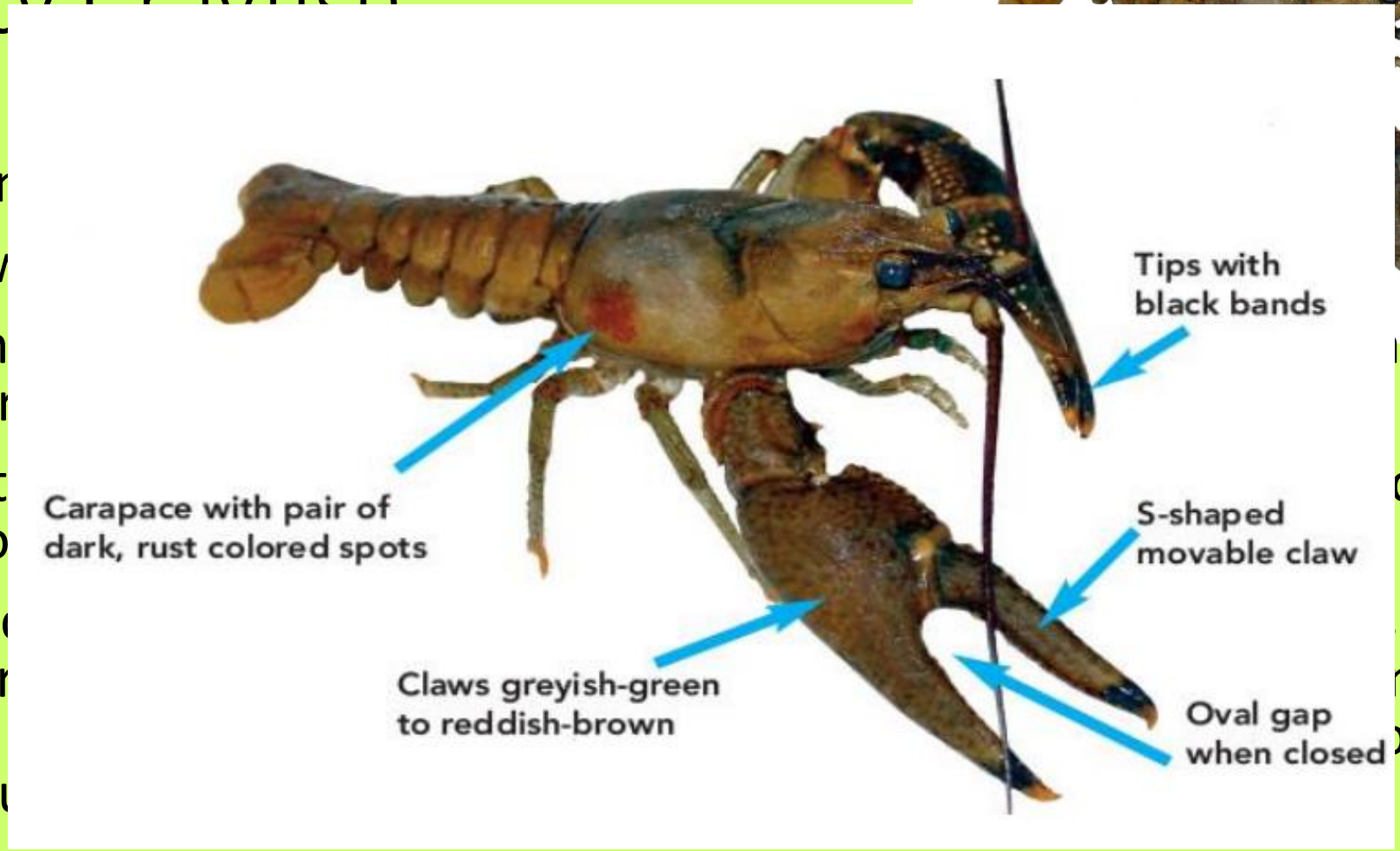


Most veligers produced (99%) do not survive past the settlement stage due to unsuitable substrates, temperature, oxygen, or water velocity. Despite the high rates of mortality, each adult can successfully produce up to 30,000 offspring each year. As a result, zebra and quagga mussels can reach densities of over 100,000 mussels per square meter!

FLATHEAD LAKE BIO STATION
UNIVERSITY OF MONTANA

Rusty Crayfish

- Origi
- Pathv
- Meth nd and in-wate
- Habit clay, or silt botto
- Impa e hyper nails, fish eggs, r food, difficu
- Not currently in Montana.



New Zealand Mudsnails

llast water, game fish imports

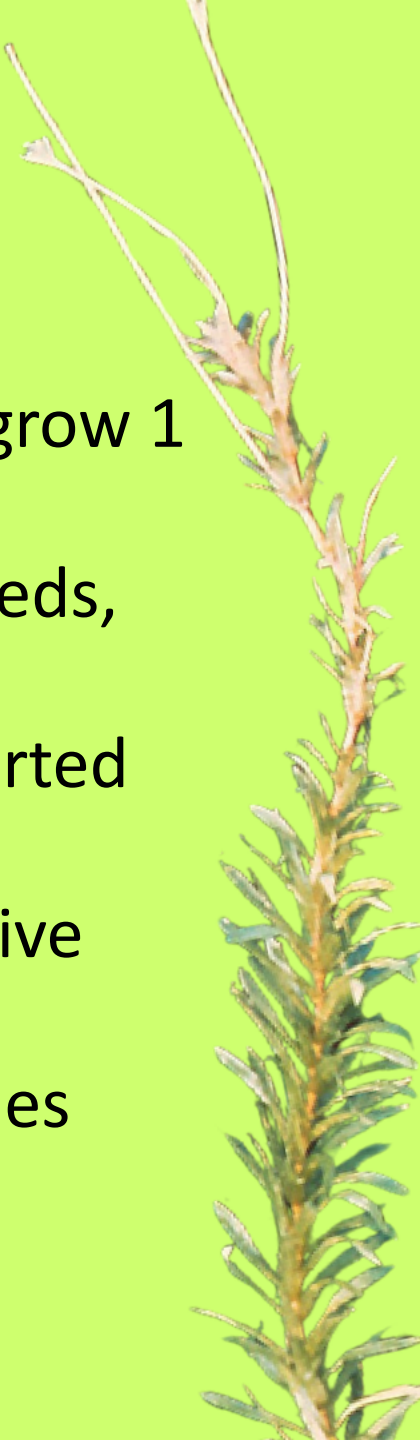
ction, felt-bottomed waders,

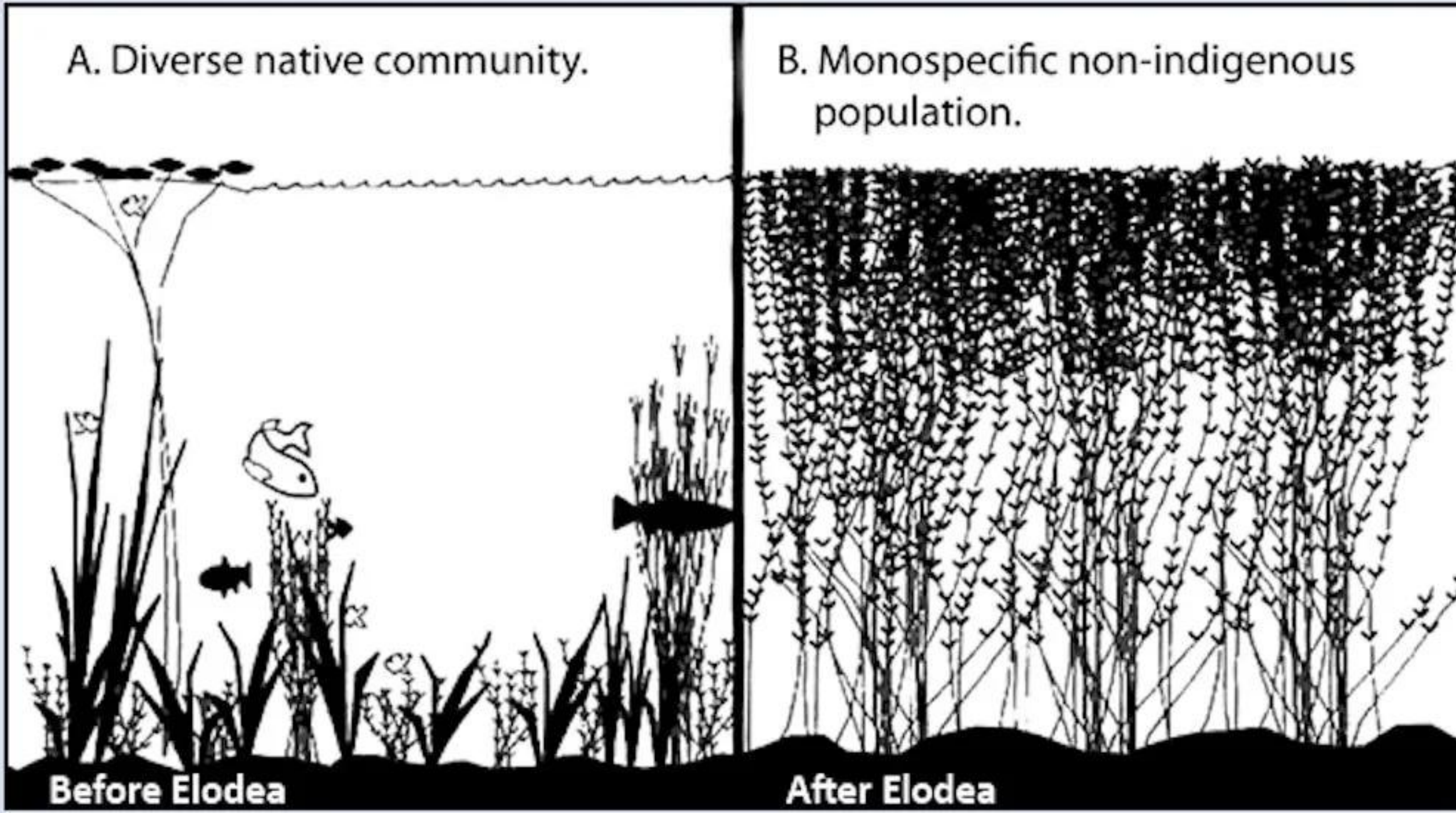
native invertebrates and

per square meter.

What about plants?

1. Grow fast: some species of invasive weeds, like hydrilla, can grow 1 inch every day and spread across large areas rapidly.
2. Reproduce quickly: and in several different ways including seeds, buds, fragments, and shoots from roots.
3. Spread easily: plants, whole or in parts, can be easily transported through human and non-human activity.
4. Tolerant of many different environments: hardy and can survive different temperature, light, water, and soil conditions.
5. Outcompete other species: create a monoculture that excludes native plants and native organisms that depend on diversity.




A. Diverse native community.
B. Monospecific non-indigenous population.
Before Elodea
After Elodea

What about plants?

- Native plants:
  - Create microhabitats that support diverse species.
  - Provide food and shelter for fish, birds, and other wildlife.
  - Protect shorelines from erosion.
  - Help keep water clean.

- Invasive plants:
  - Create monocultures that limit diversity.
  - Make water inaccessible or dangerous for humans and wildlife.
  - Clog drinking, irrigation, and hydroelectric power water pipes.
  - Very hard to remove once established.


PRINCECRAFT

What is Montana doing?

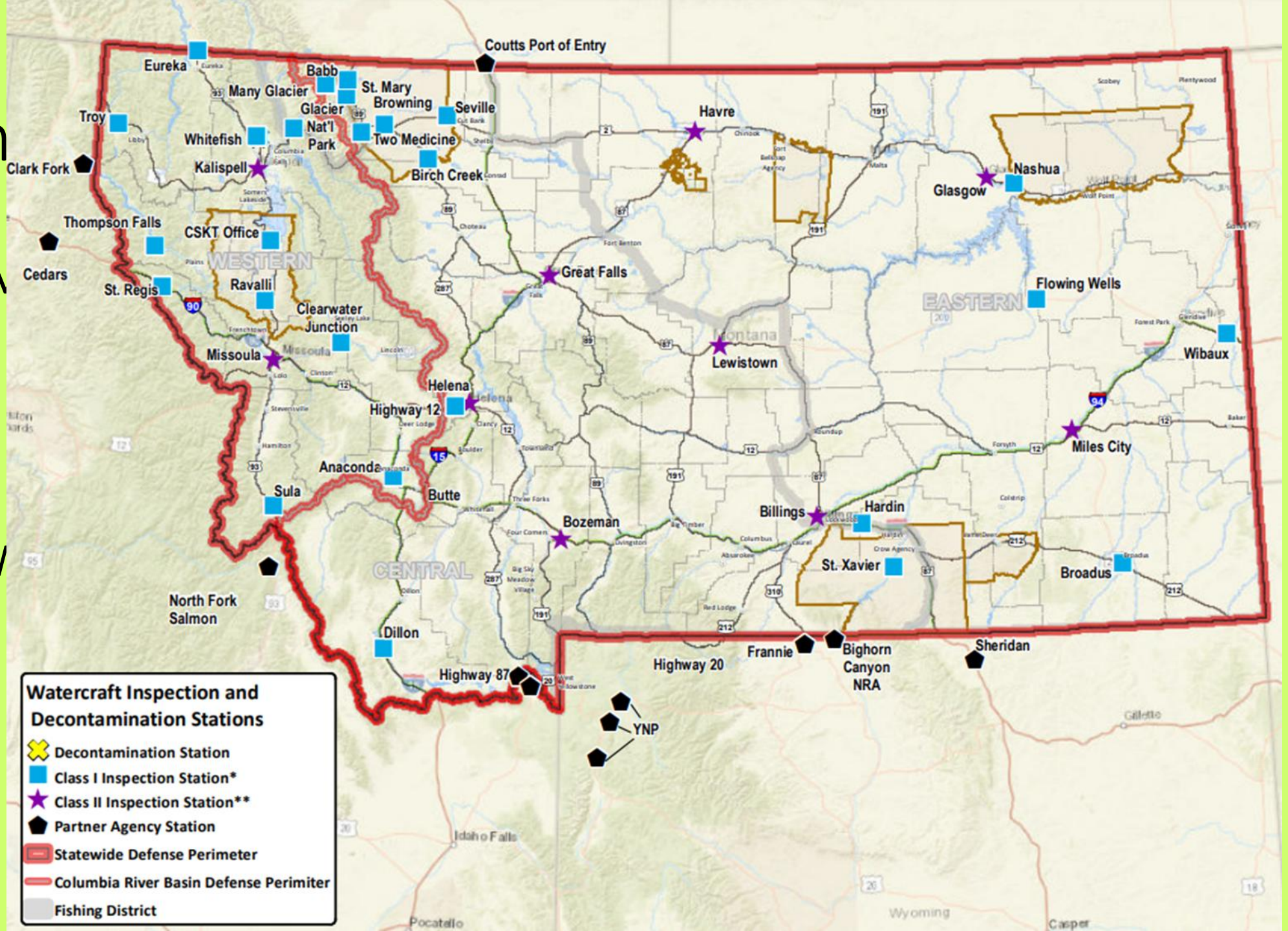
- Early detection

- Watercraft Inspection

- Outreach & Education

In

- M
- V

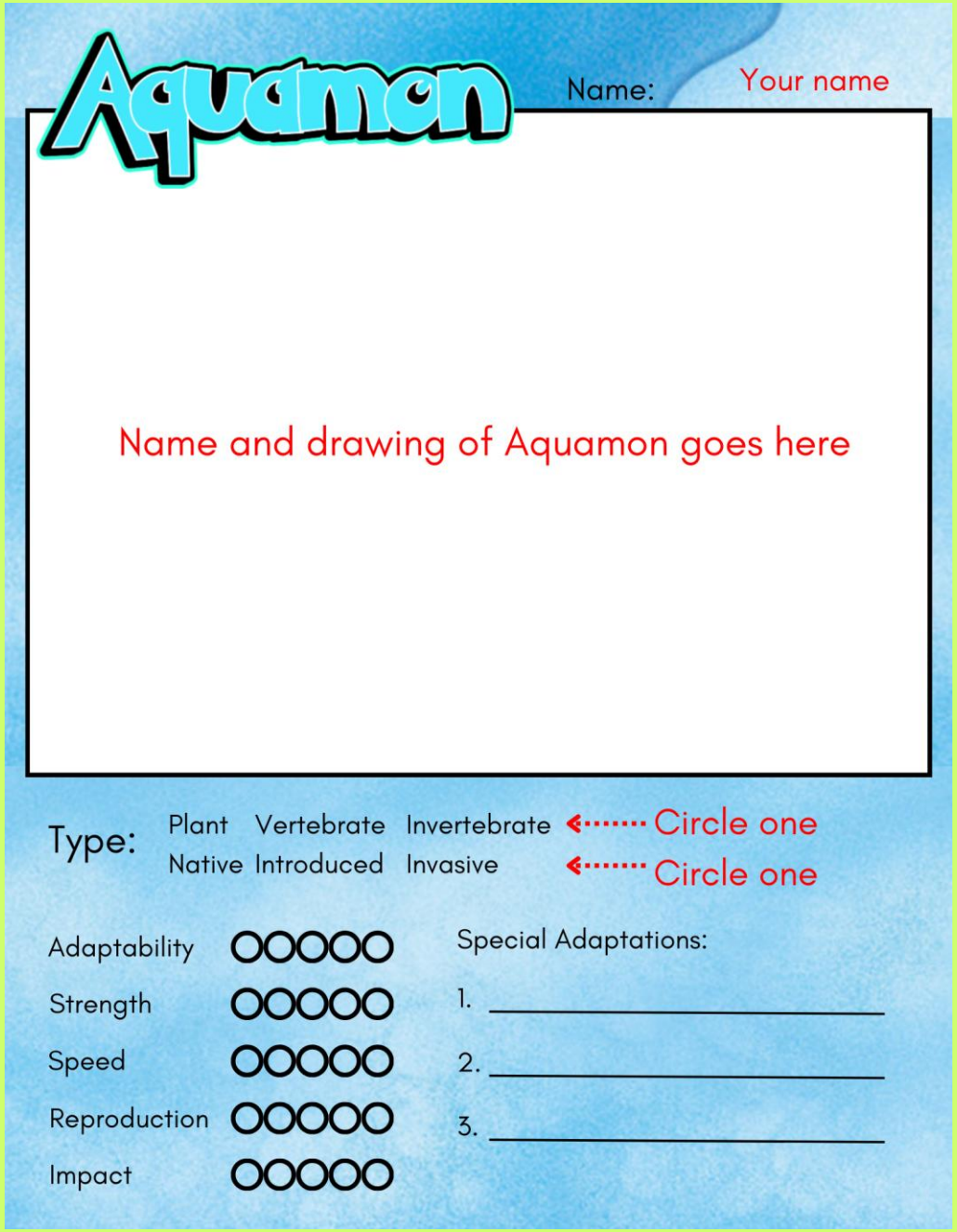

Coutts Port of Entry
Eureka
Babb
St. Mary
Many Glacier
Browning
Glacier
Seville
Troy
Nat'l
Park
Havre
Whitefish
Two Medicine
Clark Fork
Kalispell
Birch Creek
Nashua
Glasgow
Thompson Falls
CSKT Office
WESTERN
Great Falls
Cedars
Ravalli
Flowing Wells
St. Regis
EASTERN
Clearwater
Junction
Wibaux
Missoula
Lewistown
Helena
Highway 12
Miles City
Anaconda
Sula
Butte
Billings
Hardin
Bozeman
CENTRAL
St. Xavier
Broadus
North Fork
Salmon
Dillon
Frannie
Bighorn
Canyon
NRA
Sheridan
Highway 87
Highway 20
YNP
Watercraft Inspection and
Decontamination Stations
Decontamination Station
Class I Inspection Station*
Class II Inspection Station**
Partner Agency Station
Statewide Defense Perimeter
Columbia River Basin Defense Perimiter
Fishing District

Campaigns

- Clean, Drain, Dry
  - Clean: before leaving the site, clean all your equipment. Remove any visible plants, animals, dirt, and mud.
  - Drain: drain all water from equipment before transport. Pull all plugs. Remove any standing water using a sponge, towel, or wet vacuum.
  - Dry: allow all equipment to dry in the sun for at least 5 days, or manually dry all equipment.
- Don’t Let it Loose
  - Never release aquarium plants or pets into local ecosystems.

Aquamon!

- Pick your Aquamon type.
- Go to https://rolladie.net/ and roll a 5-sided dice five times.
  - Adaptability: can organism adjust to environmental changes?
  - Strength: can organism protect itself?
  - Speed: how fast is the animal or how quickly does the plant grow?
  - Reproduction: how often does the organism reproduce, how many babies do they have at once, and how do they help their babies survive?
  - Impact: are they very important in their ecosystems?
- Create your Aquamon.



Some things to think about:

- What does your Aquamon eat? Do they need special teeth or stomachs? Do they have venom?
- What types of things eat them, and how do they protect themselves?
- Where do they live? Do they live in burrows, underneath logs, in dense vegetation?
- Are they camouflaged or brightly colored?
- Do they have fur, scales, or something else?
- How do they compensate for low scores in adaptability, strength, speed, reproduction, and/or impact?
- Do they rely mostly on sight, hearing, smell, vibrations, chemoreception, or something else?
- If your Aquamon is introduced, what factors keep them from becoming invasive?
- Do they take care of their babies for a long time and protect them from predators? If not, how do their babies survive?