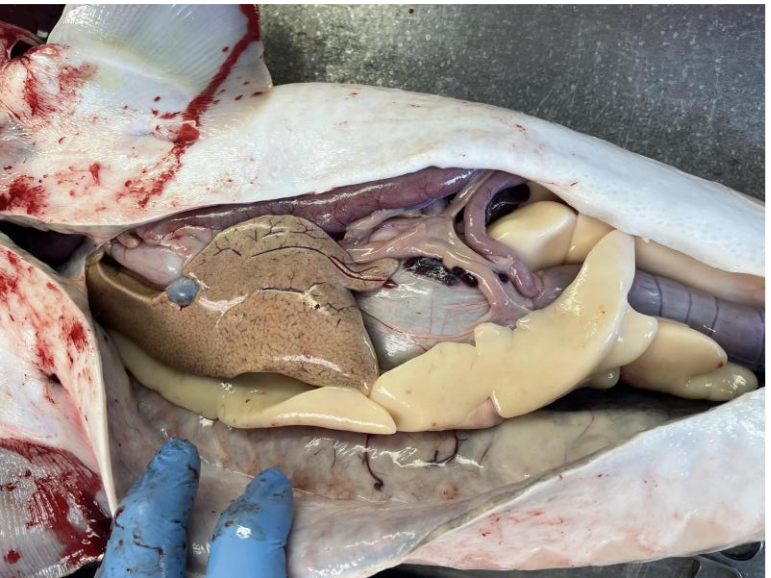
Fish hatcheries and their water

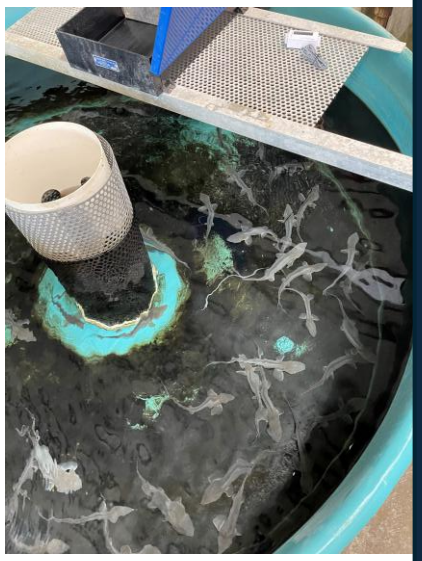
Bozeman Fish Health Center

- Provide health services to USFWS Fish and Aquatic Conservation Region 6 and other partners
  - **Bacteriology**
  - **Virology**
  - **Histology processing**
  - **Parasitology**
  - **Molecular methods**
  - **Veterinary Services**
- Work closely with 4 Fish Health Biologists



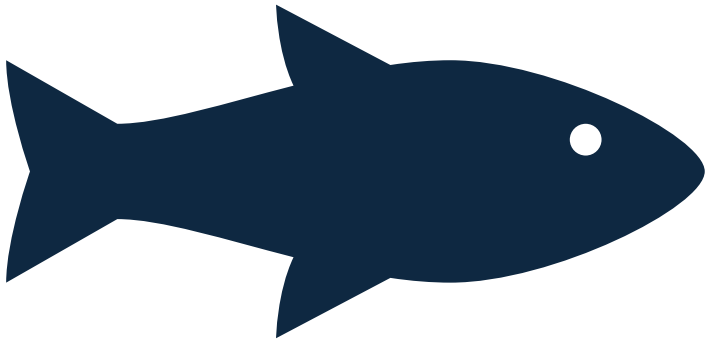
Role of USFWS hatcheries

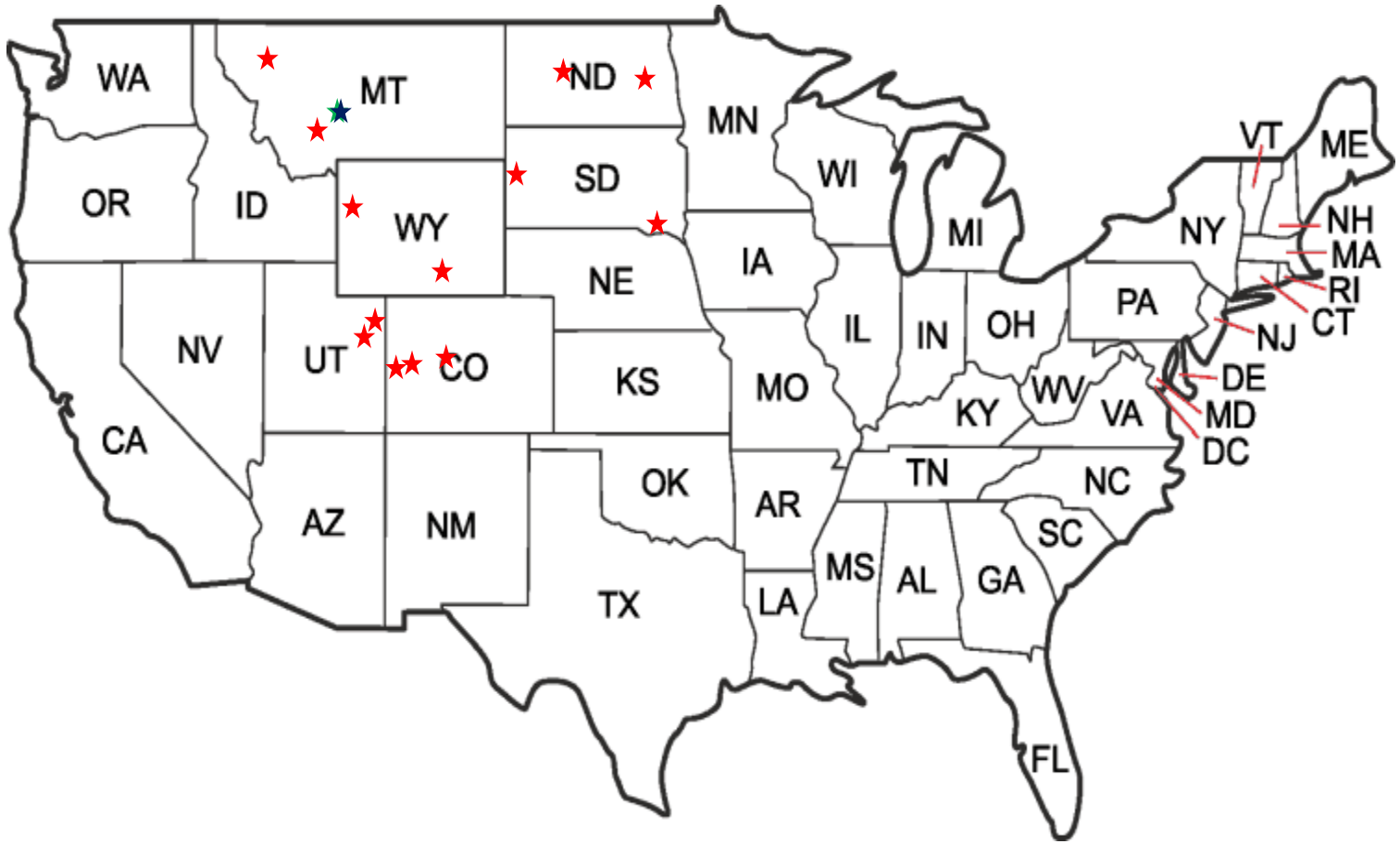
- Recreation / Mitigation
  - Production facilities: raise fish to a stockable size
  - Broodstock facilities: raise fish that produce eggs for other facilities
- Recovery: raise T&E species to support wild populations
  - Greenback cutthroat trout, pallid sturgeon, razorback suckers, humpback chubs
  - Can be a captive or wild-sourced broodstock population
- Refugia: captive population of an ESA-listed species to ensure survival in the case of a catastrophic situation.
  - Kendall Warm Springs Dace
  - Wyoming Toads



Region 6 overview

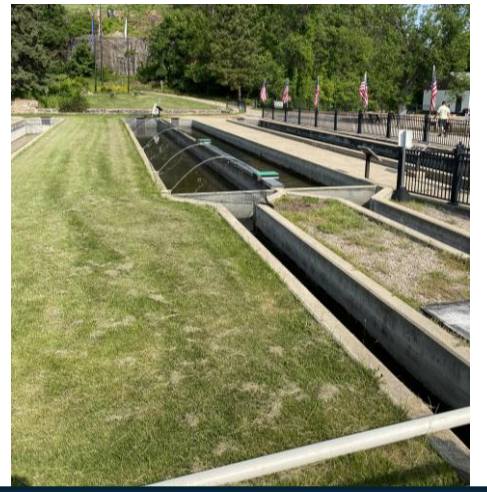
- 13 National Fish Hatcheries, plus the Bozeman Fish Technology Center



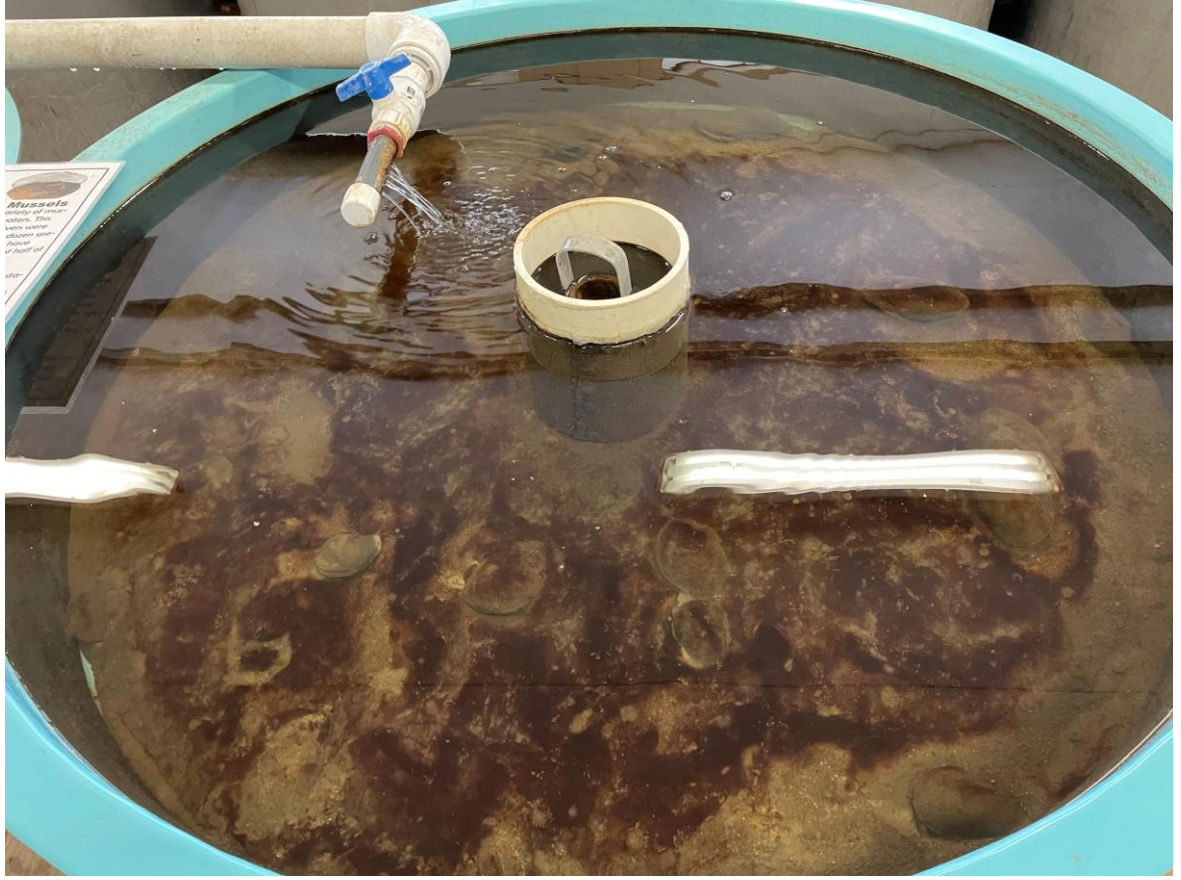


Region 6 hatcheries

- Huge geographic difference make hatcheries look and function differently



And other critters…



Getting to the water

Water sources

- Open source: Lakes, reservoirs, rivers, above ground springs, etc.
- Closed source: Underground/covered springs, wells, infiltration galleries
- Other: Municipal water

Why's water source important?

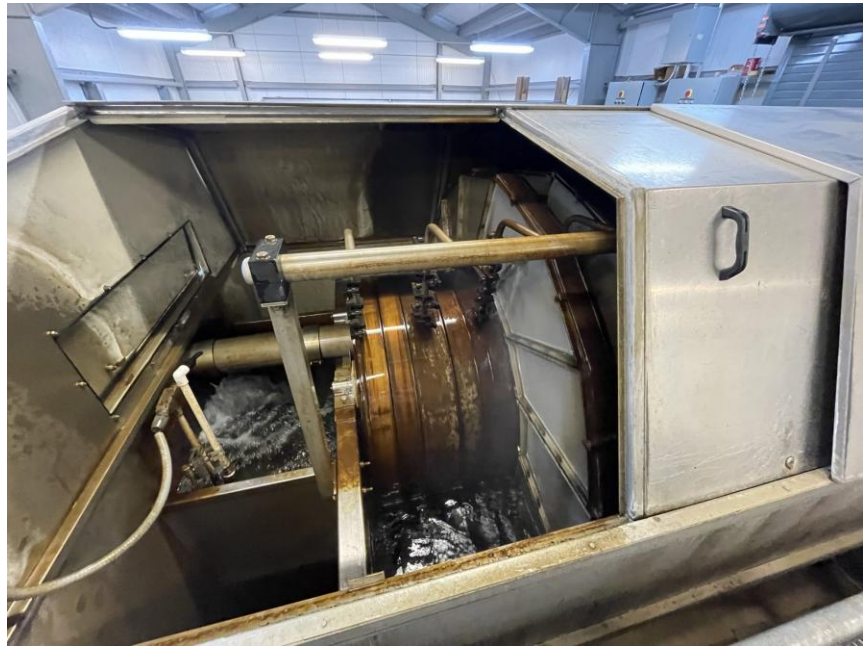
- It's the first consideration in biosecurity and preventative health!
- That's the water aquatic animals will be reared in, we don't want:
  - Pathogens
  - Chemicals (insecticides, herbicides, other pollutants)
  - Sudden/drastic fluctuations in water chemistry/quality

So which type of water is best?

… there’s pros and cons to each

Open water sources

- Pros:
  - Often have more natural water chemistry composition
  - Depending on location, water mimics wild conditions (potentially helpful with relaying environmental cues for things like spawning)
  - With water treatment (UV, filtration), risks can be mitigated
  - +/- consistent flow and large volumes of water
- Cons
  - Water treatment is costly, with frequent upkeep required
  - Temperature fluctuations may not be conducive to production goals

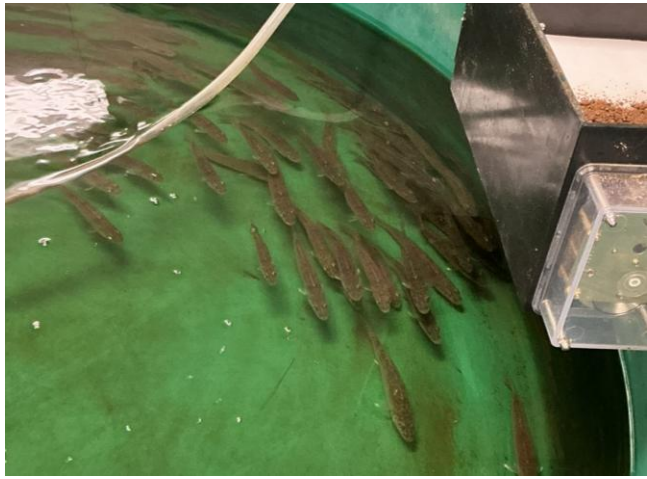


Closed water sources

- Pros:
  - Biosecure, often with no need for water treatment
  - Usually have a stable temperature year-round

- Cons
  - Water may be pumped from deep underground → potential fish rearing suitability issues
  - +/- seasonal flow fluctuations
  - Associated infrastructure (i.e., wells) can require maintenance

Different types of rearing systems



- Flow-through
- Partial re-use
- Recirculating
- Pond

- There are other types and many subtypes of rearing systems, but in our region, these are the big 4

Flow through

- This can either be single use or serial re-use
  - Single use: Water flows from source, goes through the fish rearing unit once, and is discharged
  - Serial re-use: Water still only flows through an individual rearing unit once, but then flows into another rearing unit(s) downstream, before being discharged

Partial re-use

- There is continuous new water turnover into a rearing unit, but a percentage of water is pumped back into the system instead of being discharged

Re-use or RAS

- Think display aquarium on the big scale
- 95-99% of water is re-used, with a small percentage of new water turnover each day
- These systems require careful water monitoring to ensure nitrogenous waste doesn’t reach dangerous levels
- Need life support and water treatment system, including a biofilter to break down nitrogenous waste

Pond

- Wide range of sizes
  - Ponds as small as 1/10th acre and others over an acre (4,840 sq yd)
- Largely self-sustaining systems with limited new water turnover
- Algae and plant growth can increase productivity, but too much can cause problems

Effluent

- Potential effluent products
  - Fish waste
    - Feces, uneaten feed, metabolic waste
  - Chemical use
    - Therapeutic uses
    - Disinfection of equipment and rearing units
  - Feral/escaped fish
  - Pathogens
- From a biosecurity standpoint, it's also important to assess what can get into the hatchery via the effluent system
  - Feral/wild fish, predators and wildlife, aquatic invasive species

Effluent

- In our region, there's a lot of variation in where effluent discharges:
  - Waterways (usually into a side channel of a larger waterway)
  - Drainage ditches / Leech fields
  - Septic systems (usually quarantine buildings)
  - Evaporative ponds / lagoons

- Discharge testing/monitoring requirements depend on facility infrastructure and governmental regulations
  - I.e., If discharging directly into a waterway, a NPDES permits may be required

Mitigating the impact of effluent

- To mitigate the impact hatchery effluent has on the environment, numerous strategies exist in our region
  - Settlings ponds / clarifiers
  - Drum filters
  - Auger systems
  - Chemical-induced solids removal
  - Dilution!

Hatchery 1

- Water is routed through a series of filtration: 90-micron drum filter, 1500-micron drum filter, then a 50-micron canister filter
- Clarifier
- 12-micron screen auger
  - Grinds and separates out any solid waste that has made it to the final step, including fish

Photos: Battle Ridge Builders LLC.

Hatchery 2

- Initial step: Water routed through a 100-micron drum filter
- Solids removal using chemical flocculant (alum, then a polymer)
  - Solids are collected on a conveyer belt system and donated to a local nursery, local high school agriculture program, or other land application
- Water is discharged back into source creek

Hatchery 3

- Utilizes a vertical wetland system
  - Swimming pool-like vacuum is used to remove solid waste in raceways
  - Pumped through a series of cells containing aggregate to filter out solids
  - Cell have plants to uptake surplus nutrients.
- Water is then pumped through tanks with phosphorus stripping media before being discharged

Photo: MSU/A. Sanchez-Gonzalez

Any questions?