

An underwater photograph showing a greenish-yellow fish swimming above a rocky bottom covered in numerous small, translucent fish eggs. The background is a soft-focus view of the lake floor.

# Just below the surface...

## The secret lives of northern Wisconsin's fishes

**Stephanie Shaw**

Fisheries Research Scientist, Office of Applied Science

Northern Highland Fishery Research Area

Boulder Junction, WI



2026/05/21 07:08:38

# The Office of Applied Science

*Improving Natural Resources Management Through Science*



**Fisheries Research**

**Wildlife Research**



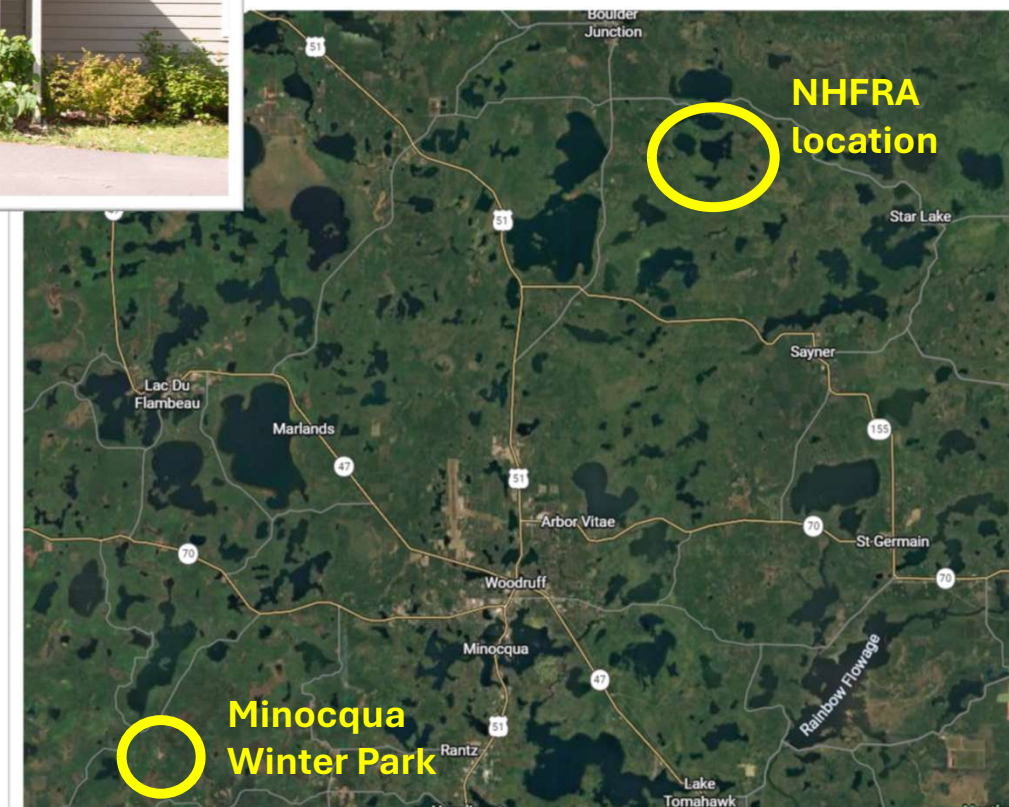
# OAS Fish Research Team

**Team Lead: Greg Sass**



**Some current research projects by OAS scientists based in Spooner and Madison**

| Trout (Mitro)                                                 | Great Lakes (Tsehaye)                                                       | Inland Lakes (Dassow, Feiner)                              |
|---------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------|
| Trout stocking assessment in Class 2 Trout streams            | Predator-prey balance in Lake Michigan                                      | Spawning dynamics of Northern Pike and Musky               |
| Neonicotinoids effects in stream macroinvertebrates and Trout | Recruitment dynamics of Lake Whitefish in Green Bay and North-Moonlight Bay | Muskellunge known age and growth                           |
| Trends in Trout populations over time                         |                                                                             | Spawning phenology of sport fishes                         |
| Beaver and Trout interactions                                 |                                                                             | Panfish responses to angling and predation                 |
|                                                               |                                                                             | Effects of alum treatments on panfish growth & recruitment |

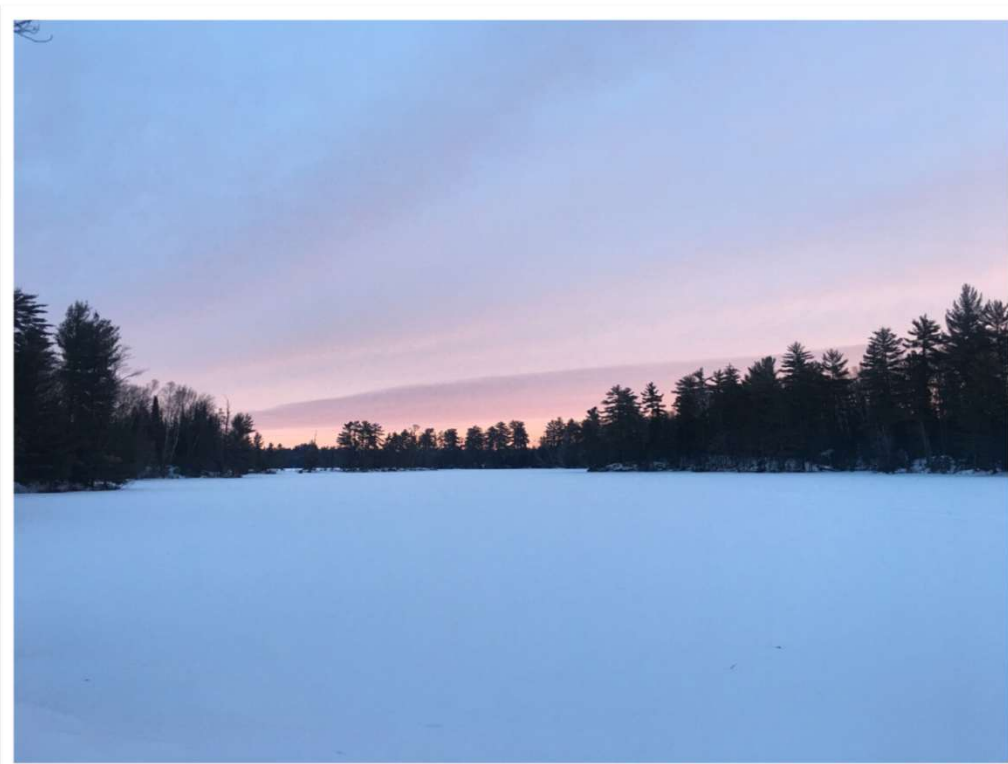


## Some current and recent completed research projects by scientists based at the NHFRA

| Long-term and Current Projects                                                          | Graduate Research                                                                       |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| NHFRA – Long-term trends in fish population and angler dynamics, regulation evaluation  | The effects of forward-facing sonar on recreational fisheries catch and angler behavior |
| Fish production responses to coarse woody habitat addition                              | Evaluation of walleye spawning reef addition in a northern Wisconsin lake               |
| Lake ice phenology and warming water effects on fish community and ecosystem            | Recently Completed Projects                                                             |
| Impact of water level fluctuations and drought on walleye spawning habitat availability | Trends in angler effort dynamics and effort distribution in declining Walleye lakes     |
| Movement and habitat use of Escanaba Lake Musky                                         | Statewide evaluation of the effectiveness of liberal bass regulations                   |
| Yellow Perch sampling efficiency and evaluation of methods for abundance estimation     |                                                                                         |
| Smallmouth Bass vulnerability to angling, catchability and discard mortality            |                                                                                         |

# A year in the life...

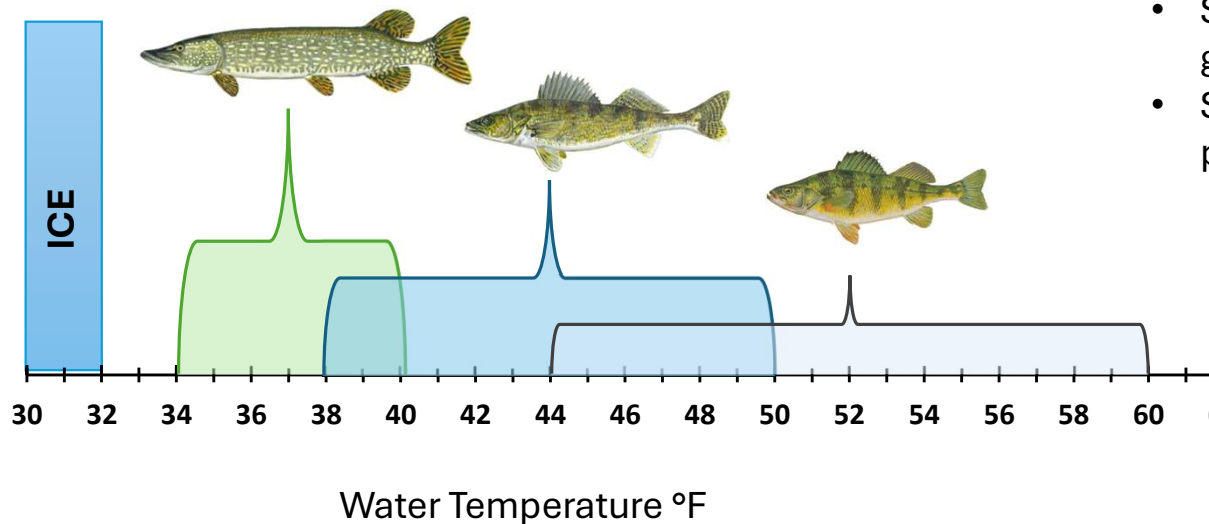
In the beginning... there was ice off... then there was the spawn...



# Early Spring Spawn

## Survival Strategies

- Very fecund – make A LOT of small eggs
- Don't put all your eggs in one basket
  - broadcast spawning = spread your eggs over a large area
  - Walleye, northern pike, musky, etc.
- Yellow Perch – protect your eggs with a safety cushion
  - Skeins = egg ribbons protected by a gelatinous mass
  - Skeins are draped over wood structure preferably but also vegetation, rocks, etc.



Fish illustrations: Virgil Beck

Image: Yellow Perch skeins on down tree in Nebish Lake 2026



# Spawning Phenology – series of connected events that occurs following ice off that establishes the food web for juvenile walleye and yellow perch

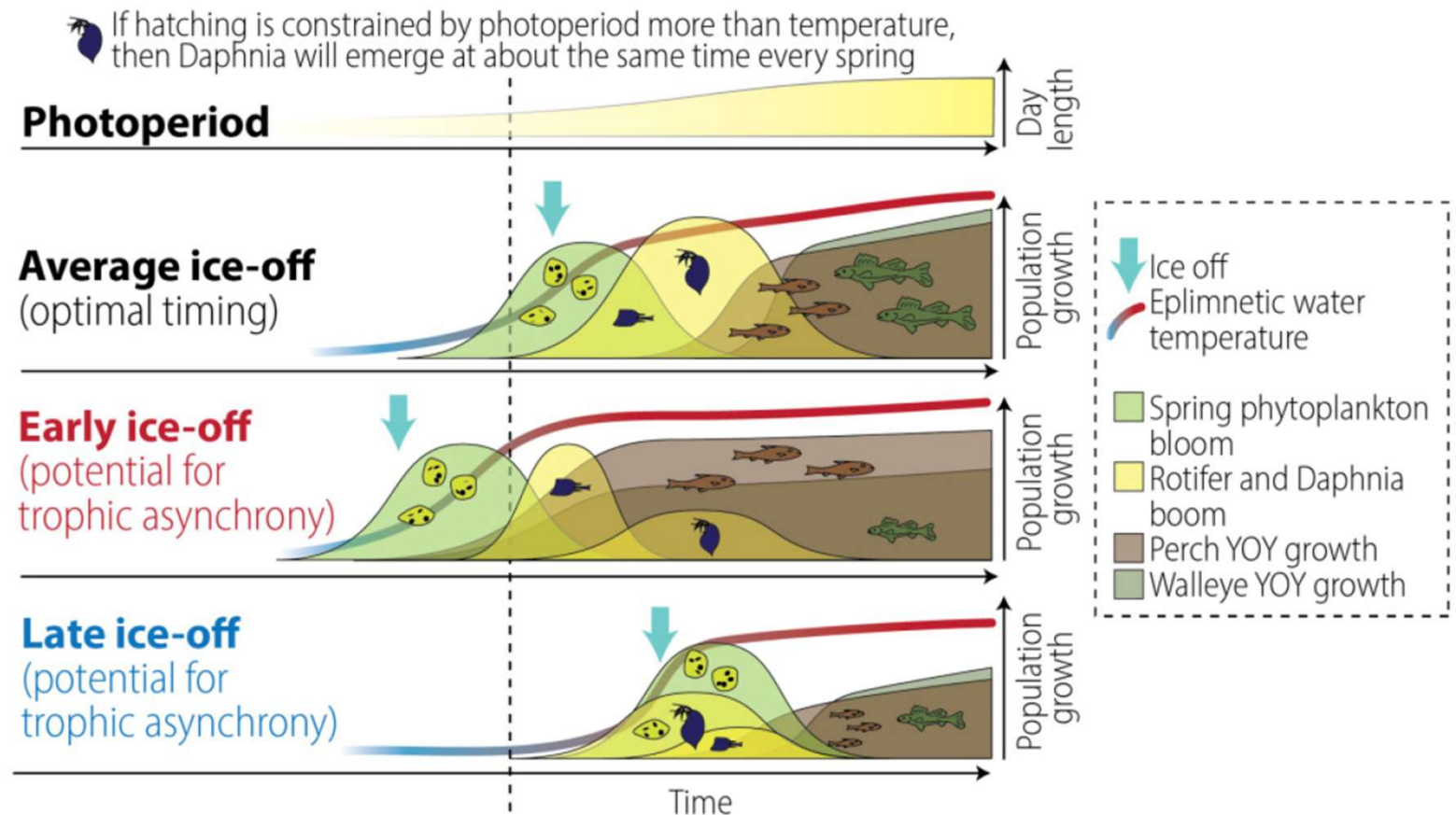
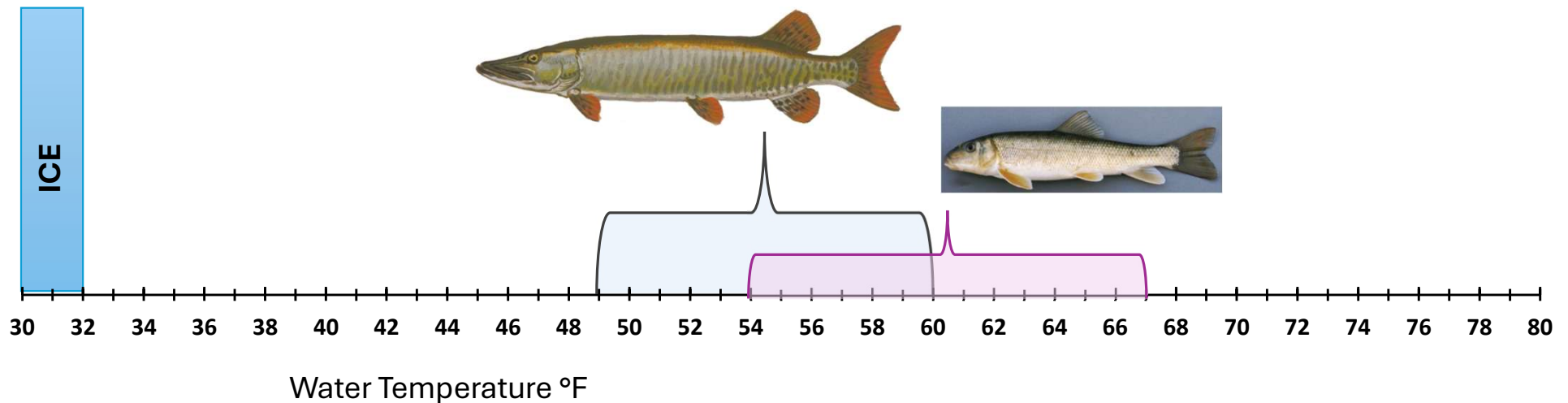


Image: Feiner et al. 2022.  
Canadian Journal of Fisheries  
and Aquatic Sciences, Vol 79,  
Issue 9, p. 1361-1604

# Mid-Spring Spawn

## Fun Fact...

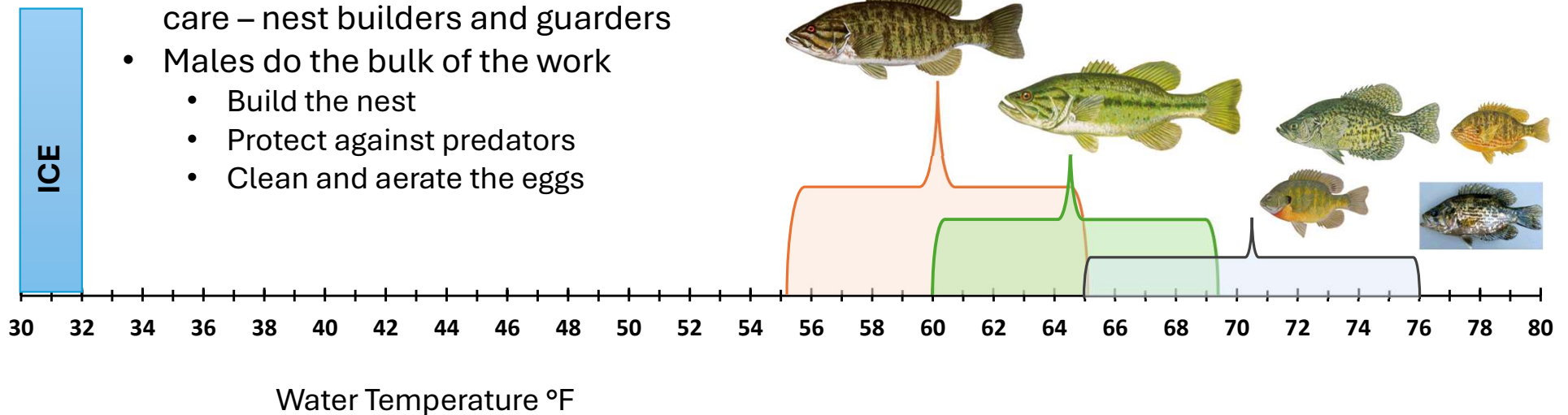
- Piscivorous predators (fish that eat other fish) spawn before their favorite prey to ensure food is available for their young
  - Walleye before Yellow Perch
  - Musky before White Sucker



# Late Spring – Early Summer Spawners

## Summer Spawning Strategies

- Water temperatures tend to be more stable at this time but there are more predators active
- These later spawners provide parental care – nest builders and guarders
- Males do the bulk of the work
  - Build the nest
  - Protect against predators
  - Clean and aerate the eggs





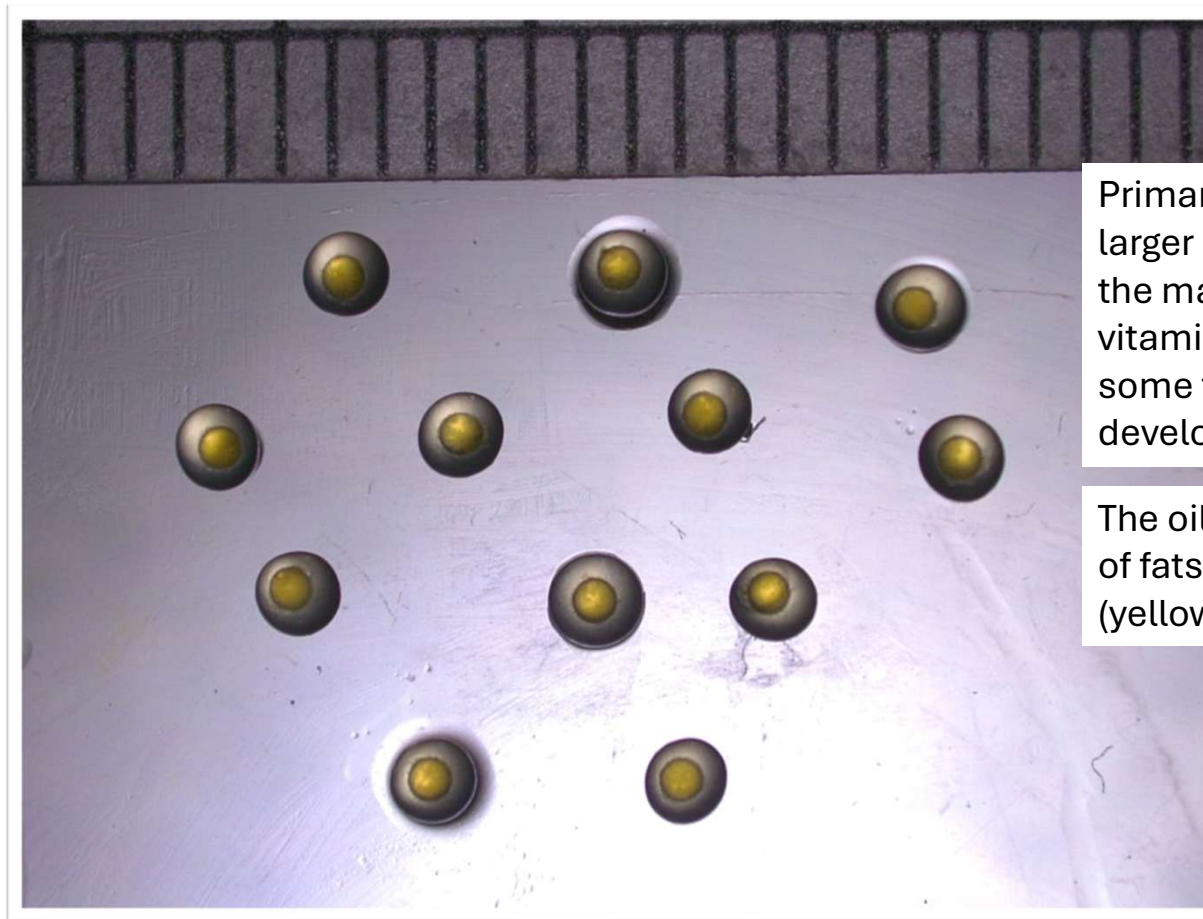
Predator Defense

2026/06/22 10:41:01

## Caring for the Eggs



# What do fish eggs look like?



Ruler divisions in millimeters

Primary yolk is clearer, larger and fills the egg. It is the main source for vitamins, minerals and some fats crucial for development.

The oil droplet is a cluster of fats within the egg (yellow spot).

Image: Escanaba Lake  
unfertilized Walleye eggs

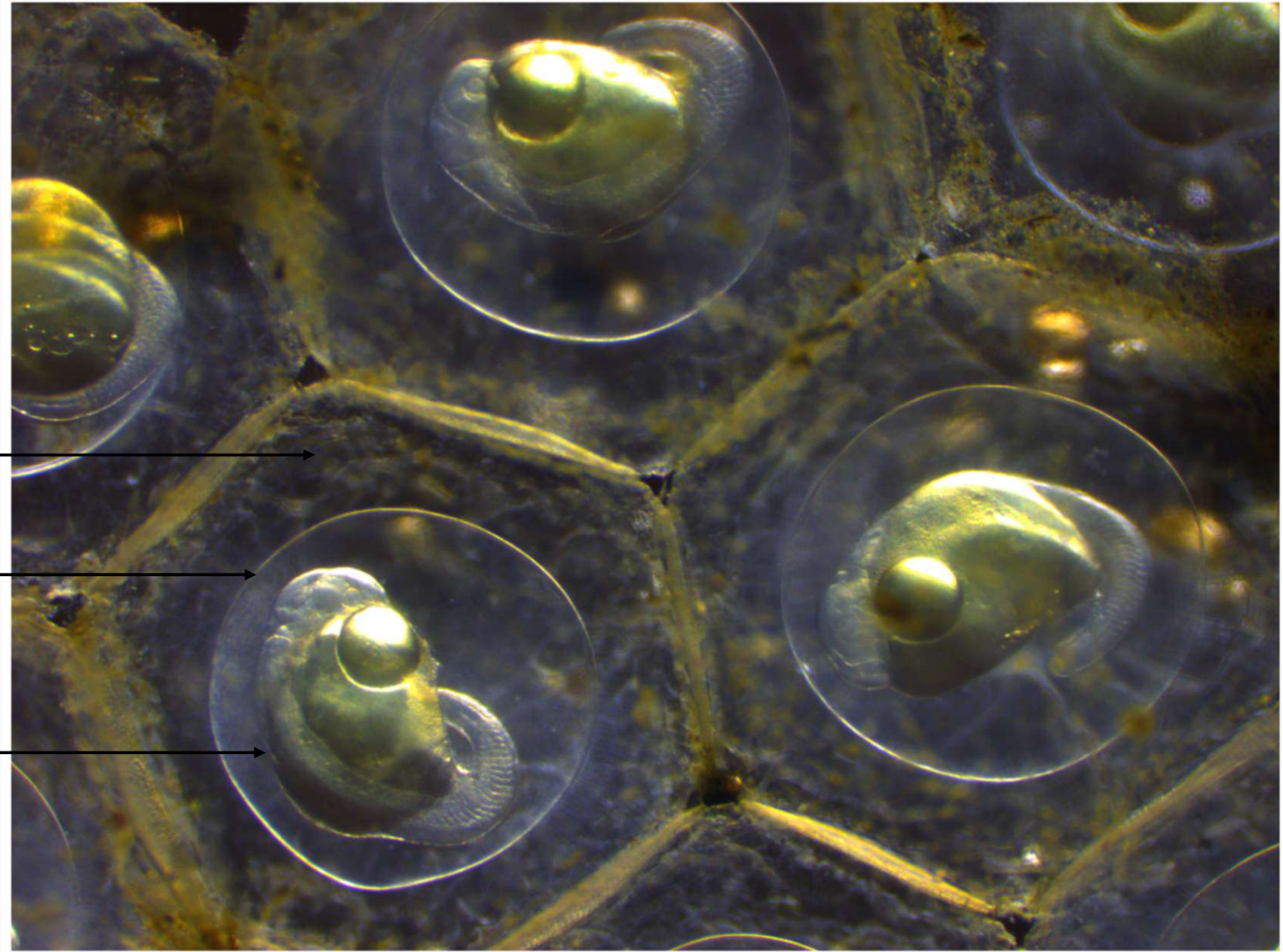
**Yellow Perch larvae  
developing within their  
eggs.**

Gelatinous material of the  
perch skein

Egg

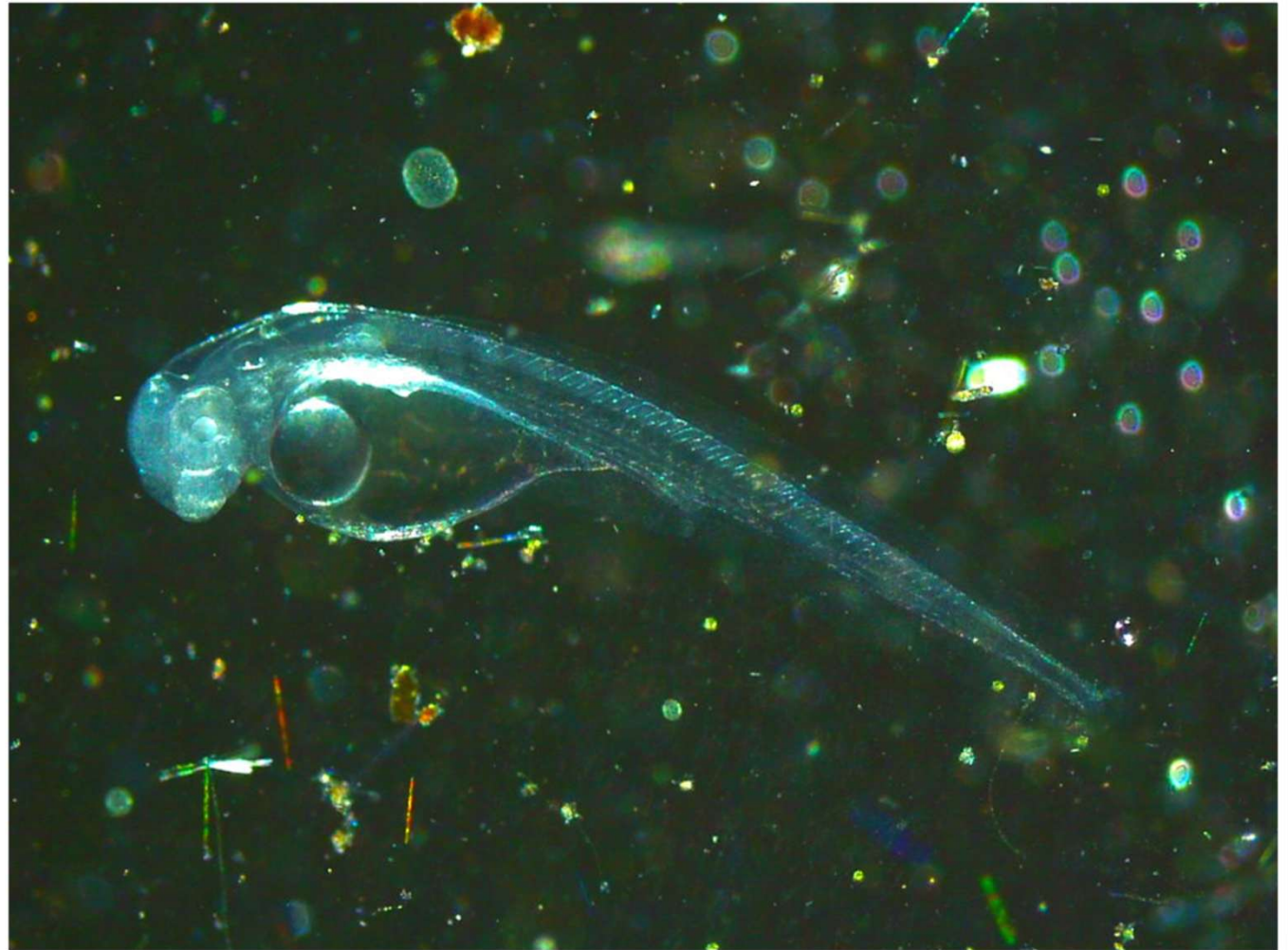
Larvae developing around  
the primary yolk

Image: Yellow Perch larvae, Escanaba Lake



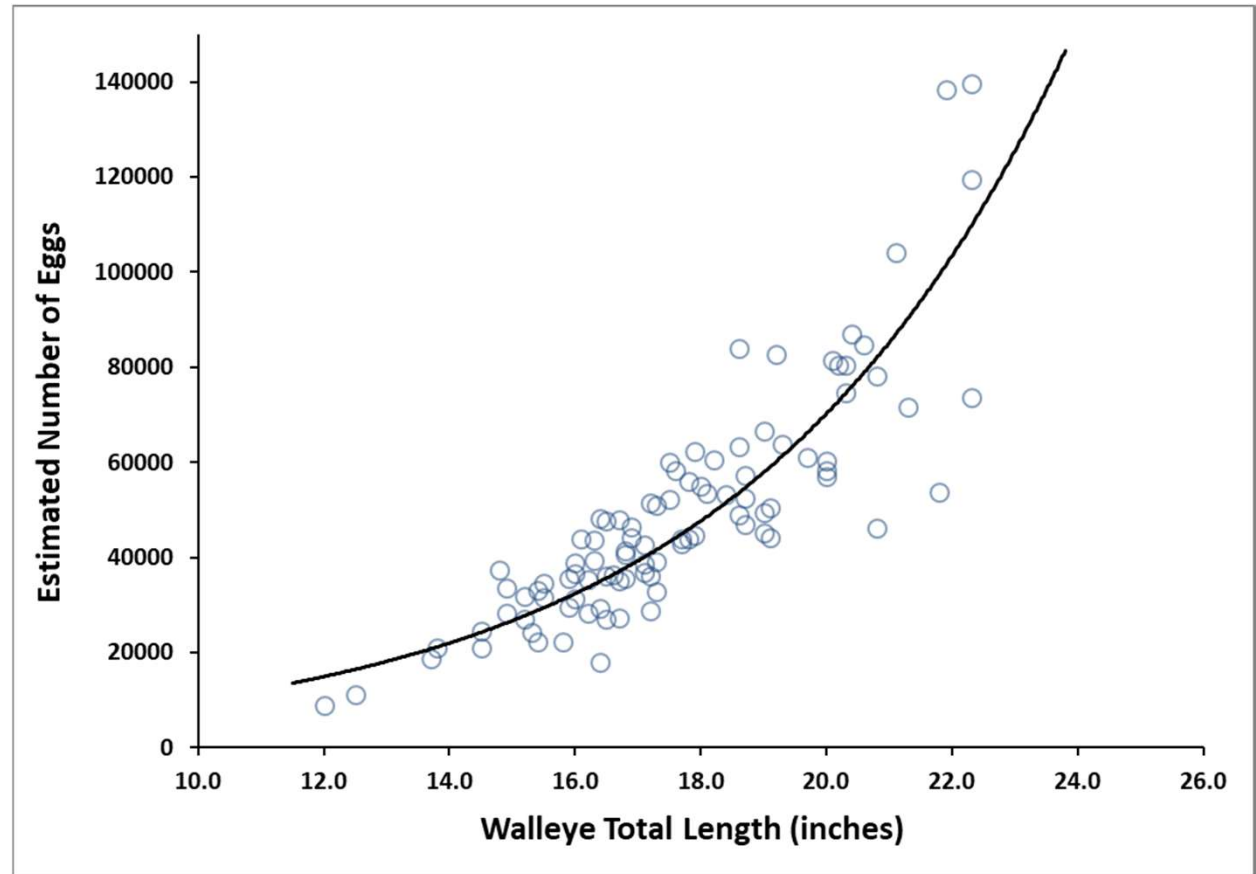
- When fish hatch they are still relatively undeveloped and cannot feed freely.
- They settle into the substrate and continue to rely on the yolk for nutrition.
- By the time the yolk is used up the larvae are developed enough to transition to outside food sources such as zooplankton.

Image: developing Yellow Perch sac fry outside the egg, with yolk, Escanaba Lake 2026



# Fun Facts About Fish Eggs

- How many eggs does a fish have?
- **Fecundity** = “the capacity to produce offspring”
- The number of eggs per individual.
- Increases exponentially with length

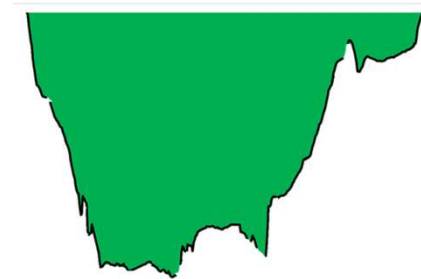
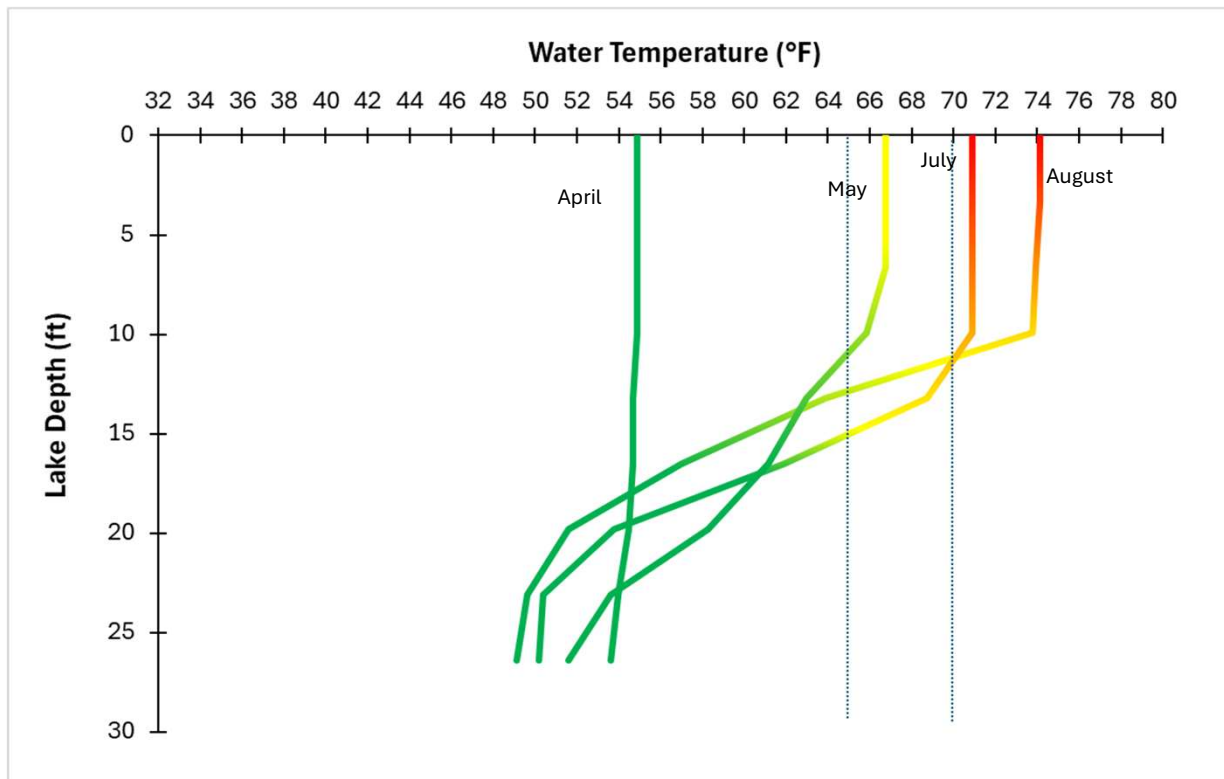


Summer



# Summer – temperature & stratification

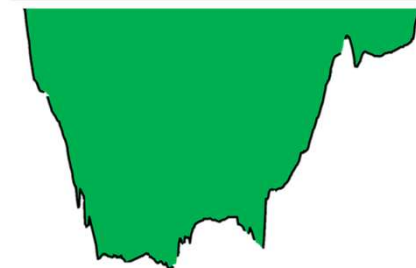
All fish have an 'optimal temperature range' that is where their metabolism works the best. Temperatures outside of this range can be stressful. This example demonstrates how water temperatures stratify mid-summer and can create stressful conditions in the upper water column where the water is warmest.



**April** – entire water column within optimal temperature range



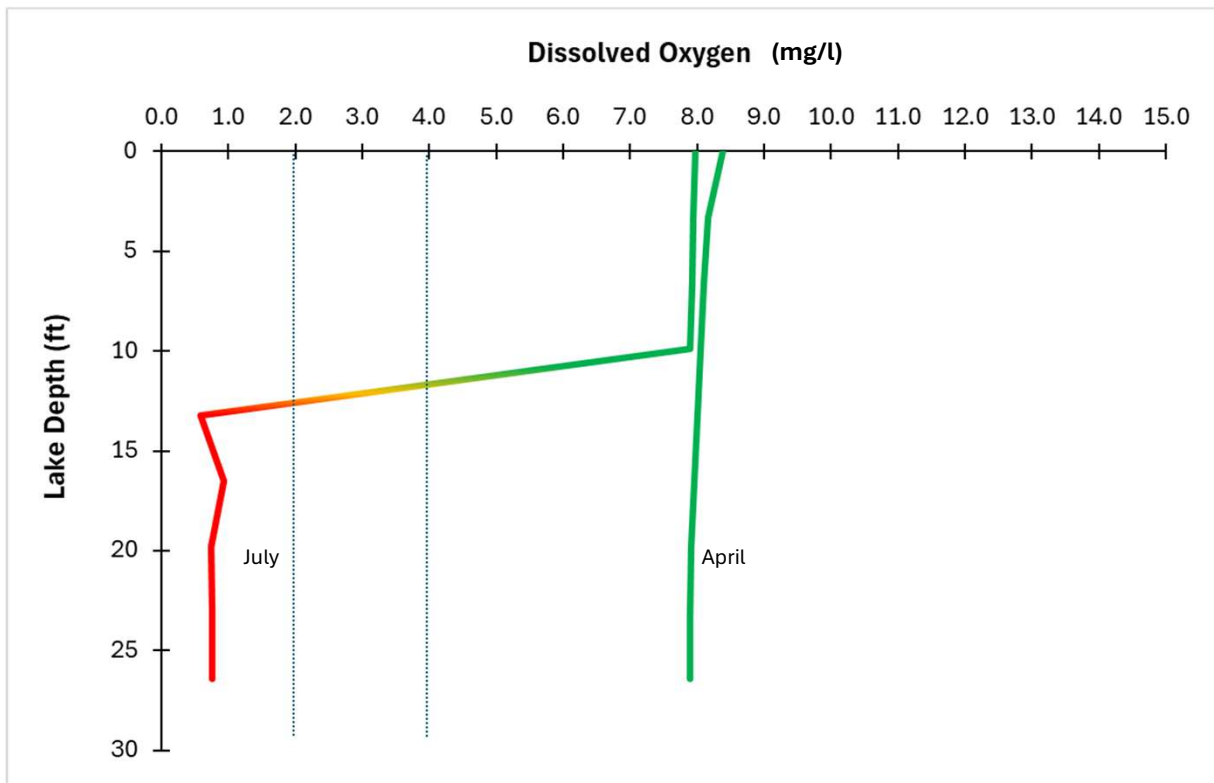
**July/August** – upper water column is becoming too warm and near the upper limit or above optimal temperature range



**October** – after turnover and mixing the entire water column is back within optimal temperature range

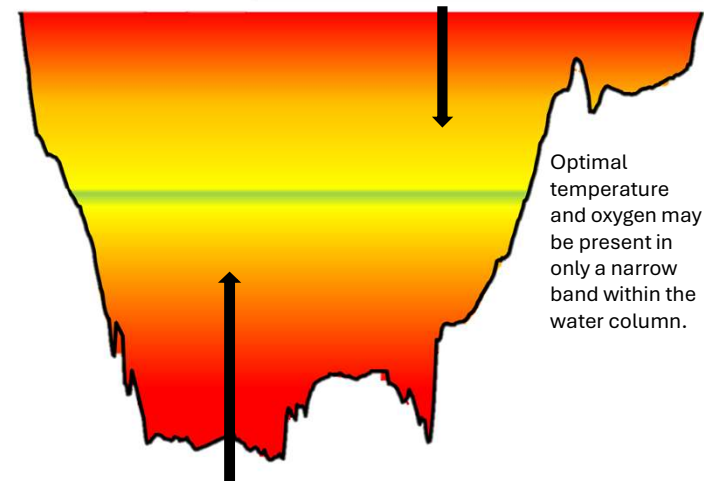
# Summer – dissolved oxygen

Stratification of temperature and dissolved oxygen within the water column in the summer months can create habitat limitation for species that require cold water (cisco and trout). It can also create stressful conditions for species that prefer cool water (walleye and perch). This is an extreme example of how dissolved oxygen availability becomes limiting in the lowest depths during the summer at the same time surface water becomes too hot limiting optimal habitat for important forage species like cisco.



## Summer Habitat Squeeze

Temperature limitation from surface



Dissolved oxygen limitation from bottom



# Fall

- Day length is decreasing
- Surface water cools eventually leading to the mixing or flipping of the water column (i.e., fall turnover)
- Fall turnover increases the available temperature and oxygen habitat for fishes
- Fish begin consuming more calories in preparation for a cold winter. As a result, angler catch rates often tend to be higher in the fall than the summer months.

# Winter

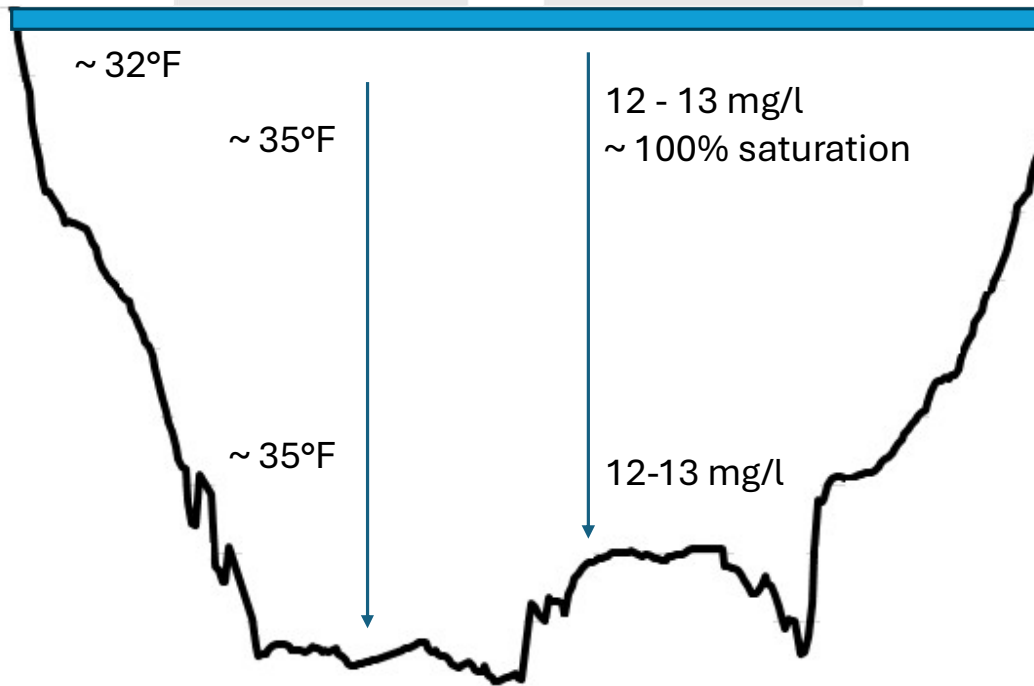
How do fish survive below the ice?





## Temperature

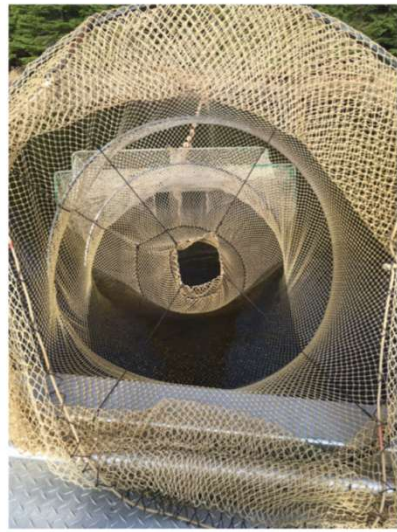
## Dissolved O<sub>2</sub>



- Water is the densest around 39-40°F.
- As the surface water cools to freezing the forming ice floats on the slightly warmer water below.
- Temperature just below the ice is close to freezing but remains low and relatively stable throughout the rest of the water column.
- Colder water holds more oxygen than warm water. The colder water temperatures in the winter have consistent high oxygen saturation below the ice.
- Declines in oxygen can occur as organic material breaks down below the ice and there is no mixing of the water column to replace it with higher oxygenated water. Oxygen declines can be strong enough to cause hypoxia and winter kills of fish in some cases.

# How do we collect info about fish populations?

Fyke Net



Measuring fish length and weight



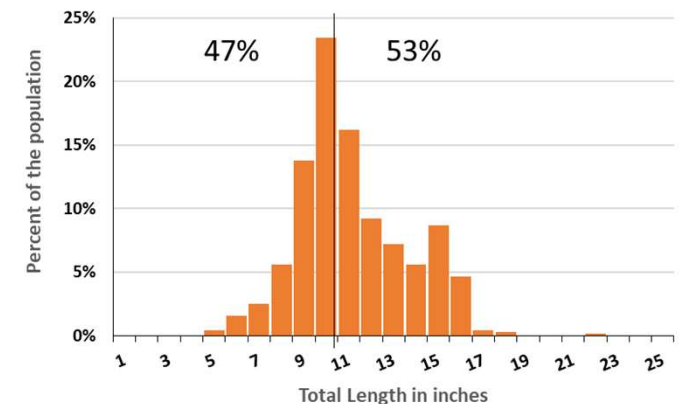
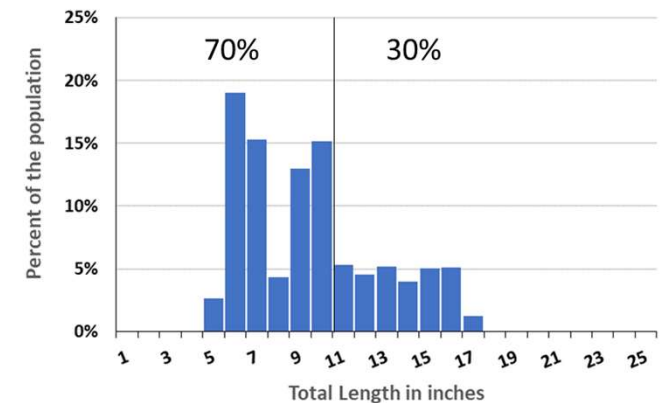
Electrofishing



# What does fish data tell us?

- Length information gives size structure
  - How many fish of different size classes are in our population
- Length and weight gives condition (“fatness”)
  - Can tell us about forage availability and overall health
- Length and age together gives growth rate information
- Numbers and age together tell us about mortality rate

Example of a bass population dominated by smaller fish 10-inches and under.



The same bass population, several years later after a regulation change, that is showing an increase in size structure which includes more fish 11-inches and larger.

# How do we age fish?

## Fish are like trees...?

- Temperature influences growth rate throughout the year creating growth chronologies
  - Summer / Fall = warmer temperatures and faster metabolism + eating more = faster growth
  - Winter = cold temperatures and slower metabolism + eating less = slower growth rate and
  - The combination of these differences in seasonal growth rate create alternating “bands” that can be used to count years
    - light band + dark band = 1 full year

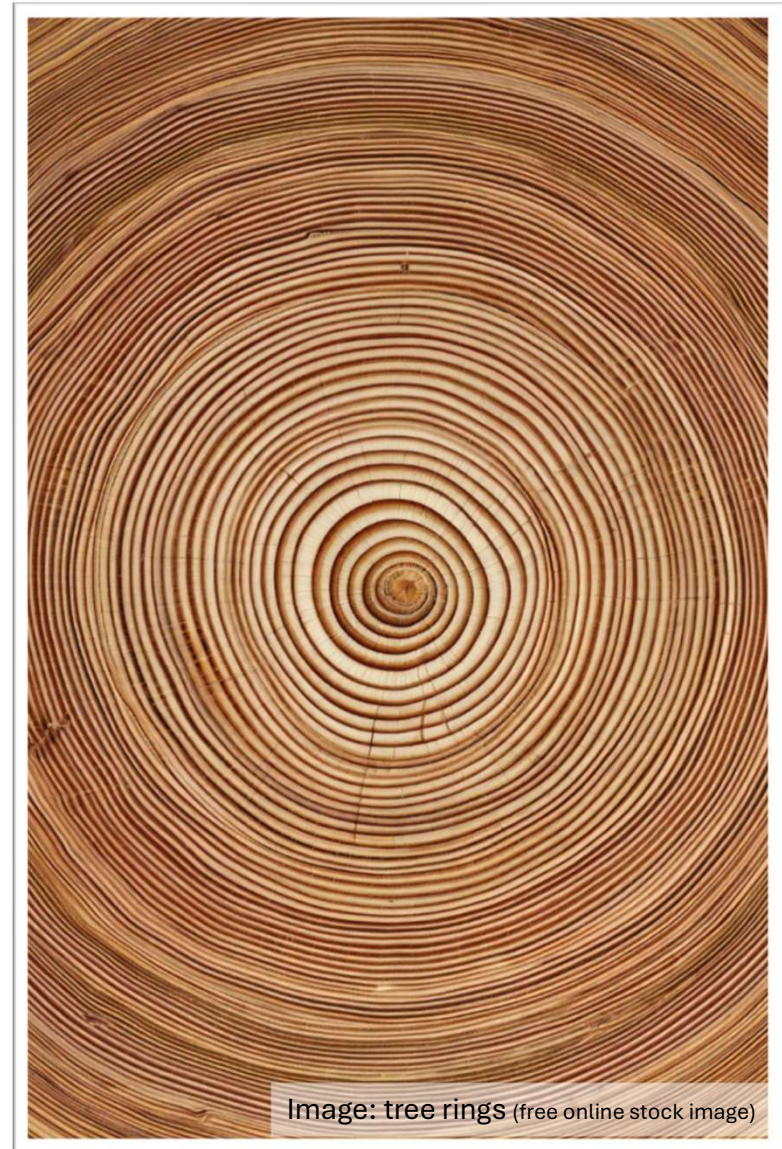
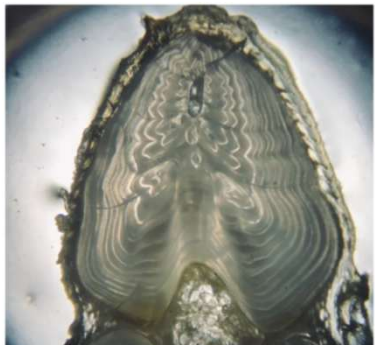


Image: tree rings (free online stock image)

# How do we age fish?



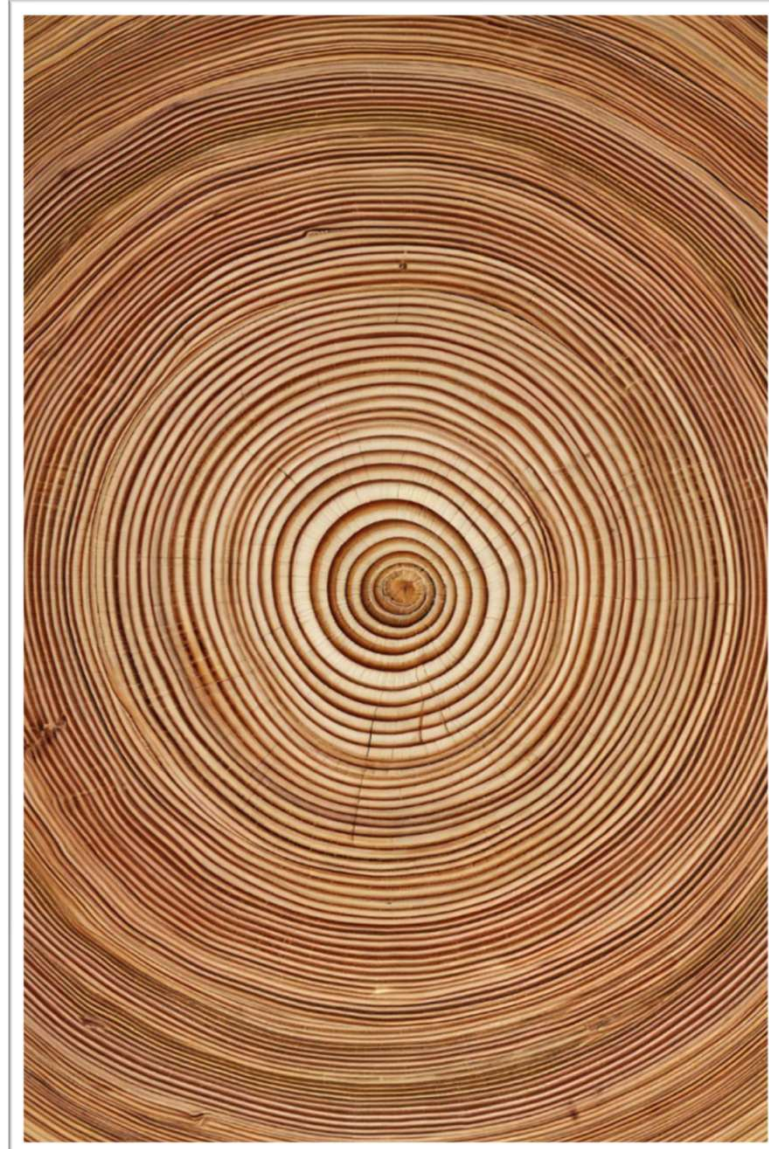
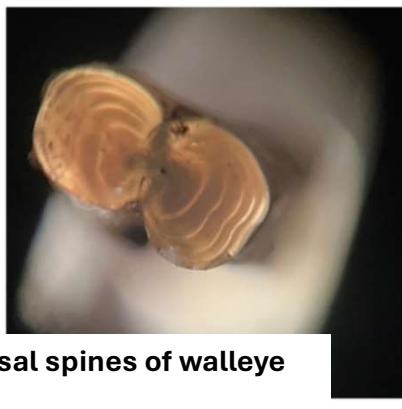
Rings in a Lake Sturgeon fin ray (USFWS)



Rings visible in an otolith ("ear bone").  
Walleye (NHFRA)



Rings visible in the dorsal spines of walleye  
(NHFRA).



**For more information, please visit...**

WDNR Office of Applied Science:

<https://dnr.wisconsin.gov/topic/Research>

Northern Highland Fishery Research Area:

<https://dnr.wisconsin.gov/topic/research/AboutNHFRA>

Current fishing regulations:

<https://dnr.wisconsin.gov/topic/fishing/regulations>

Fisheries Survey Reports:

<https://dnr.wisconsin.gov/topic/Fishing/reports>

<https://dnr.wisconsin.gov/topic/Fishing/north/trtycrslrvys>

