

ARCTIC GRAYLING: A NEW HOPE

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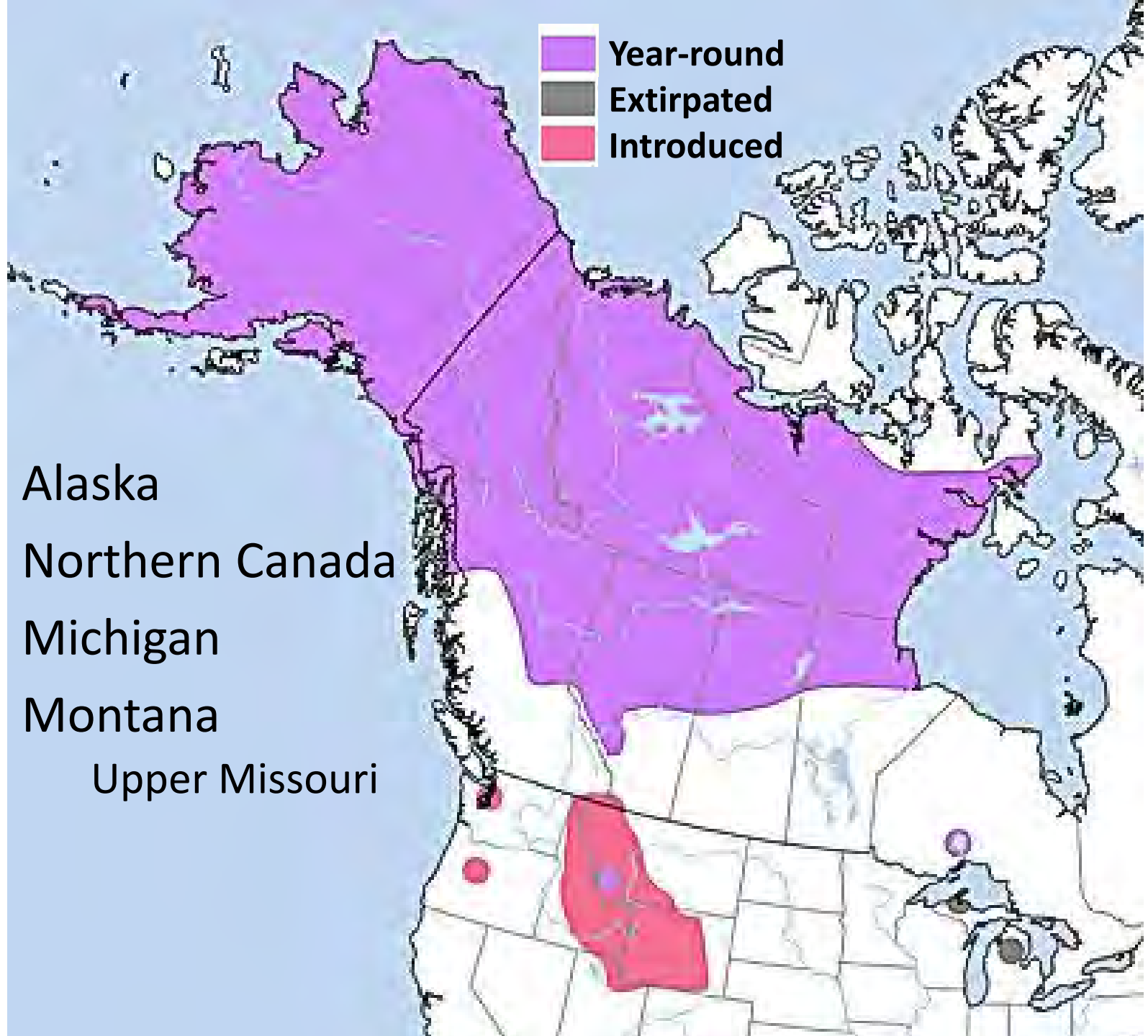
Abbreviations

- AGR: Arctic Grayling
- BKT: Brook Trout
- BNT: Brown Trout

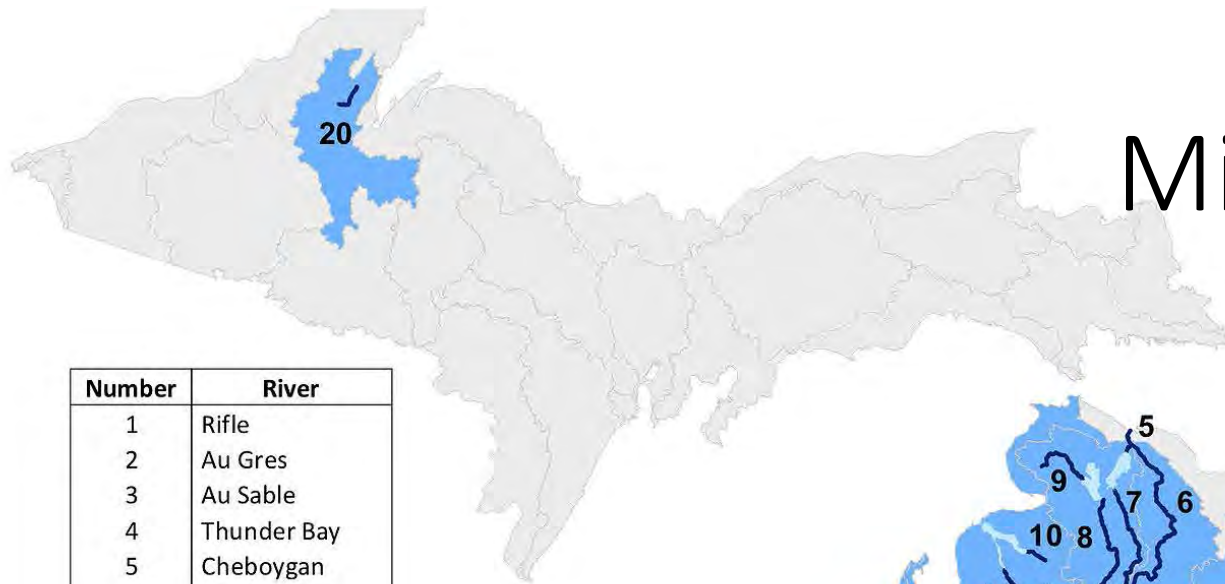




Alaska
Northern Canada
Michigan
Montana
Upper Missouri



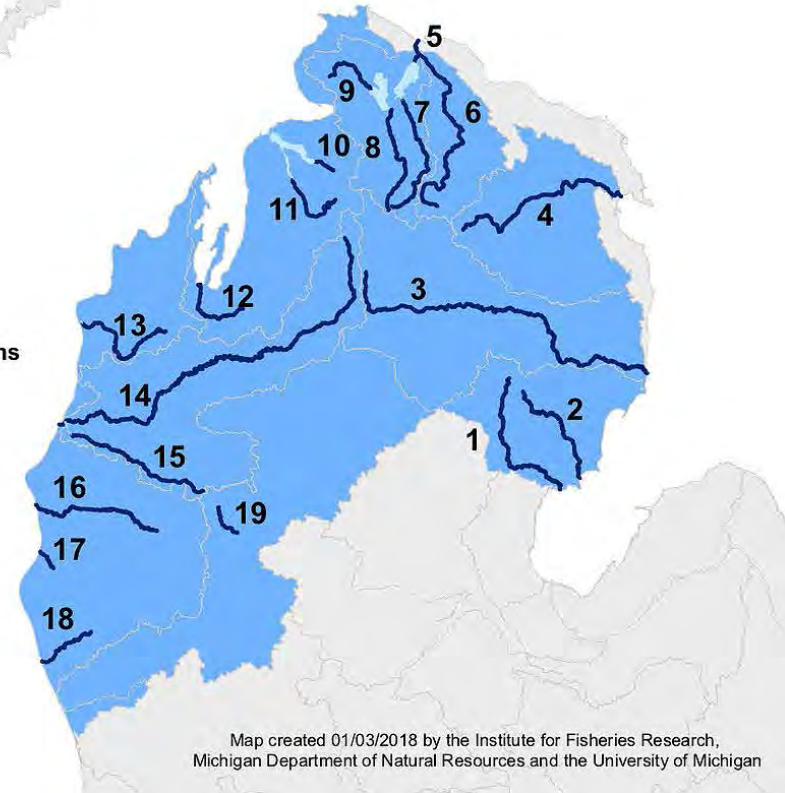
Michigan



Number	River
1	Rifle
2	Au Gres
3	Au Sable
4	Thunder Bay
5	Cheboygan
6	Black
7	Pigeon
8	Sturgeon
9	Maple
10	Boyne
11	Jordan
12	Boardman
13	Betsie
14	Manistee
15	Little Manistee
16	Pere Marquette
17	Pentwater
18	White
19	Hersey
20	Otter

Historic Grayling Locations

- Rivers
- Watersheds

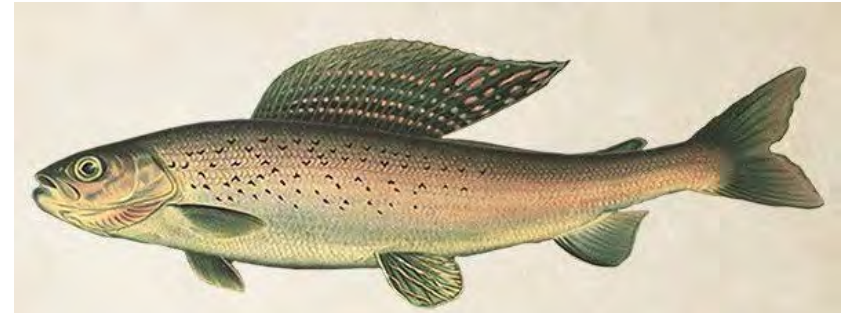


Map created 01/03/2018 by the Institute for Fisheries Research, Michigan Department of Natural Resources and the University of Michigan

Grayling were once the dominant stream salmonid in the Lower Peninsula, MI

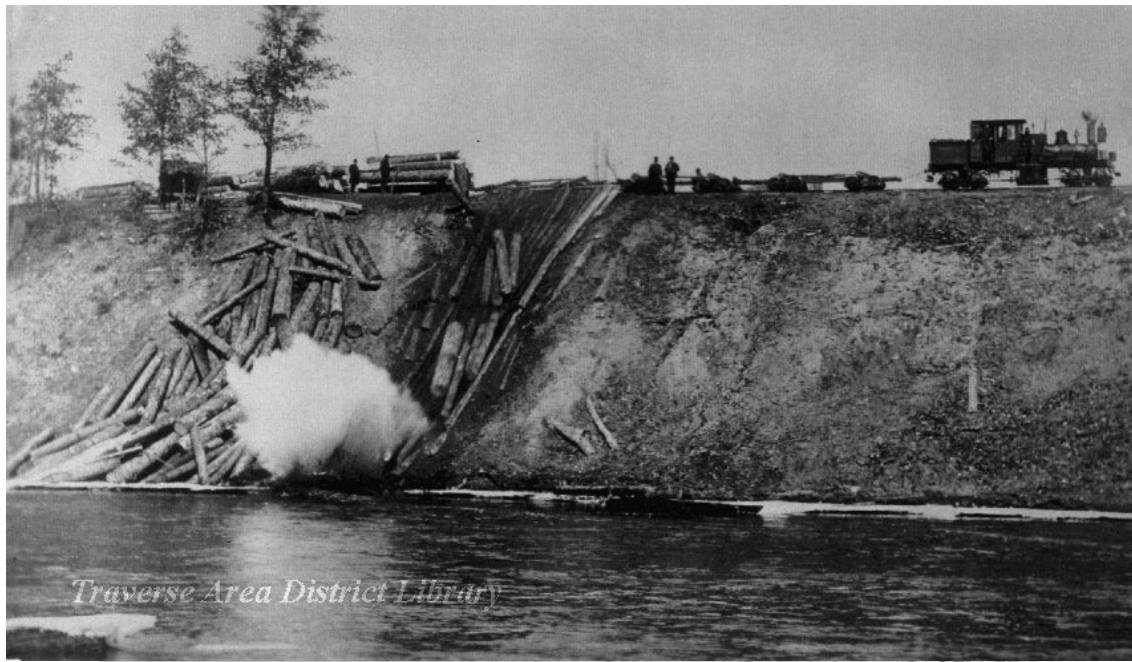
Over-fishing

- Paul Young recalled his father telling tales of men catching Grayling nearly every cast
- *They would toss the fish on the bank until the pile reached **shoulder height***
- *The men would select several for their creels and **leave the rest to rot***



Logging

- Erosion
- Sedimentation
- Turbid water
- Dams
- Spring release of logs
 - AGR spawning
- Loss of AGR eggs, fry



Competition

- Introductions of non-native species
- Competition for resources



Extirpation

- Combination of three key stressors
 - over-fishing, logging, competition
- The last remaining Grayling was caught in the Otter River in 1936



Previous Restoration Attempts

Episode i	1900-1941	fry
Episode ii	1958-1960	fry
Episode iii	1987-1991	yearlings

All unsuccessful

Key problem: rapid outmigration without returns

Temperature limitations?

Species	Optimal Temperature		Lethal Temperature	
	°C	°F	°C	°F
AGR	9.5-16	49.1-60.8	29.3	84.7
BKT	11-16	51.8-60.8	25.3	77.5
BNT	12-19	53.6-66.2	27.2	81

Success in Montana: the RSI

Remote site incubator

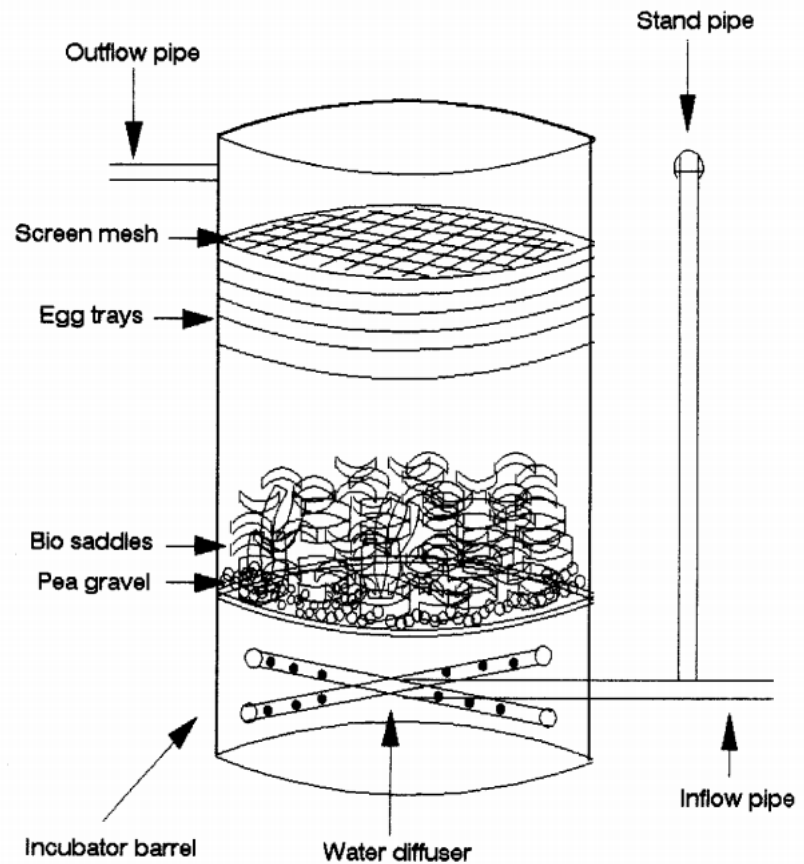


Figure 1. Components of the remote site incubator.

Success in Montana: the RSI

- Allows fish to imprint on stream water at eyed egg stage
- Re-established resident AGR populations
- Current study at GVSU test utility of RSIs in MI waters using Rainbow Trout eggs as a surrogate



Episode iv does have a new hope

- Build on MT's success
- Research, not stocking fry, collaborative effort
- Increased confidence that MI reintroduction will be successful

But...

- Many unknowns need to be addressed to ensure success

Study Design

- **Goal:** Gain insight into potential impediments to successful reintroduction of Arctic Grayling to Michigan streams
- **Objectives:**
 1. Assess potential effects of predation and competition
 2. Early life imprinting (corresponding to RSI use) to establish residency in streams
- Three part study: imprinting, predation, competition

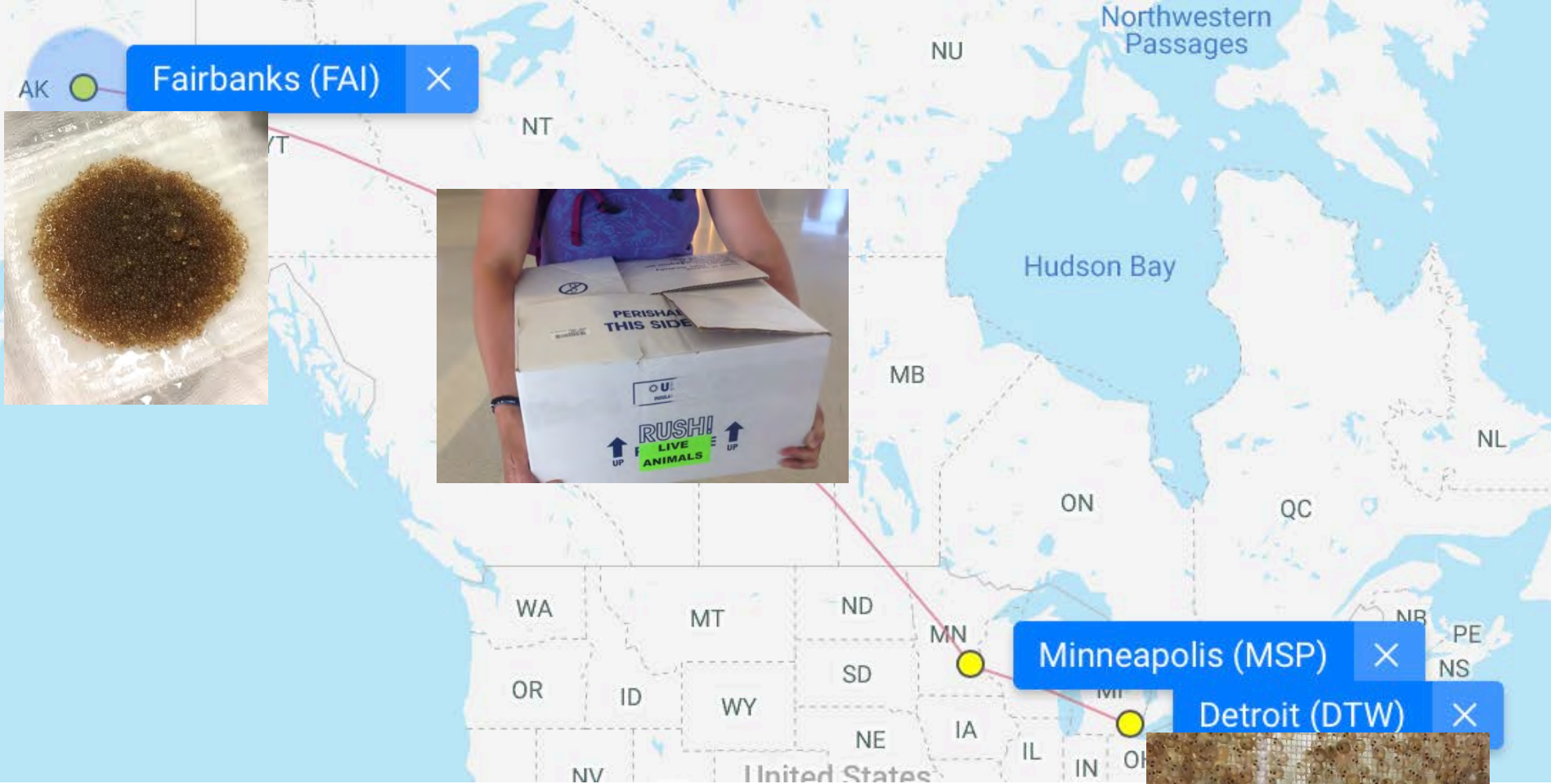


Egg Collection: AK F&G

- Wild stock
 - Chena River, near Fairbanks, AK
- Date: 15May18
- Collection from 22 pairs of male/female
- Total eggs: 5,000



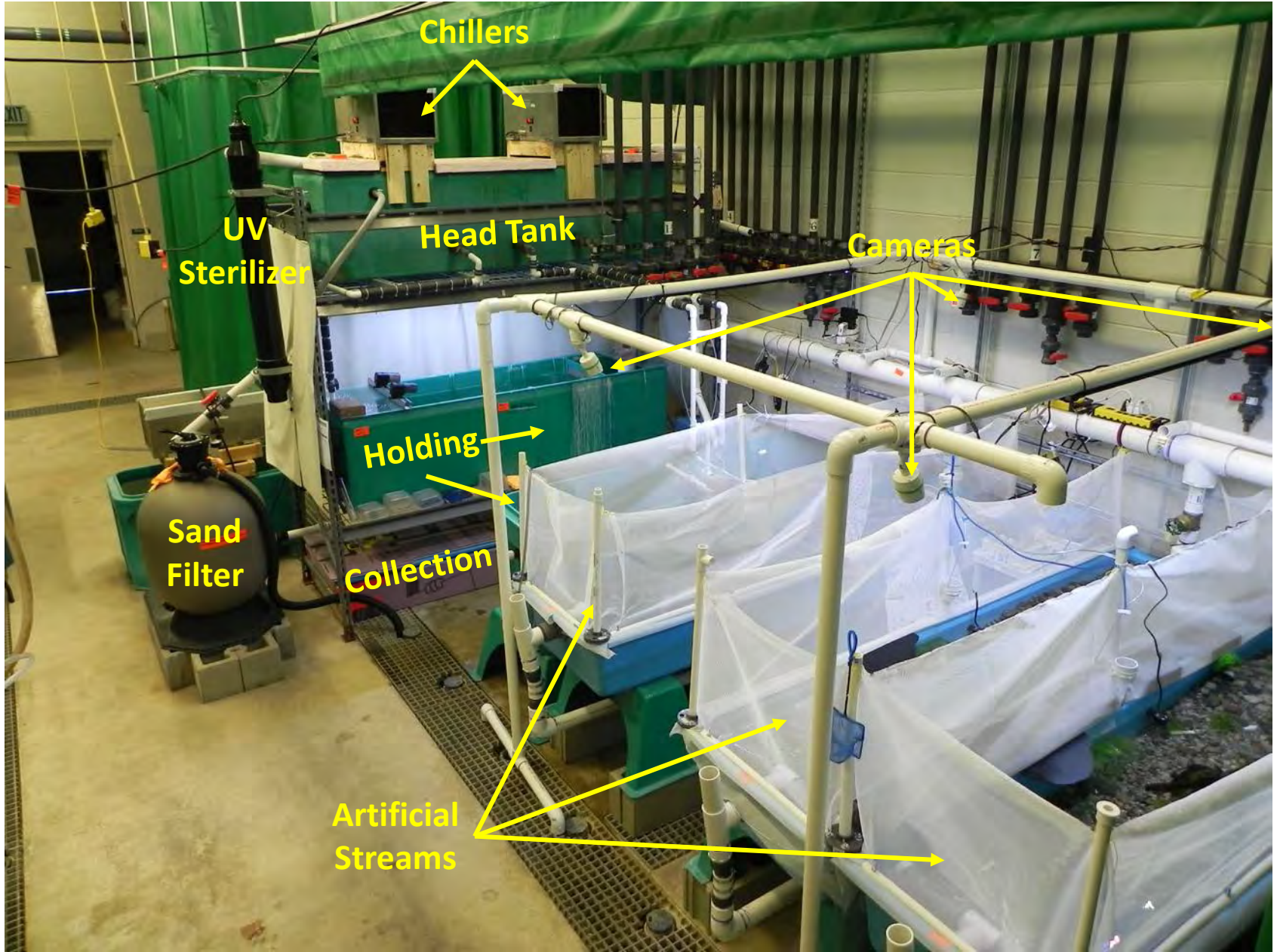
Adult Arctic Grayling, Chena River, AK



- Arrived in Fairbanks: 30May18
- Departed with eyed eggs: 4Jun18
- Hatch date: 8Jun18 (21 days after egg take)



Lab Set-up



Lab Set-up



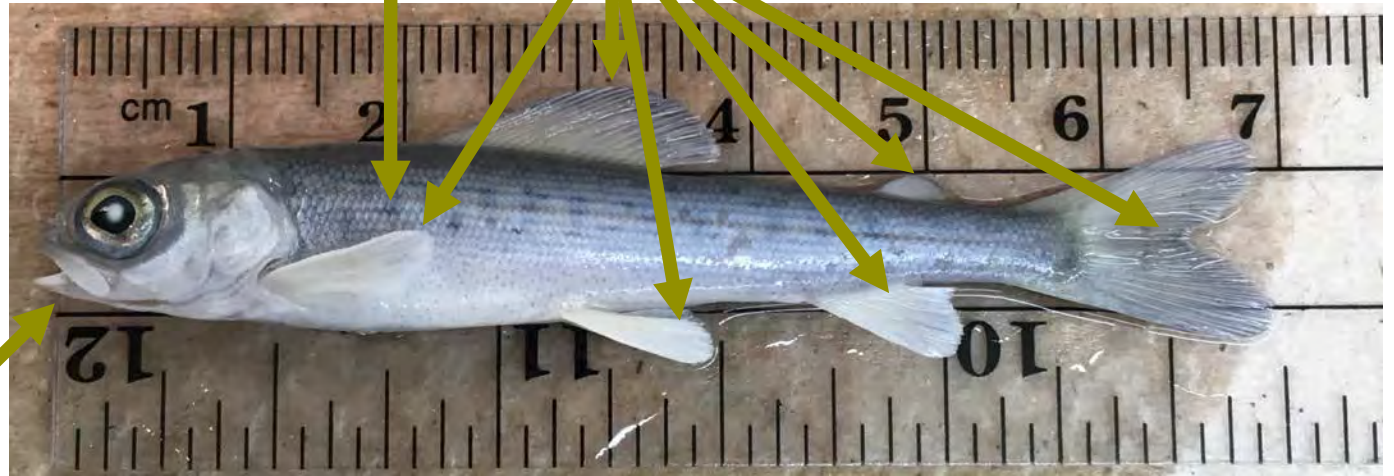
Rearing





Dark “v” spots

Fin formation



Formation of jaw and square shaped mouth



ARCTIC GRAYLING
H. Singer

Imprinting

Background: Imprinting

- Hatchery-reared AGR in both MT and MI showed dramatic migrations and disappeared shortly after stocking
- MT RSI use resulted in AGR establishing stream residency at or near introduction site
 - This suggests potential imprinting to stream at early life stages

Background: Imprinting

- There is no information on imprinting processes of AGR
- Our study seeks to address this knowledge gap for AGR using methods employed on other fishes

Imprinting

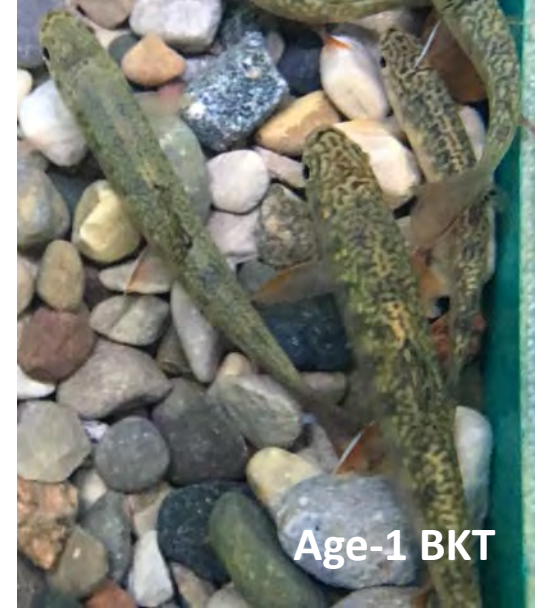
- Thyroid hormone analysis to determine stages imprinting occurs
 - Elevations in thyroid hormone levels of juvenile coho salmon are associated with timing of imprinting
- **2018 Collections**
 - *Pre-hatch, immediately post-hatch, swim-up, eight total bi-weekly samplings*
- Water choice experiments to determine if AGR develop a preference for their “home water”

Predation



Background: Predation

- **Predation by resident trout may be the most significant hurdle to establishing resident AGR populations**
- Effects of young BKT and BNT on newly hatched AGR survival
- Smaller trout are often found in higher density in streams
- Eggs and fry are nutrient rich diet items to smaller trout



Age-1 BKT



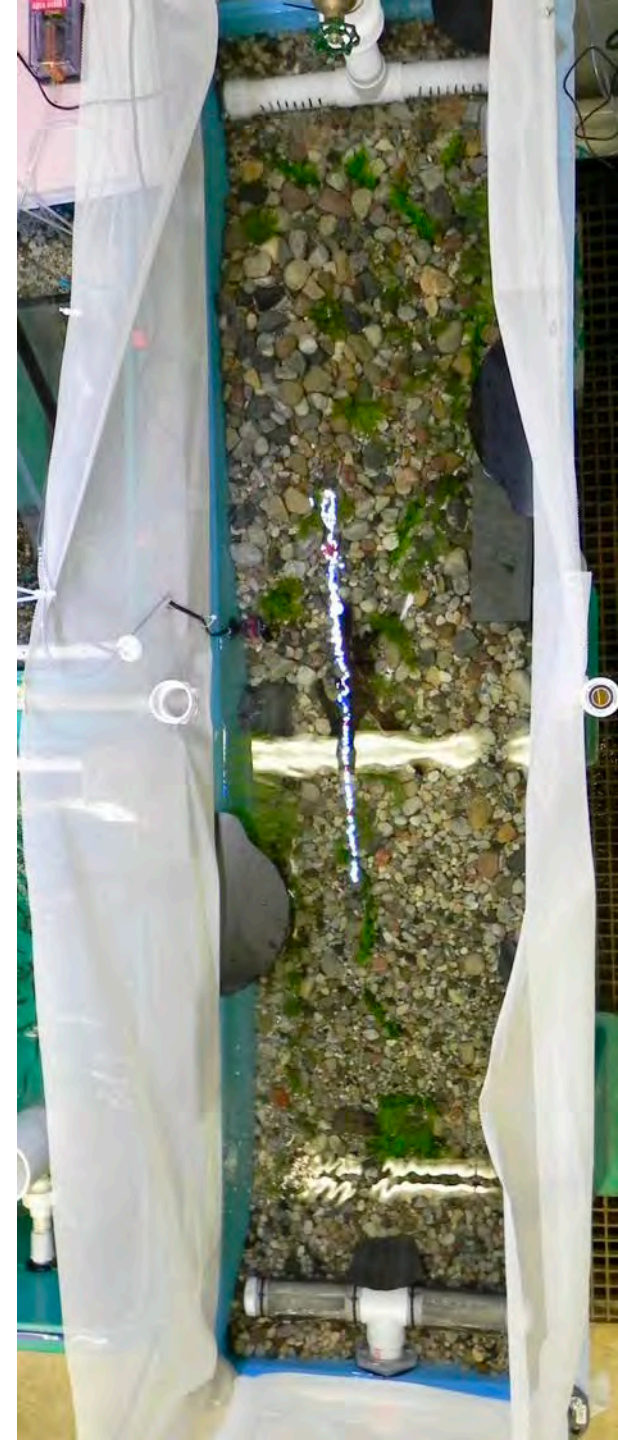
AGR fry



Age-1 BNT

Study Design: Predation

- Three artificial streams
- Multiple treatments with adaptive design
- Trials recorded remotely using camera system
- Trial Methods:
 - Acclimated predator
 - Add 20 AGR to stream
 - No human presence during trial
 - End of trial: remove predator, recapture and count AGR



Number of Grayling Consumed per Trial
(Min - Mean - Max)

Predator	TOD	Trial Length	Number of Grayling Consumed per Trial (Min - Mean - Max)		
		(hr)	1 Predator	2 Predators	3 Predators
BKT	Day	1	NA	NA	2.0 - 3.2 - 6.0
BKT	Day	2	0.0 - 3.9 - 8.0	6.0 - 8.7 - 12.0	7.0 - 12.8 - 17.0
BKT	Night	2	0.0 - 2.3 - 7.0	3.0 - 5.0 - 7.0	3.0 - 7.5 - 12.0
BNT	Day	2	0.0 - 6.0 - 15.0	18.0 - 18.5 - 19.0	NA
BNT	Night	2	0.0 - 2.2 - 3.0	NA	NA
Control	Day	1			
Control	Day	2			

Preliminary Results

- Maximum number AGR preyed upon by BNT: 19 (2 predators)
 - With 2 BKT, maximum AGR preyed: 12 (2 predators), 17 (3 predators)
- BKT predation relatively additive with each predator added

Total number of trials: 74



Predation

- AGR vulnerability appeared to decrease over time as development progressed
 - Exhibited schooling behavior, hiding in substrate, rapid movements to avoid predation
- Management implication:

Understanding hatch and early life survival rates will help us better estimate the number of eggs that need to be reared in RSIs on a given stream reach to achieve desired densities of young AGR
- *Path forward:*
 - Several repeated trials in a shorter period of time, starting sooner after hatching
 - Fine tuning of study parameters: trial length, number of predators, light conditions



Competition

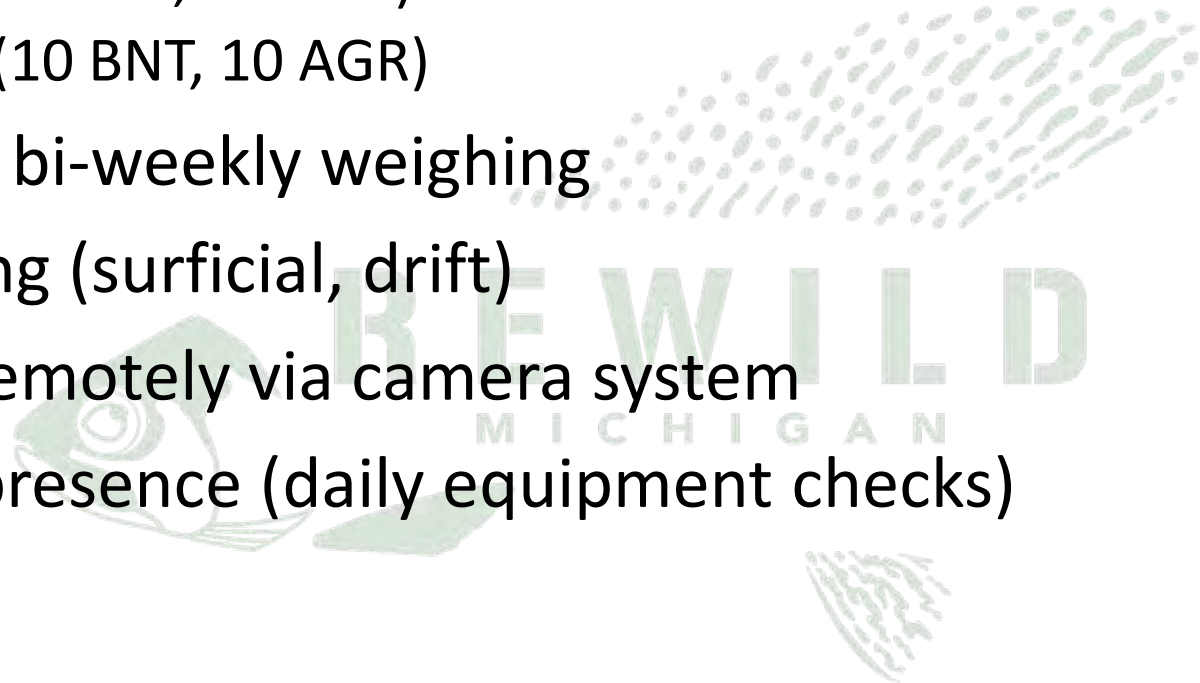
Background: Competition

- Competition between age-0 resident trout could adversely affect Grayling survival
 - Due to distinct size advantage early in growing season
 - Aggressive interactions may push Grayling into poorer microhabitats
- Focus on changes in growth, behavioral interactions and habitat use of age-0 resident trout and Grayling in artificial streams



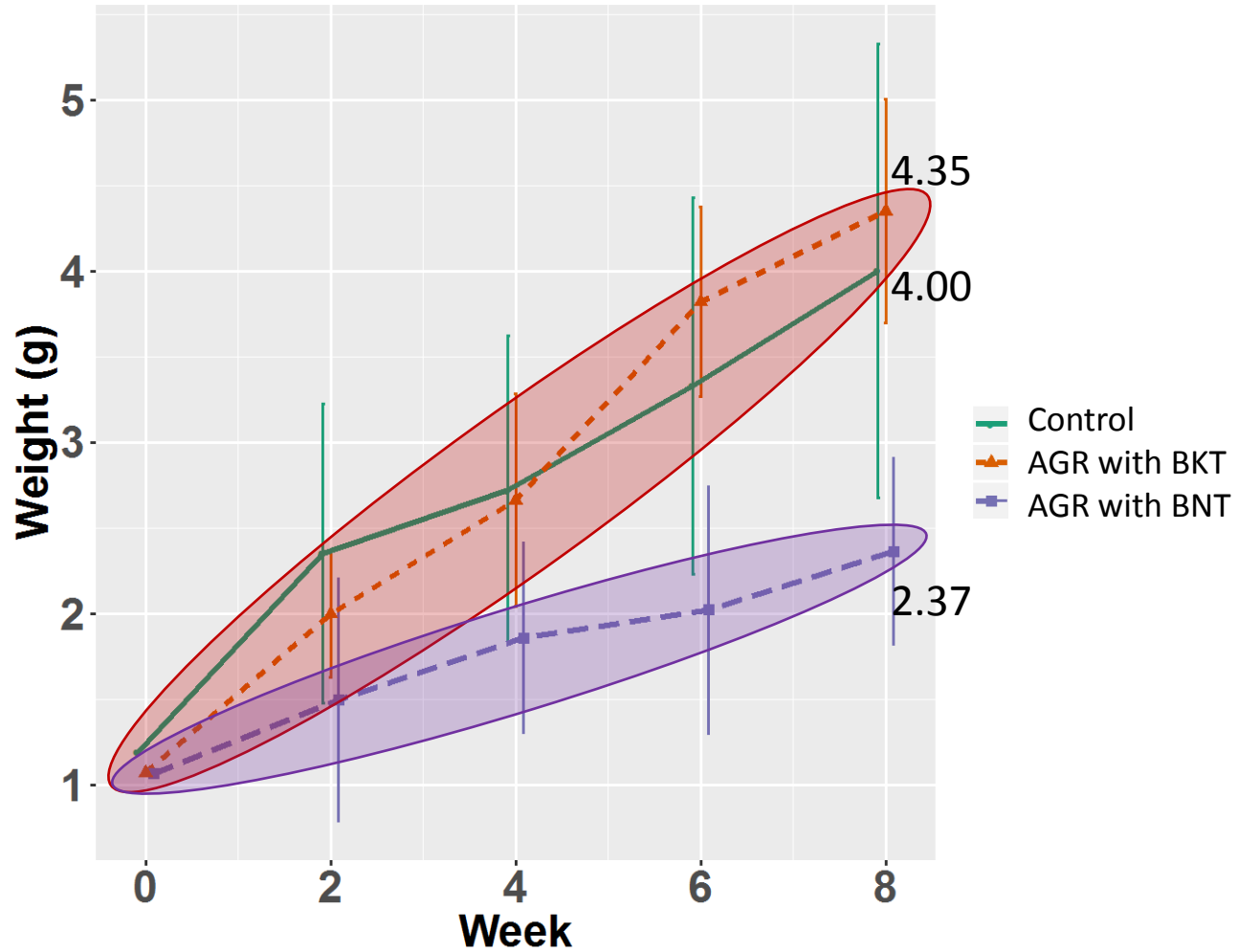
Study Design: Competition

- Three artificial streams
- Treatments:
 - Control (20 AGR)
 - BKT treatment (10 BKT, 10 AGR)
 - BNT treatment (10 BNT, 10 AGR)
- Two month trial, bi-weekly weighing
- Automatic feeding (surficial, drift)
- Trials recorded remotely via camera system
- Limited human presence (daily equipment checks)



Mean weight of AGR: Competition Trial

Mean \pm SD



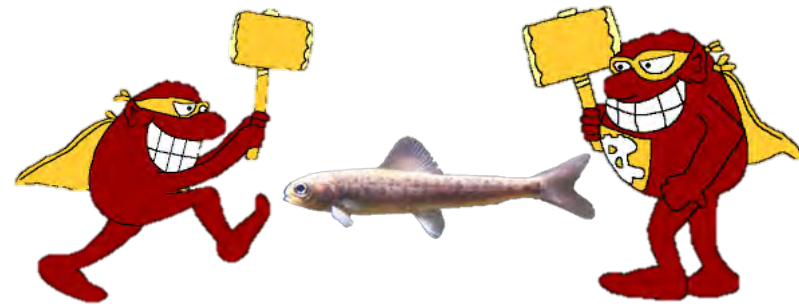
Preliminary Data

Competition

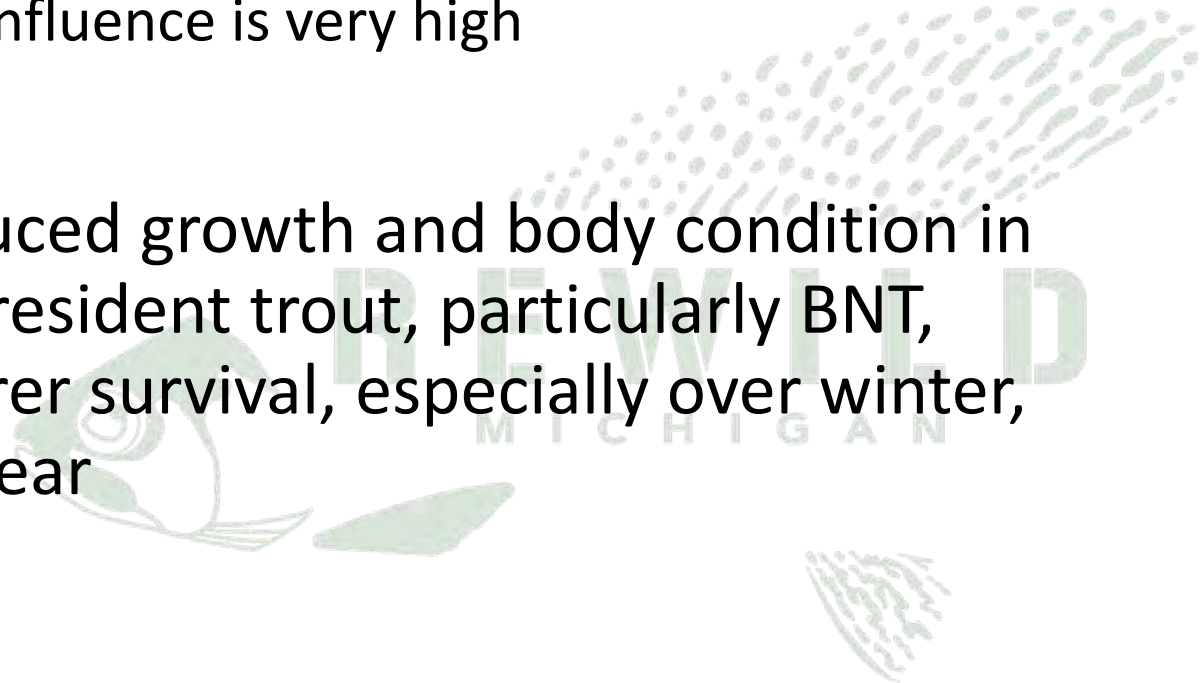
- Growth of AGR may not be affected by presence of BKT
- In presence of BNT, AGR growth was poor
 - Mean weights:
 - 4.35g AGR with BKT
 - 2.37g AGR with BNT
 - 60% mortality of AGR with BNT
- *Important: this is based on single, two month trial. These are very preliminary results. The additional years of research will increase our confidence in the data*



Summary



- AGR receive a “double whammy” in presence of BNT
 1. High predation rate that potentially continues across broader period of time
 2. Competition influence is very high
- Significantly reduced growth and body condition in the presence of resident trout, particularly BNT, may lead to poorer survival, especially over winter, during the first year



Summary

- BKT are a different story:
 - Age-1 BKT did prey upon AGR fry during predation trials but at a lower rate than BNT
 - Competition:
 - AGR and BKT seen schooling together regularly during daily lab checks
 - AGR growth may not be suppressed by the presence of BKT of the same age class





THERE IS HOPE!

- These initial trials provide critical insight and demonstrate the feasibility of the reintroduction.
- This research will help guide in targeting suitable communities in which Grayling can thrive.
- *But we do not have the whole story yet.*



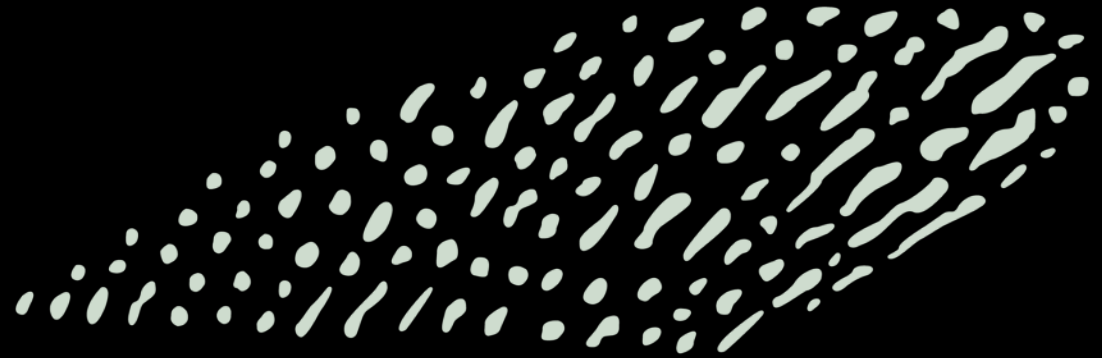
When? Where?

- We are still a few years off to see eggs in rivers.
 - Need UV sterilizer at Oden FH to start rearing.
 - Brood stock will need 4 years to reach maturity.
- Nominated MI rivers for potential reintroduction:
 - Maple
 - Upper Jordan
 - Boardman
 - Upper Manistee
- Nominations will continue to be reviewed

Nominations

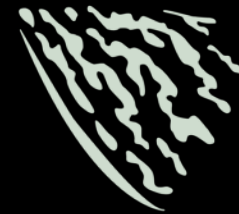
- If you are interested in nominating a stream, tributary, etc:
 - Community support is key
 - Think about the fish community
 - Is it likely to support a successful Grayling reintroduction?

You Can Help!



REWILD

M I C H I G A N



www.rewildmichigan.org

Other ways to help

- Video analysis
- Financial support
- Grayling Guard
- Historic MI AGR mounts
- Historic pictures or information





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and all the others who have helped to make this project a reality





QUESTIONS?

Chena River, near Fairbanks, AK