Lab Testing Results from Live Fish Trials with the New Tiny V3D Predation Tag

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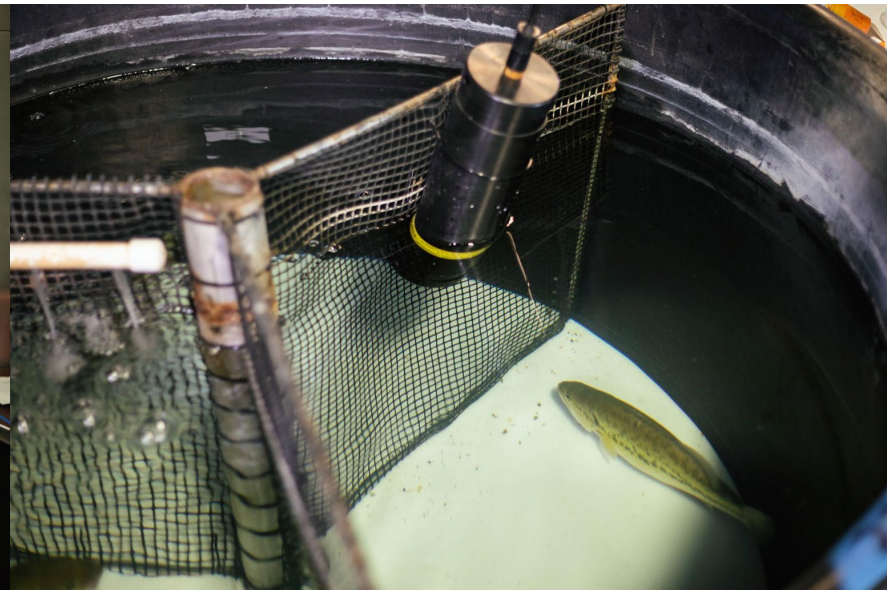

Biotelemetry PWT

Date: Feb. 2, 2022

Overview

- Background
- Research Questions
- Methods
- Results
- Looking Forward

V3D Transmitter Overview

- Polymer trigger mechanism
- Reactive w/ stomach acids
- Untriggered vs Triggered

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V3D Trigger Mechanism

Research Questions

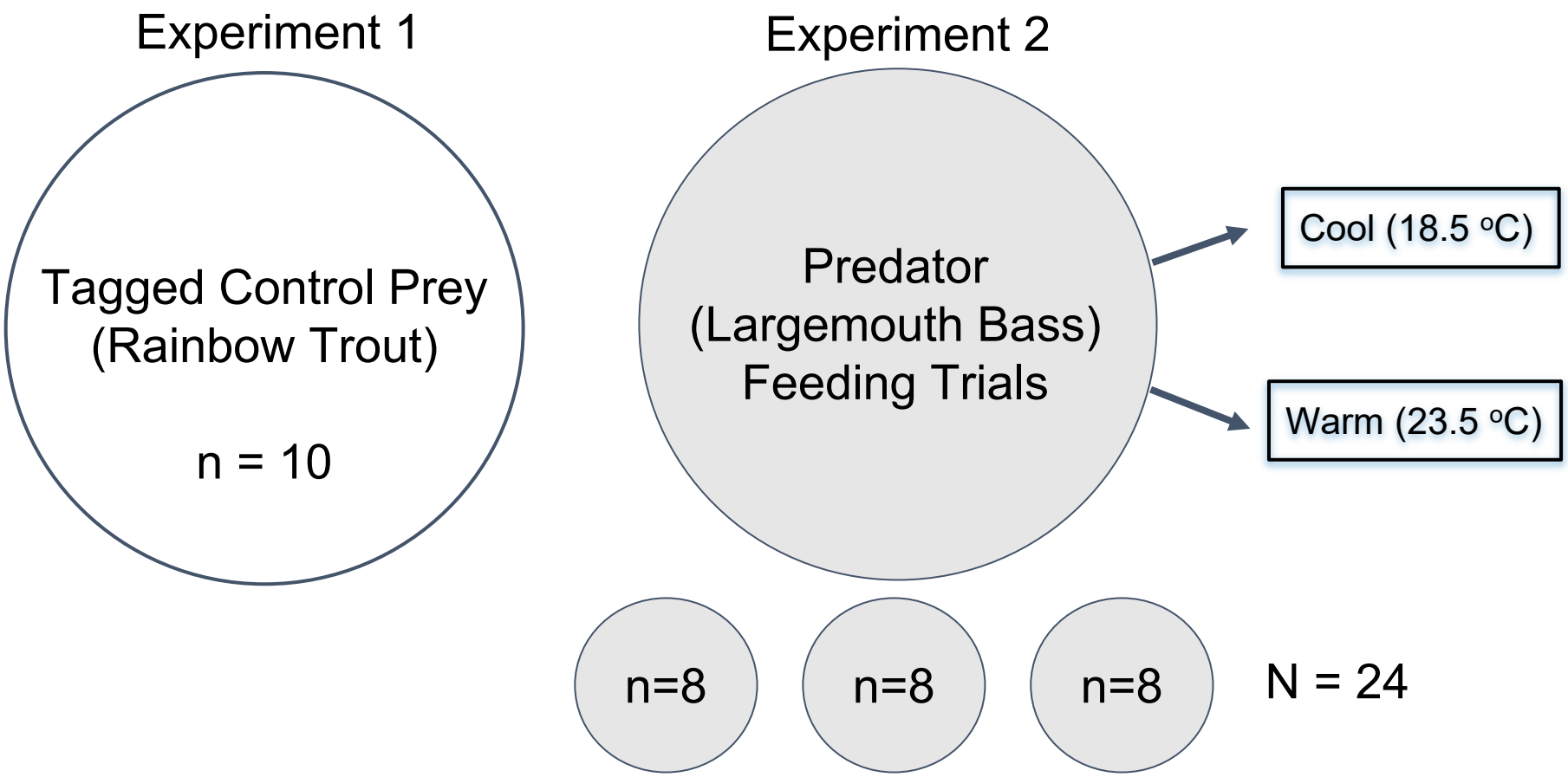
Objectives:

- Assess false trigger rate in control-tagged *O. mykiss*
- Quantify performance metrics on the novel transmitters' corrosive trigger
- Measure efficacy of corrosive trigger during a predation event
- Determine trigger and tag expulsion metrics at two temperature regimes (cool, warm)

Research Questions

- Do transmitters trigger without a predation event (i.e. false positive, trigger in prey/subject spp.)?
- Do transmitters trigger when consumed (i.e. false negative, predation w/o trigger) ?
- What effect does temperature have on the trigger times of the V3D transmitters?
- Are the tags retained by predators long enough to detect a predation event?

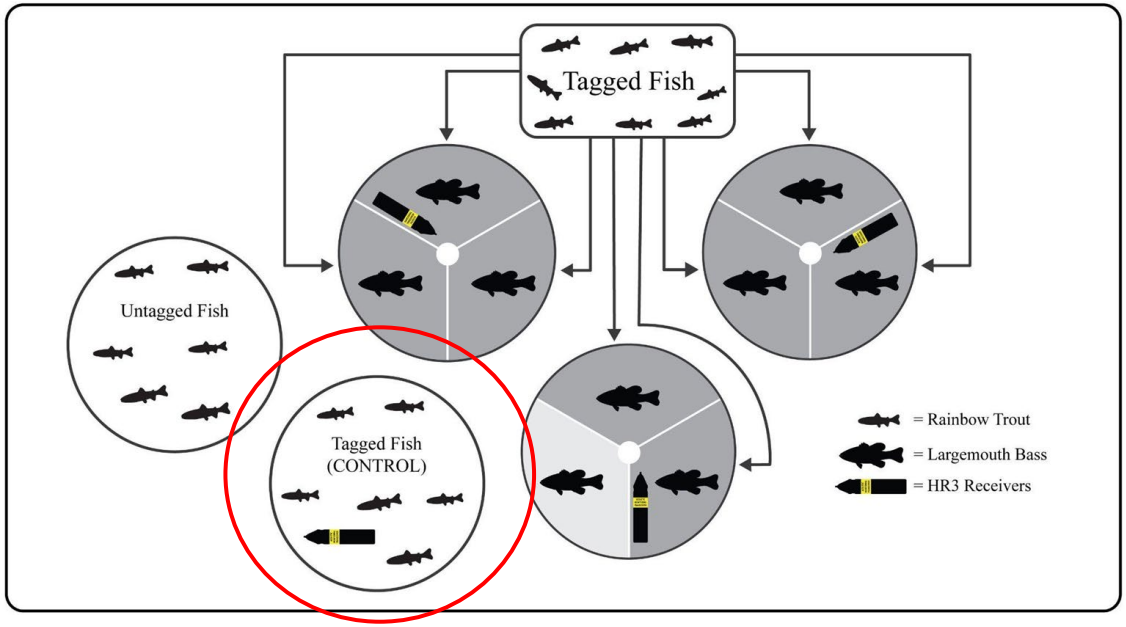
Methods


Experiment 1
Tagged Control Prey
(Rainbow Trout)
n = 10
Experiment 2
Predator
(Largemouth Bass)
Feeding Trials
Cool (18.5 °C)
Warm (23.5 °C)
n=8
n=8
n=8
N = 24

Methods

Tagged Control Group

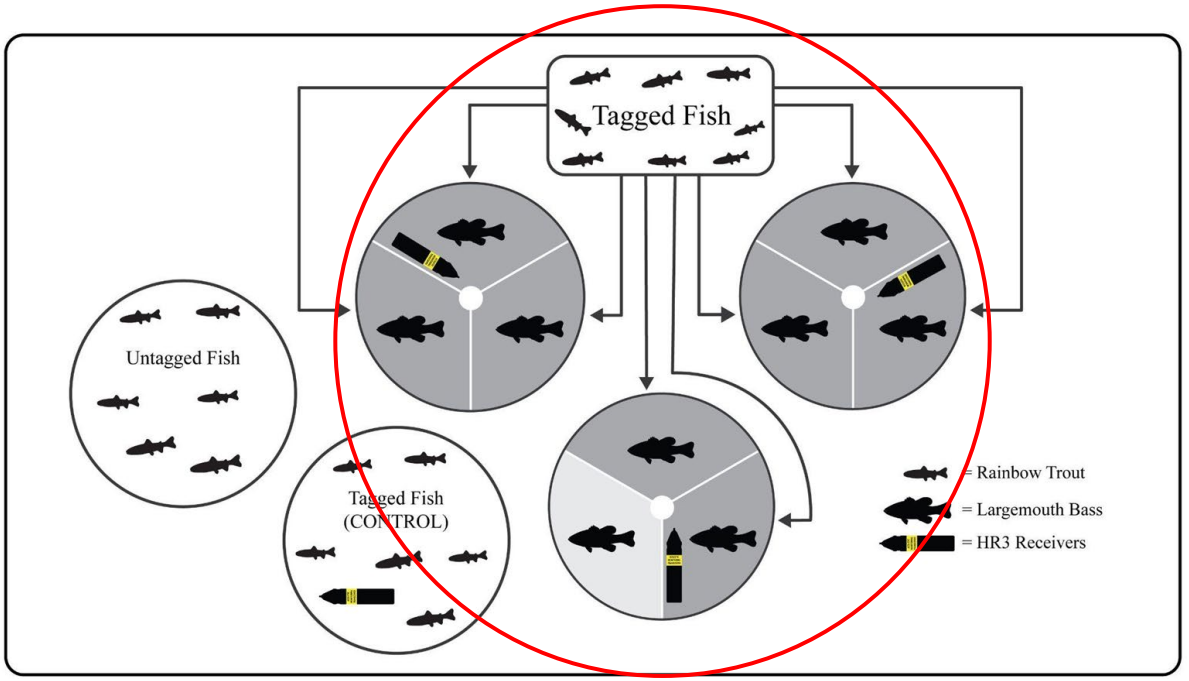
- Rainbow trout (prey)
- n = 10
- Acoustically tagged w/ (Innovasea V3D)
- 307 kHz, 4x15mm, 0.33g in air
- ~ 100 mm or smolt size
- Held at 18.5 ^{o}C, 21 days



Methods

Predator Feeding Trials

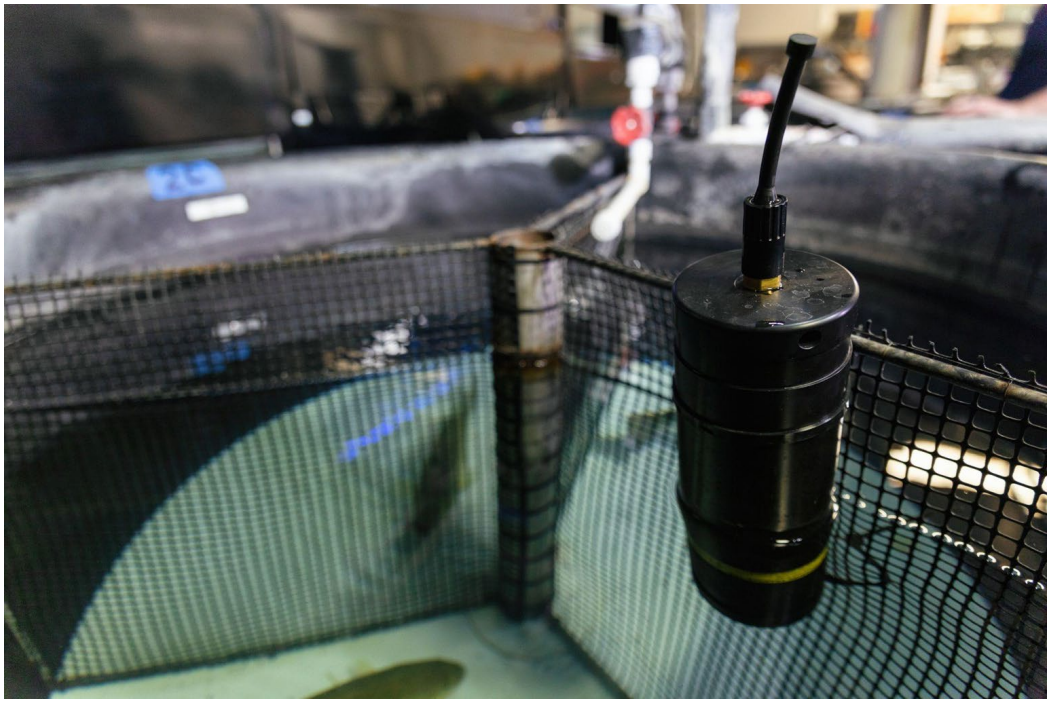
- Largemouth Bass x Rainbow Trout
- 3 replicates
- 8 feedings/trial
- Cool (18.5 ^{o}C)
- Warm (23.5 ^{o}C)
- n = 24 feedings/temp.
- N = 48 feedings total



Methods

Temperature Regimes

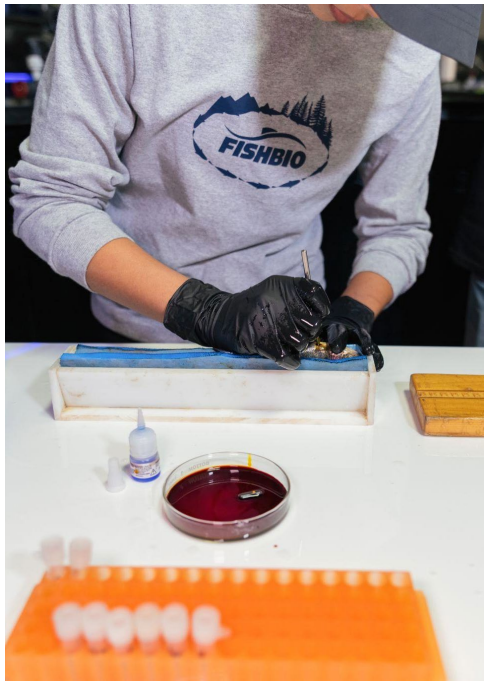
- Mean 18.5^{o}C and 23.5^{o}C
- HOBO temperature loggers



Methods

- Predator FL (mm), Weight (g) prior to each feeding trial (warm and cold water)
- Prey FL (mm), Weight (g) prior to tagging

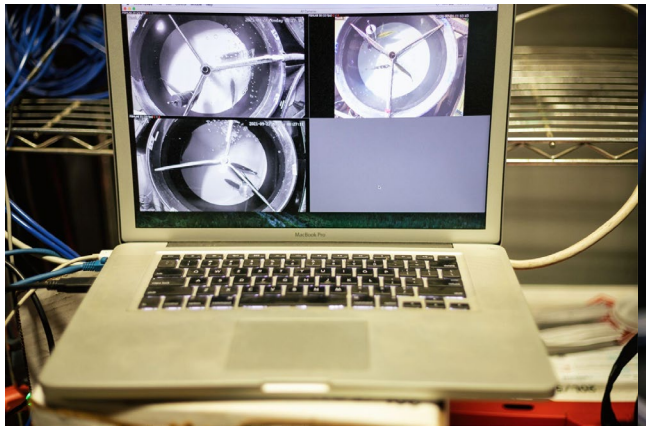
Methods



- Anesthetized (Alka Seltzer Gold)
- Surgically implanted activated, sanitized (betadine) transmitter
- Closed using surgical adhesive (3M Vetbond)
- Confirm activation of transmitter

Methods

- Predation, evacuation, and trigger events recorded
- 24 hr infrared video observation
- Fathom Software (Innovasea, Nova Scotia,CA)
- Statistical analysis (package “stats”; R Core Team 2021)
- Normality test, Welch’s t-test, Wilcoxon Rank-Sum test, Linear Regression



Results

General Summary

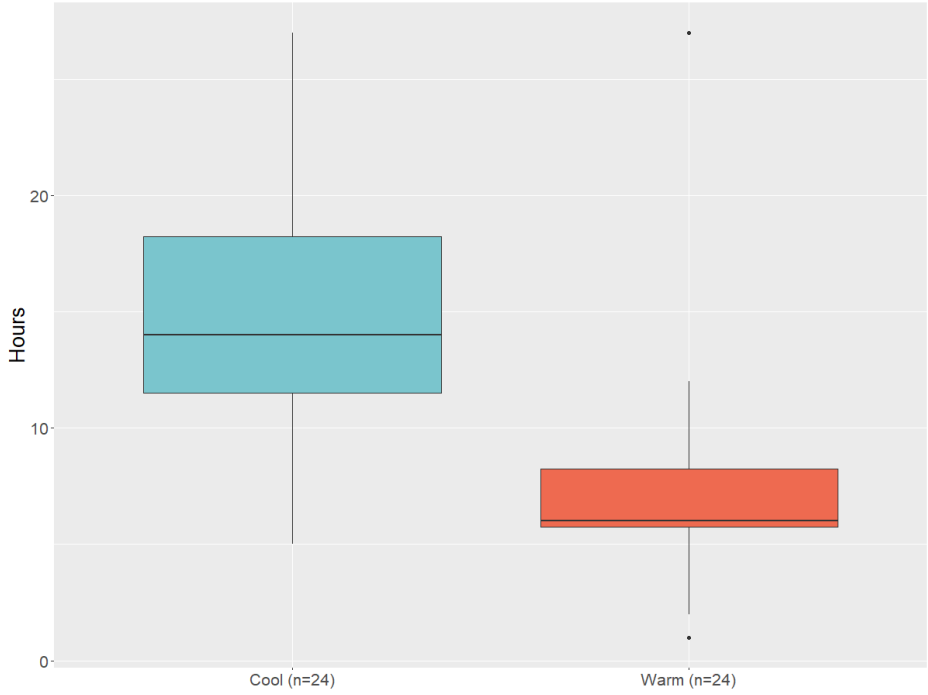
- No triggers in tagged control
  - Observed slight trigger erosion in control tag triggers

- 100% trigger rate in all predator feeding trials
  - 96% of tags triggered within 24 hours
  - All tags triggered before evacuation from predators
  - Expulsion times varied widely between trials
  - Most tags were expelled within 200 hours after consumption

Results

Predator Feeding Trials

- Predation to trigger (hours)
- Cool trial – 18.5 ^{o}C
- Warm trial – 23.5 ^{o}C
- Median cool: 14 h (IQR: 11.50-18.25 h)
- Median warm: 6 hours (IQR 5.75-8.25 h)
- Statistical difference

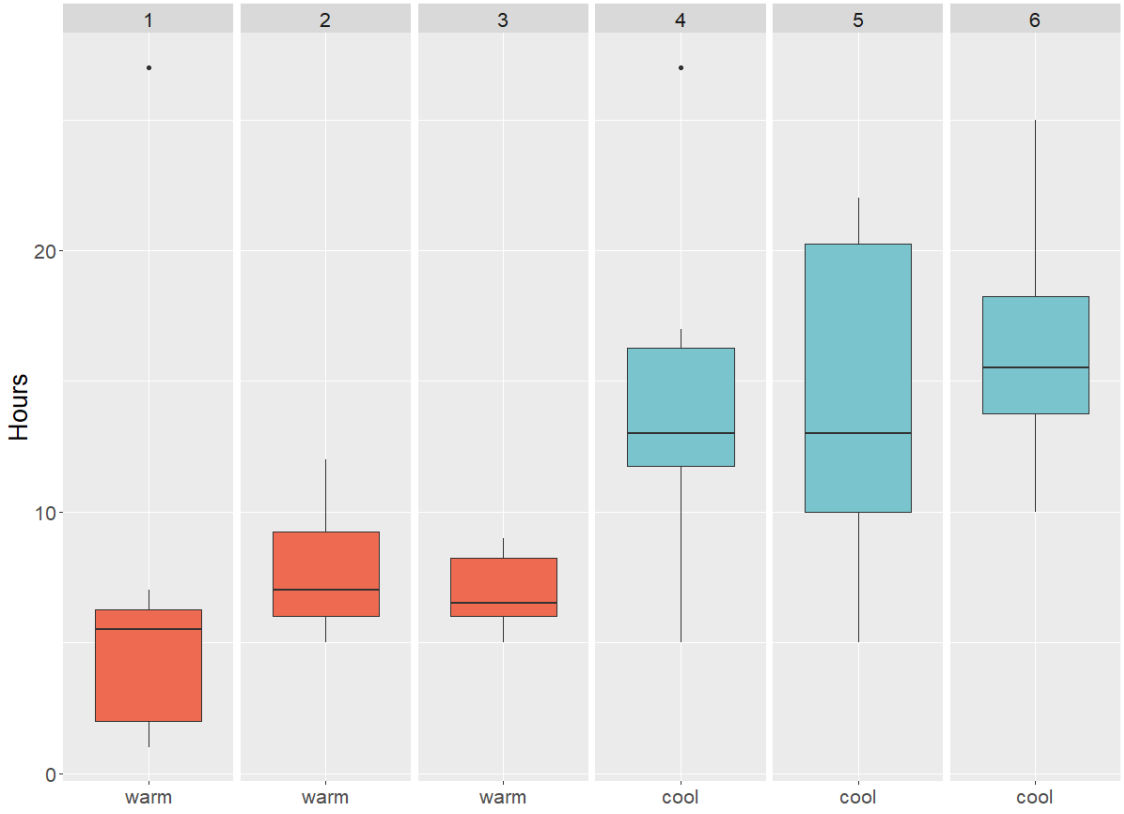


Wilcoxon Rank-Sum; $p < 0.001$

Results

Predator Feeding Trials

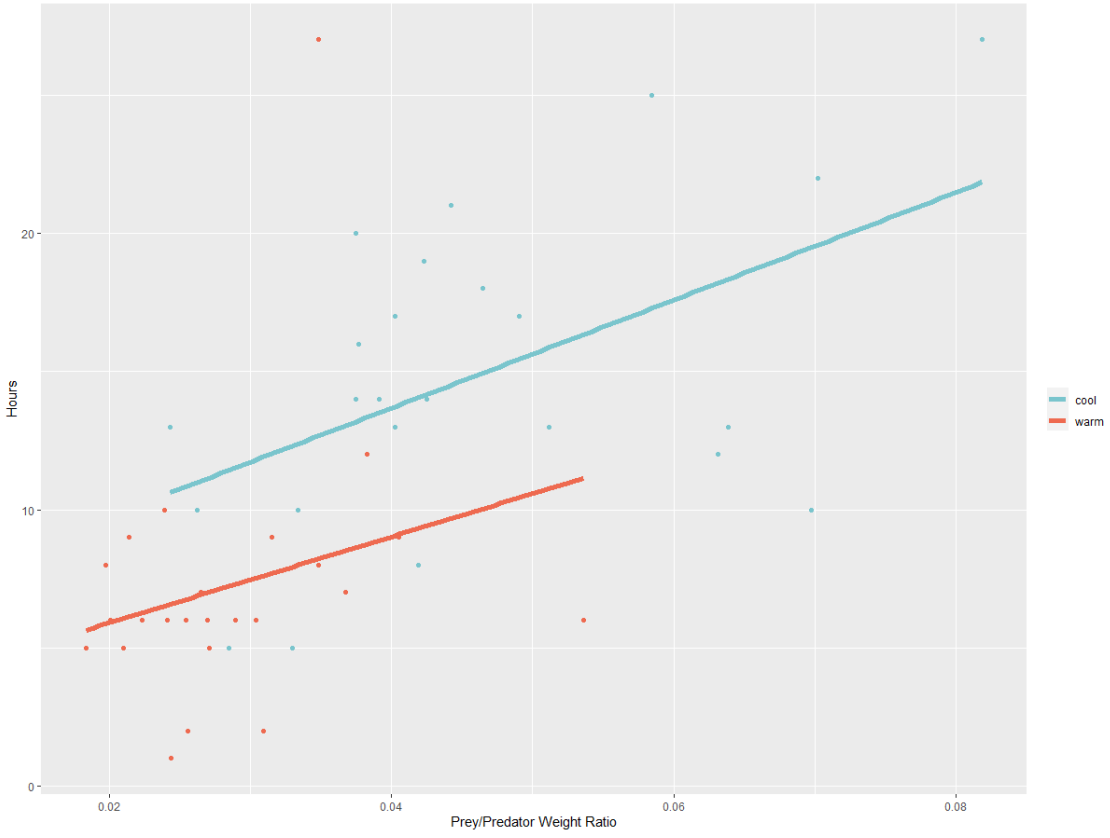
- Trigger time (hours)
- Individual trials
- Cool trial – 18.5 ^{o}C
- Warm trial – 23.5 ^{o}C
- n = 8 per boxplot



Results

Predator- Prey Mass/ Trigger Time

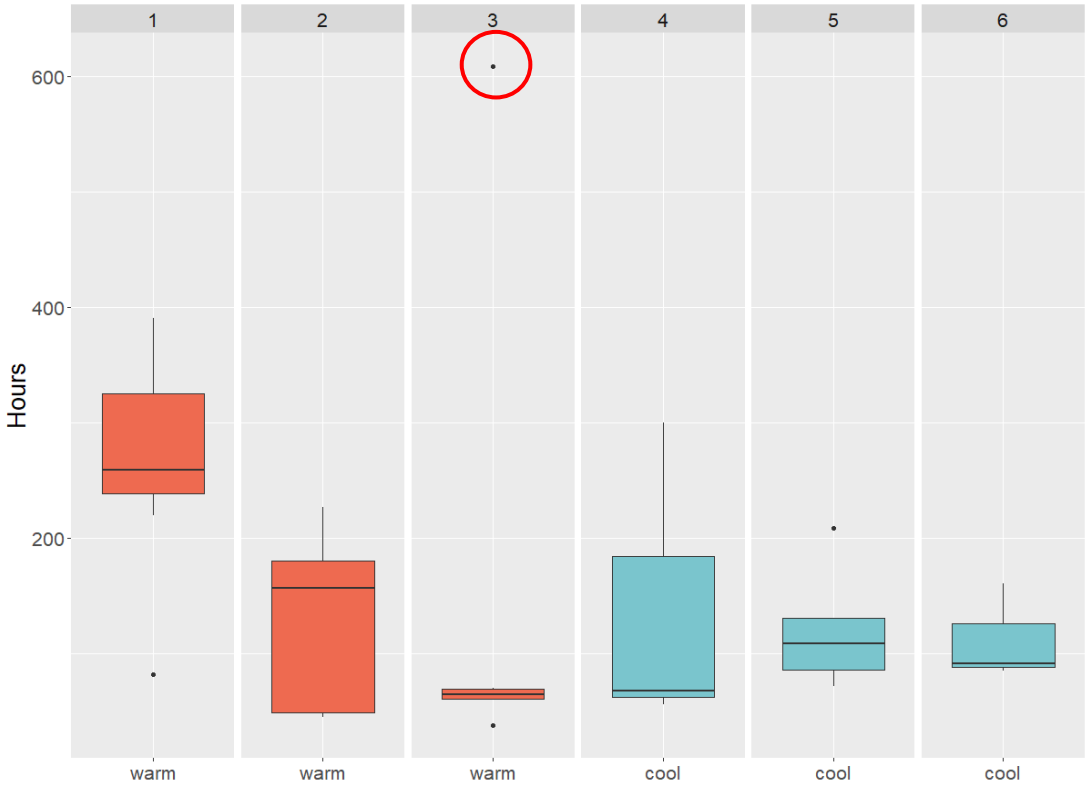
- Time in hours
- n = 24 per temp regime
- Cool trial – 18.5 ^{o}C
  - slope = 195.2
  - intercept = 5.9
  - *P*-value = 0.01*
  - R^2 = 0.26
- Warm trial – 23.5 ^{o}C
  - slope = 155.8
  - intercept = 2.8
  - *P-value* = 0.22



Results

Predator V3D Retention

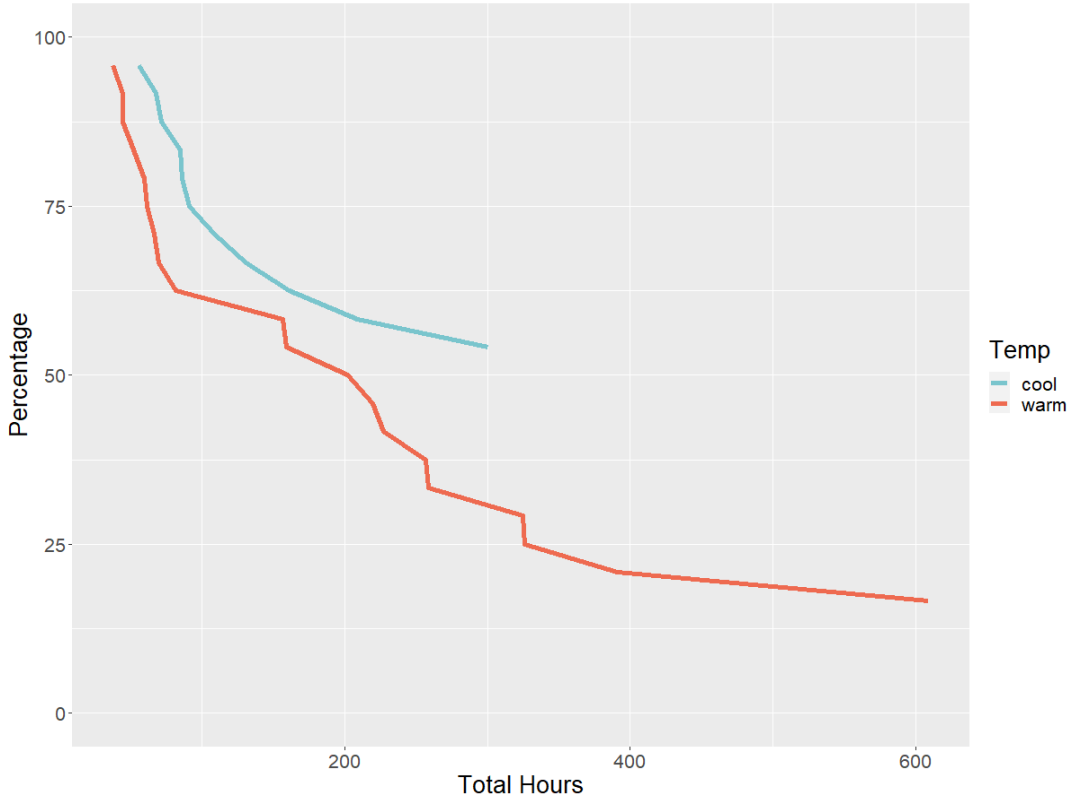
- 66.7% tag expulsion
- Regurgitation ~ 1 week (median = 162.0 h)
- Defecation ~ 1 week (median = 164.8 h)
- Range 38-600 h
- Not all tags expelled by study conclusion



Results

Predator V3D retention

- Decay curve of retained V3D/time
- warm, n = 20/24
- cool, n = 12/24
- Warm ~ 25% retention at 300 h
- Cool ~ 60% at 300 h
- 60.4 % retention (warm/cool) > 48 h



Summary

- No false positives observed
- No false negatives observed
- Apparent temperature effect (metabolic influence)
- Trigger times increased with pred./prey size relationship
- Predator V3D retention ~ 1 week (* tested feeding rate, temps.)

Looking forward

- Applications
  - Passage Structure Monitoring (weirs, screens, pumps)
  - High density array monitoring (reach scale, multi-D studies, forebays and spillways)
  - Spp. less mobile, high fidelity, small home range
- Pilot mesocosm study in uncontrolled environment
  - Striper, black bass, native pikeminnow, catfish
  - Behavior, homerange, array density
  - Predator detection probability  + Probability of a predation event
- Additional studies at colder temperatures regimes (e.g. CV salmonid smolt)

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