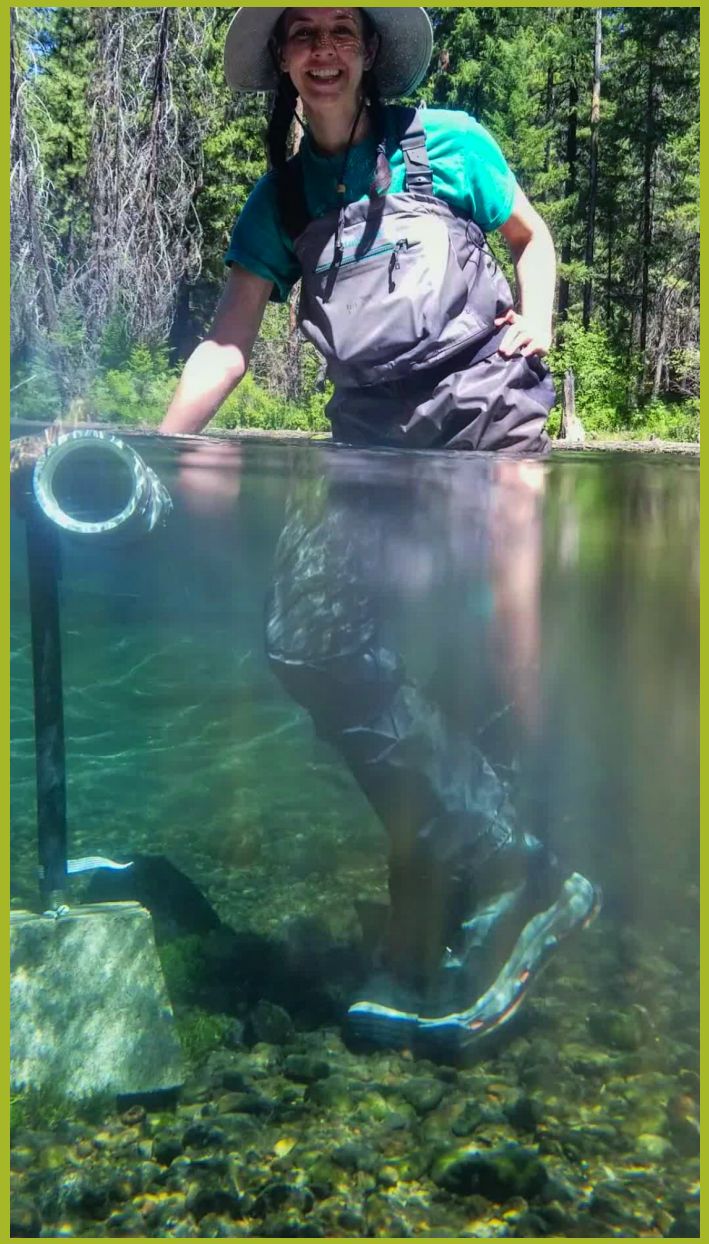


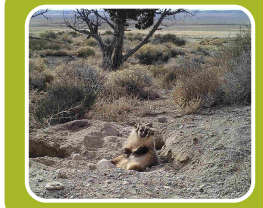
UNDERWATER CAMERA SYSTEMS

A DIY design for field research in freshwater systems

Introduction

Remote cameras are a useful tool for terrestrial and aquatic research

1. Non-invasive
2. Non-lethal
3. Observe species in their natural setting



First documentation of badger burying carcass four times its weight.

Monitoring salmon populations migrating past dams to spawning habitat.

Estimate endangered shark populations in protected and non-protected habitat.

Presence and dispersal of rare Sierra Nevada red fox.

Introduction

Terrestrial Remote Cameras

1. Widely available
2. Variety of models
3. Low-cost
4. Long battery life

Underwater Remote Cameras

1. Few model options
2. Many require tethers
3. High-cost
4. Limited battery life

Waterproof Action Cameras

1. Widely available
2. Memory capacity limits
3. Low-cost
4. Short battery life

Images: Q13 Fox, UW Photography, Amazon

Introduction

Recording video underwater has other challenges

- Complex backgrounds
- Water clarity
- Debris
- Light conditions

Introduction

Aquatic research would benefit from an accessible, low-cost solution for underwater observations

A DIY design has the potential to alleviate some underwater recording challenges by:

1. Building camera housing with accessible materials
2. Requiring only basic power-tool knowledge for construction
3. Utilizing low-cost, non-technical camera equipment
4. Improving battery life and high capacity memory card to increase recording time

How to build a low-cost underwater camera housing for aquatic research

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Abstract

Remote cameras are an increasingly important tool in field-based biological research. Terrestrial researchers can purchase inexpensive off-the-shelf cameras, but aquatic researchers face challenges in adopting similar systems for underwater science. Although technology allows researchers to deploy cameras in any aquatic environment, high procurement costs are often a barrier, particularly for studies that require the collection of lengthy videos. In this note, we provide a detailed guide

Introduction

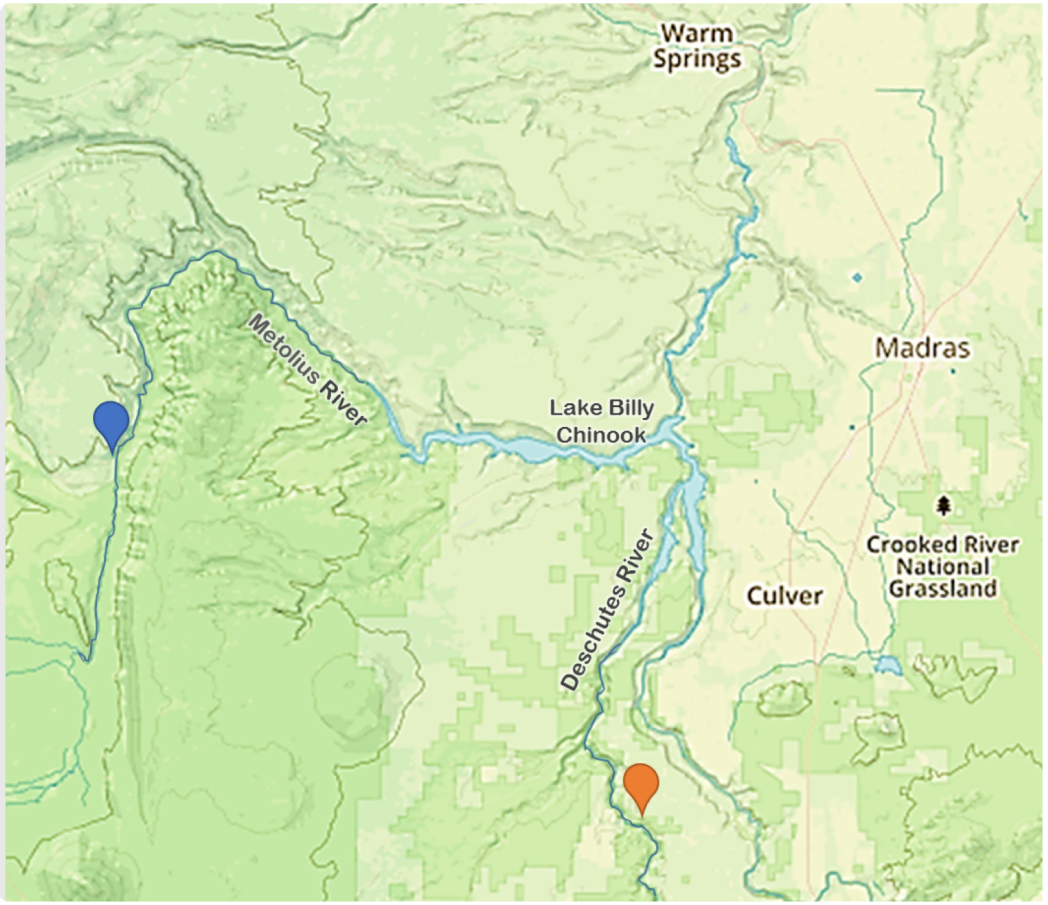
To study the viability of utilizing a DIY marine design for freshwater observations, three underwater camera systems were constructed and deployed in two rivers of differing water clarity.

Q1. Is this DIY design viable for freshwater research?

In addition, researchers need a foundation for what is observable within the video frame in order to determine the system's usefulness.

Q2. Are there differences in fish identification with differing water clarity and light conditions?

Study Areas



Metolius River

- Near Candle Creek
- Clear water clarity

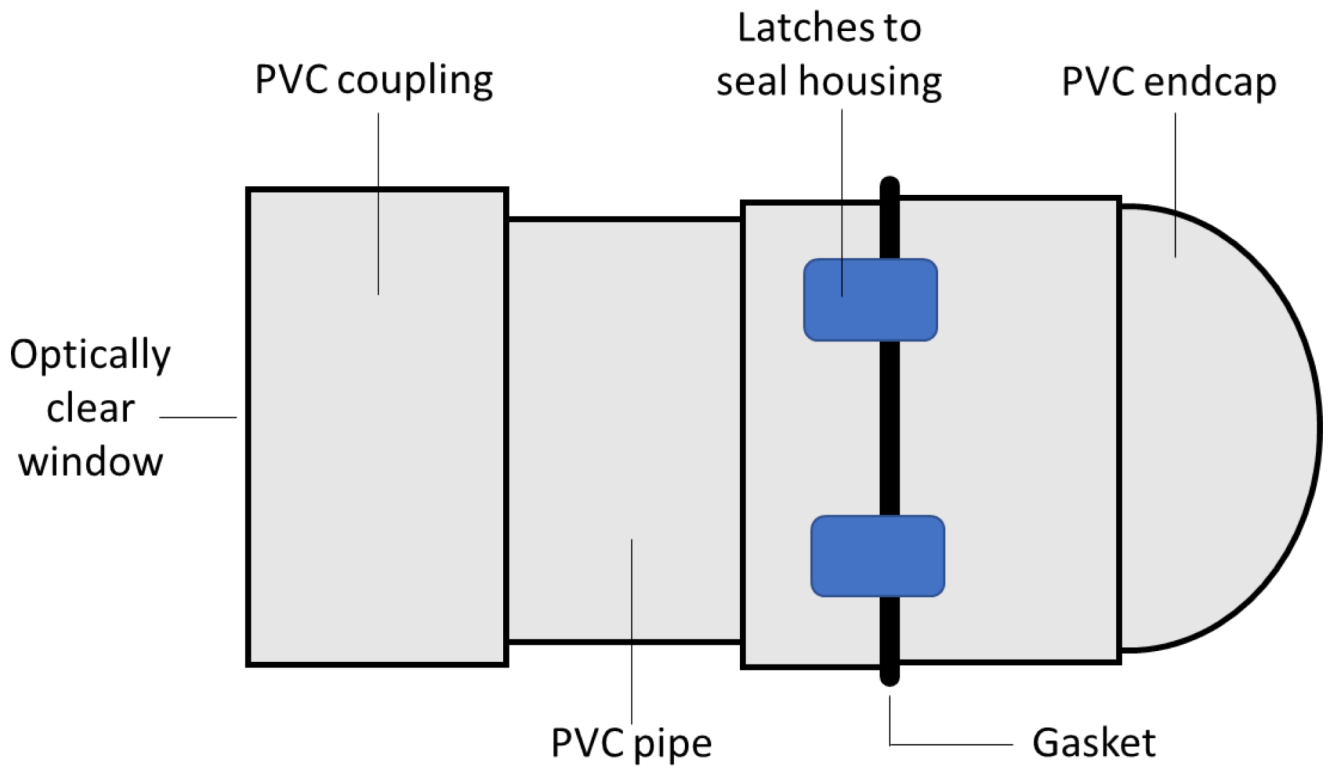
Deschutes River

- Middle Deschutes
- Near Crooked River Ranch
- Turbid water clarity

Methods

Camera Housing Construction

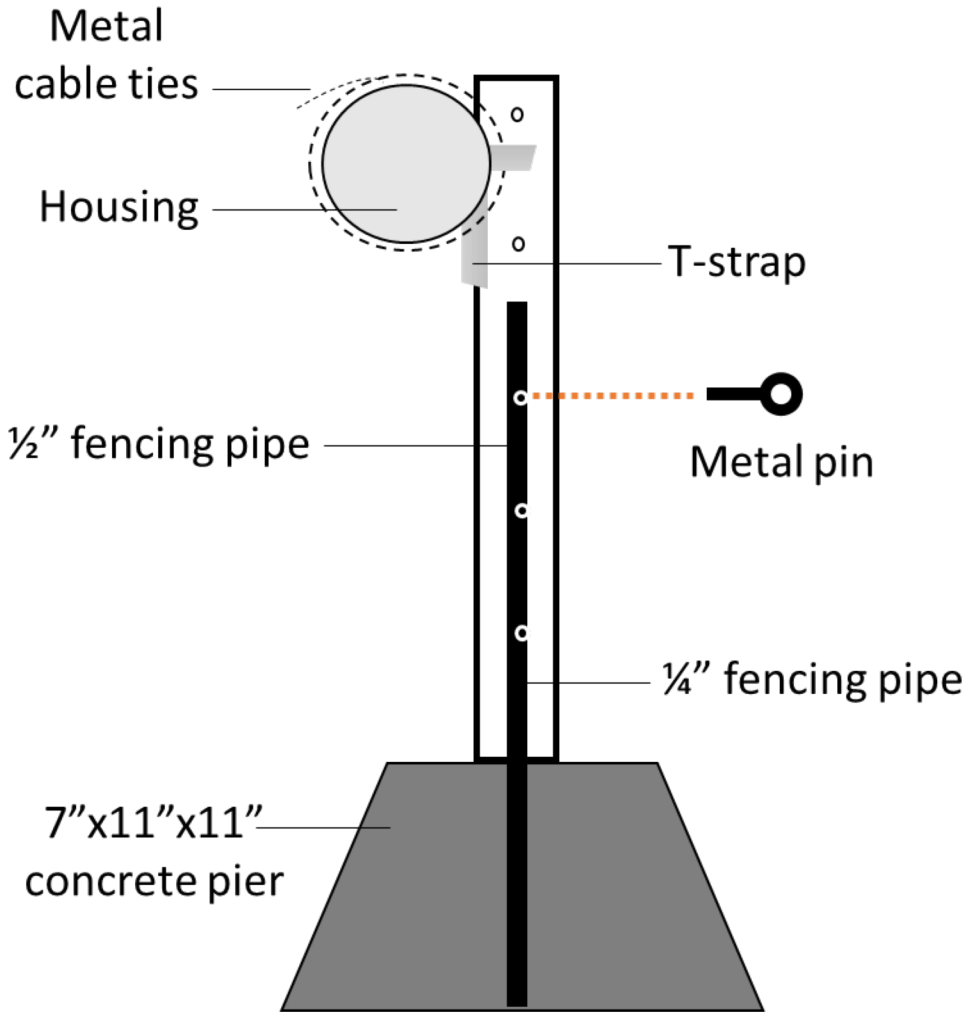
- Main components:
  - Body
  - Endcap
  - Window
- Materials
  - PVC
  - Optically clear acrylics
  - Marine sealant, epoxy
- Tools
  - Miter saw
  - Drill



Methods

Anchor Construction

- Two main components:
  - Concrete block with rod
  - Metal pipe
- Materials
  - Concrete deck pier
  - Metal piping
  - Metal cable ties, T-strap
- Tools
  - Drill press
  - Drill



Methods

Equipment

- GoPro Hero5 Session
- 128GB Samsung Evo Select memory card
- 22,000mAh RavPower external battery

Images: Amazon.com

Putting it together

Housing

Camera Equipment

Anchor

Underwater Camera System

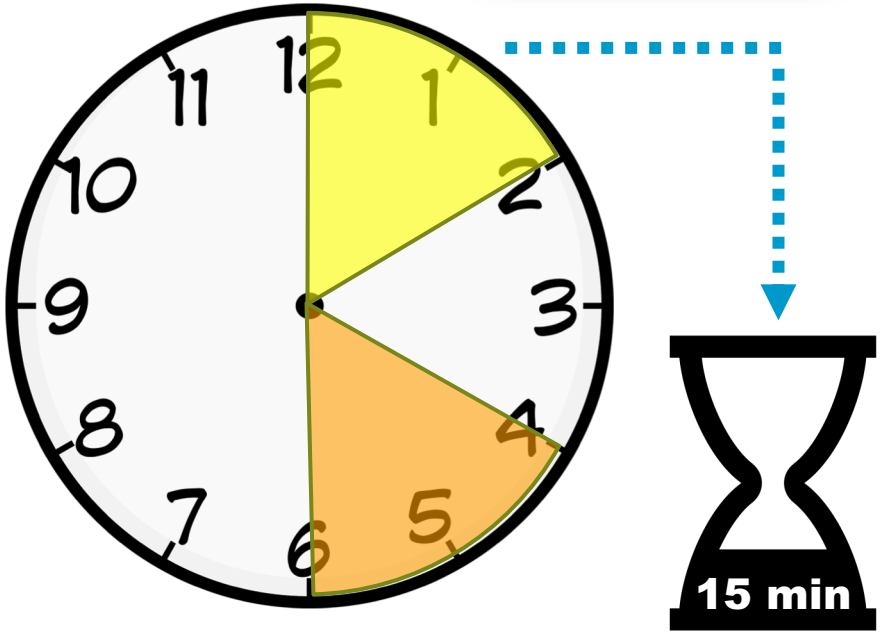
Methods

Deployment

- Underwater camera systems hiked into study areas
- Submerged for three days in clear and turbid rivers
- Each camera continuously recorded video until meeting memory capacity

Video Observation

- Two sample windows studied:
  - 12:00 - 2:00pm (Full sun)
  - 4:00 - 6:00pm (Part Sun)
- Sample videos watched in 15 minute increments
- Categorized and recorded individuals within video frame using definitions



Methods

Species Definitions

MOSTLY VISIBLE

Individuals are categorized by species. To define each individual with some degree of confidence, the subject must display at least three of the four listed characteristics listed below. Juveniles, however, are defined by one characteristic.

Rainbow Trout:	**Brown Trout:**	**Bull Trout:**
pink lateral line	no pink lateral line	no pink lateral line
black spots	black/red spots + halos	light colored spots
green dorsal	brown, golden body	brown, golden body
truncate tail	truncate tail	truncate tail

Whitefish:	**Large-scale Sucker:**	**Kokanee (spawning colors):**
silver/bronze body	gray/white body	green body
large scales	distinct color separation	red head
small white mouth	large scales	large upturned mouth
forked tail	forked tail	truncate tail

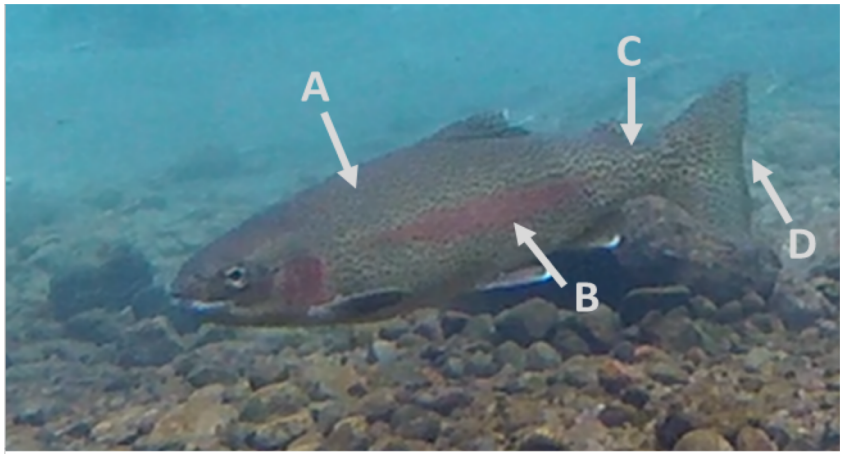
Juvenile:
parr marks

PARTIALLY VISIBLE

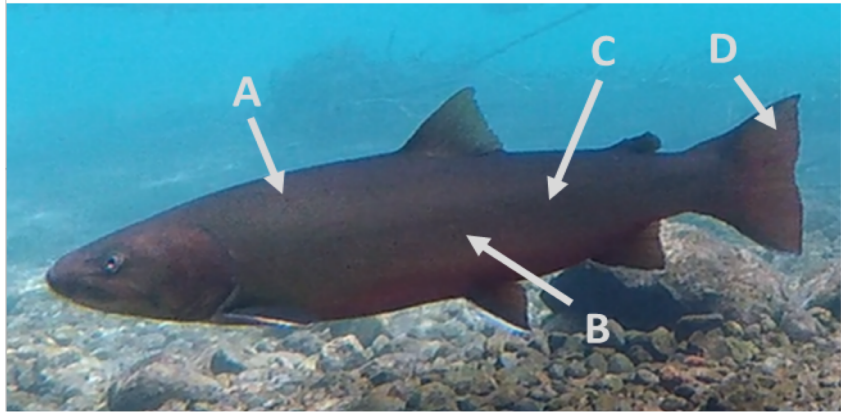
Fish may not always be completely visible within the frame. In this case, fish are categorized by the characteristics below.

Partial fish:	**Unknown foreground:**	**Unknown background:**
only fin	only 2 characteristics	oval shape shadow
only tail	moves against current	moves against current
only head		

Examples

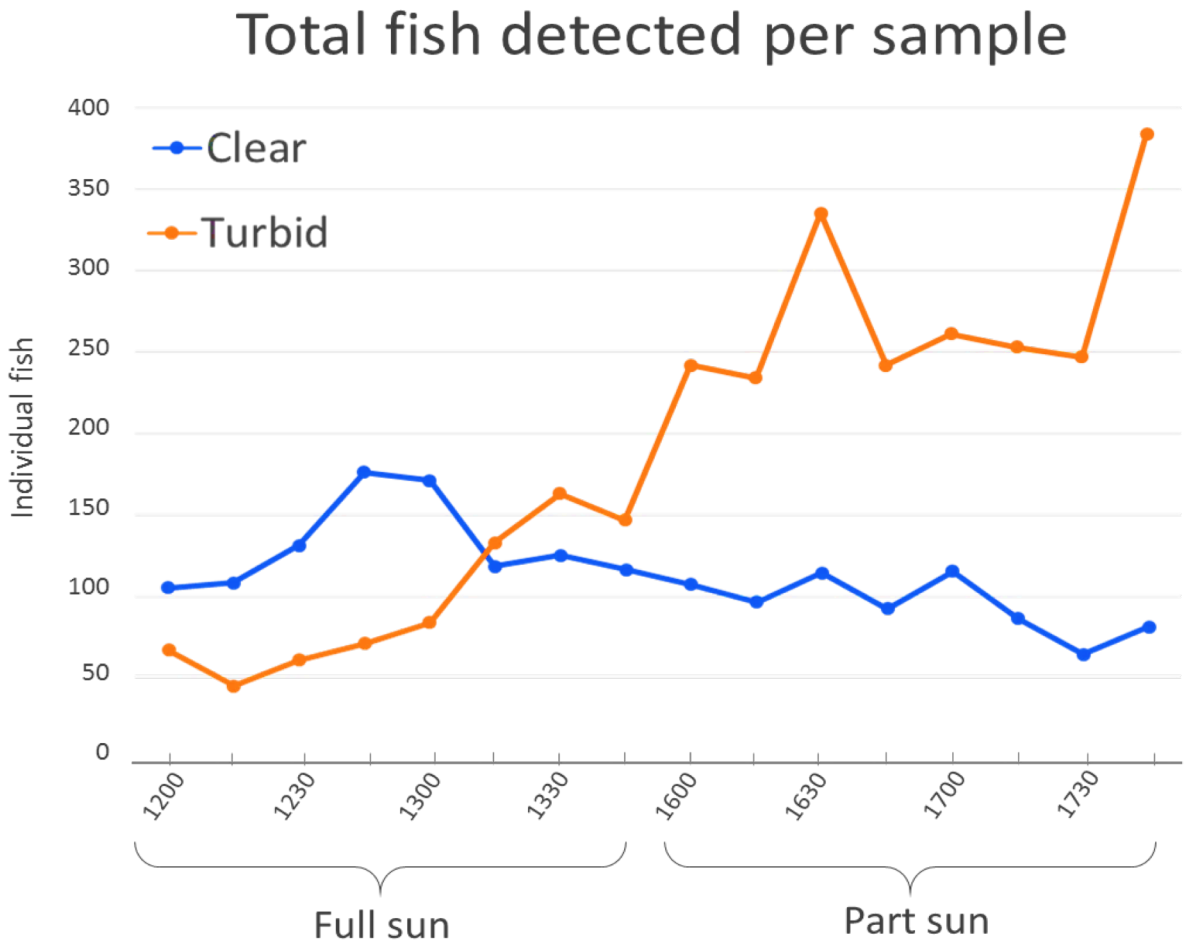


Top: A-green dorsal, B-pink lateral line, C-black spots, D-truncate tail
Bottom: A-brown body, B-light spots, C-no pink lateral line, D-truncate tail

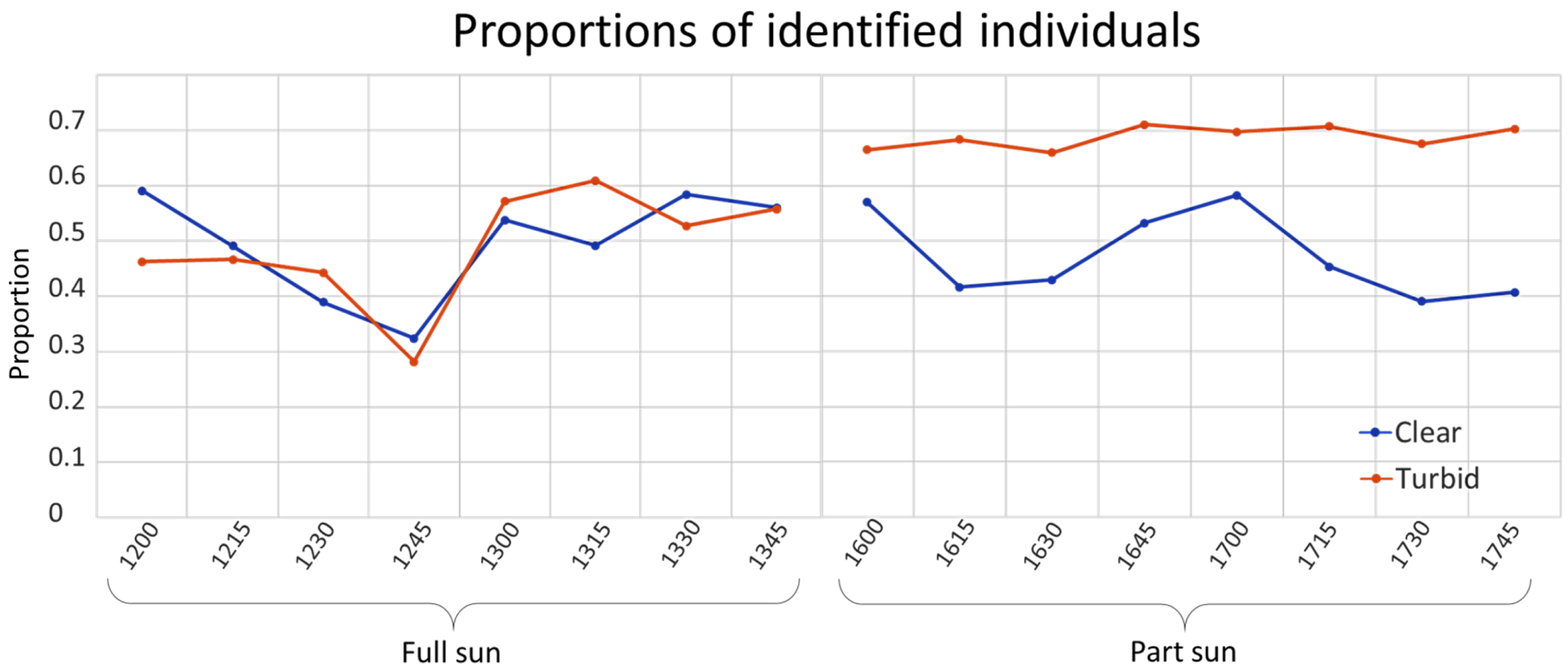


Results

- 200+ total hours of video recorded
  - 72 hours observed
- 288 total observations
  - 4774 total fish detected
- Observable fish reduced by camera focal length
  - Metolius: 5-10 feet
  - Deschutes: 3-5 feet



Results


Proportions of identified individuals
Proportion
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1200
1215
1230
1245
1300
1315
1330
1345
1600
1615
1630
1645
1700
1715
1730
1745
Clear
Turbid
Full sun
Part sun

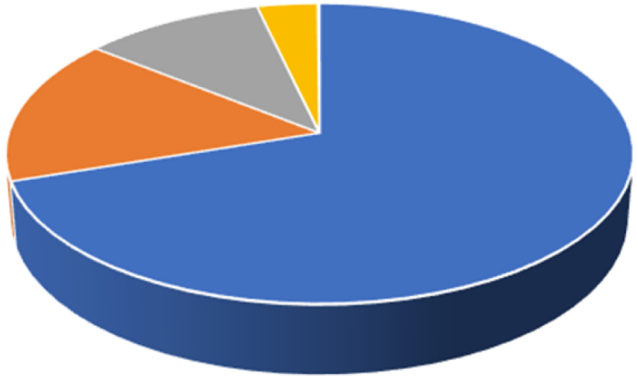
Results

Species Composition

- Whitefish most abundant
- Native and non-native differences
- More species observed in the Deschutes

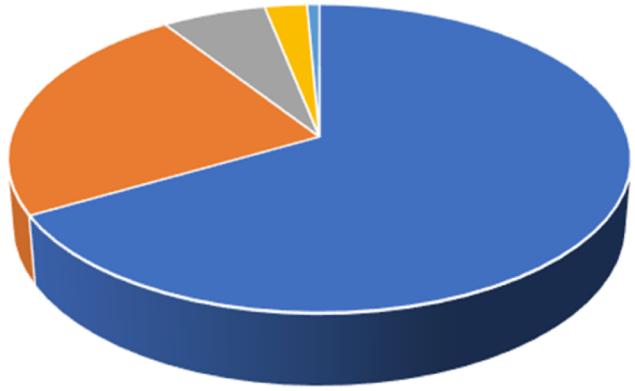
Metolius River

- Whitefish 69.9%
- Juveniles 15.8%
- Rainbow trout 10.6%
- Bull trout 3.5%
- Brown trout 0.1%



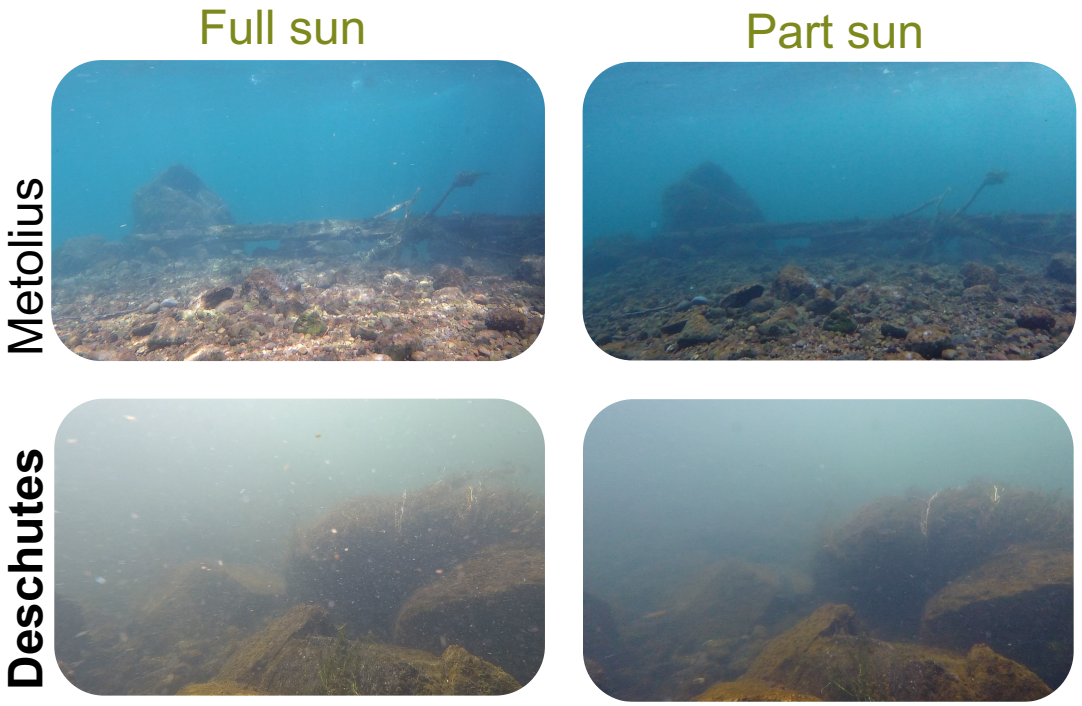
Deschutes River

- Whitefish 66.9%
- Juveniles 23.6%
- Brown trout 6.2%
- Rainbow trout 2.5%
- Other 0.7%



Discussion

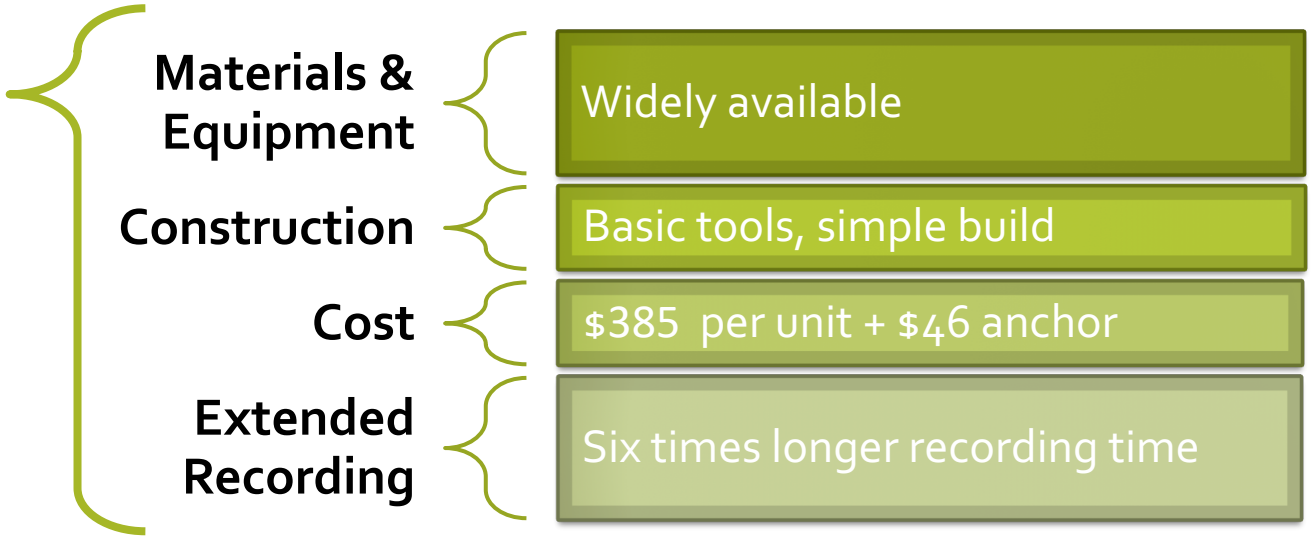
- Water clarity
  - Turbidity may not severely hinder observations until threshold
  - Focal length reduced with turbidity
- Light conditions
  - Limits observable details
  - Revealed fish activity differences



Discussion

Is the underwater camera system a viable and accessible solution for freshwater research?

- No system failure/malfunction
- Capable of recording long lengths of video
- Improved Accessibility



Discussion

Monitor habitat above and below beaver-dam analogs

Estimate or survey trout populations

Monitor restoration projects: dam removal, habitat for Oregon spotted frog

What about the fish videos????

Questions?

- Want a copy of Wild Things? Email me and I'll send a link.
    - zamarrie@oregonstate.edu
- Whitefish Crash Courses for ODFW can be viewed on Instagram
- Species, behavior and other interesting tidbits can be viewed on YouTube