Fish Passage in Montana Culverts: Phase II – Passage Goals

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MDT serving you with pride

Issues Known to Impact Fish Passage through Culverts

- Drop Height
- Excessive Velocity
- Lack of Plunge Pool
- Shallow Flow

We also know these things can change with time.

1.1 m/sec

2.8 m/sec

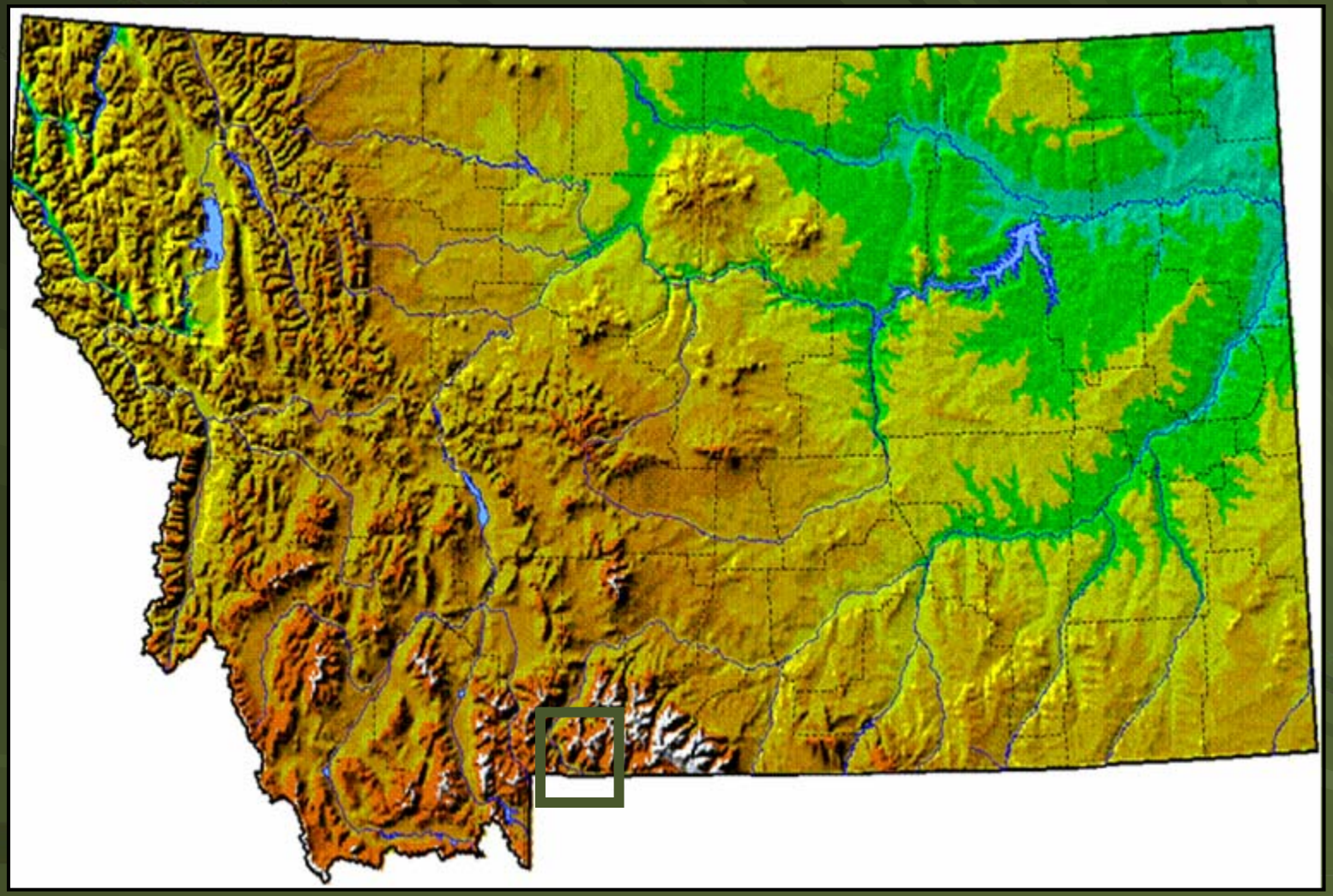
What we don't know...

- Are there probability based goals for fish passage that are better than goals based on absolutes?
- Are there stream connectivity goals that can be realistically met?

Our Fish Passage Field Study

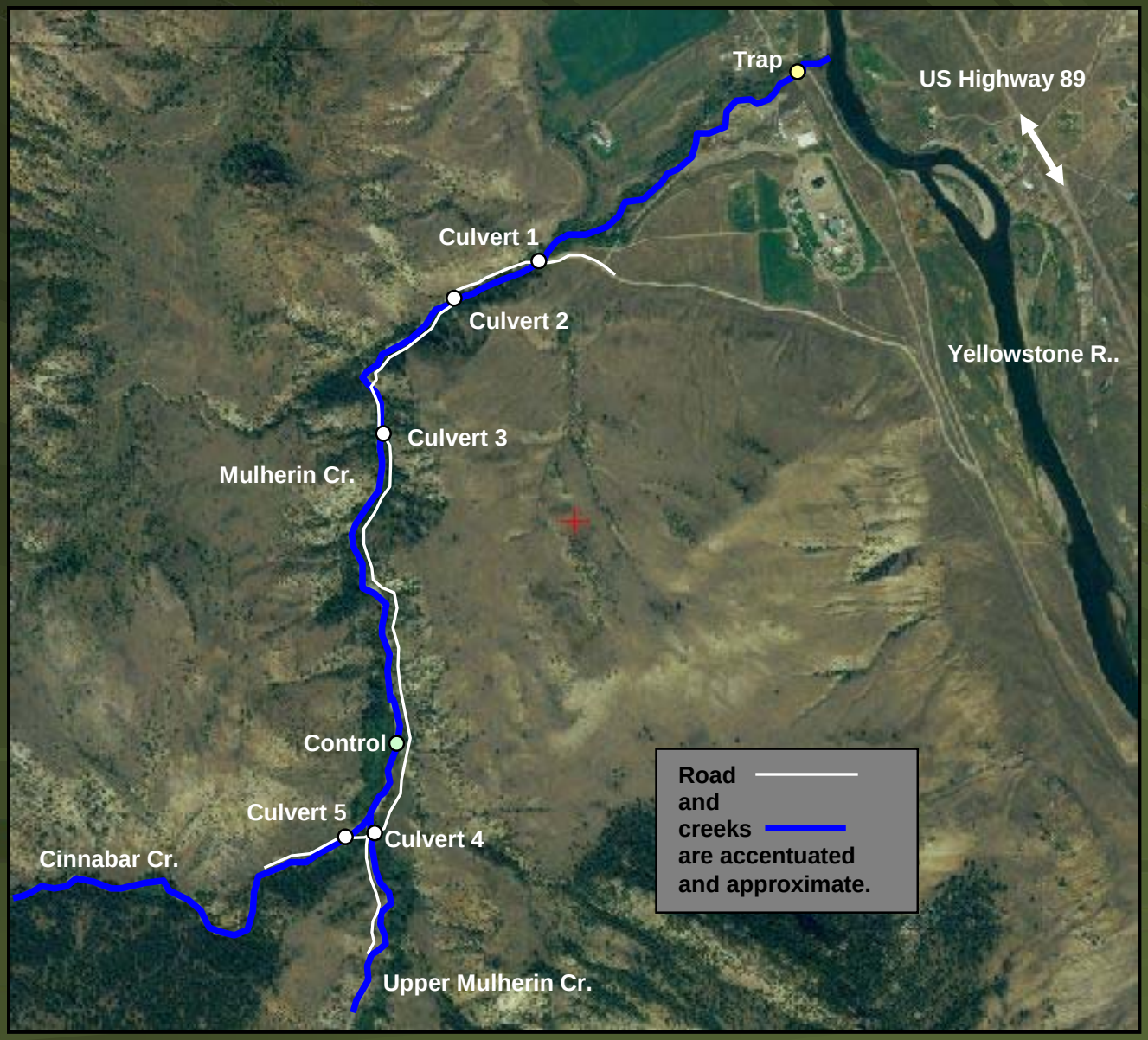
Track electronically tagged fish throughout a culvert-intense stream system over annual and fish mobility hydrologic cycles.

Study Location



Mulherin Creek

Mulherin Creek



Road is through Gallatin National Forest, but is maintained by Park County.

Mulherin Creek

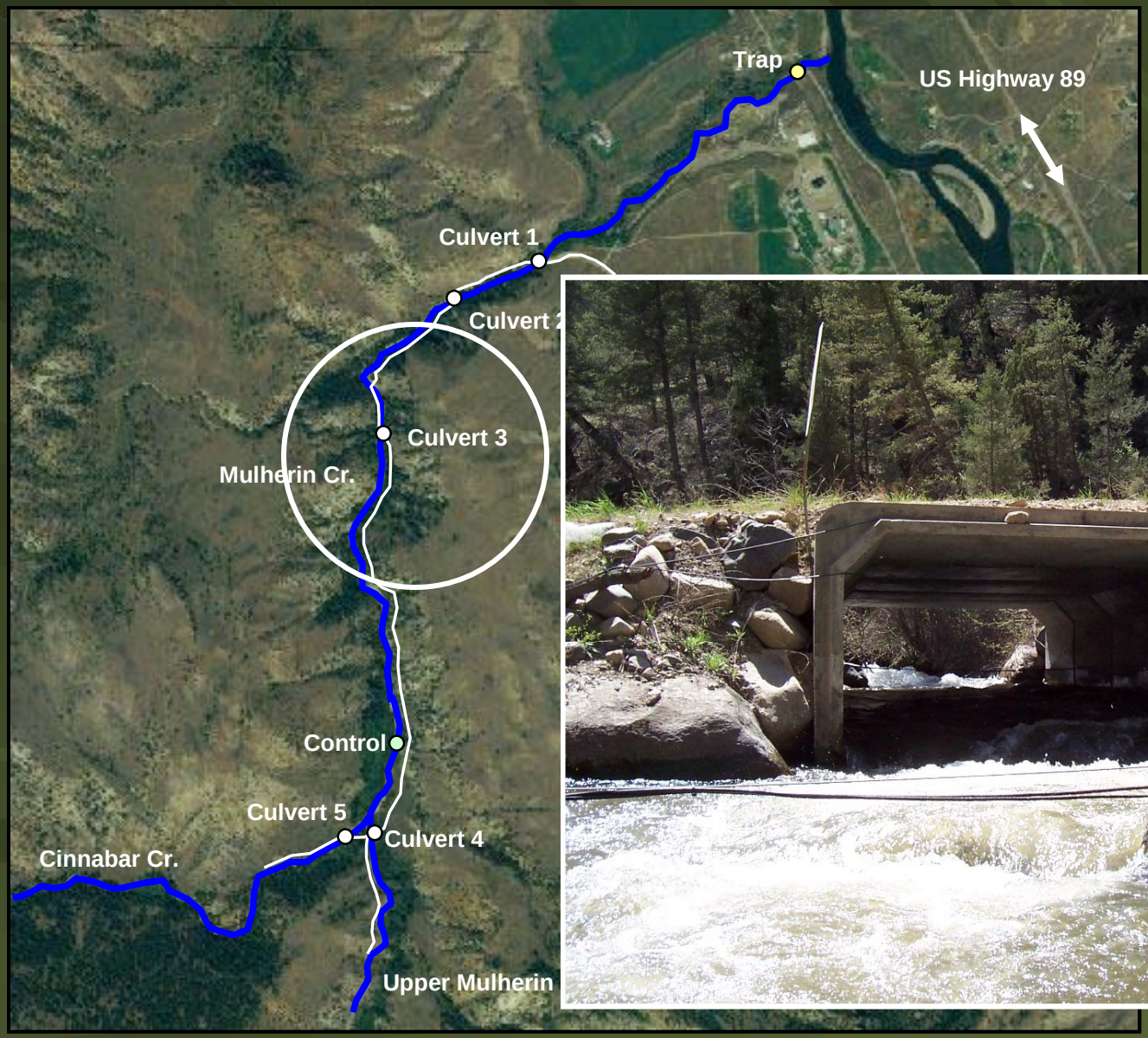
Mulherin Creek

Culvert 1

Mulherin Creek

Culvert 2

Mulherin Creek

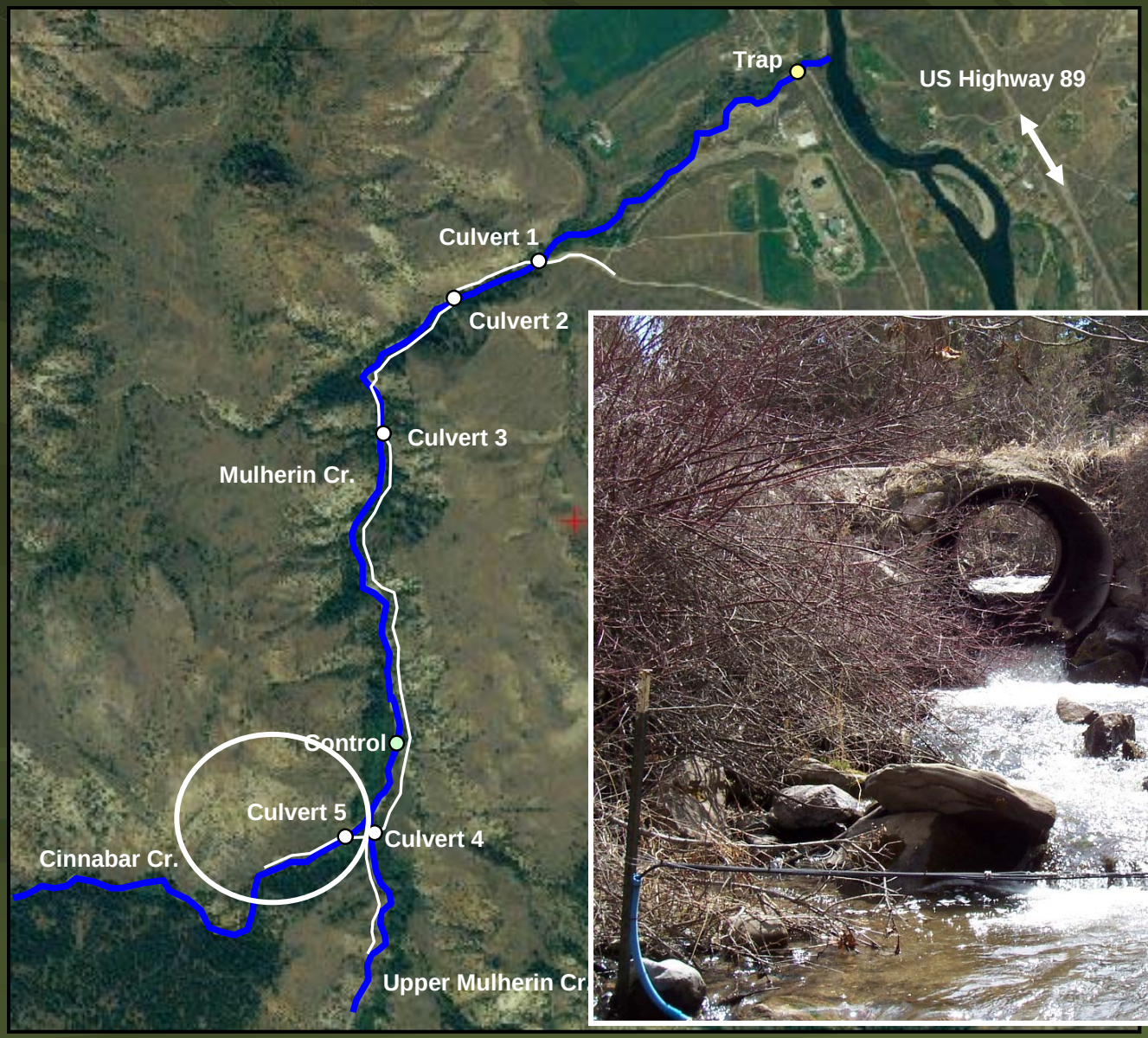


Culvert 3

Mulherin Creek

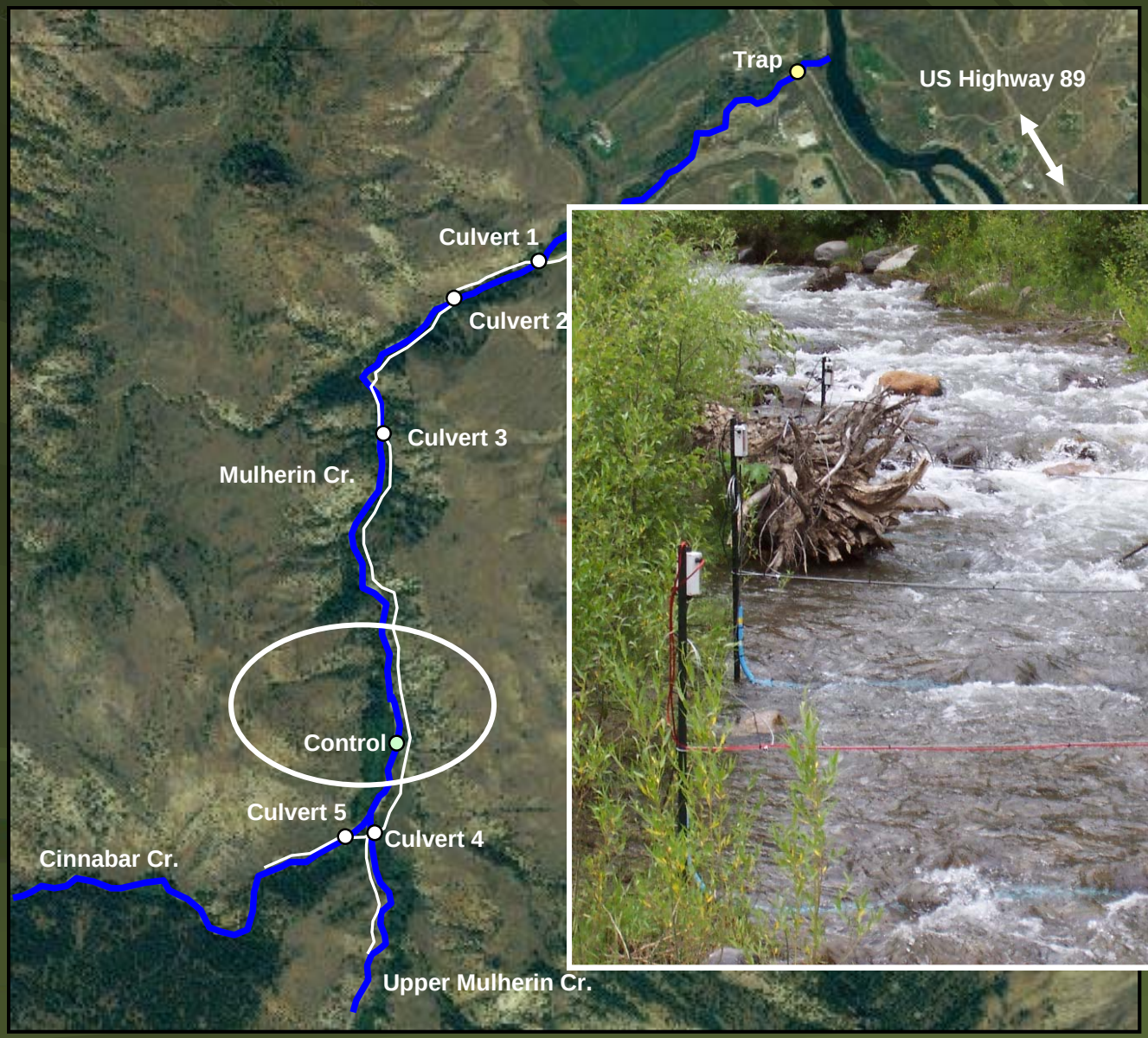
Culvert 4

Mulherin Creek



Culvert 5

Mulherin Creek



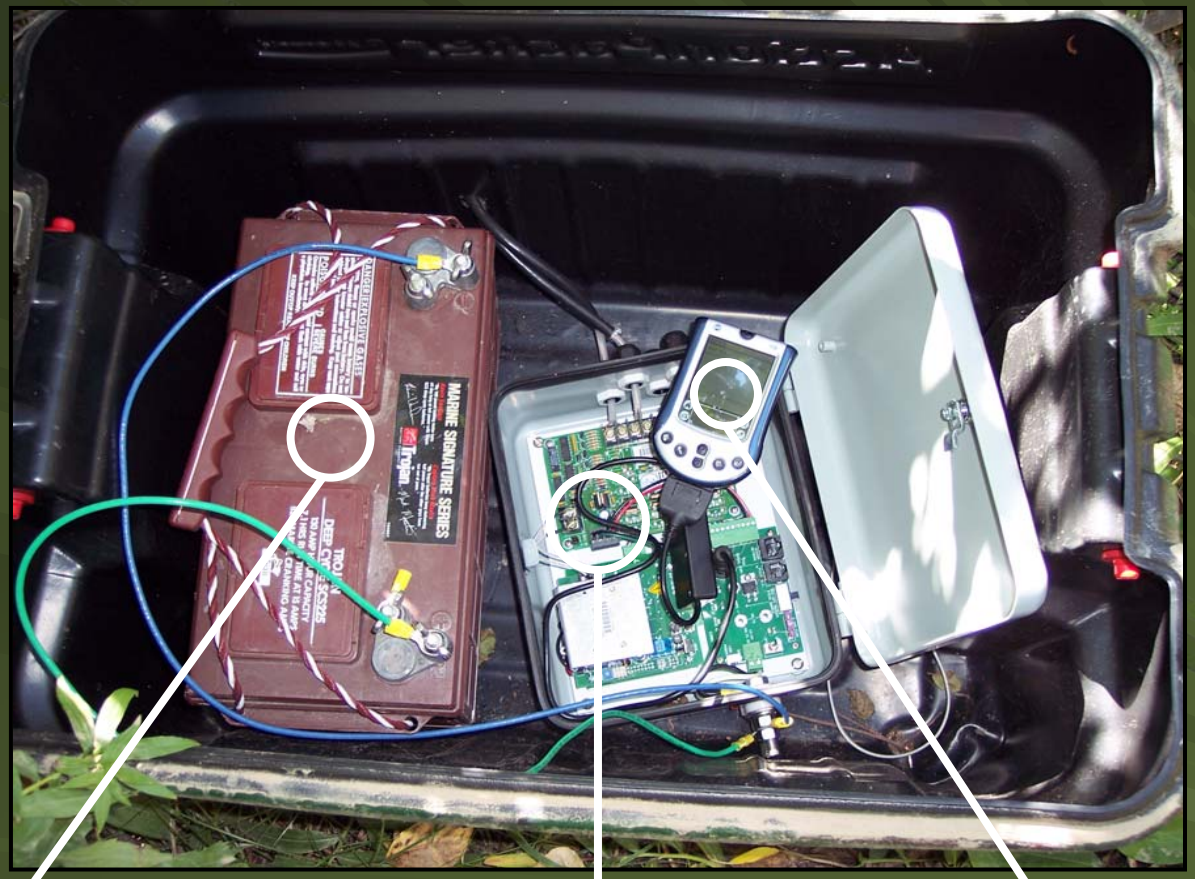
Control

Half-Duplex PIT Tags

Advantages

- Record individual passing through many culverts
- Single physical capture
- Records exact time of activity

Half Duplex PIT Tag Readers and Antennas



12 volt deep cycle

RFID reader

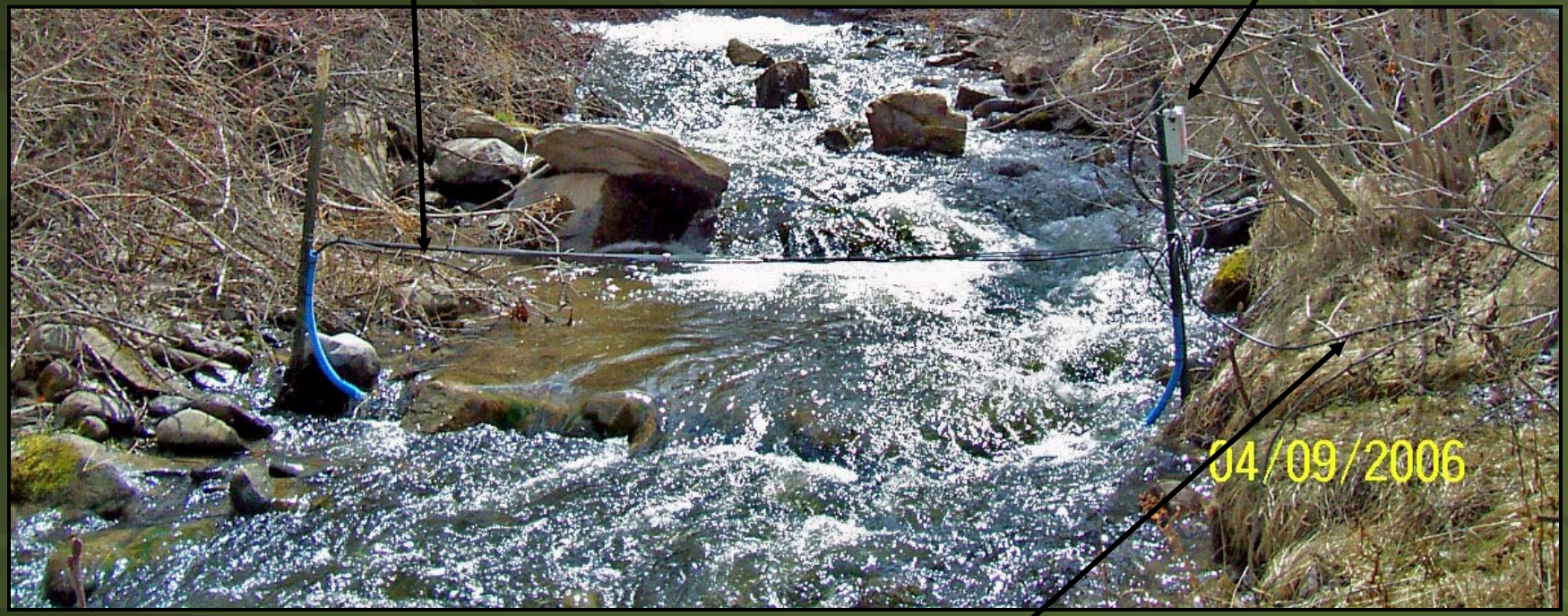
Data logger

5 day limit

Antenna Installation

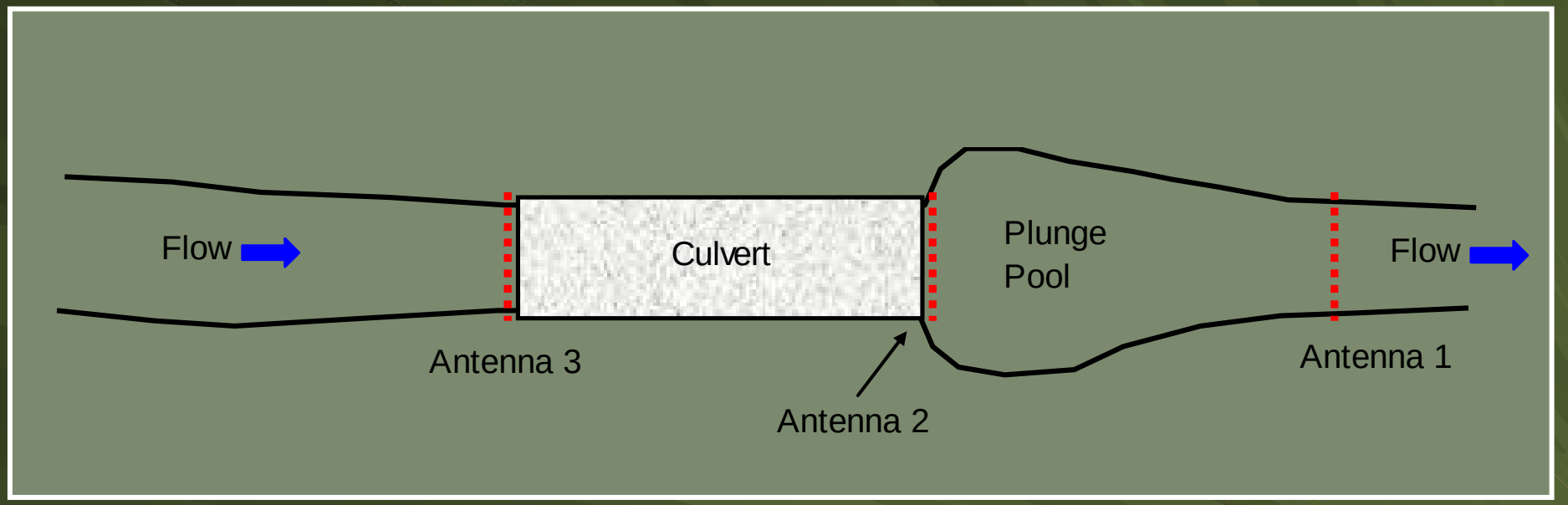
The antenna loop is 12 gauge stranded wire

Antenna tuner



Twin-axial cable from antenna to reader

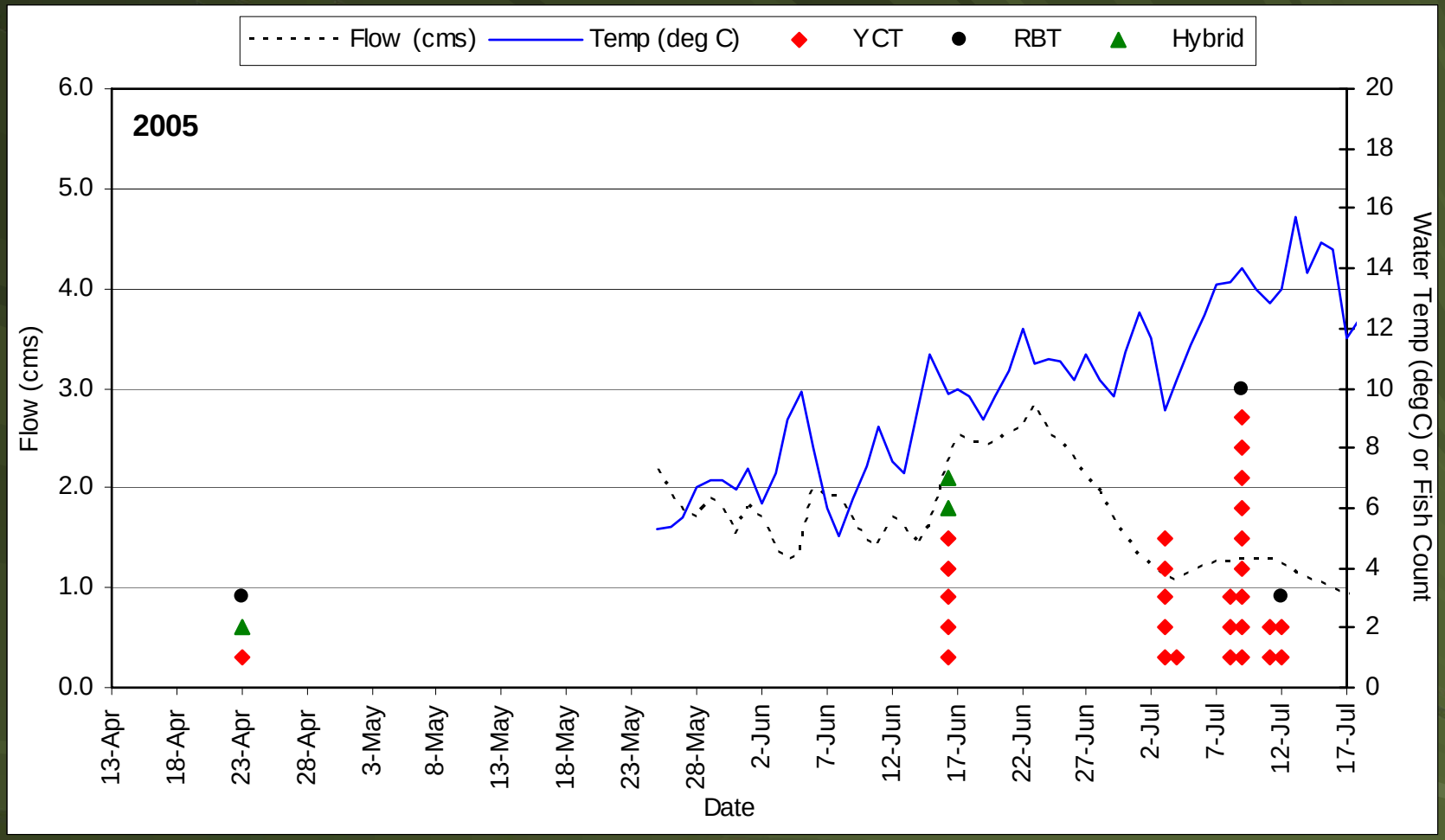
Antenna Placement



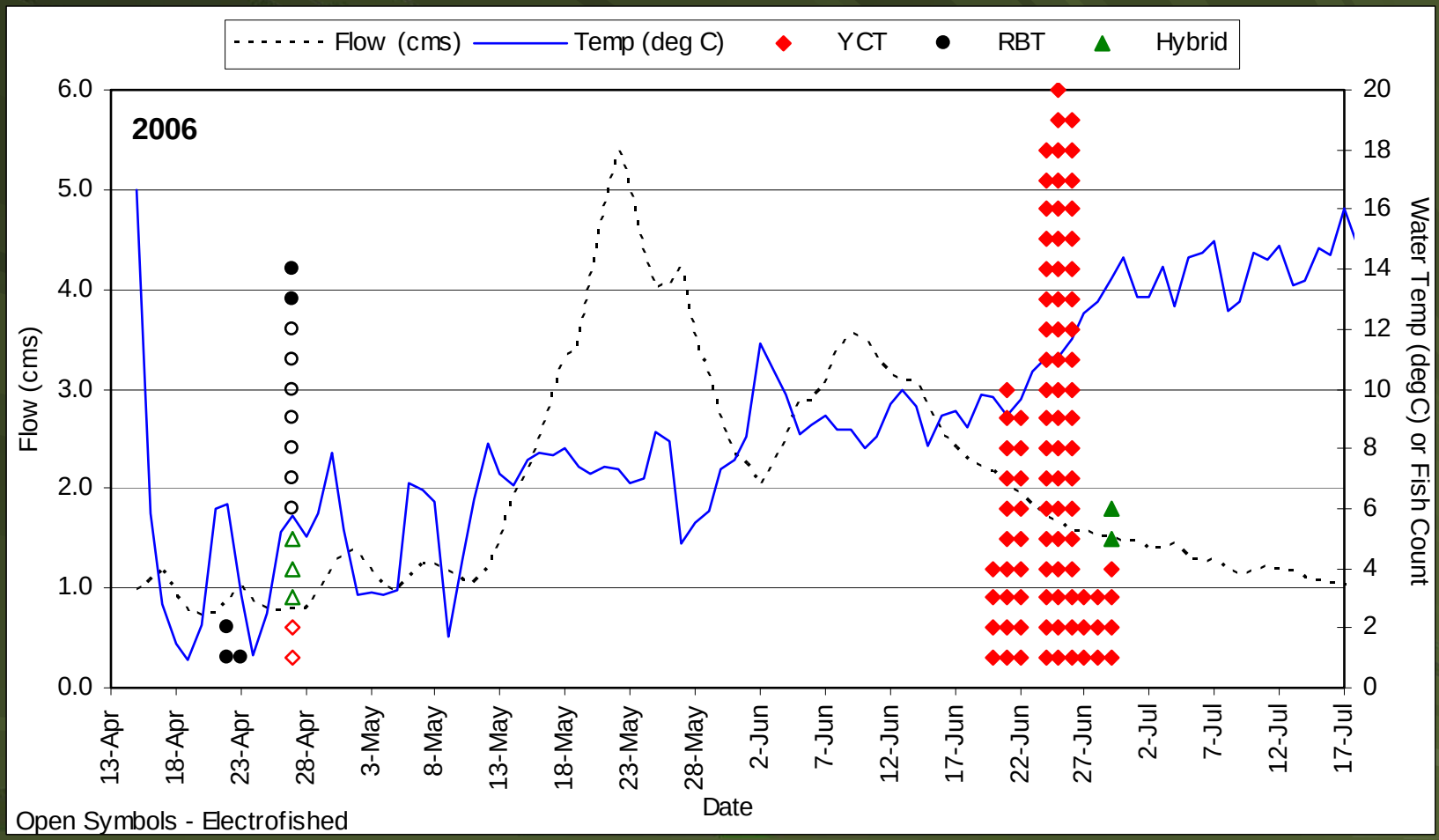
Trapping and Tagging

- 2005-2006
  - 143 Individuals tagged
  - 119 YCT
  - 13 RB
  - 11 Hybrid

Trapping and Tagging



Trapping and Tagging



Hydraulic and Hydrologic Data

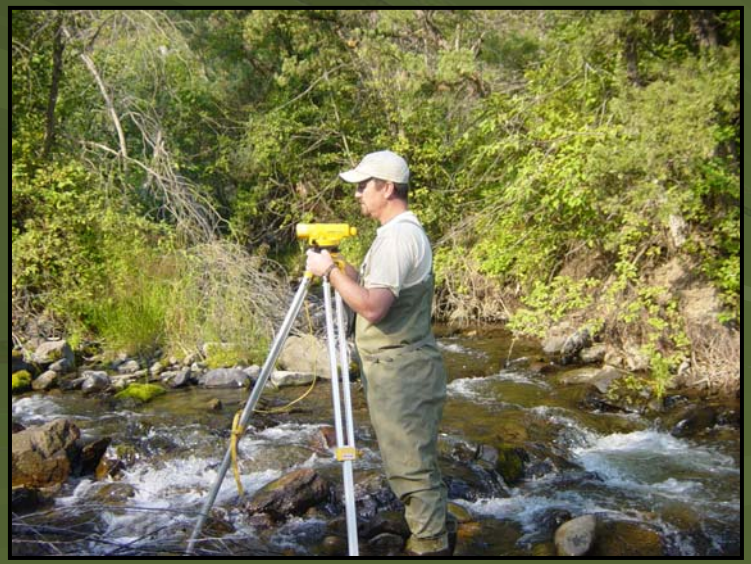
Data logger of stage and temperature...

USGS method to convert stage to flow rate...

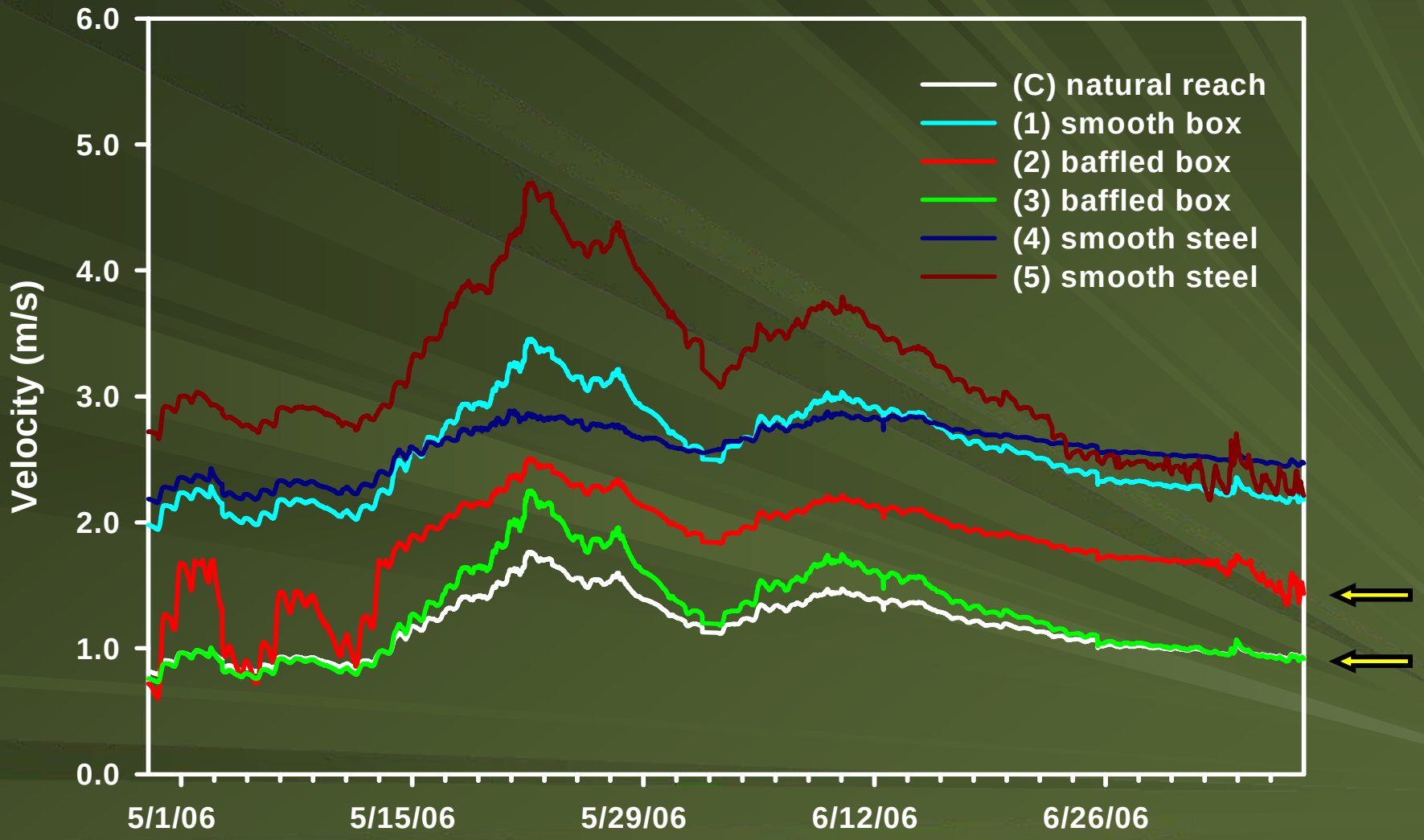
measure culvert geometry...

correlate cross sectional flow area (A) to flow rate (Q)...

V = Q/A provides velocity at any point in time.

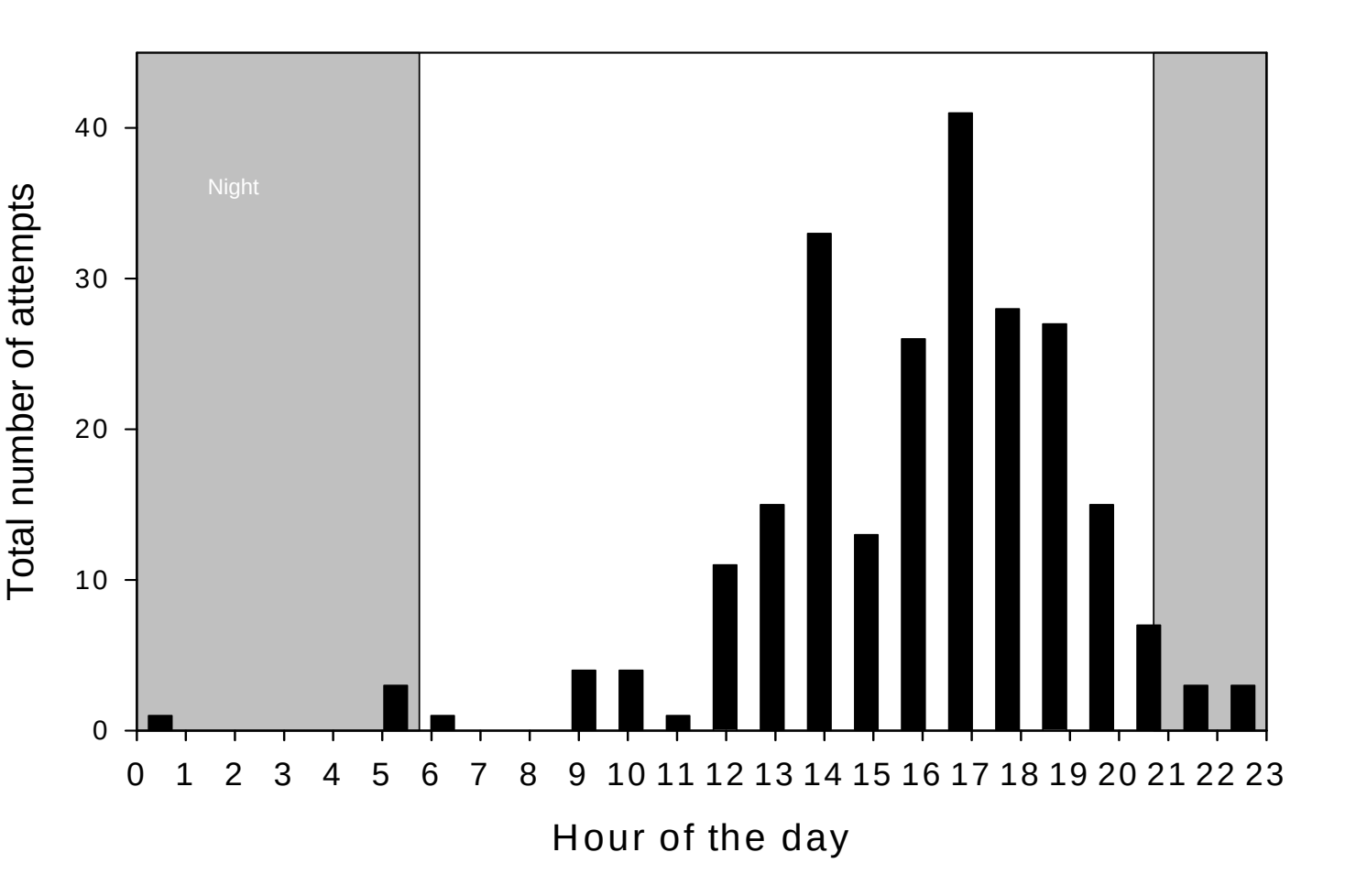


Water Velocities



Baffled culverts act like natural reach.

Fish Travel Timing

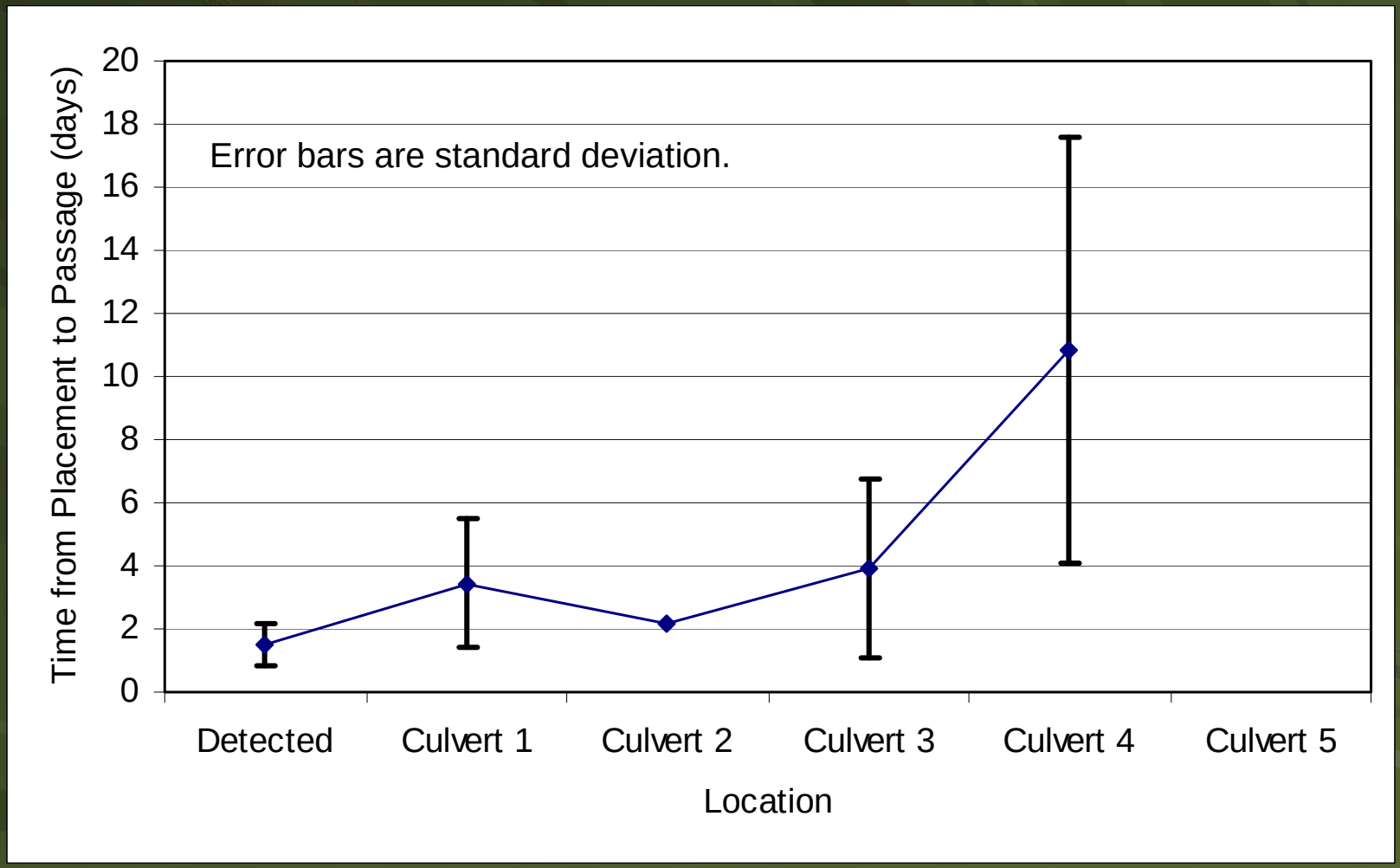


Most fish move between noon and dusk.

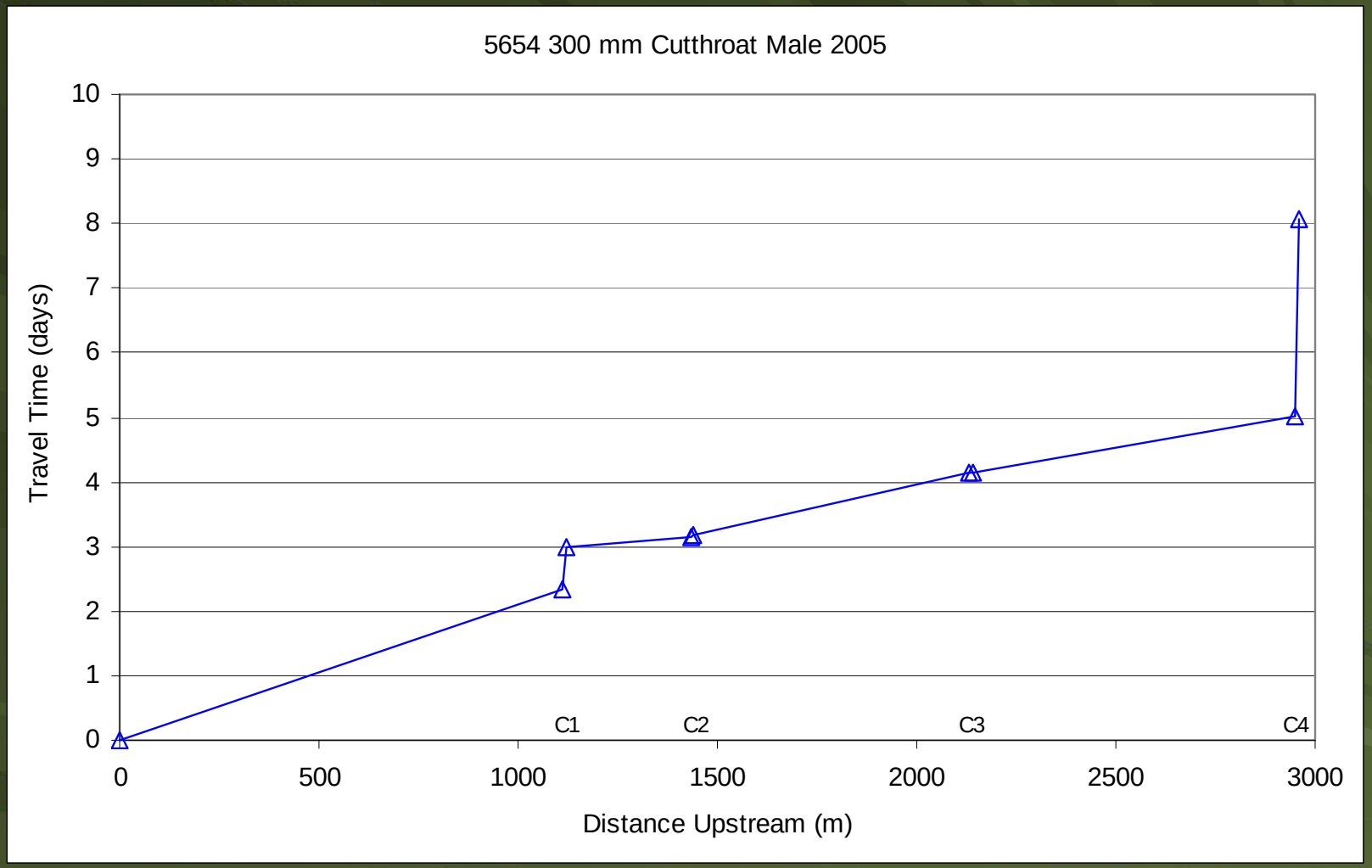
Time to Pass Through a Culvert

Fish must speed through the smooth culverts, but can rest along the way in the baffled culverts.

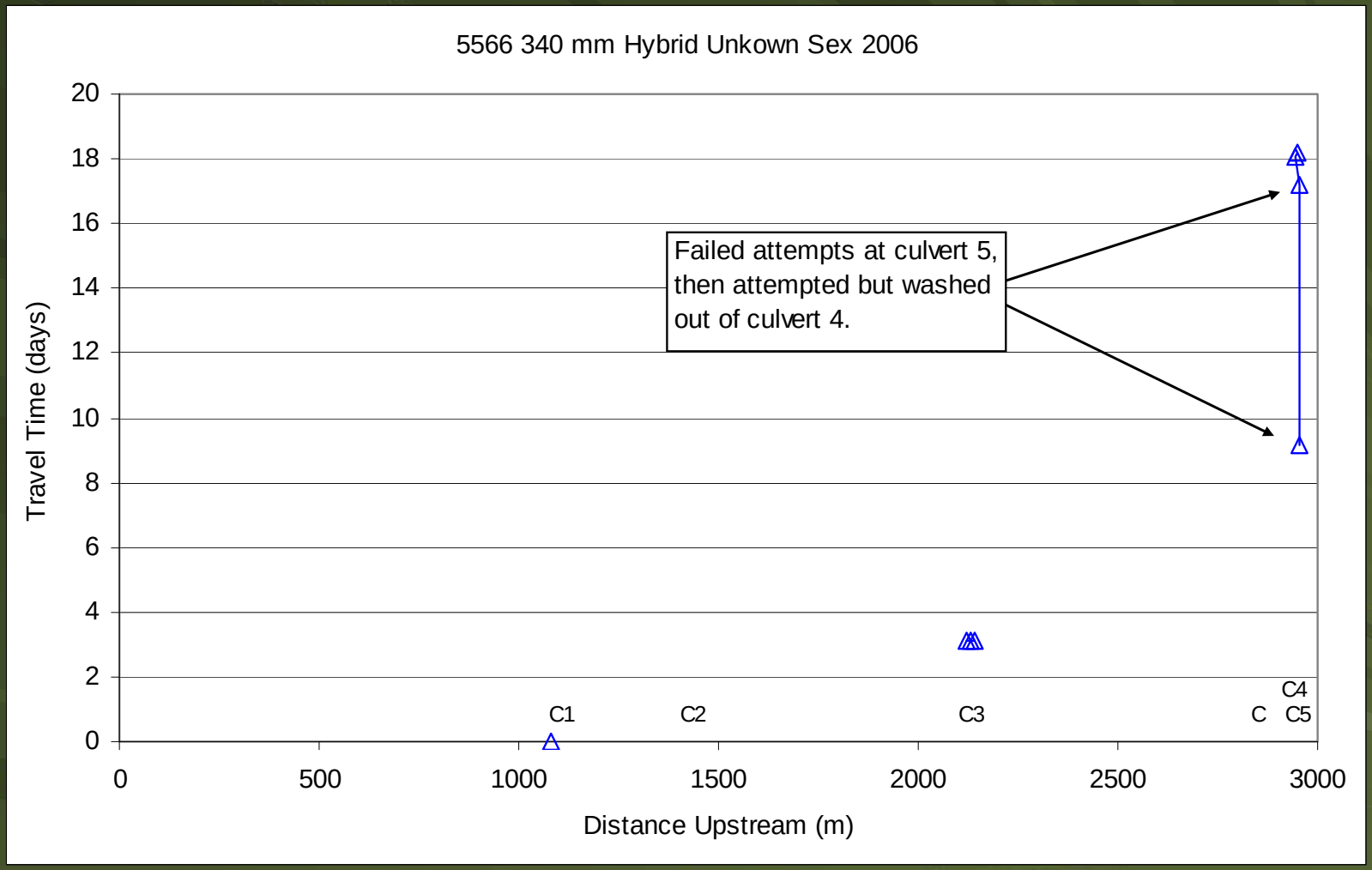
Time to Reach Points in the System



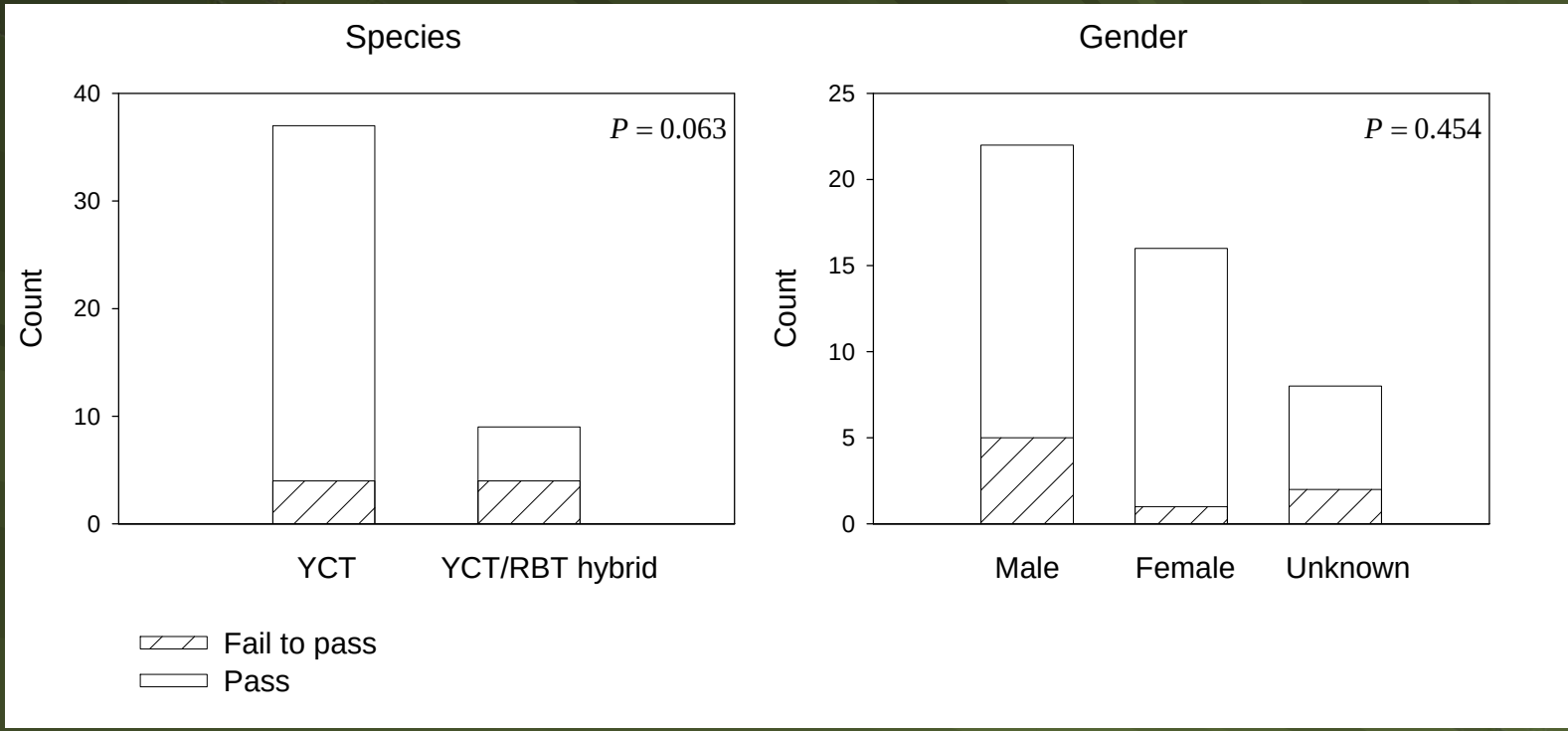
Travel History – Individual Fish



Travel History – Individual Fish

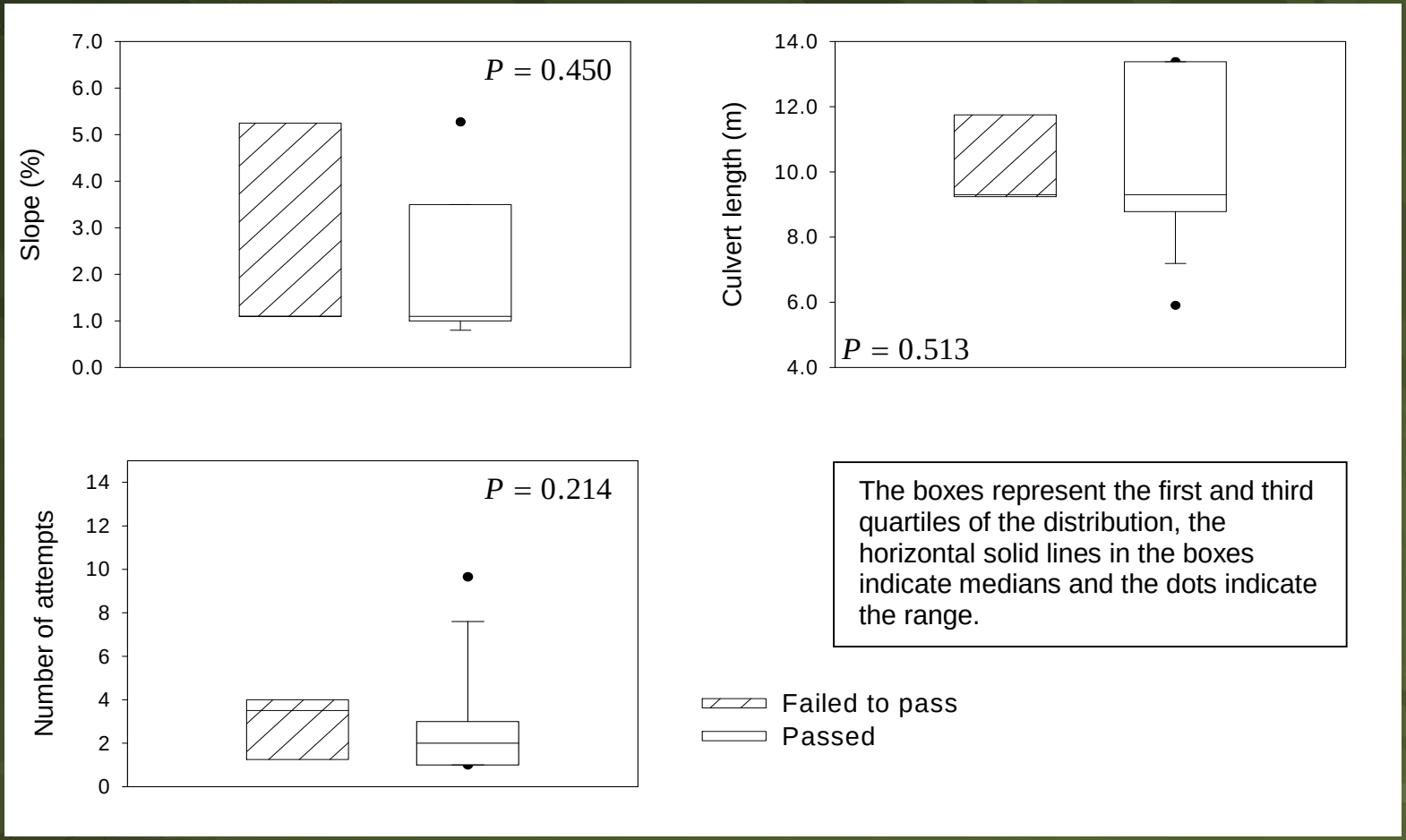


Effect of Species or Gender



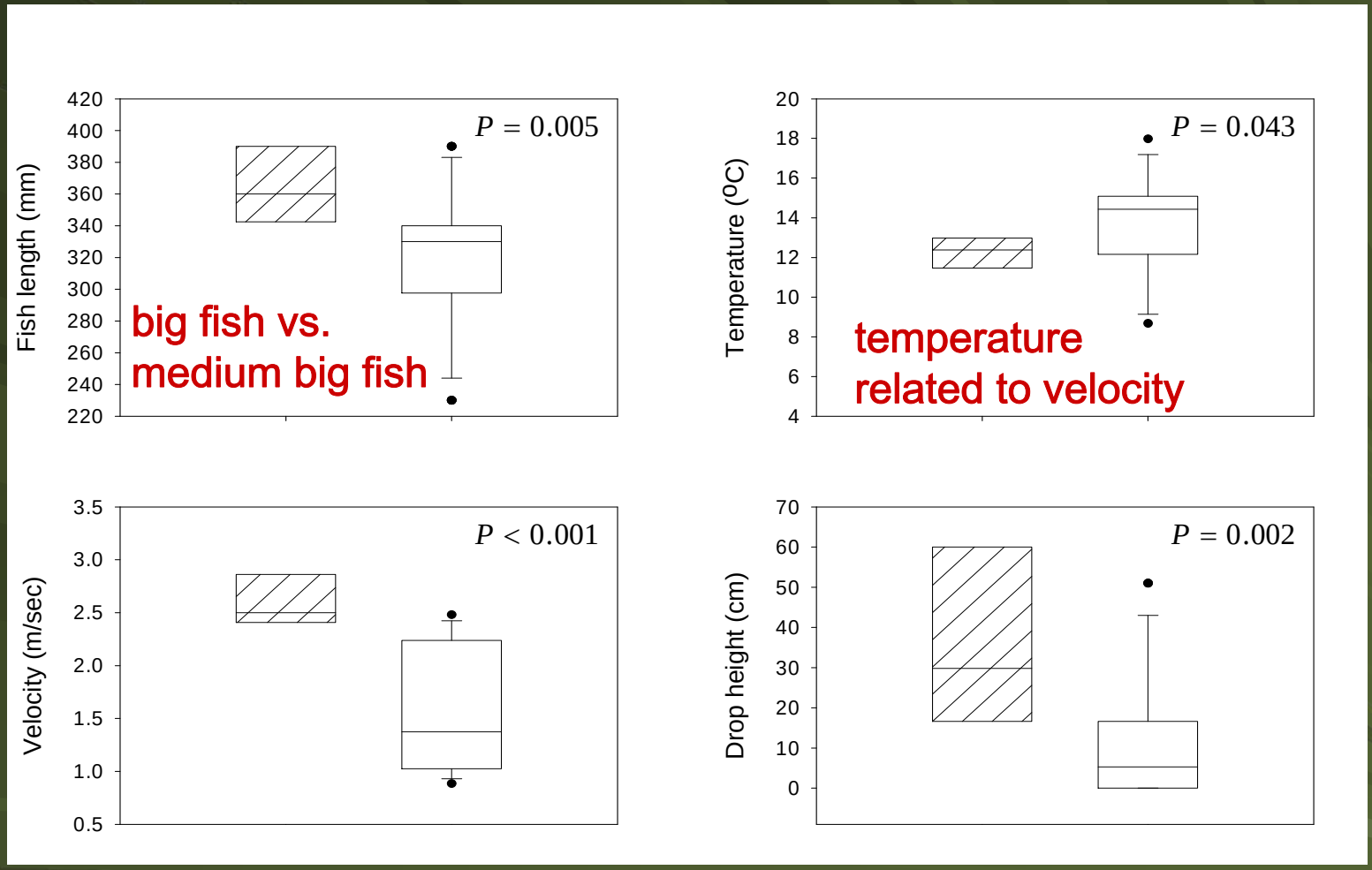
No difference in ability to pass culverts by gender or species.

Factors not Related to Pass/No Pass



No significant effect of slope, length, or number of attempts.
Remember – not much diversity in slope or length.

Factors Related to Pass/No Pass

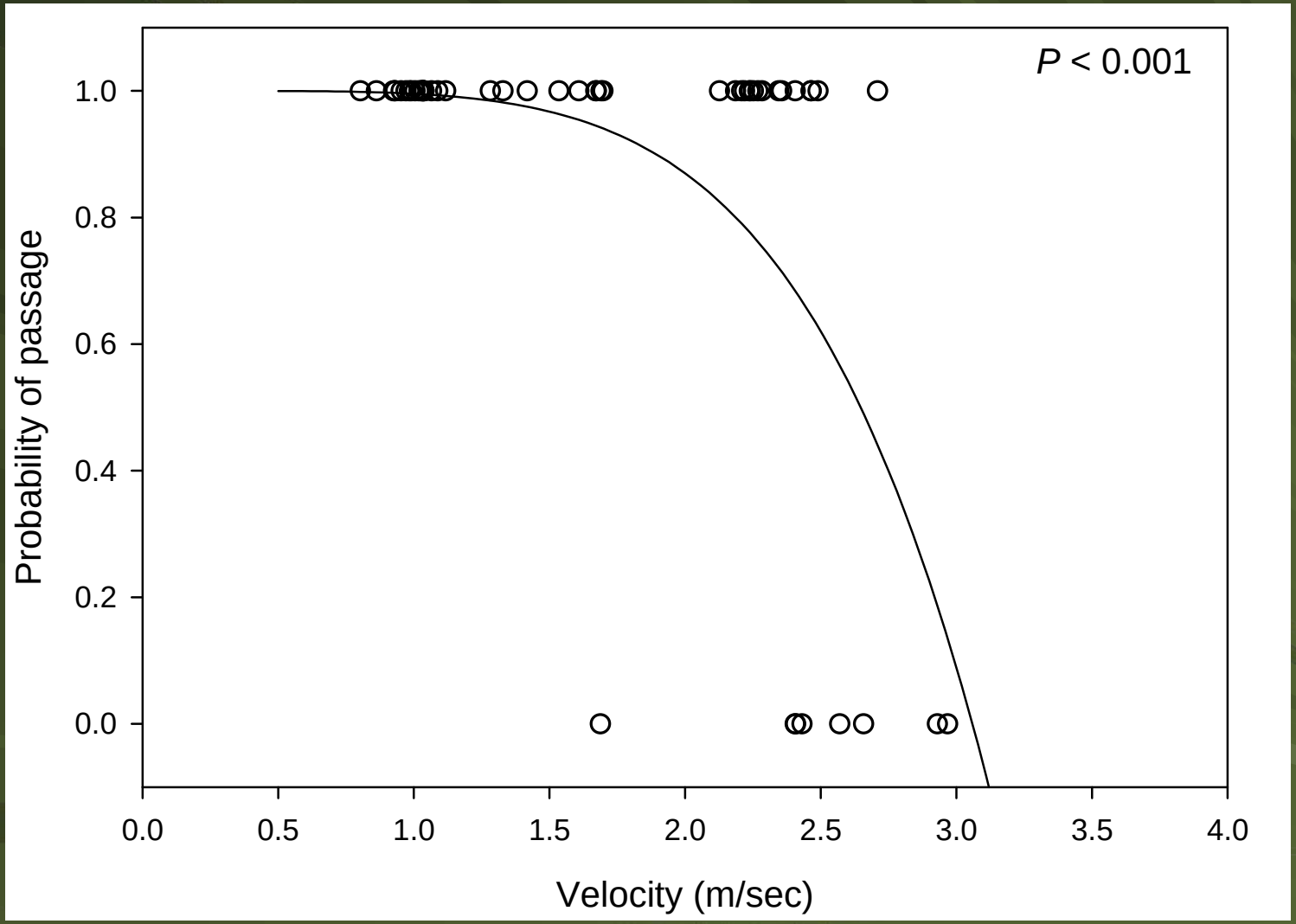


Culvert length, drop height, water velocity, and water temperature all significantly affected pass/no pass.

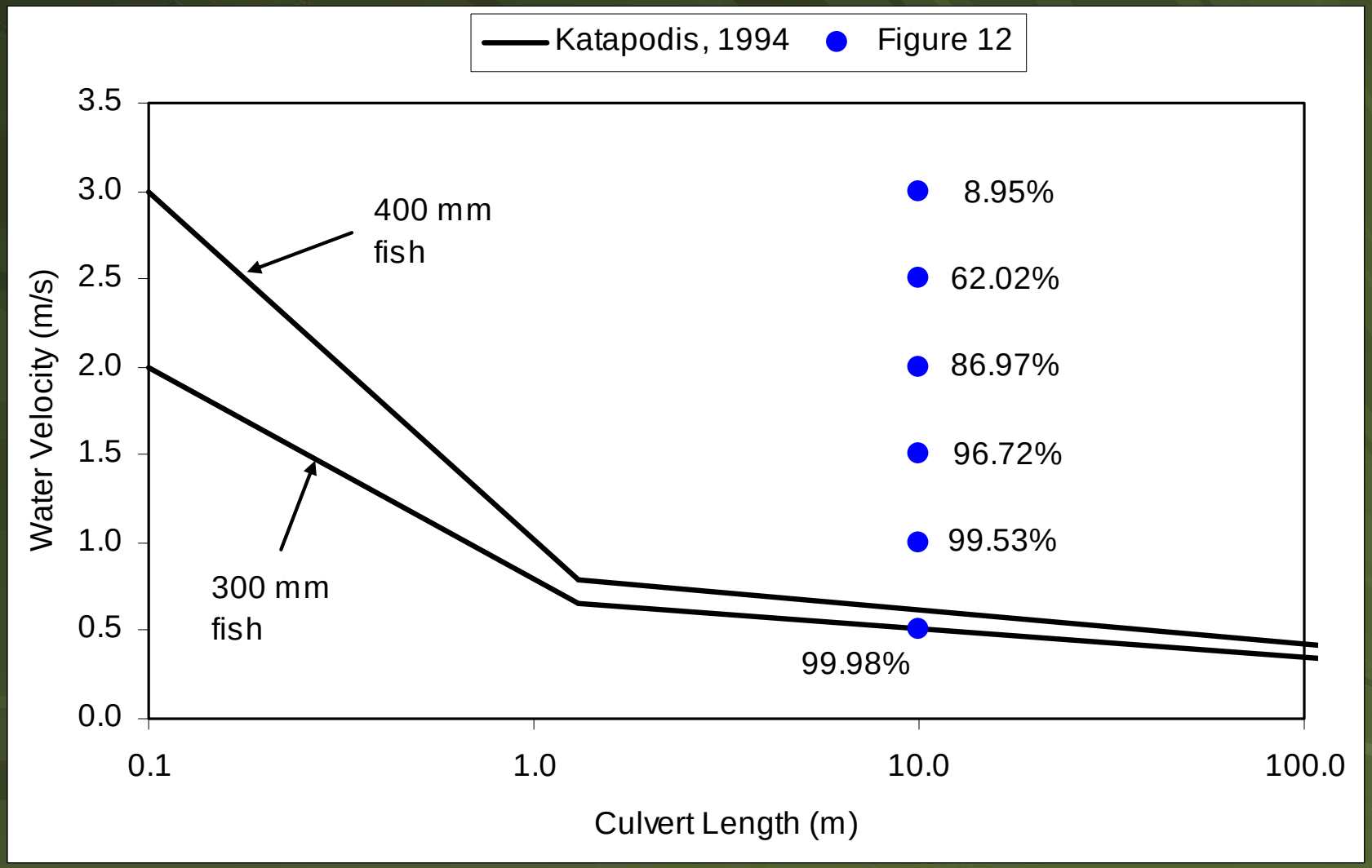
Probability of Passing a Culvert

Factors	Comments
Culvert Slope	Not Significant
Culvert Length	Not Significant
Number of Attempts	Not Significant
Water Temperature	Co-Variate of Velocity
Fish Length	Big vs. Medium Big
Drop Height	Not Diverse (n ~ 5)
Water Velocity	Strongest Indicator

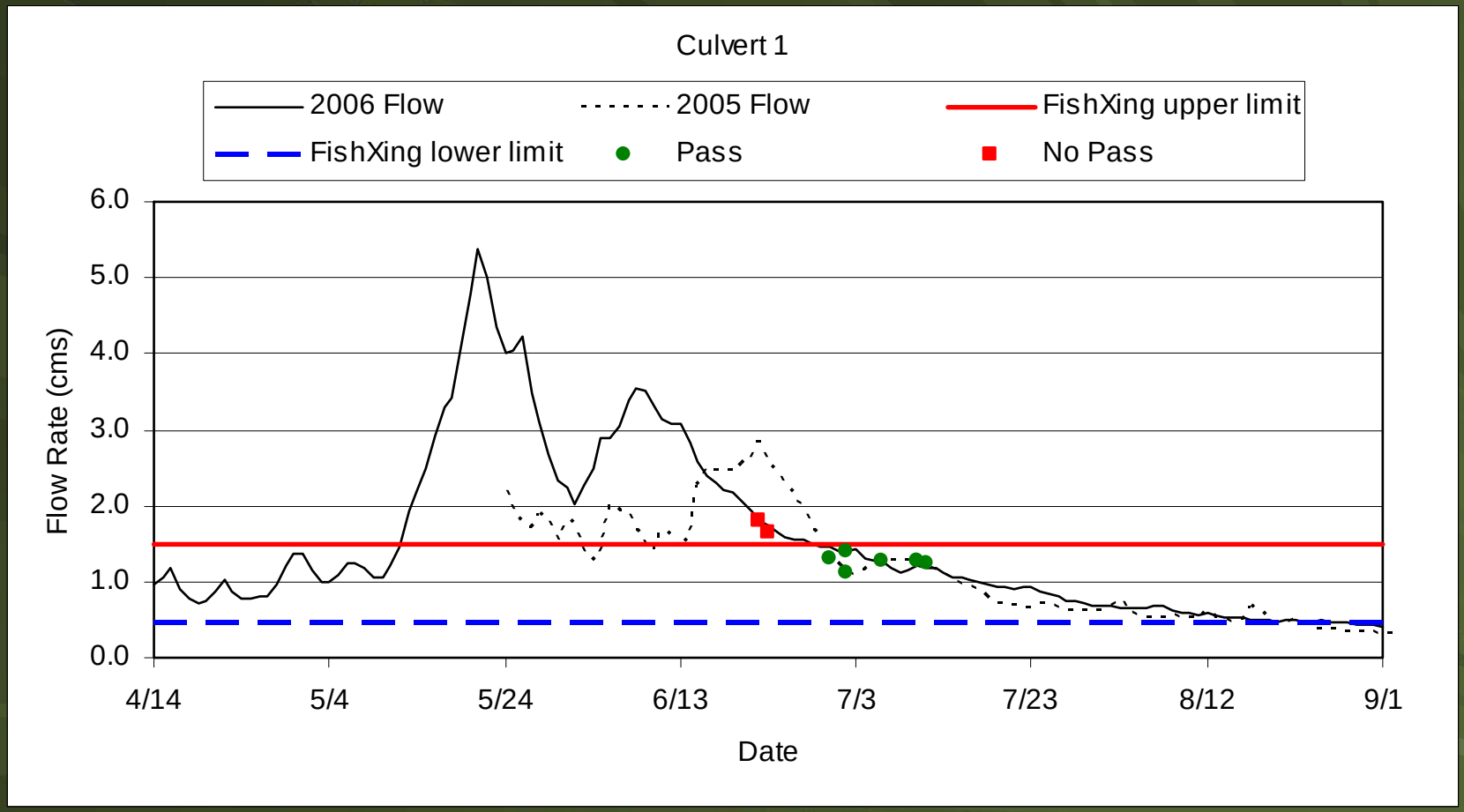
Probability of Passing a Culvert



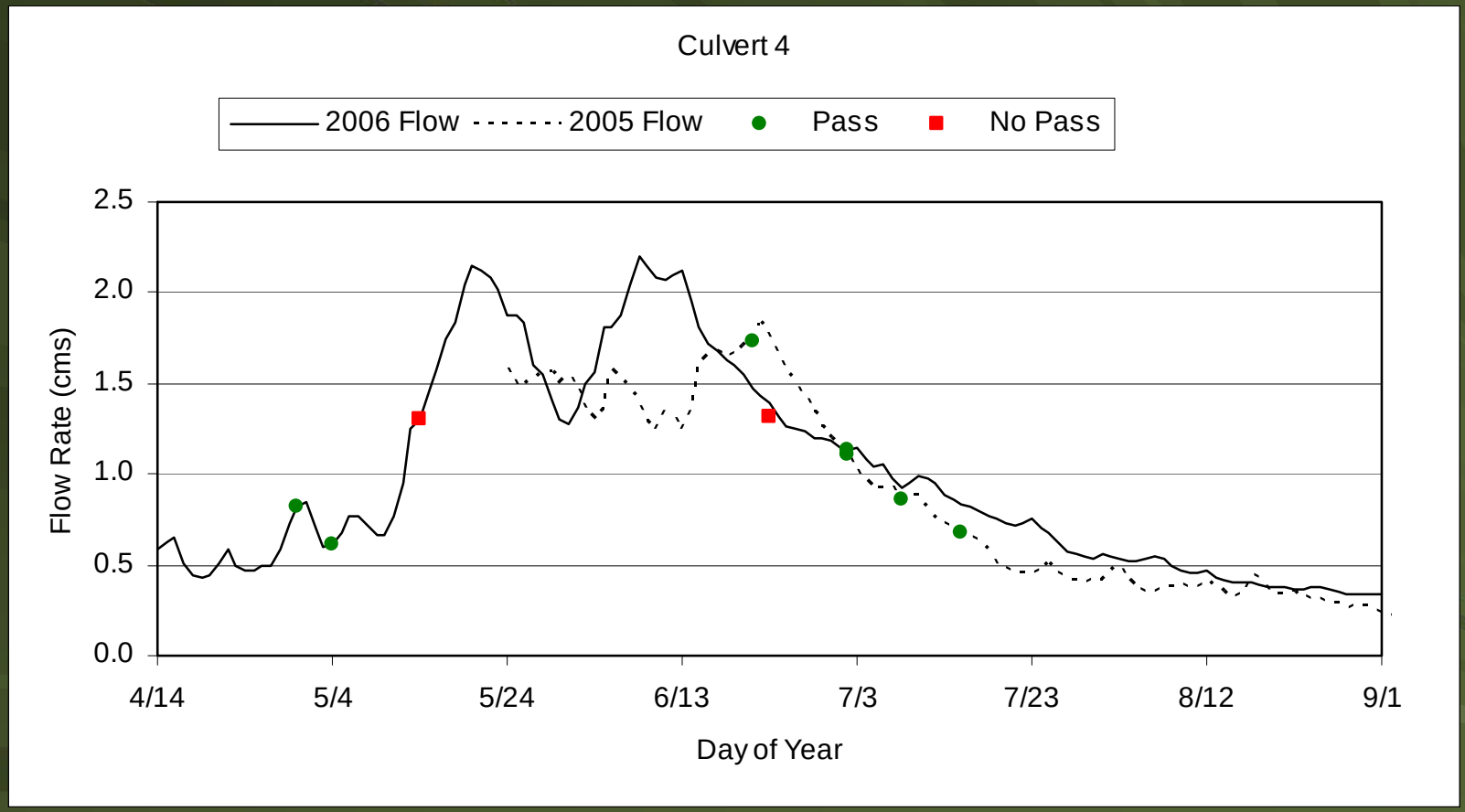
Probability of Passing a Culvert



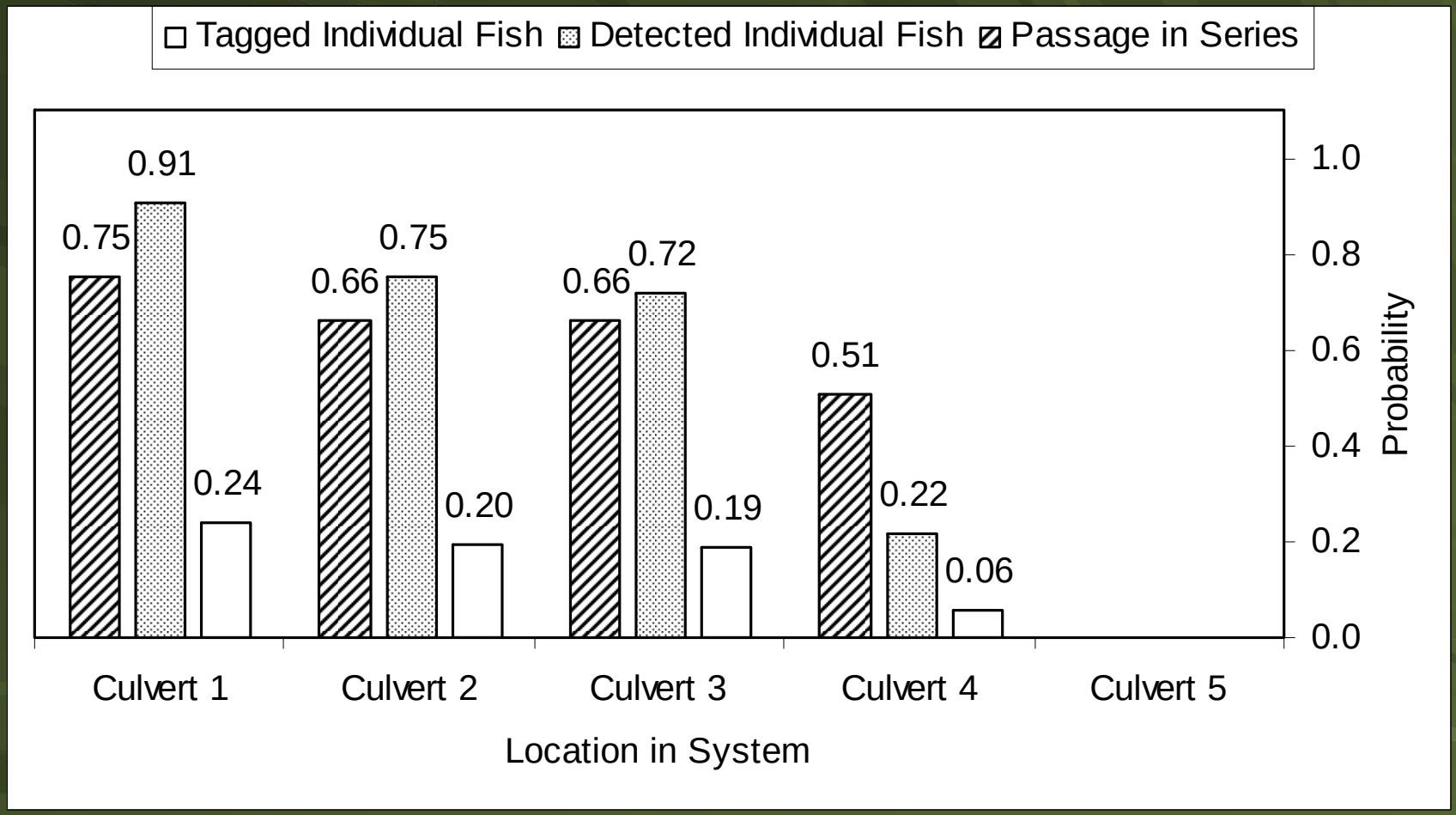
FishXing Passage Windows



FishXing Passage Windows



Probability of Passing through the System



Probability Based Passage Goals

Reach	Length (km)	Spawning Gravel total m²	Spawning Gravel m²/km
trap to culvert 1	1.1	124.7	113.4
culvert 1 to culvert 2	0.3	4.9	15.8
culvert 2 to culvert 3	0.7	17.5	25.4
culvert 3 to culverts 4 and 5	0.8	38.0	45.8
Upper Mulherin	1.6	136.4	85.3
Cinnabar	6.5	680.5	104.7

Culverts 4 and 5 – most bang for your buck! Low probability of passage as is, and would open up long spawning gravel-rich areas.

Conclusions

- Velocity is a strong probability based indicator of passage success and should be used as the basis of establishing passage goals.
- The baffled concrete box culverts in the study performed well.
- Prioritize based on passage goals and probability of passage.

Questions?