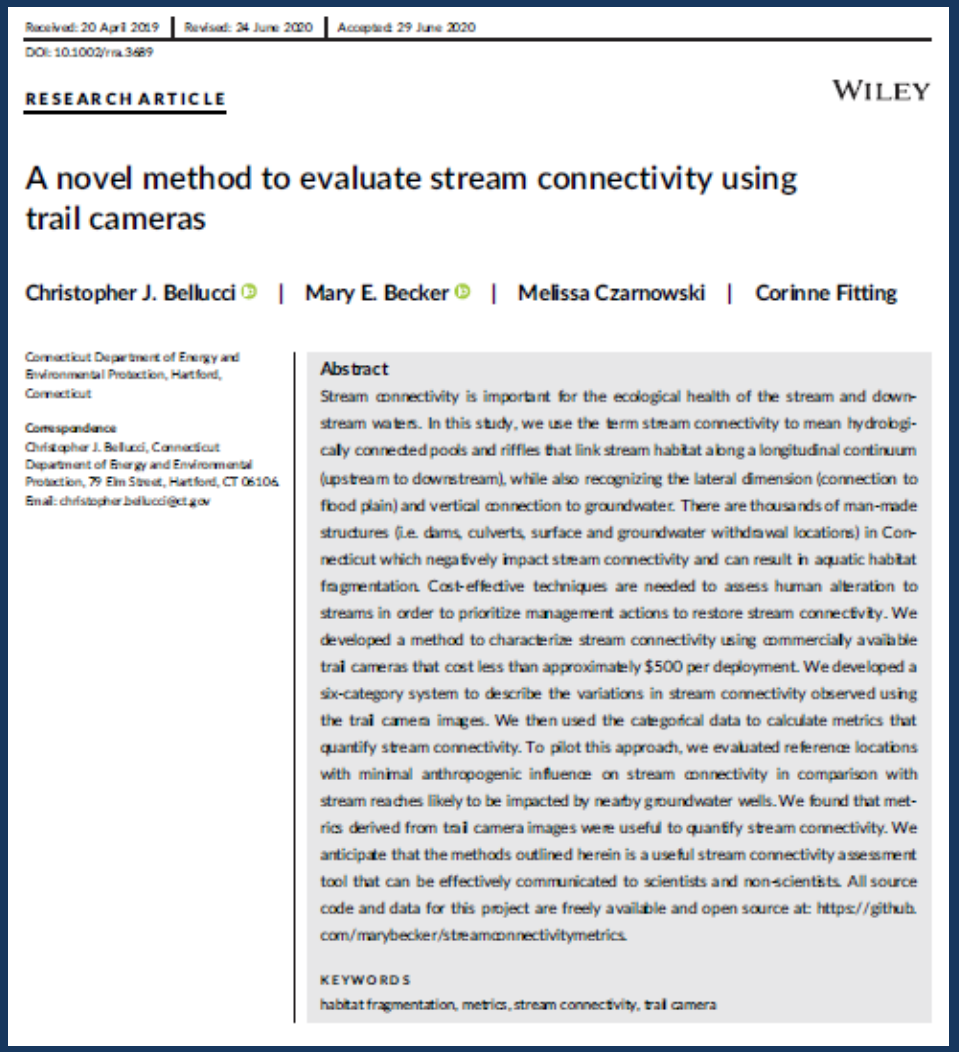
Monitoring Stream Connectivity with Trail Cameras

December 17, 2020

Melissa Czarnowski
Forest Ecosystem Monitoring Cooperative Conference



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RESEARCH ARTICLE

WILEY

A novel method to evaluate stream connectivity using trail cameras

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Abstract

Stream connectivity is important for the ecological health of the stream and downstream waters. In this study, we use the term stream connectivity to mean hydrologically connected pools and riffles that link stream habitat along a longitudinal continuum (upstream to downstream), while also recognizing the lateral dimension (connection to flood plain) and vertical connection to groundwater. There are thousands of man-made structures (i.e. dams, culverts, surface and groundwater withdrawal locations) in Connecticut which negatively impact stream connectivity and can result in aquatic habitat fragmentation. Cost-effective techniques are needed to assess human alteration to streams in order to prioritize management actions to restore stream connectivity. We developed a method to characterize stream connectivity using commercially available trail cameras that cost less than approximately $500 per deployment. We developed a six-category system to describe the variations in stream connectivity observed using the trail camera images. We then used the categorical data to calculate metrics that quantify stream connectivity. To pilot this approach, we evaluated reference locations with minimal anthropogenic influence on stream connectivity in comparison with stream reaches likely to be impacted by nearby groundwater wells. We found that metrics derived from trail camera images were useful to quantify stream connectivity. We anticipate that the methods outlined herein is a useful stream connectivity assessment tool that can be effectively communicated to scientists and non-scientists. All source code and data for this project are freely available and open source at: https://github.com/marybecker/streamconnectivitymetrics.

KEYWORDS
habitat fragmentation, metrics, stream connectivity, trail camera

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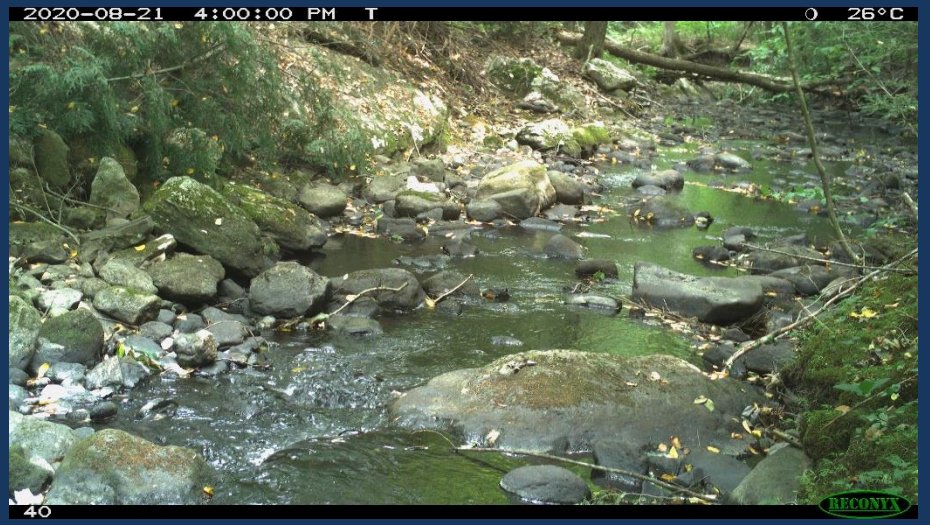
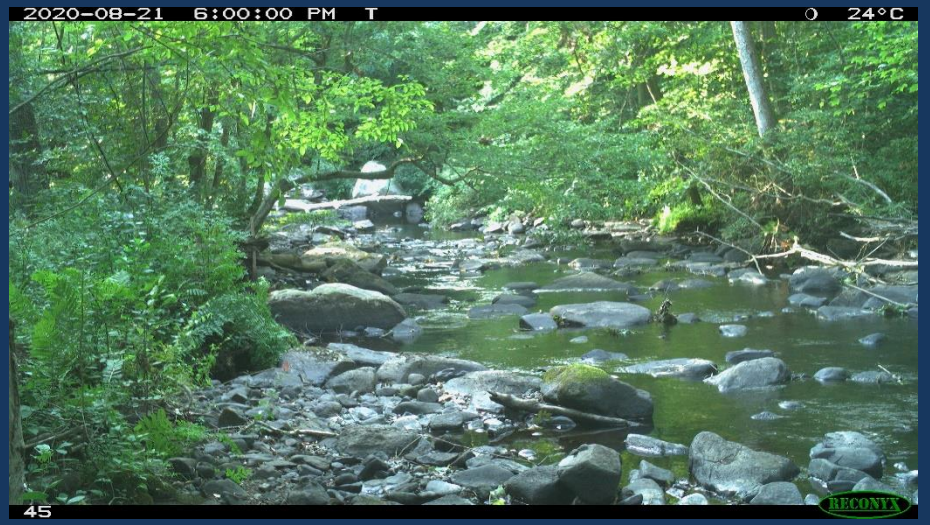
https://onlinelibrary.wiley.com/doi/epdf/10.1002/rra.3689

Overview

- Background
- Method
- Metrics
- Examples

Why monitor streamflow with pictures?





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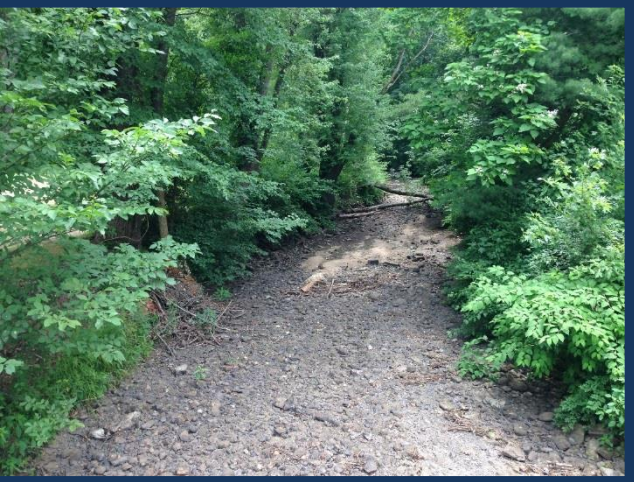
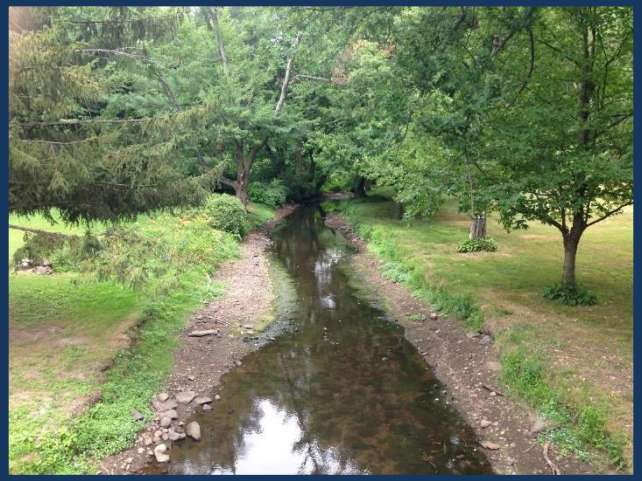
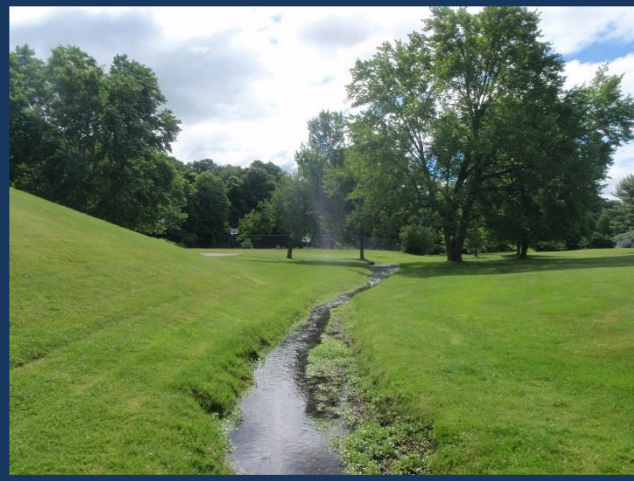
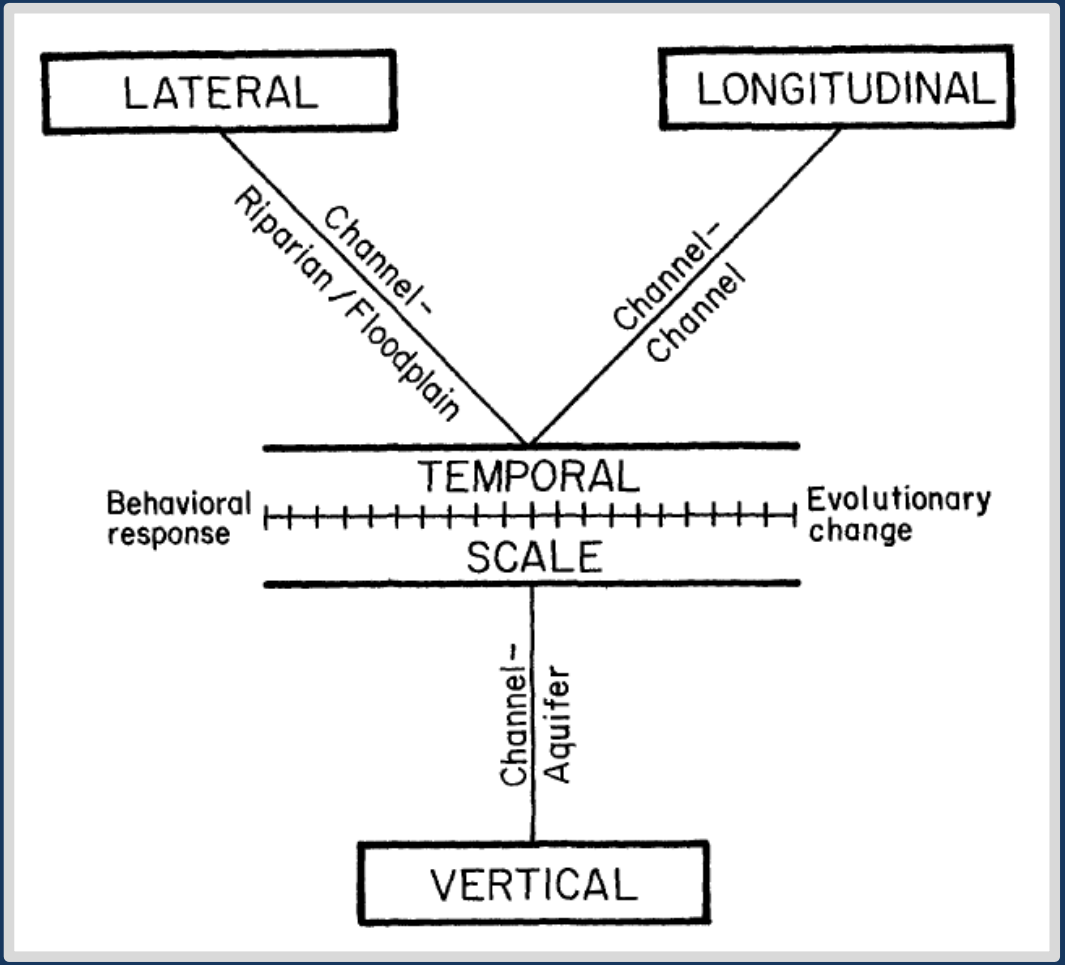
Importance of High-Quality Photos

- Photos are data that provide a record of conditions
- Photos need to be clear, centered, and without any obstructions.

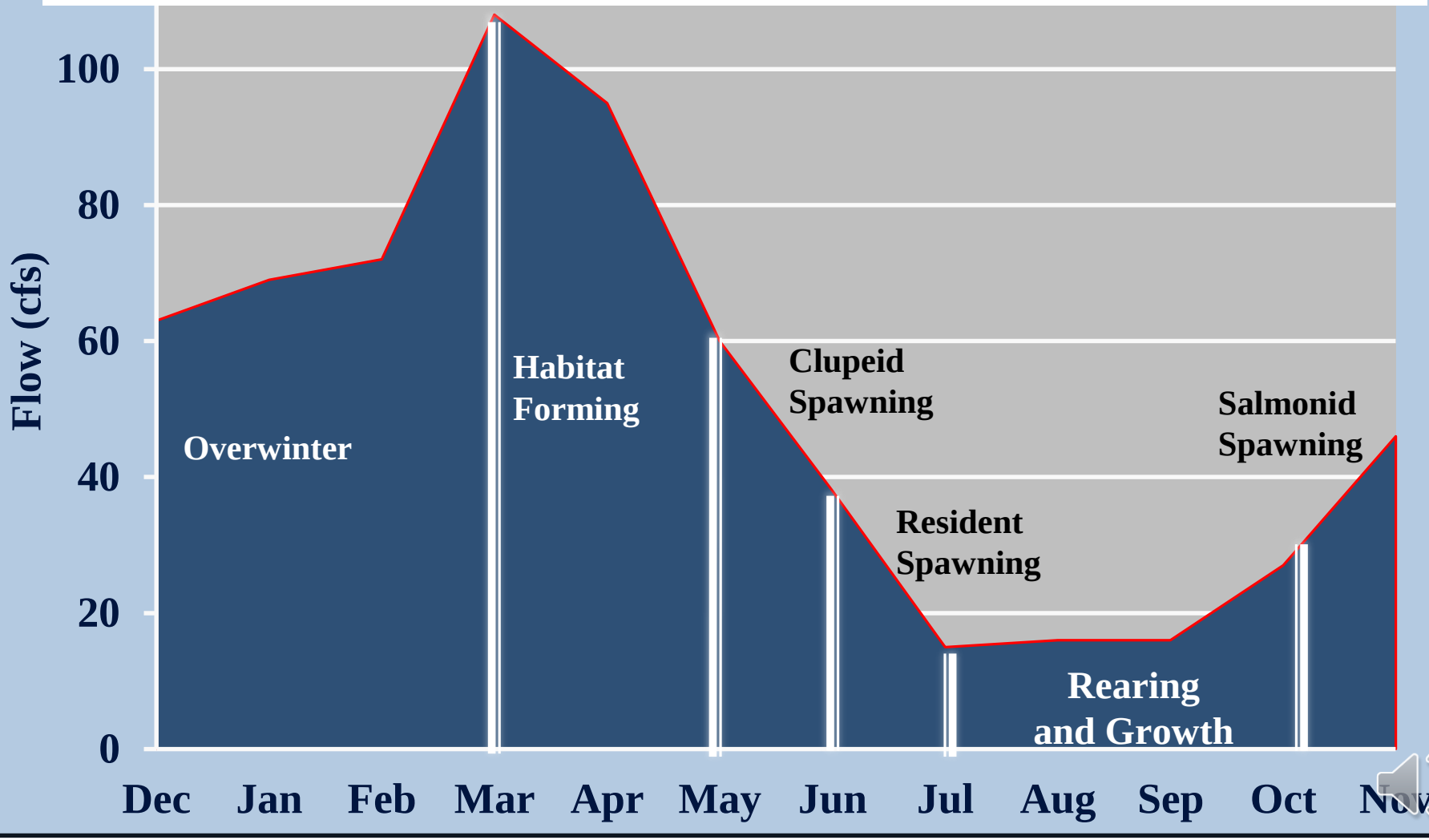
Examples of high-quality photos.

Flow-Habitat Connectivity



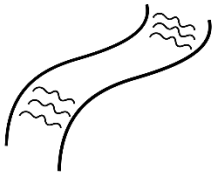
Study Period

July- October	Rearing and Growth	Flows needed to sustain aquatic life including resident and anadromous species. Typically the season of highest conflict with human uses.



Method

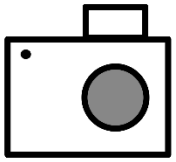
Select Locations



Capture at Least 1 Riffle-Pool Sequence

Trim Vegetation

Deploy Trail Camera

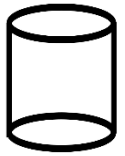


Collect Hourly Images

Field Check and Download Images

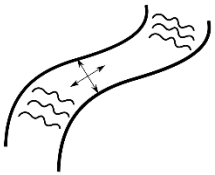
Quality Control Image Data

Store and Organize Image Data



Calibrate Image Readers

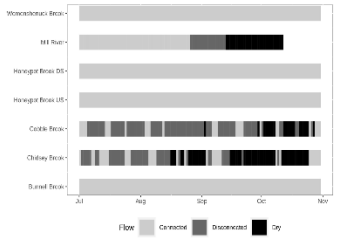
Assign Stream Connectivity Category to Images



Quality Control Image Stream Connectivity Category

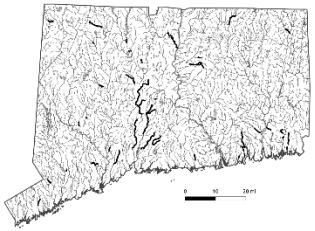
Store Category in Database

Calculate Average Daily Stream Connectivity Metrics



Visualize Metrics

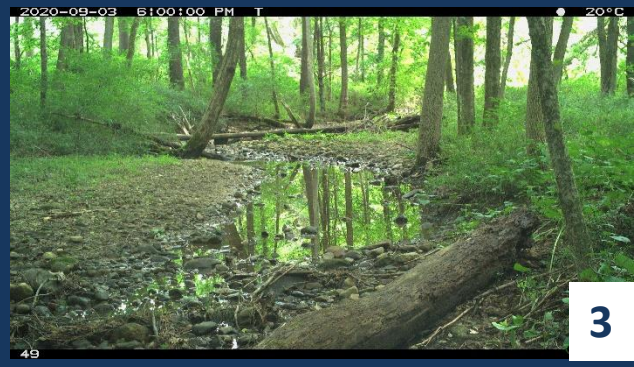
Inform Stream Management



Flow Categories

1

2



3

Disconnected

4

5

6

Connected

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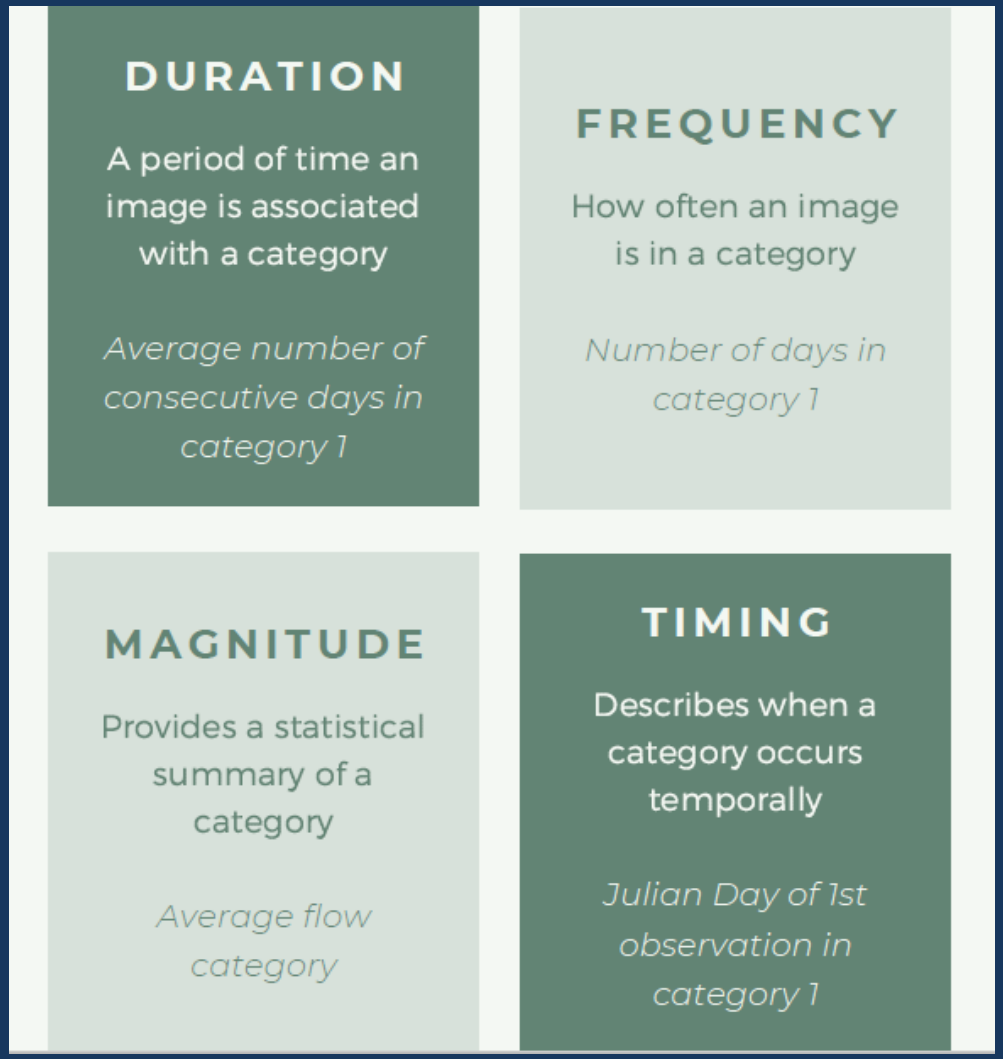
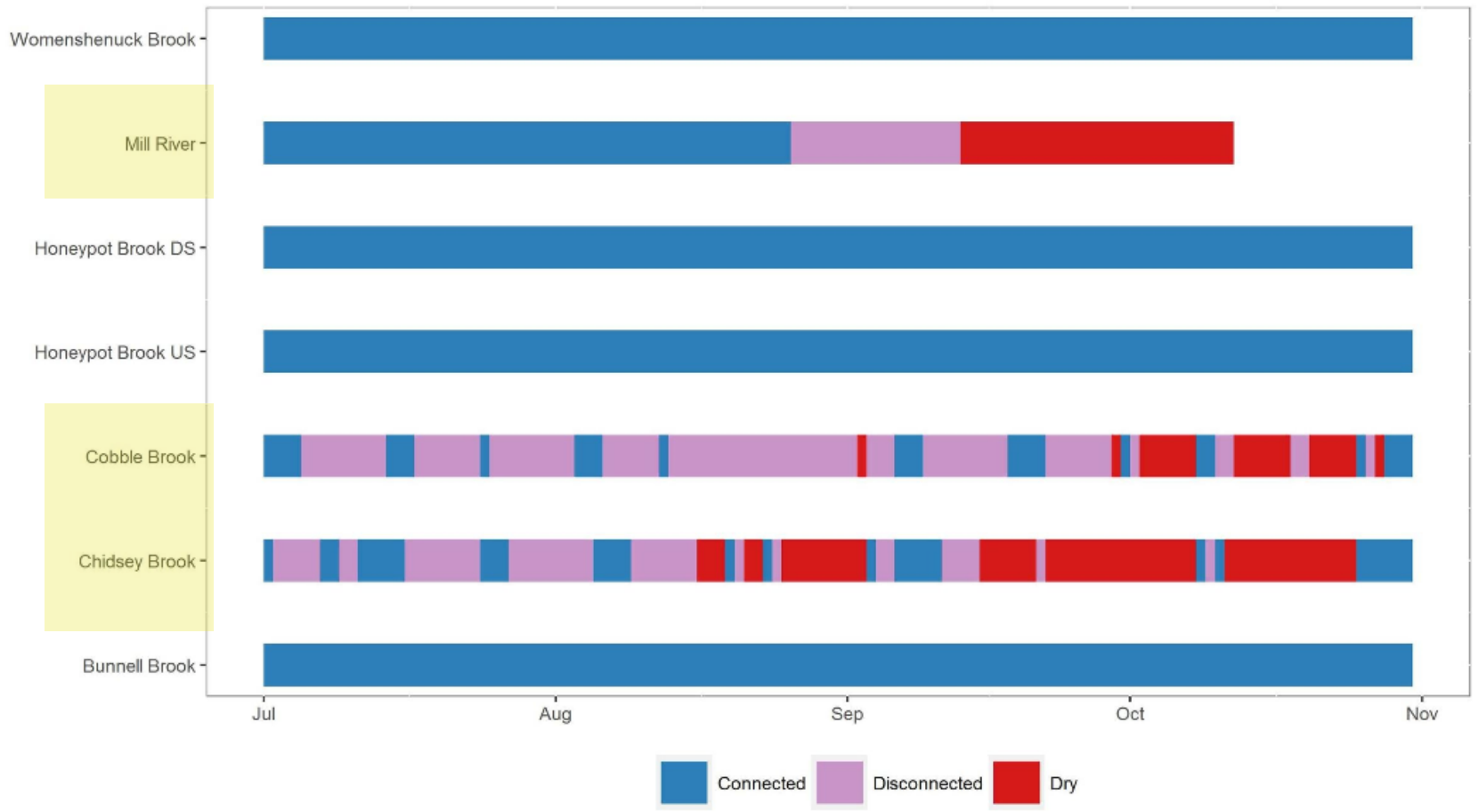
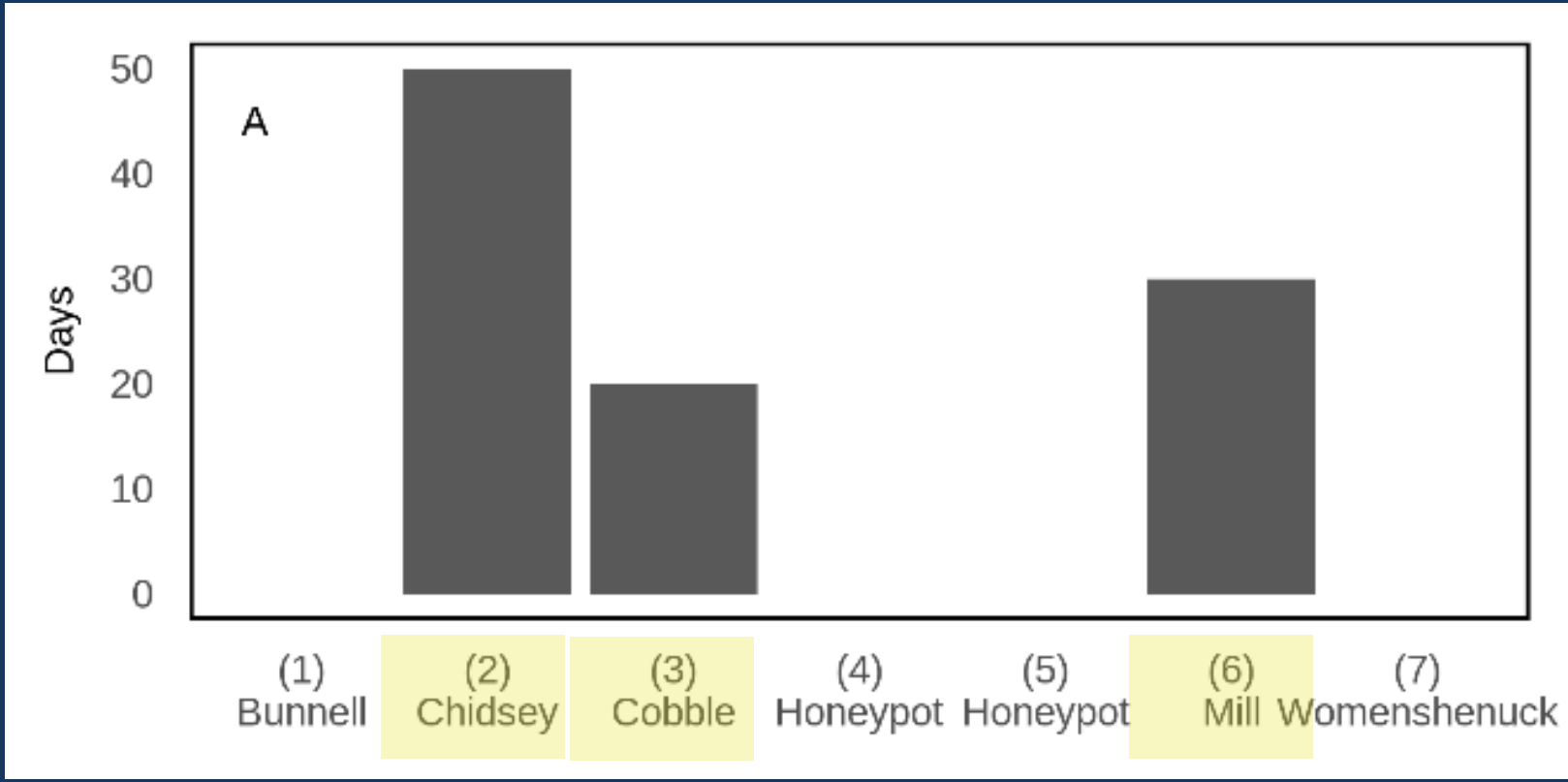
30 Stream Connectivity Metrics



Timing & Duration Metrics

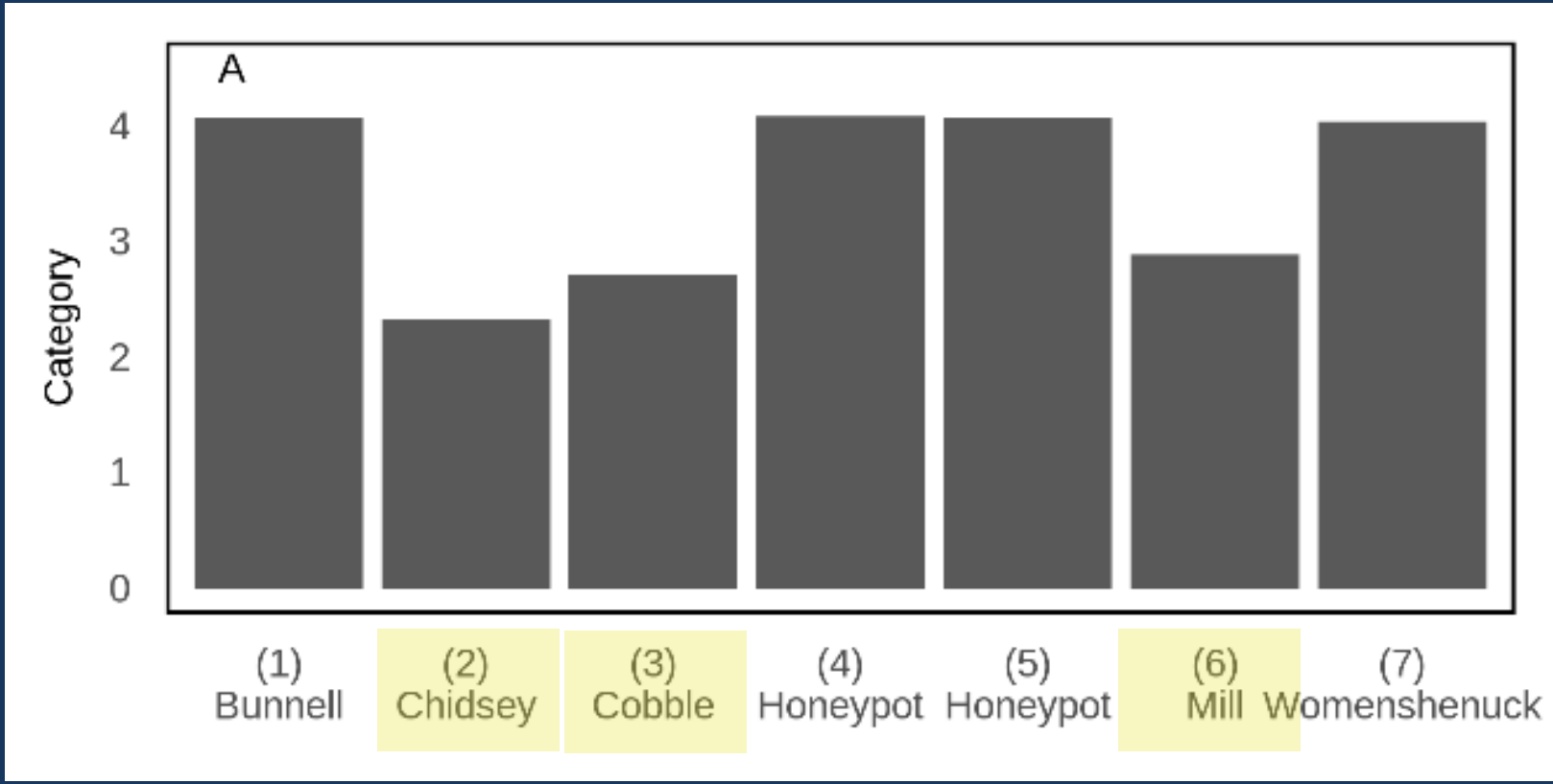


Frequency Metric



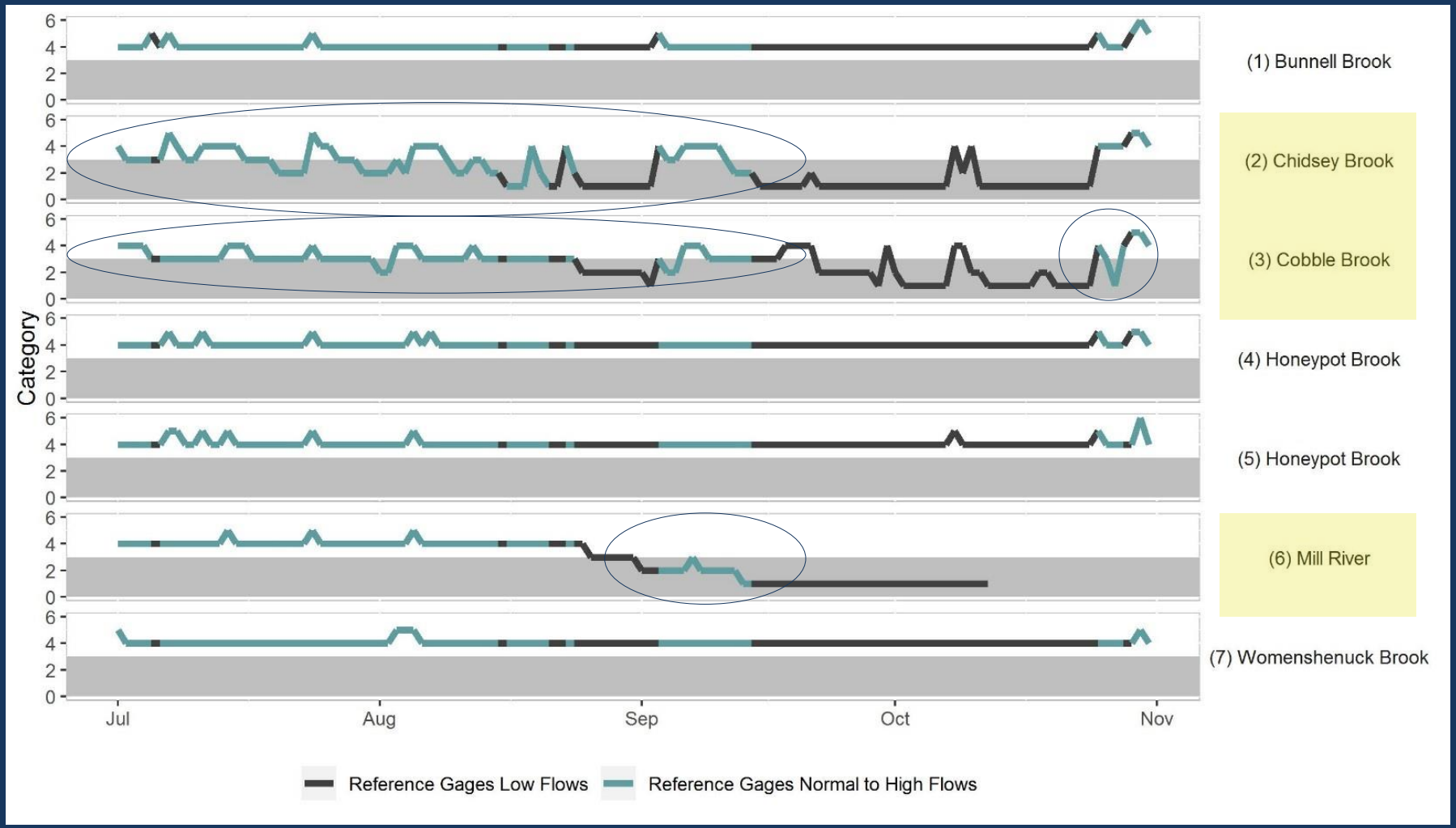
Number of days from July through October in which the flow was dry (Category 1)

Magnitude Metric

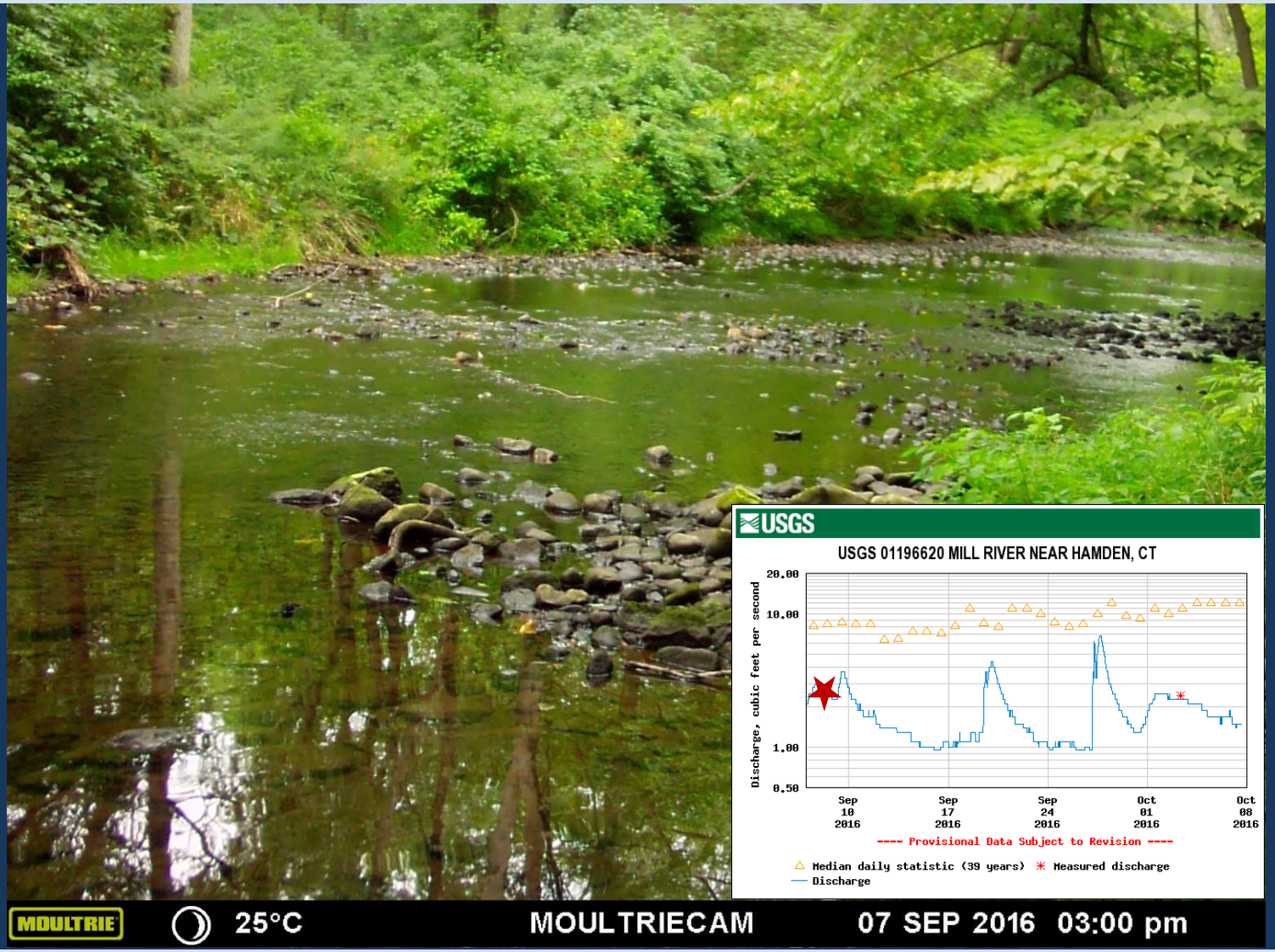


Average Flow Category from July through October

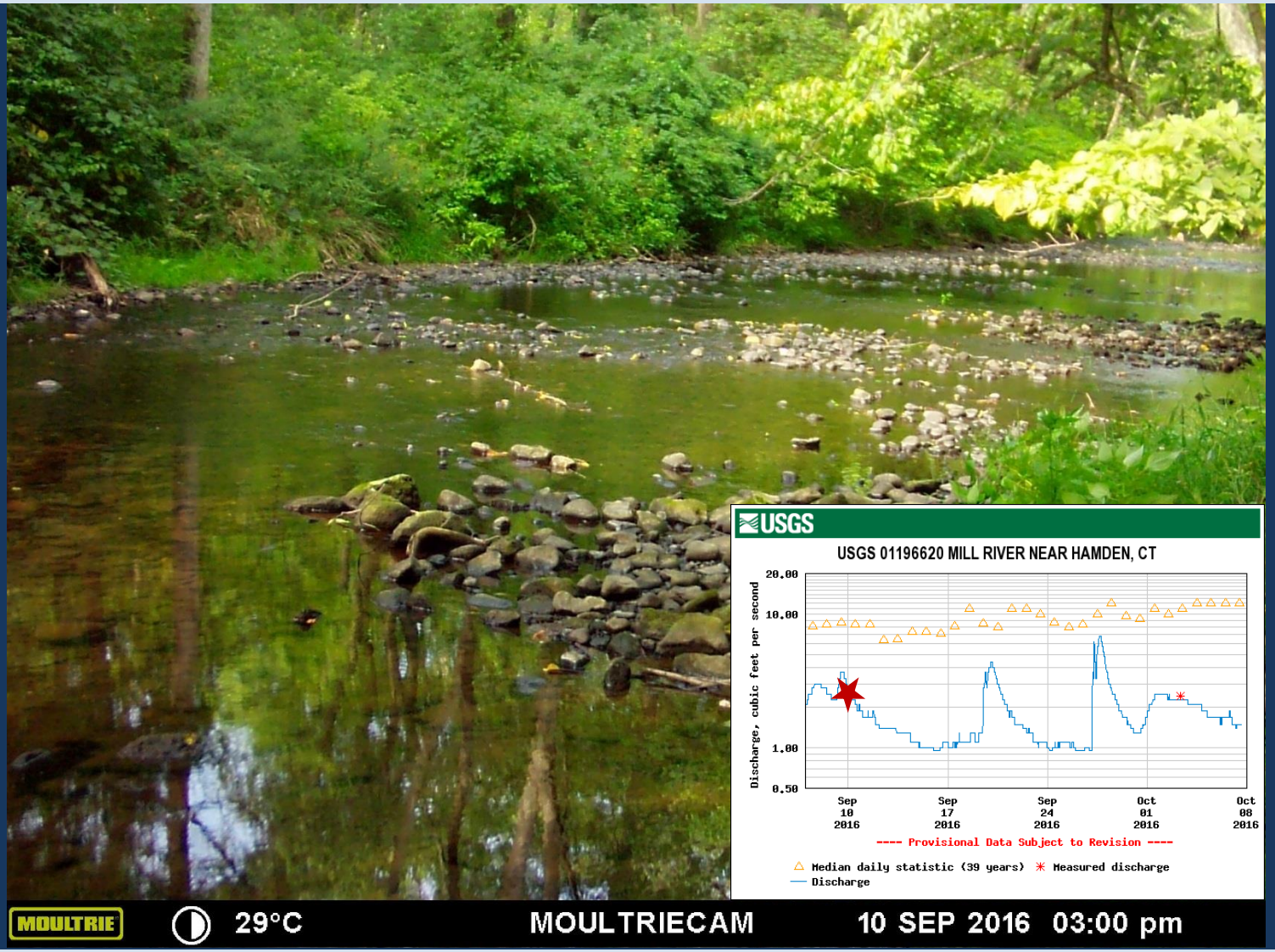
Metrics Example



September 7, 2016 – 2.70 cfs



September 10, 2016 – 2.20 cfs



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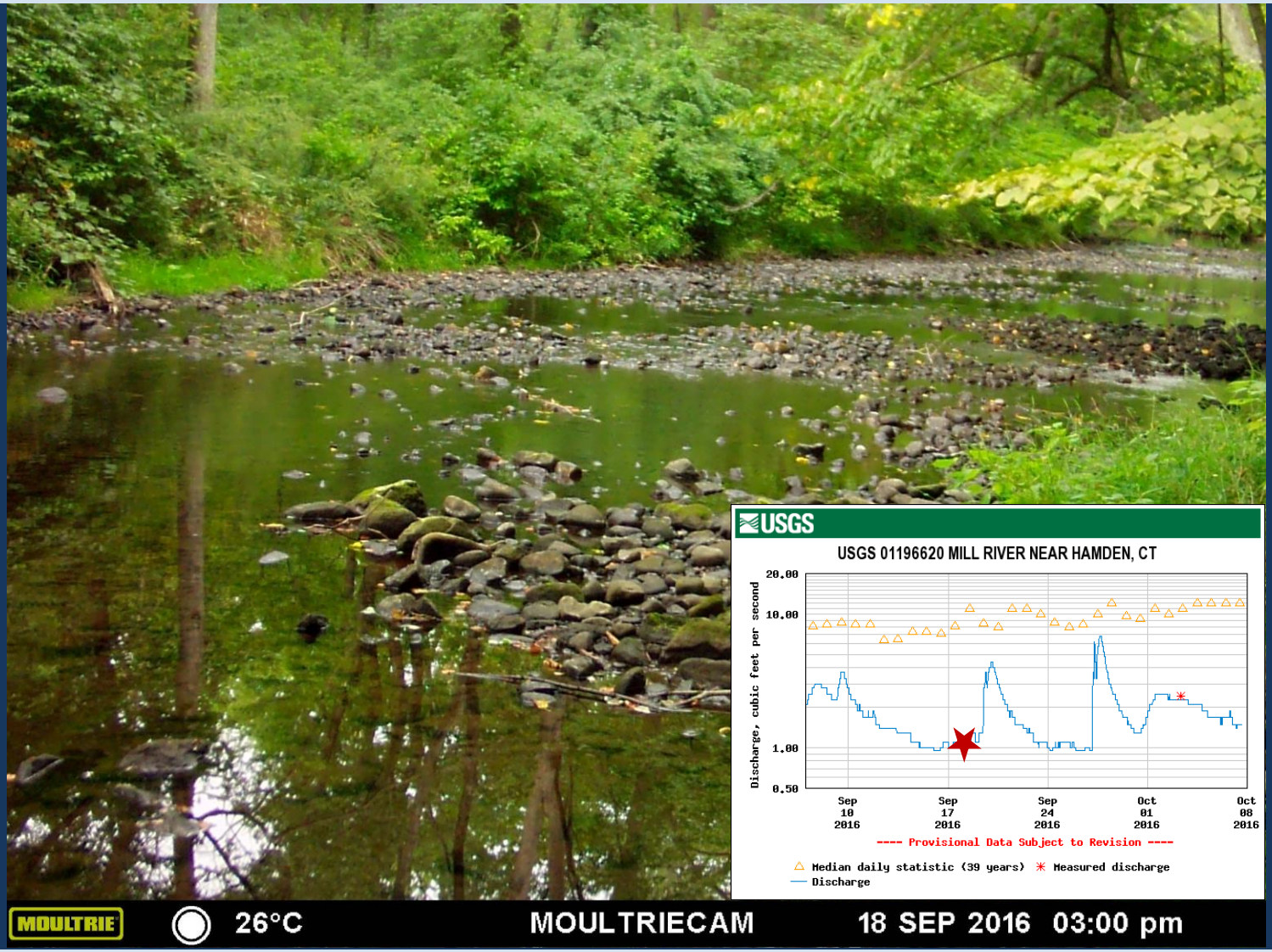
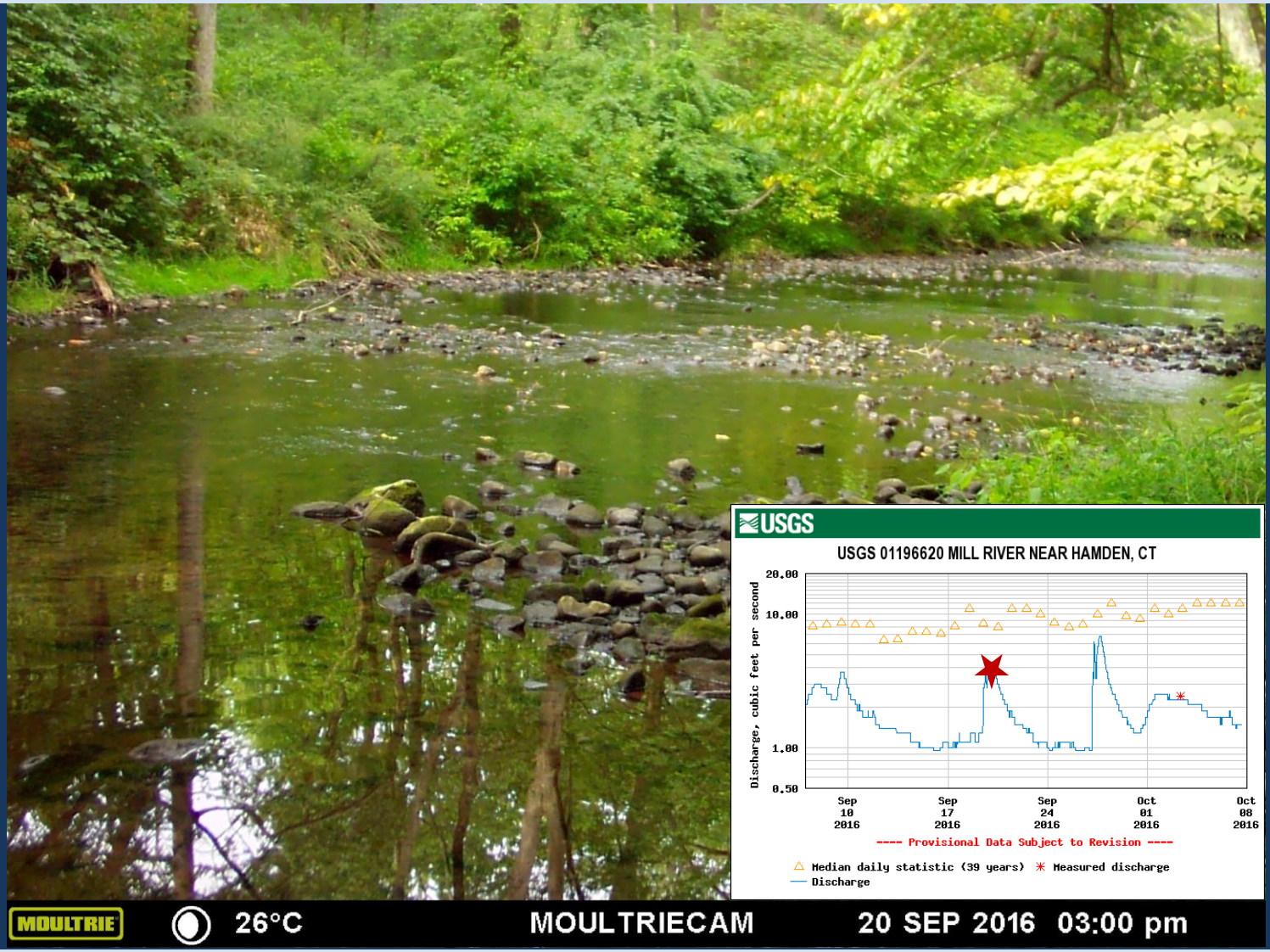
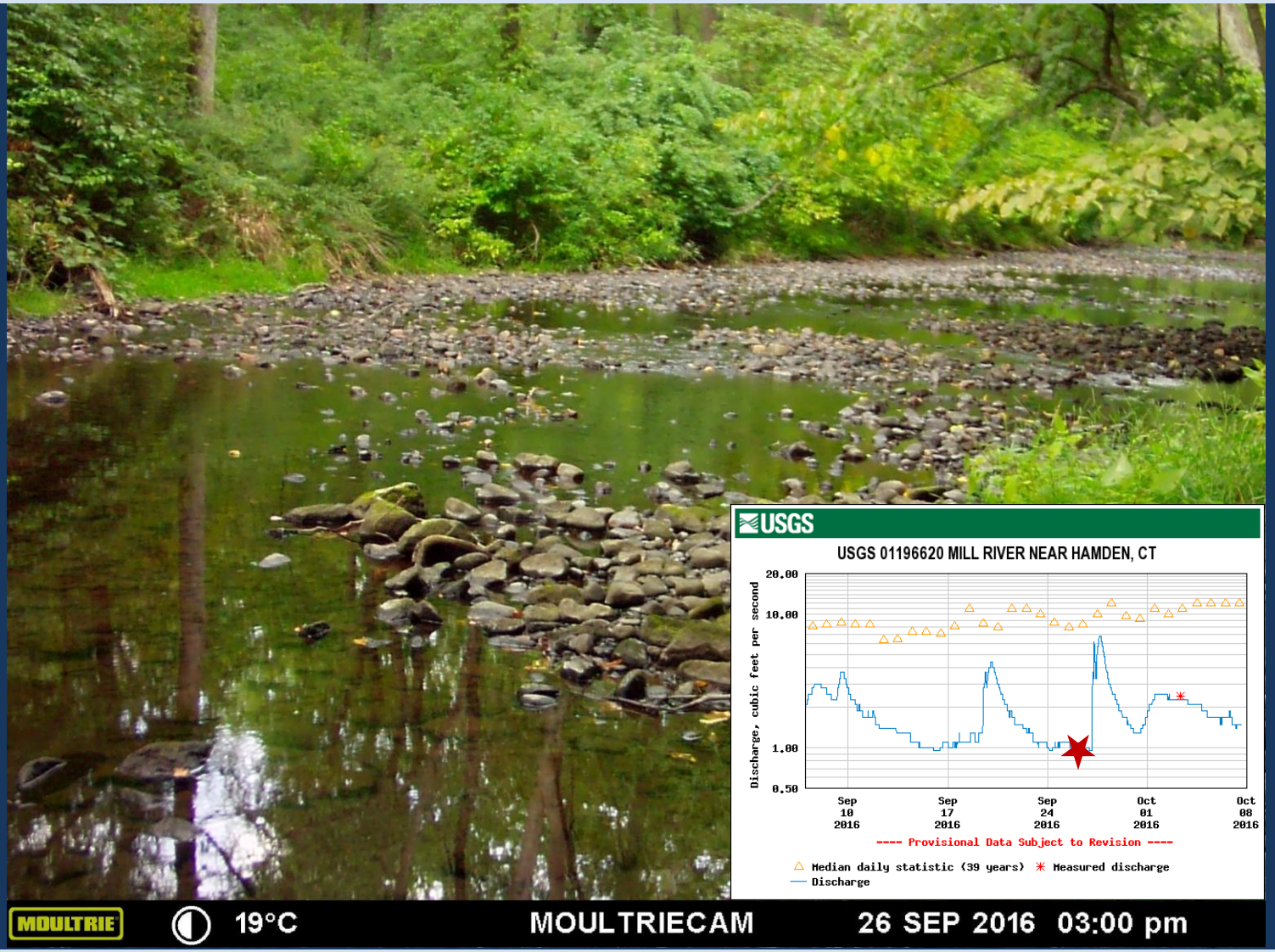
September 18, 2016 – 1.20 cfs



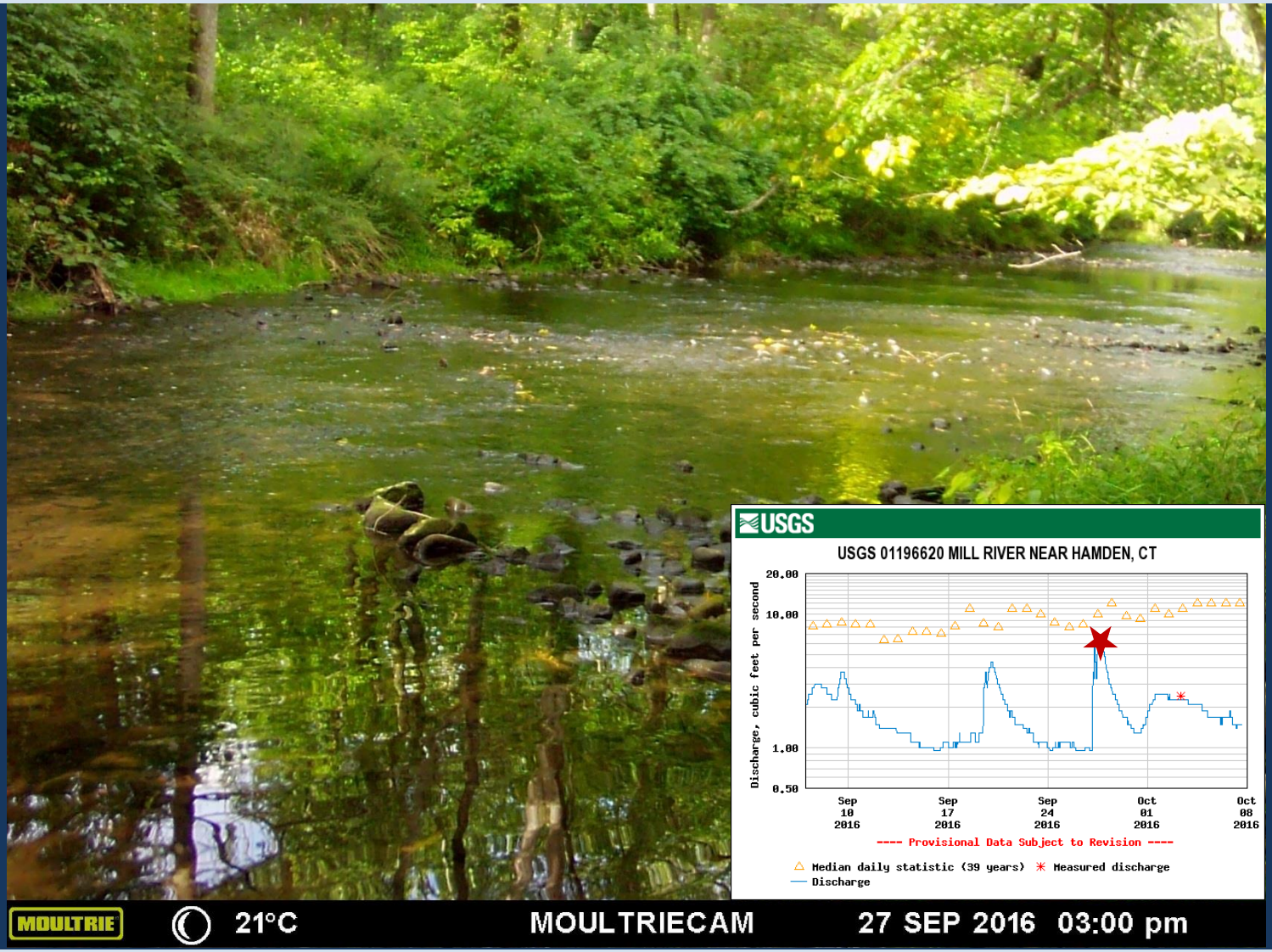
September 20, 2016 – 3.20 cfs



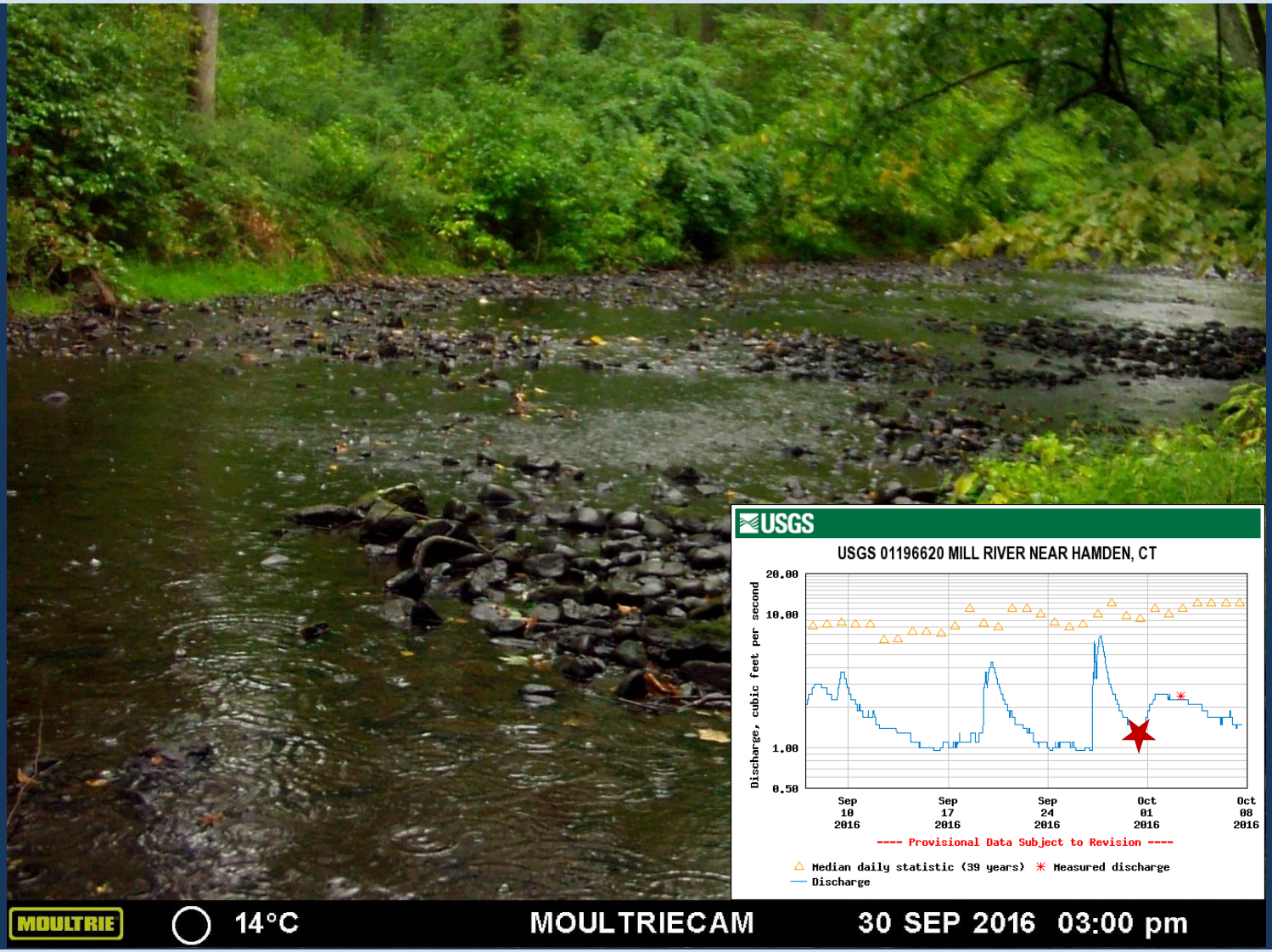
September 26, 2016 – 0.97 cfs



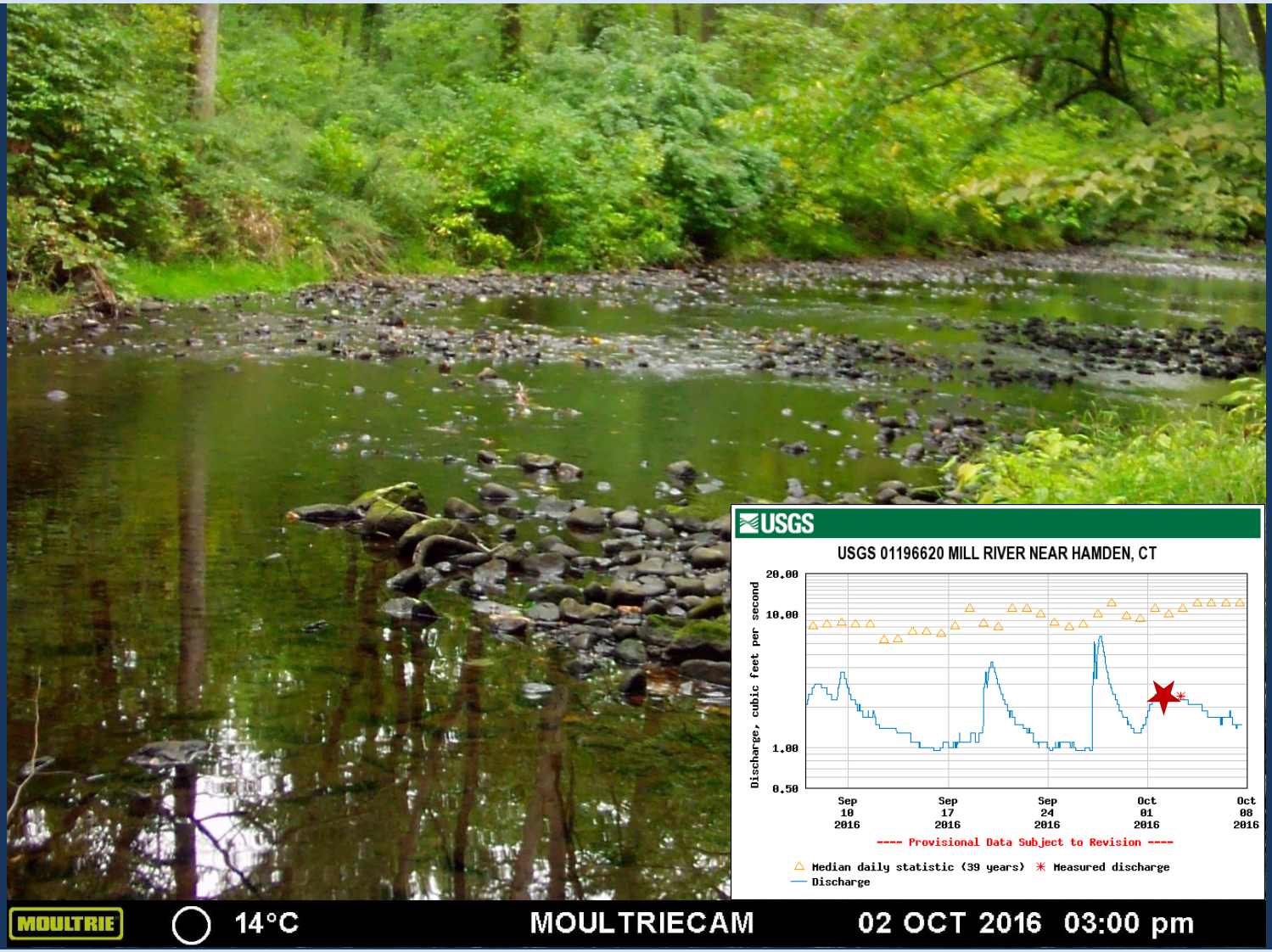
September 27, 2016 – 4.00 cfs



September 30, 2016 – 1.40 cfs



October 2, 2016 – 2.40 cfs



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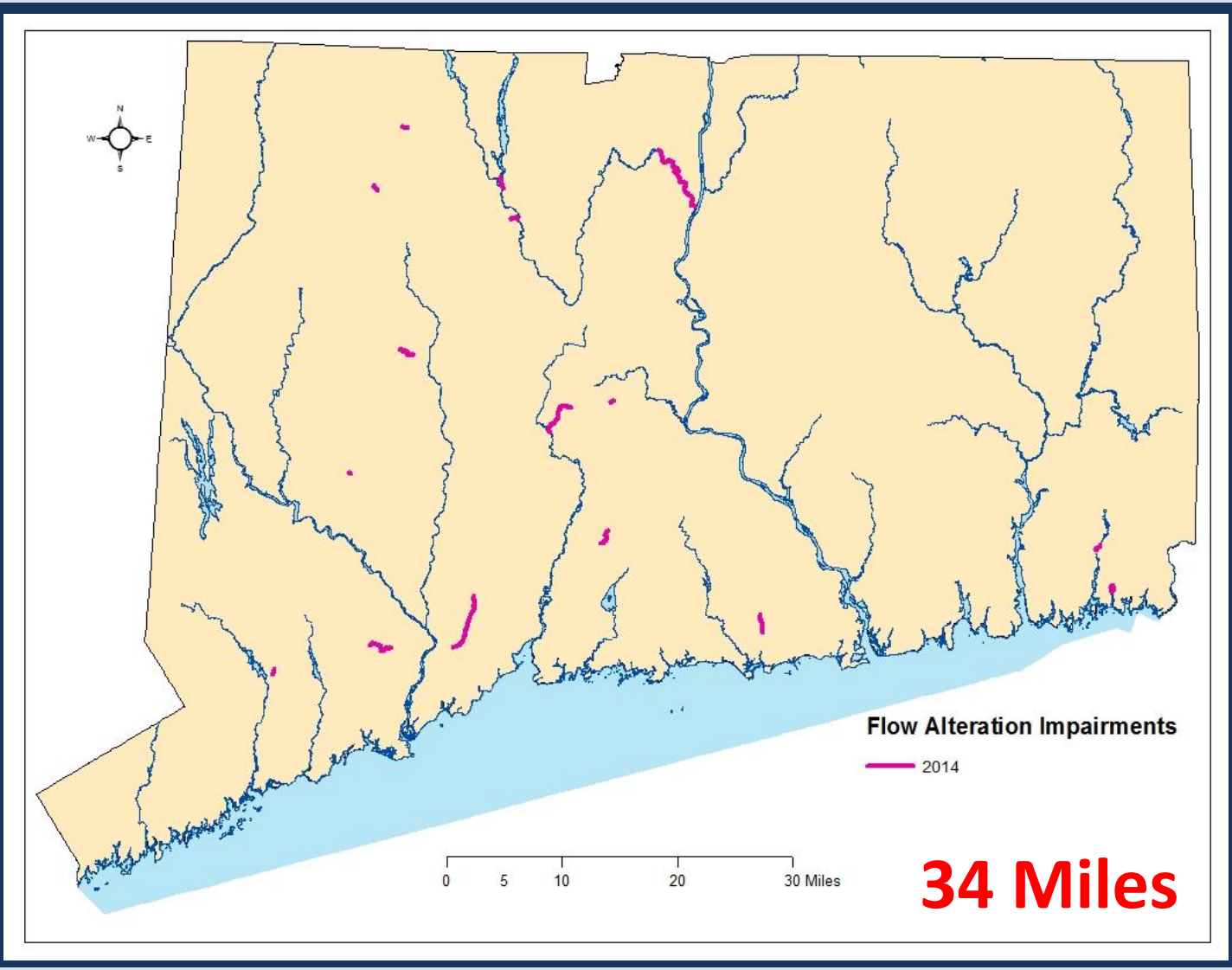
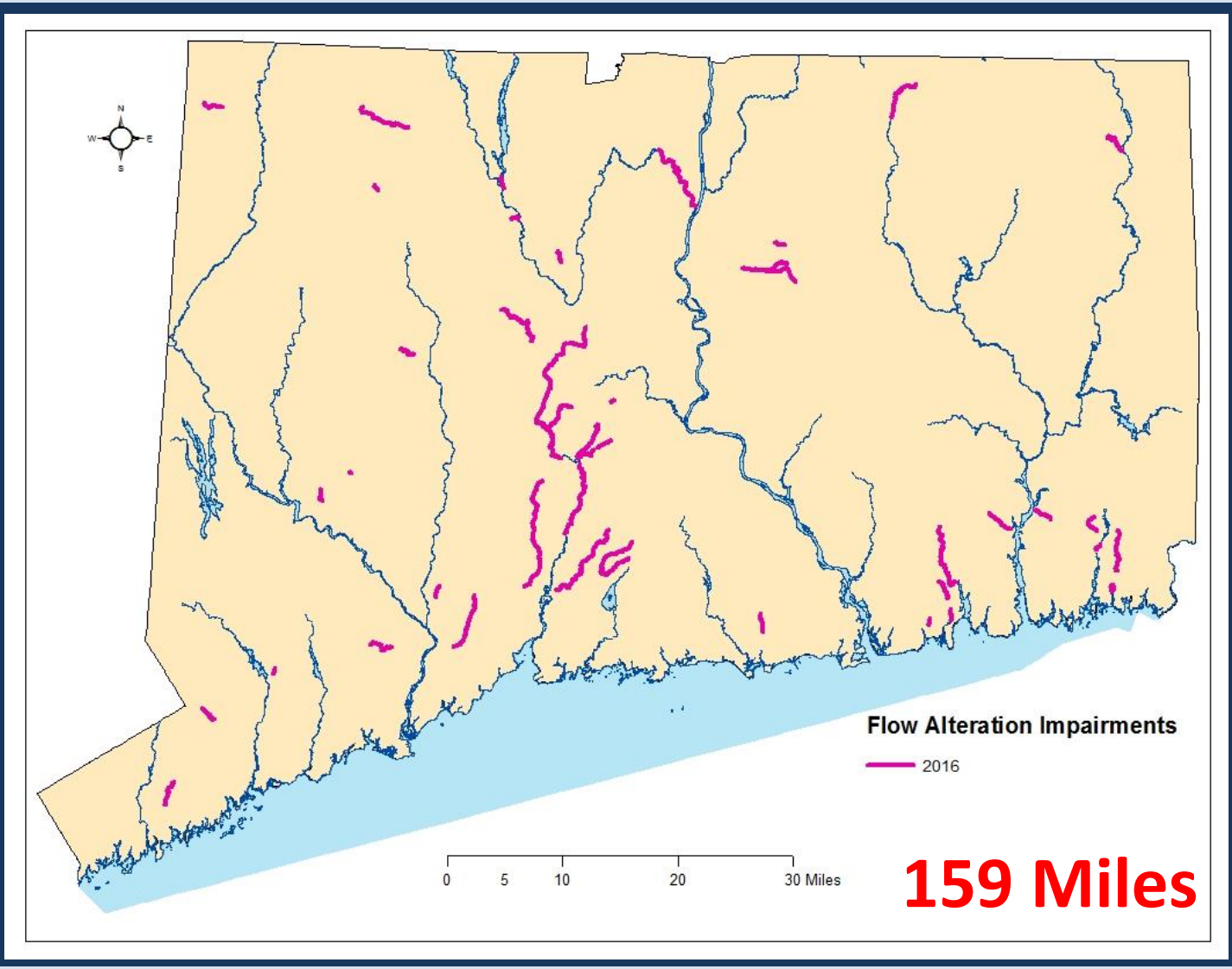
Better Accounting of Flow Alteration



Better Accounting of Flow Alteration



Bonus – Wildlife Images

Source Code & Data

Freely available and open source at:
https://github.com/marybecker/streamconnectivitymetrics

Questions?

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