Jun 21st, 2:15 PM - 3:00 PM

Case Studies II: Citizen Science on the Move: Detailing the Spawning Migrations of Alewife and Blueback Herring in a Coastal Massachusetts Watershed

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Citizen science on the move:

Detailing the spawning migrations of alewife and blueback herring in a coastal Massachusetts watershed

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Community effort

The many fish sponsors:

>100 individuals and organizations adopted ~1000 herring

~175 students from Falmouth public schools

About 85% of the program costs in 2015 and a similar percentage in 2016

Other support:

Falmouth Rod & Gun Club

Sporting Safety Conservation and Education Fund of Falmouth (SSCEFF)

Falmouth DNR

Volunteers:

Peter J. Hargraves
Bruce Bertschmann
Linda Chambers
Thomas Carignan
Robert Delano
Emily Ferguson
Mary Fox
Iris Jones
Steve Jones
Pat Keoughan
Roger Kligler
Pamela Kokmeyer
Linda Lutz
Martin Monk
Frank Okrasinski
Carl Peterson
Erica Szuplat
Mitch Buck
Wendi Buesseler
Terry Hughes
Ken Kostel
Izja Lederhendler
Greg Pinto
Anne-Marie Runfola
Steven Treistman
Betsy Gladfelter
Camile Romano
Andy Nabreski
R. Charles Martinsen

And many many others!

Falmouth WATER Stewards (Protect · Preserve · Restore)

Falmouth Rod & Gun Club, Cape Cod, Massachusetts

Coonamessett River Trust

Scientific support from many sources

Assistance and advice:

Heidi Golden, UConn

Cameron MacKenzie, MBL

Derrick J. Alcott, UMass

Wendi Buesseler, CRT

Joel Llopiz, WHOI

Ben Gahagan, MA DMF

Brad Chase, MA DMF

John Sheppard, MA DMF

Warren Winders, SRBT

And many many others!

Whether your working on salmon or herring

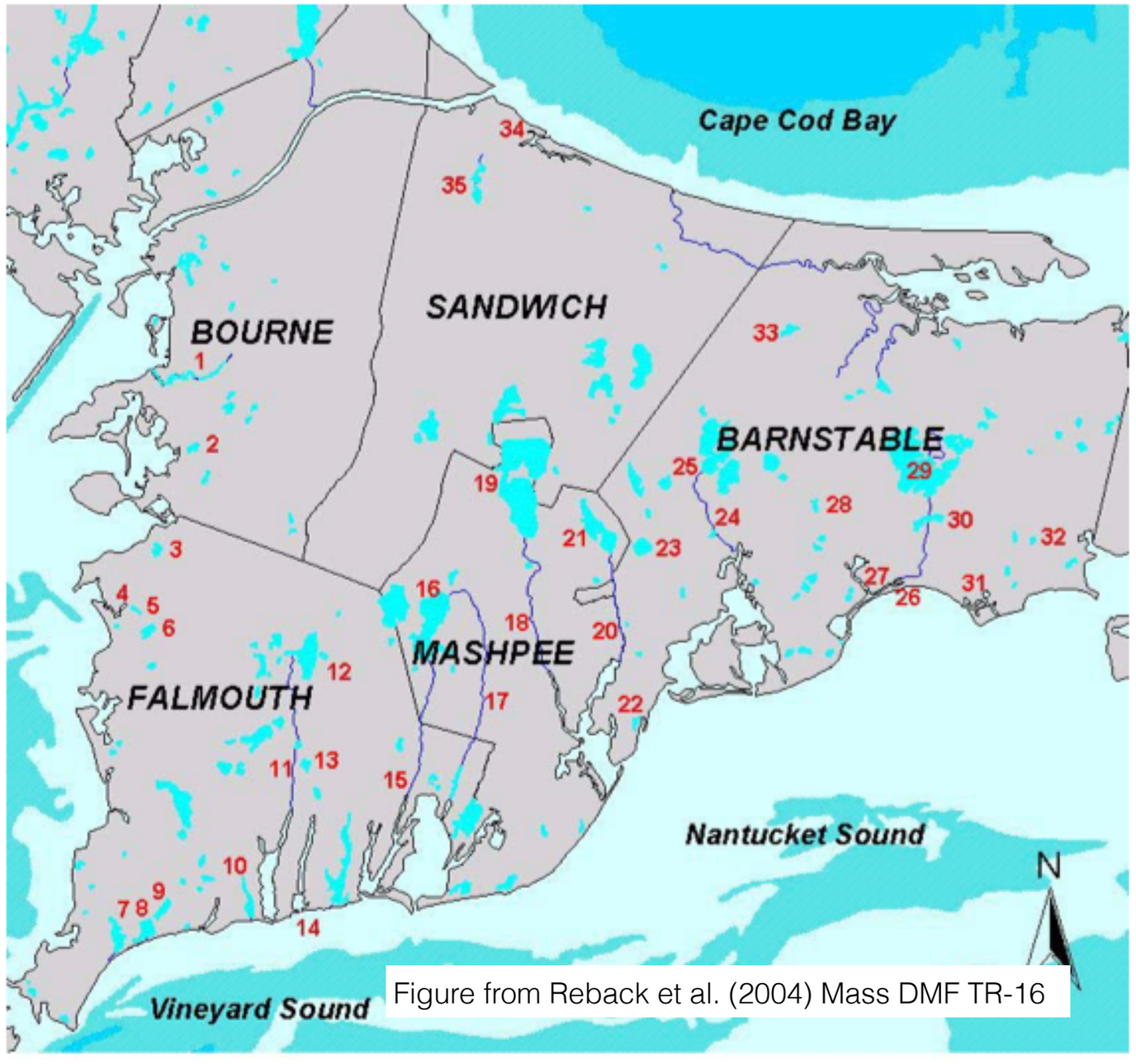


Figure from Reback et al. (2004) Mass DMF TR-16

observations of many populations are needed

Volunteer counts can help

Visual counts by volunteer groups are a means for obtaining data on a large number of runs

Currently there are a large number of herring count efforts in Massachusetts

Photo: CRT

Counts alone cannot tell us about nuanced movement patterns

How long does it take an individual to reach a spawning pond?

When during the day do fish move most?

Do fish spend a significant period of time in freshwater?

Interactions with specific barriers?

Do some fish stop before the visual counting station?

RFID tags can tell us about nuanced movement patterns

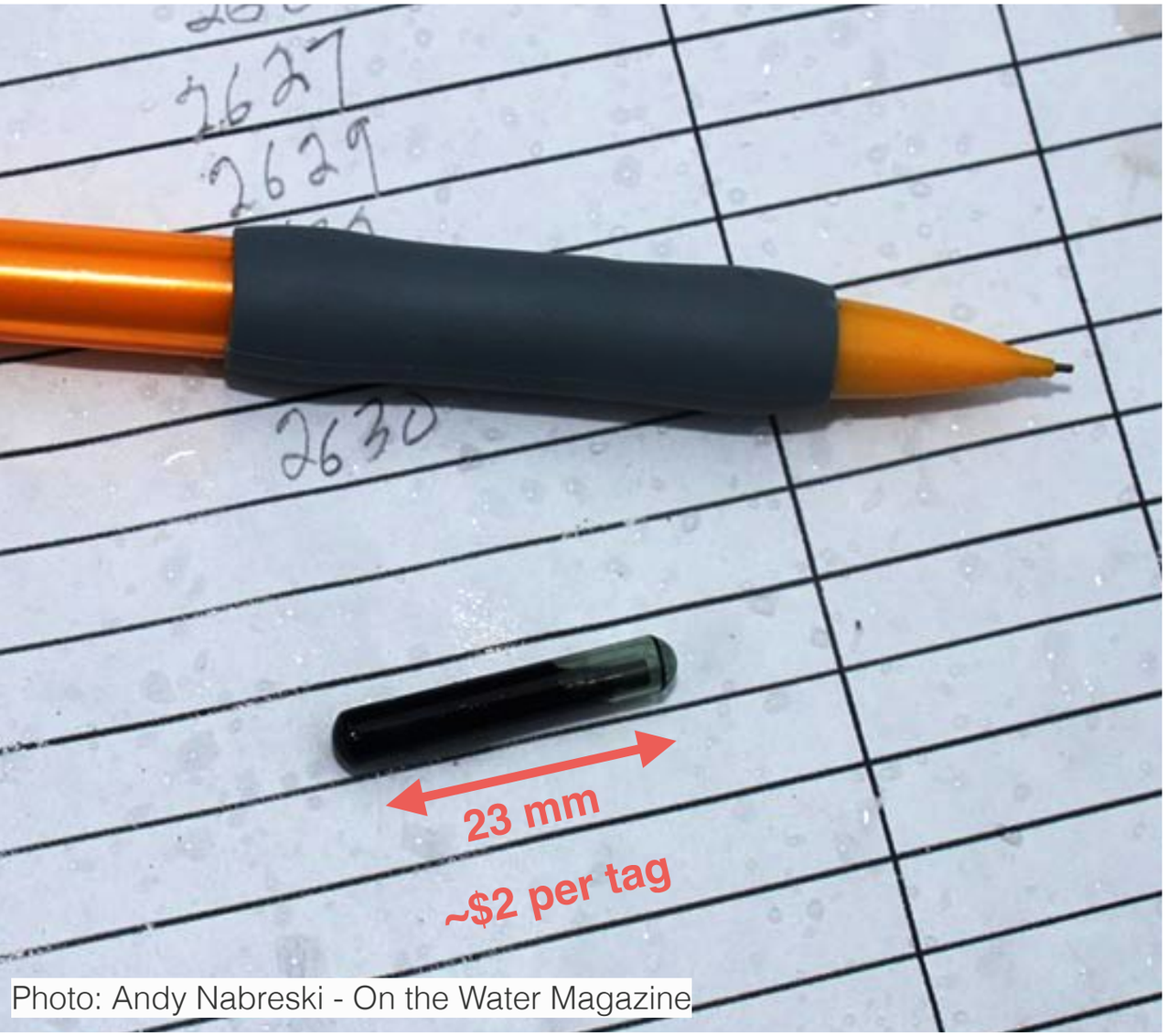
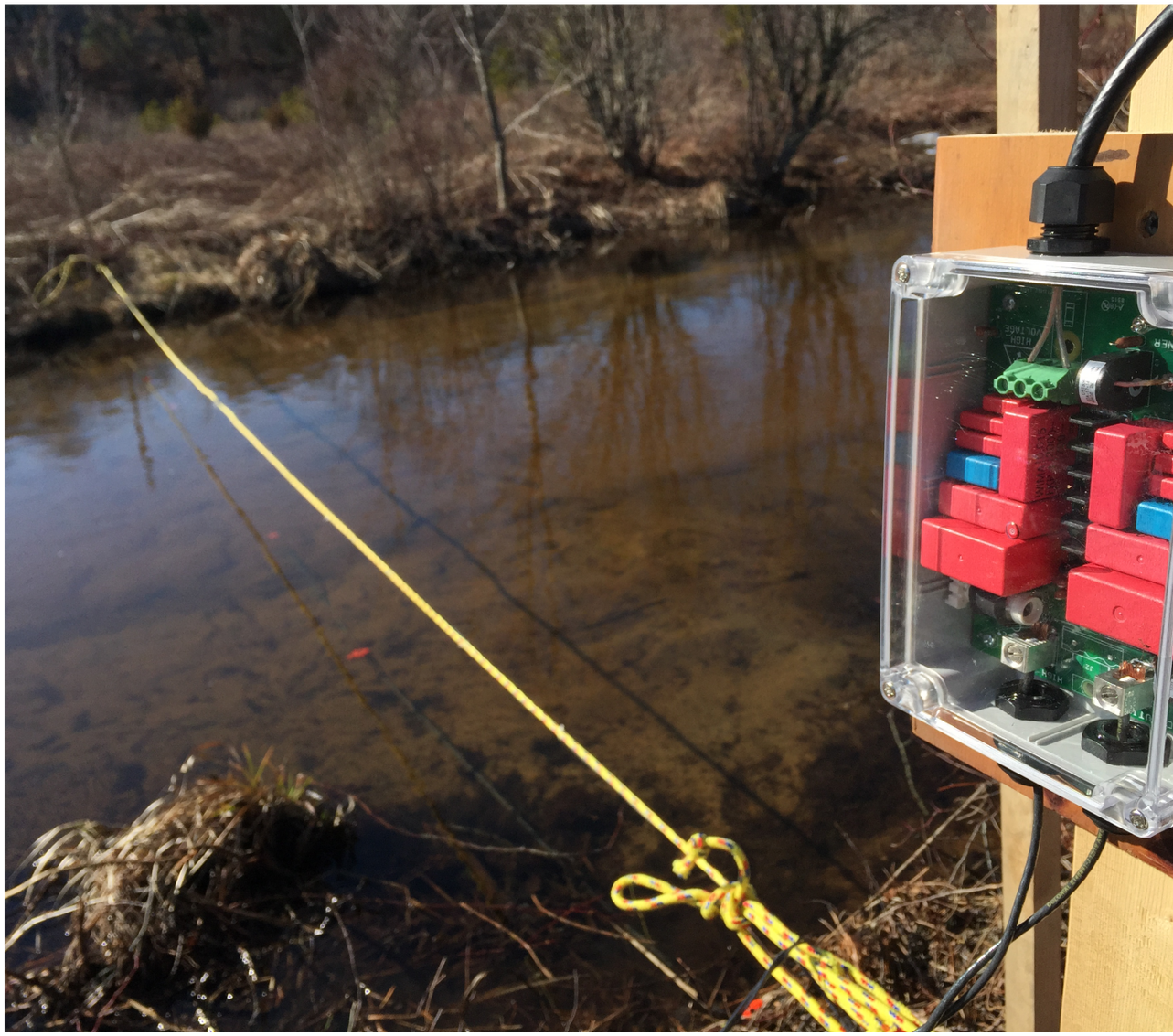


Photo: Andy Nabreski - On the Water Magazine



Technology advanced and user friendly

RFID tags can tell us about nuanced movement patterns

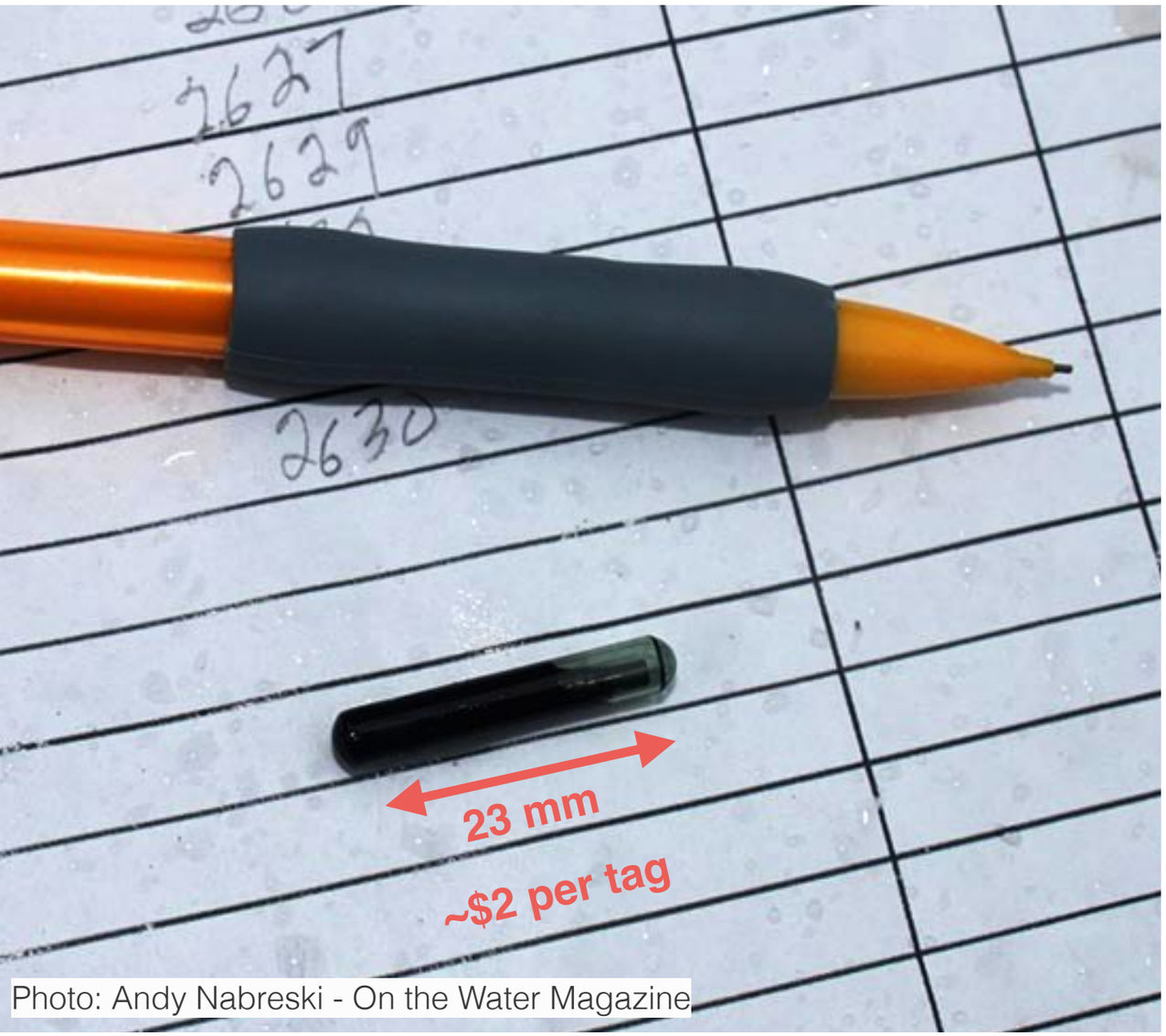
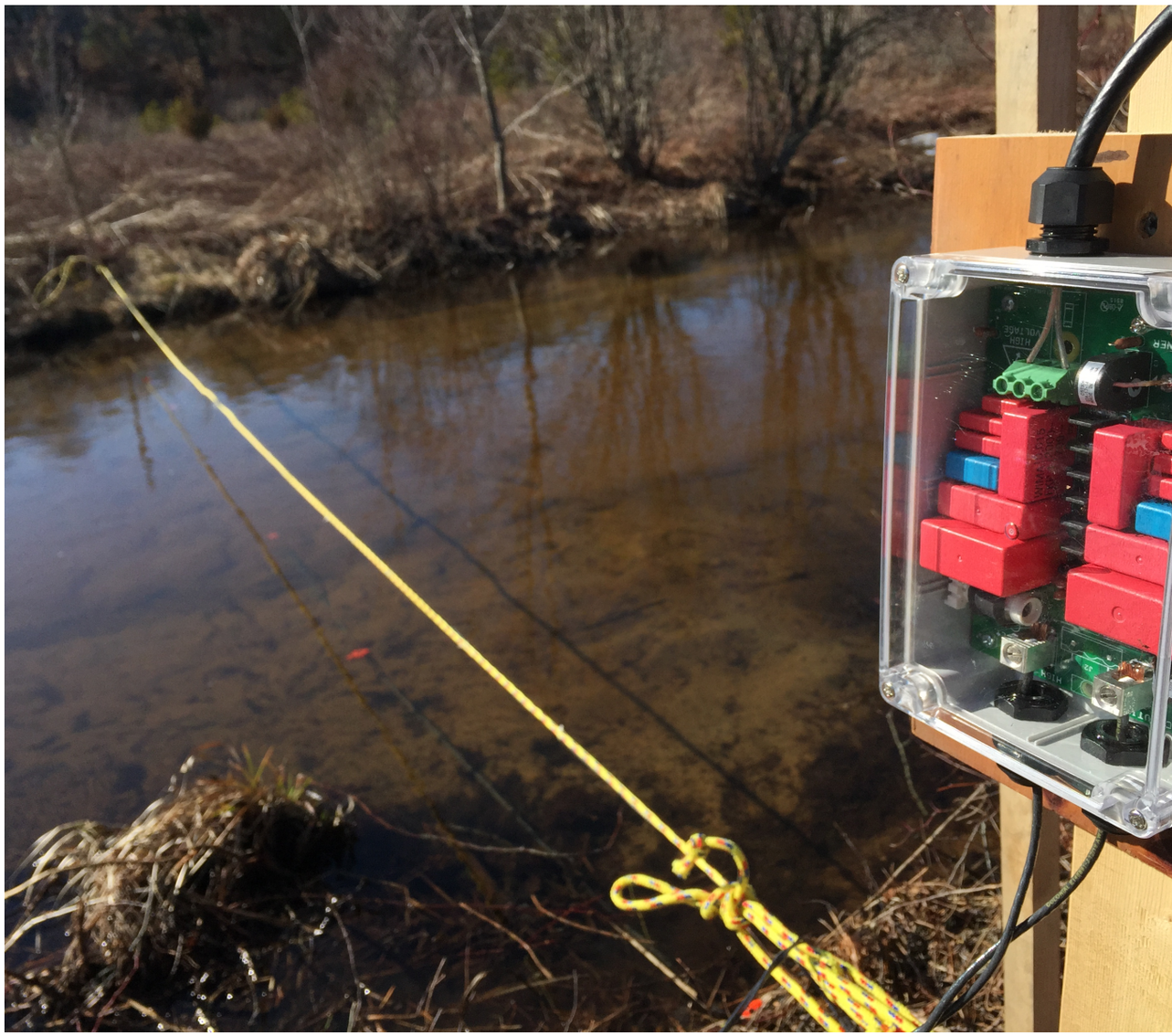


Photo: Andy Nabreski - On the Water Magazine

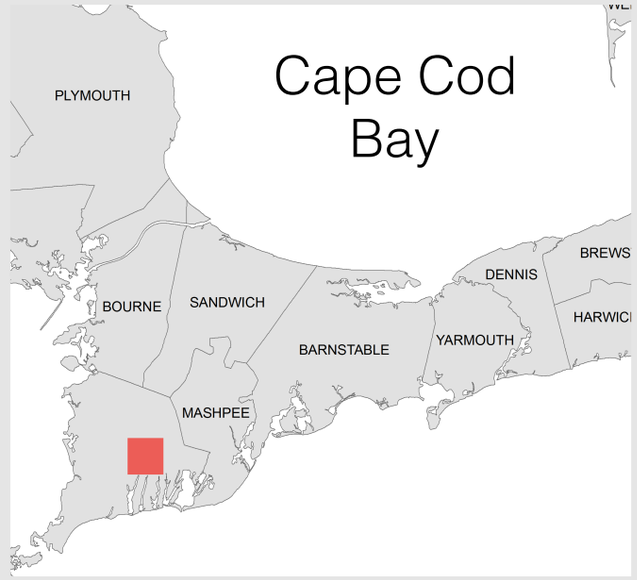


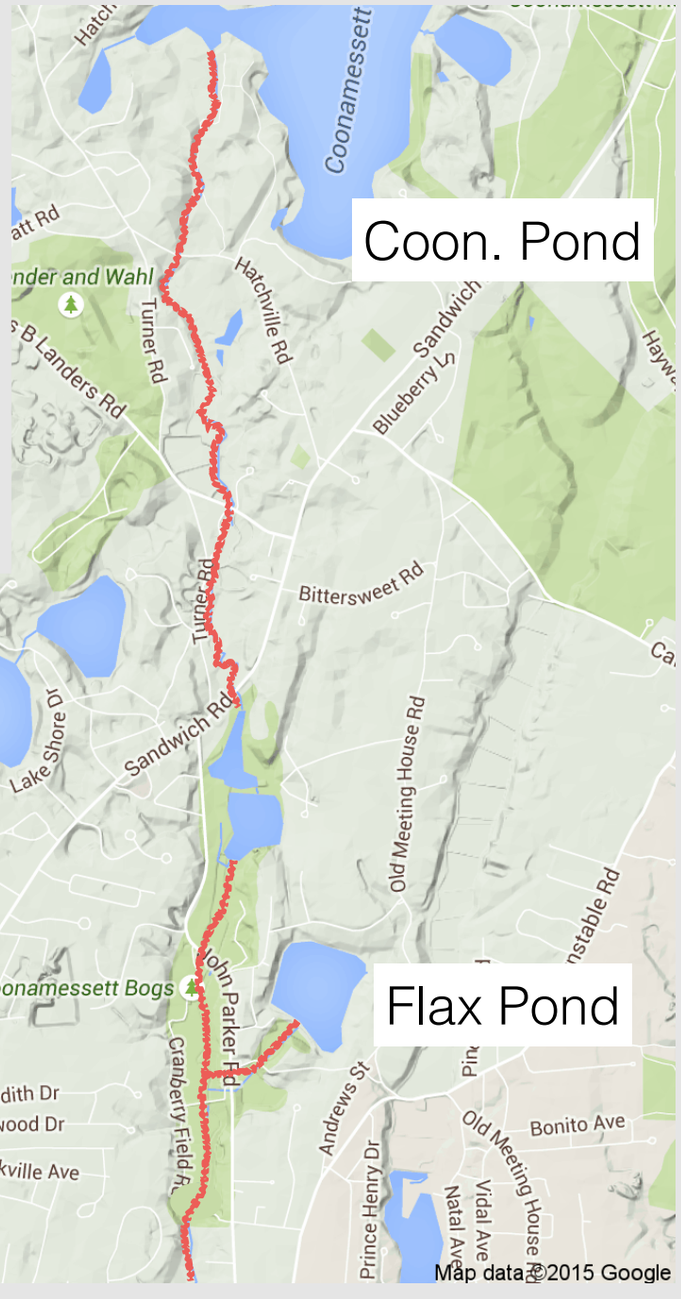
Potential role for volunteer groups here as well

Example of a volunteer based exploration of movement in a local MA watershed

Moderate length run (~5 km in length)

Currently at least two ponds used for spawning (potentially other areas as well)





River herring

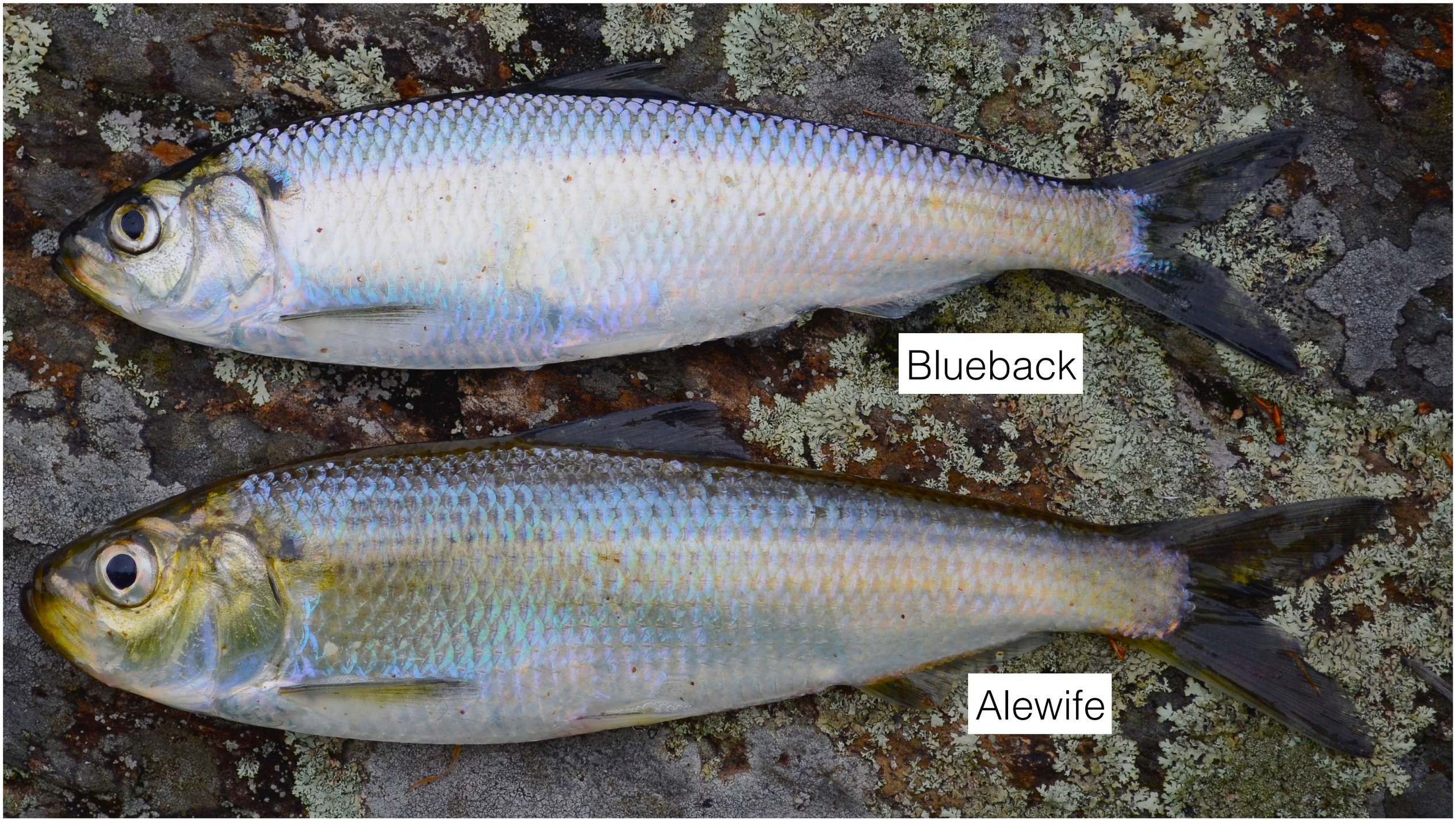


Photo: Chris Bartlett - Maine Sea Grant

LAKES AND STREAMS

Juveniles

Larvae

Eggs

SUMMER/FALL

ESTUARIES

Juveniles

SPAWNING

SPRING

ALOSINE LIFE CYCLE

FALL/WINTER

SPAWNING

Multiple years

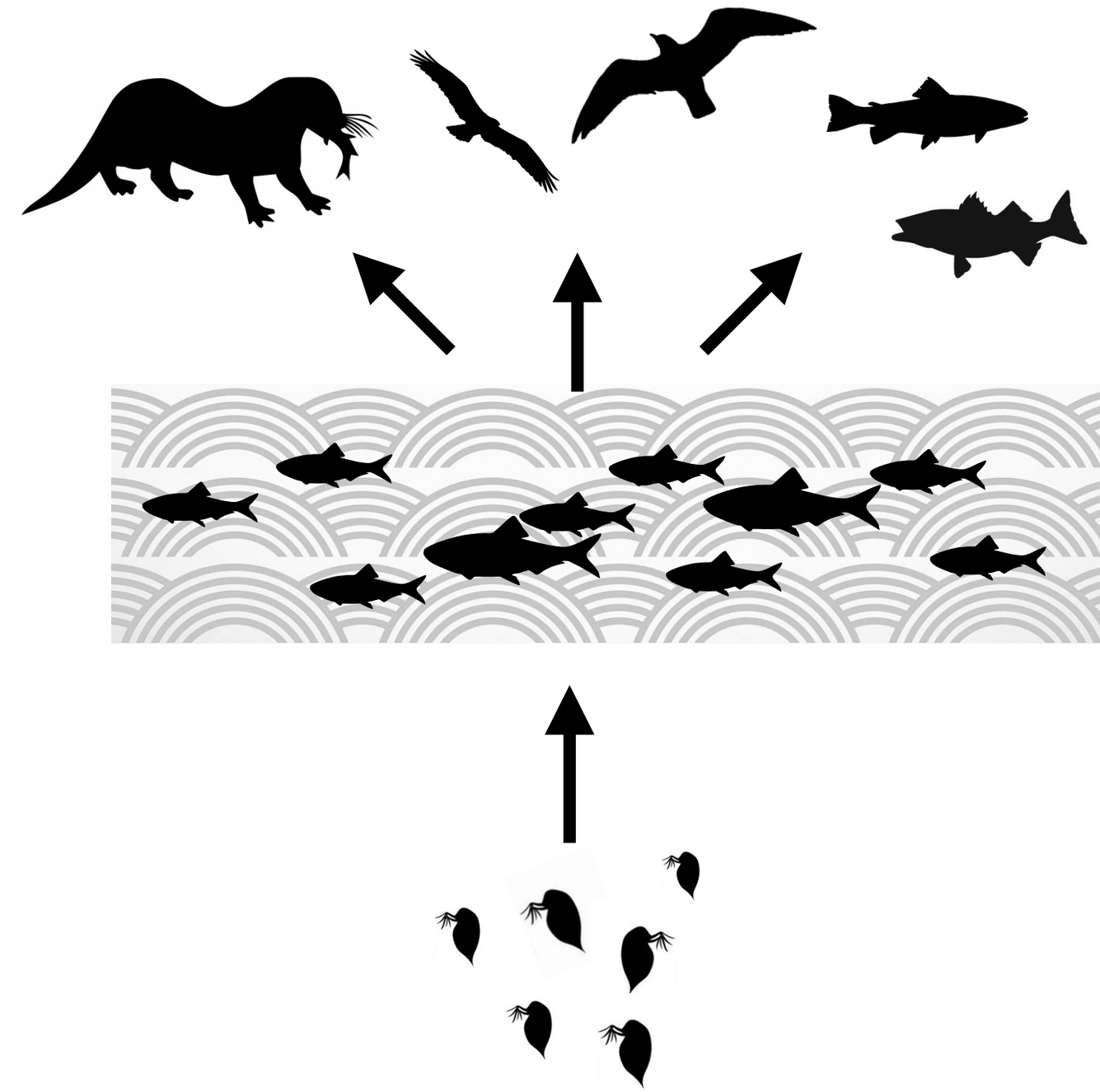
NORTHEAST CONTINENTAL SHELF

Ripe Adults

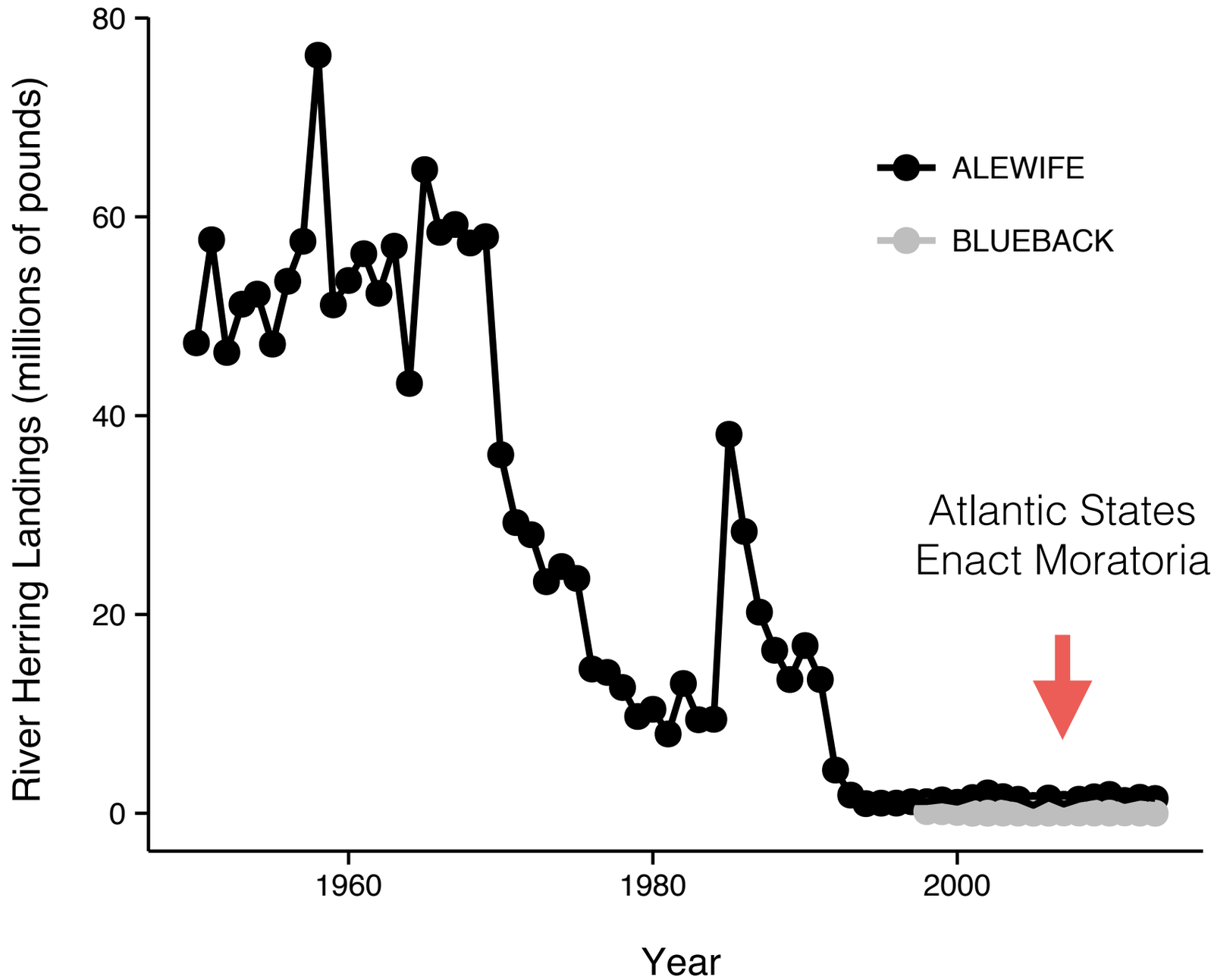
Mature Adults

Ecological importance

- Link freshwater and marine ecosystems
- Important prey species for predators in both environments
- Canonical keystone predator in freshwater (shape zooplankton community)
- Important to people as well



Recently river herring have been identified as species of concern



Data: NMFS Fisheries Statistics Division

Example of a volunteer based exploration of movement in a local MA watershed

Long history of herring harvest

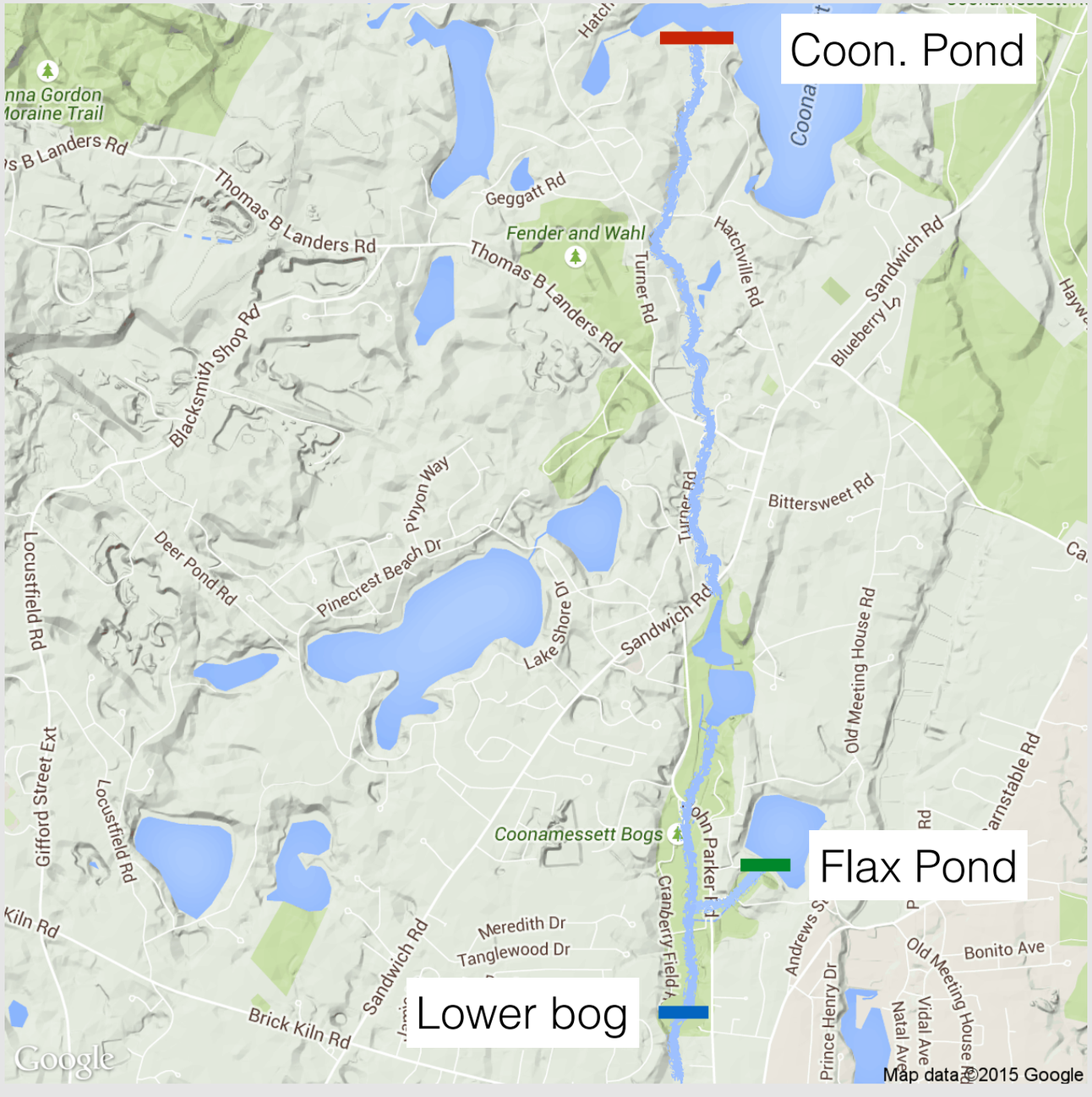
Historically a productive river

Restoration plans in the pipeline

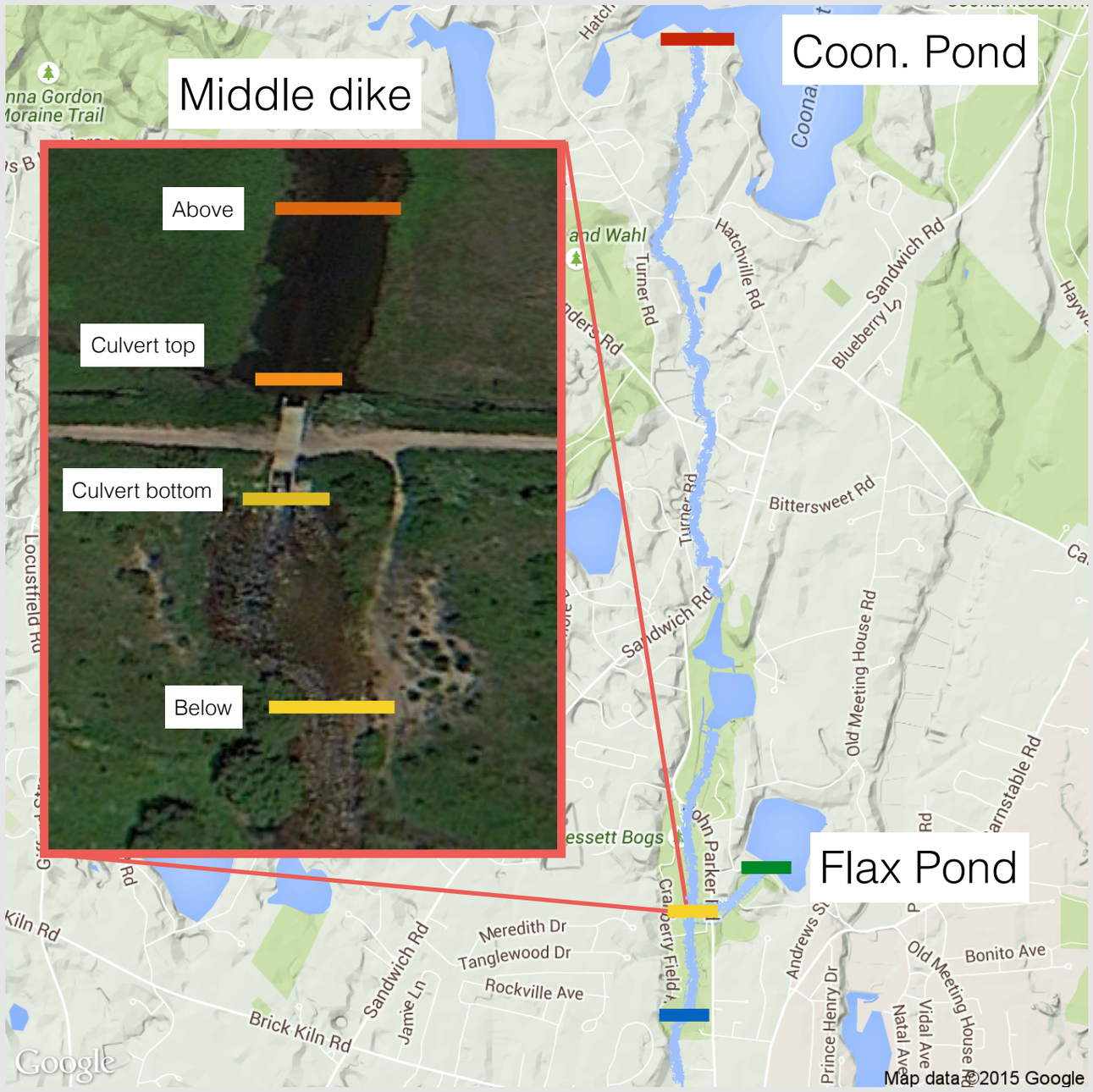
Antenna locations

Antennas placed in strategic position within the watershed

One near tagging site and one at each pond (where spawning is thought to occur)



Other antennas in the watershed: 2015



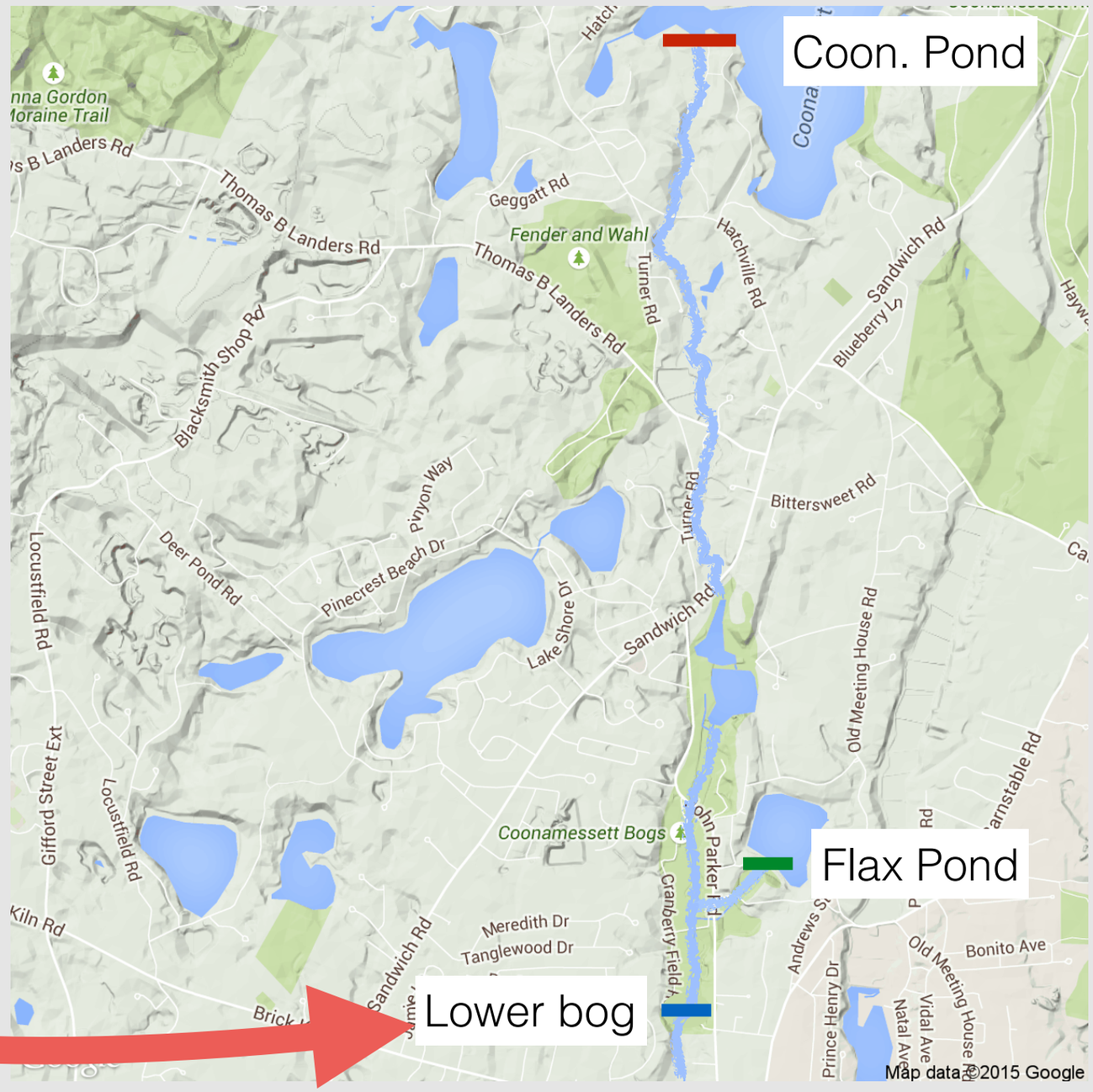
Herring tagging

Tagged ~970 fish over 2 years (2015 & 2016)

~ 820 alewives & ~ 150 blueback

Migration and outmigration studied

Tagging Site



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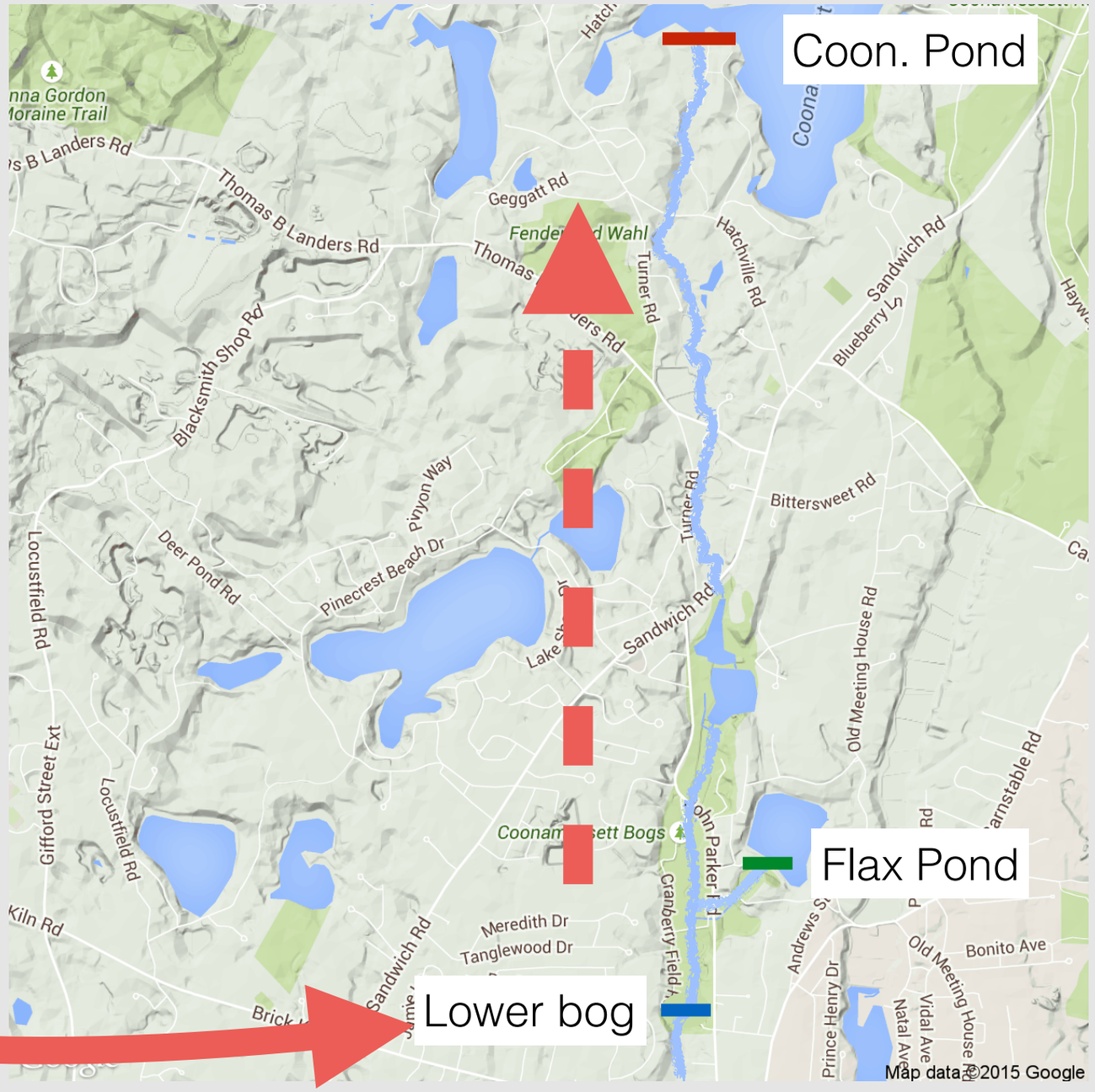

Photo: Andrea Carter Falmouth Enterprise

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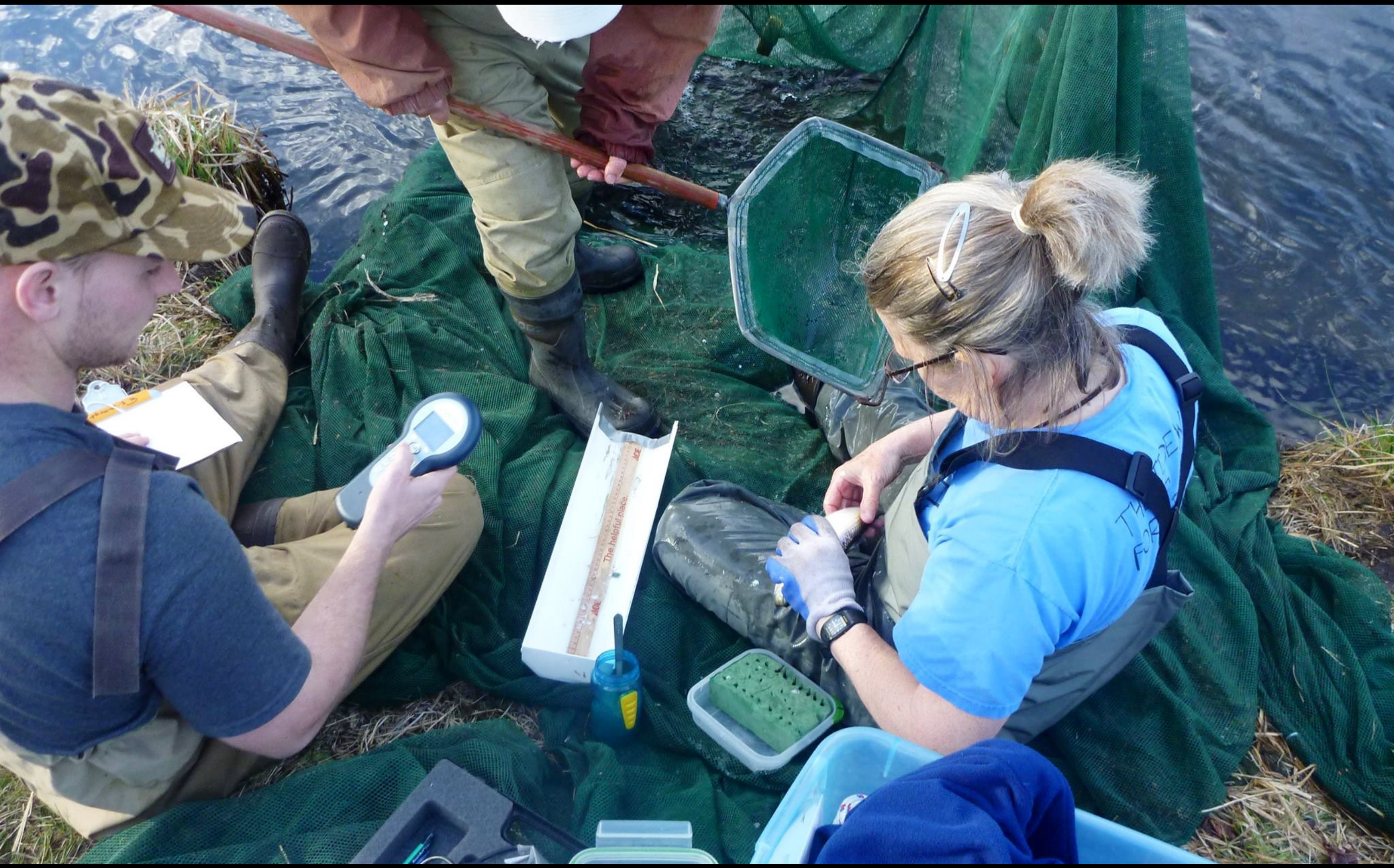
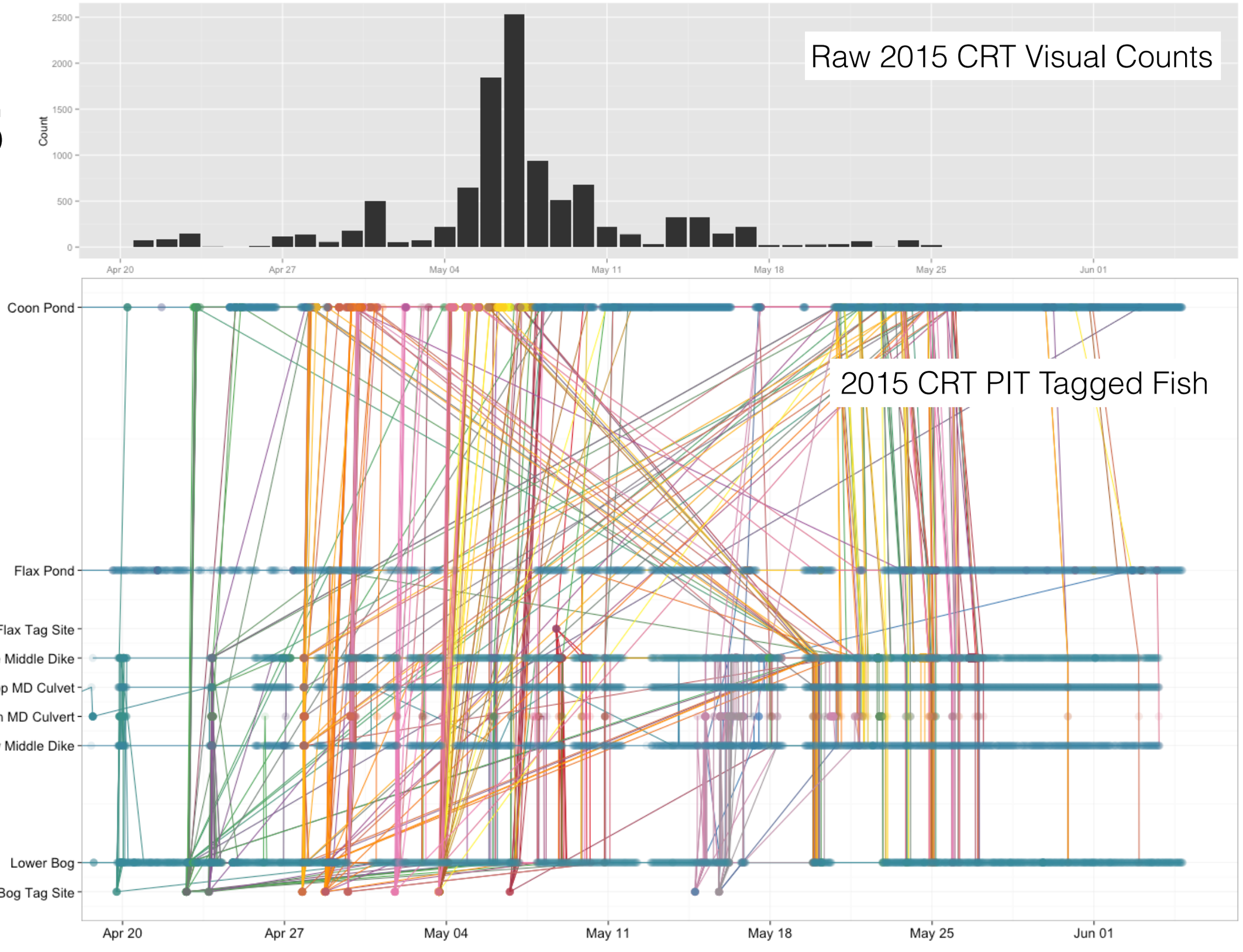


Photo: Wendi Buesseler

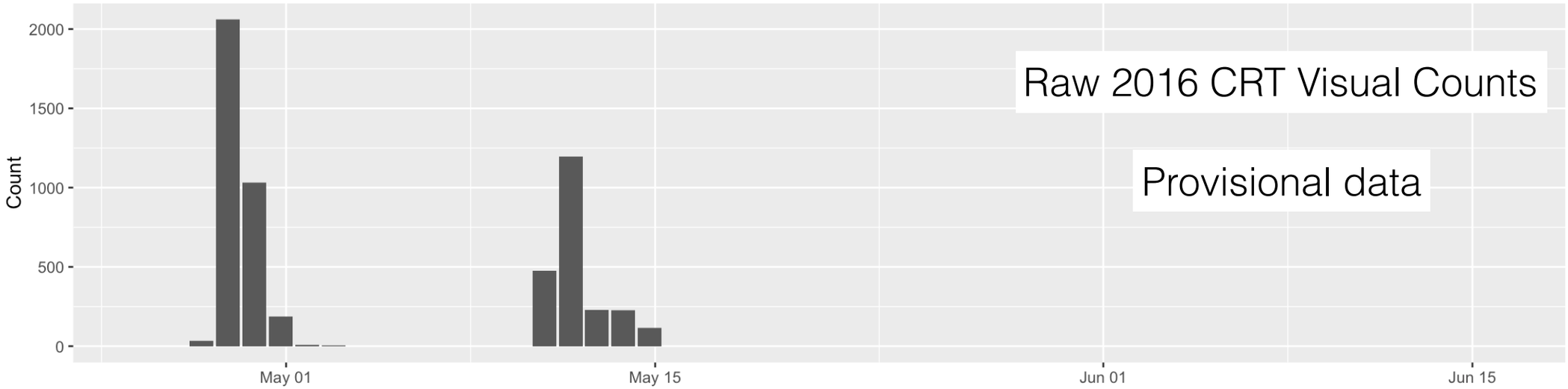
2015

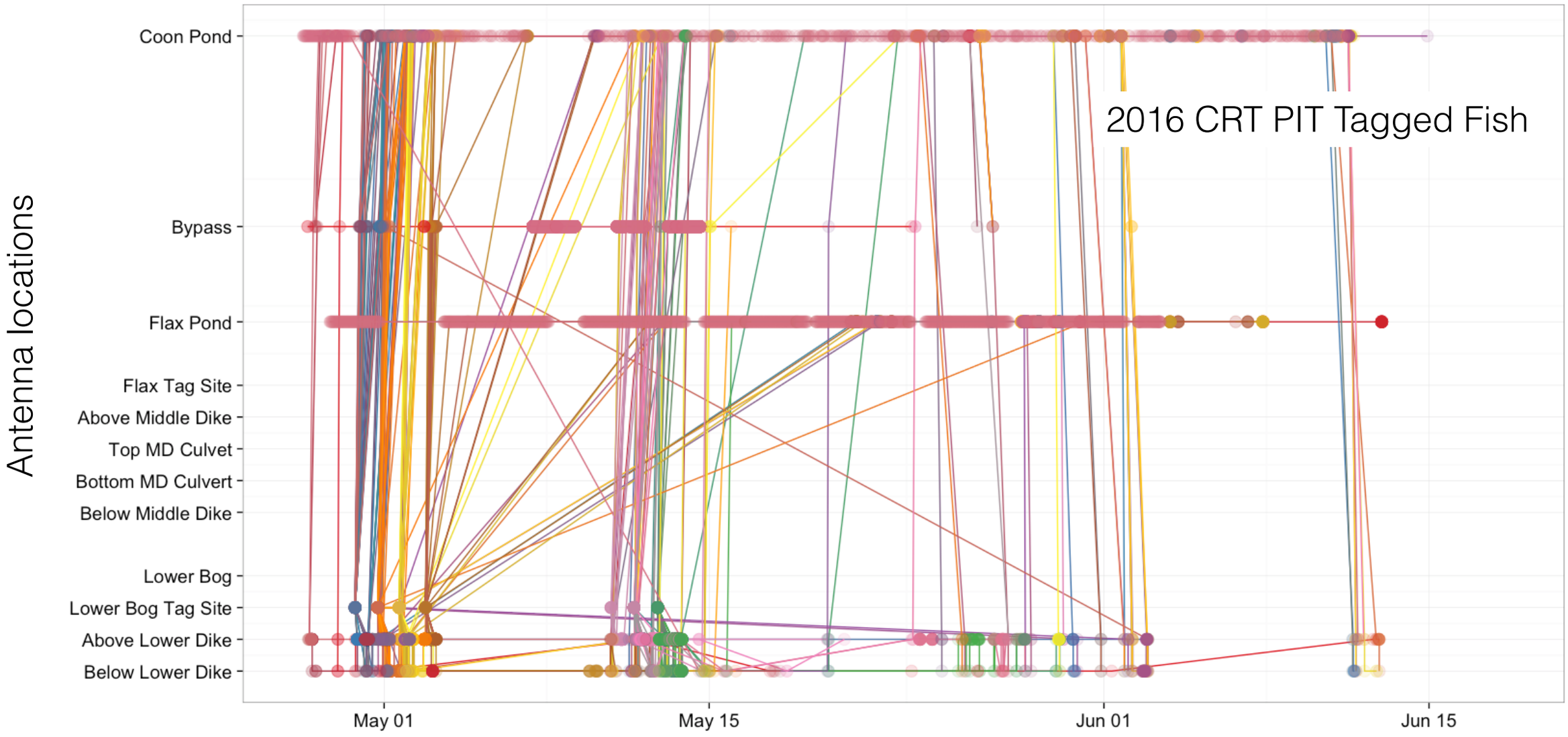


Estimated ~ 70,000 fish

~3,000 movements

2016

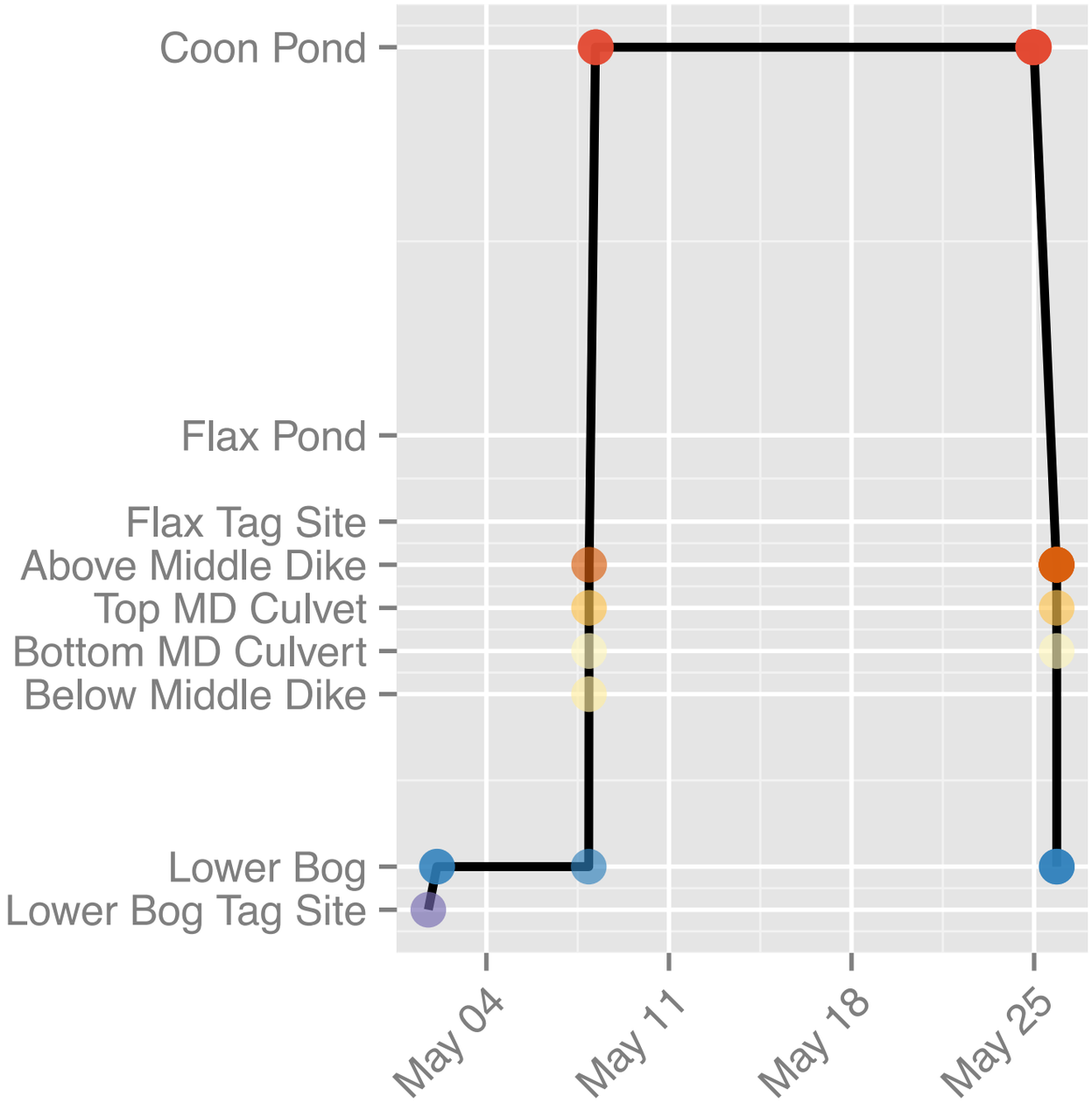


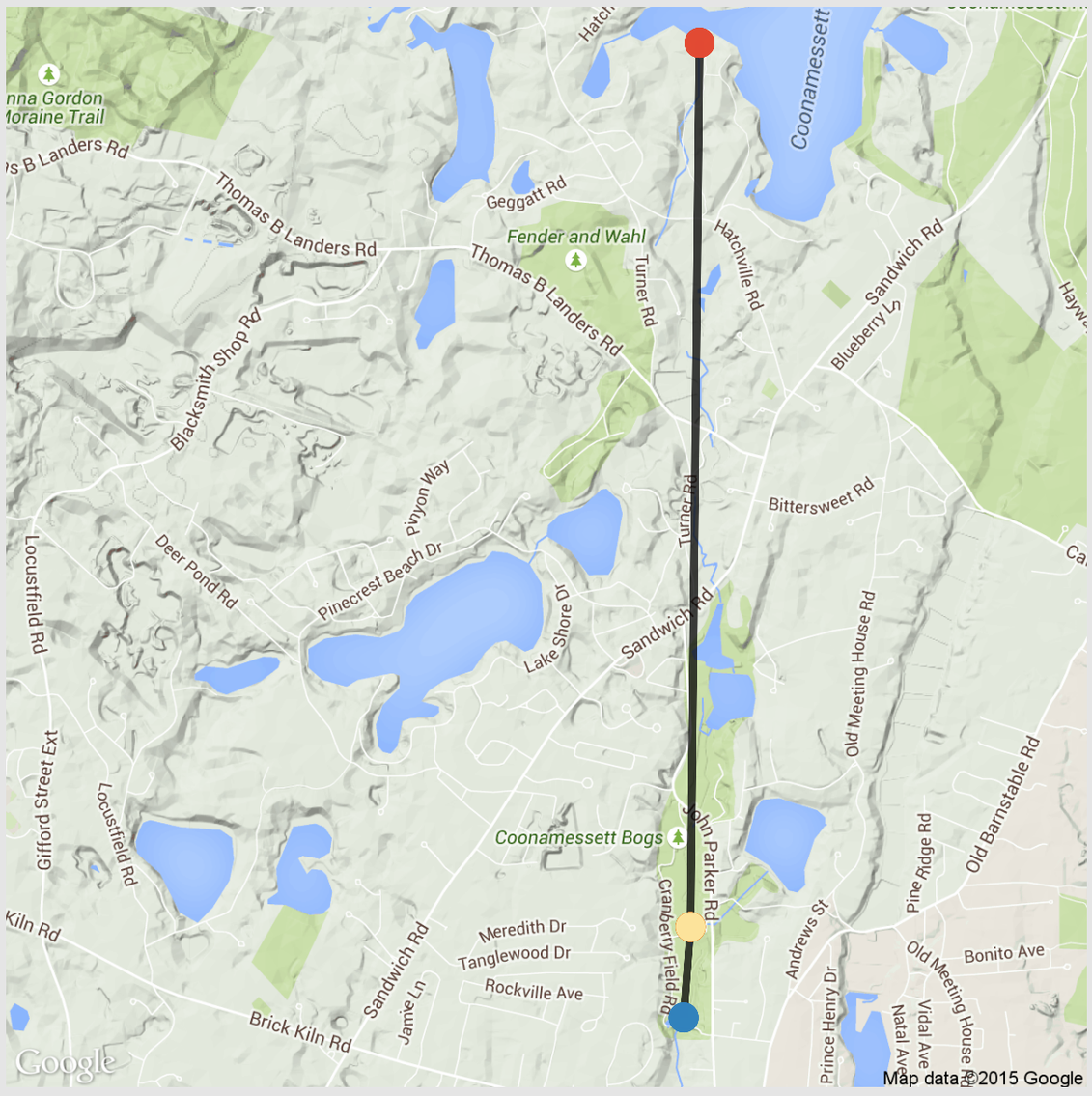


Down year — estimate forthcoming

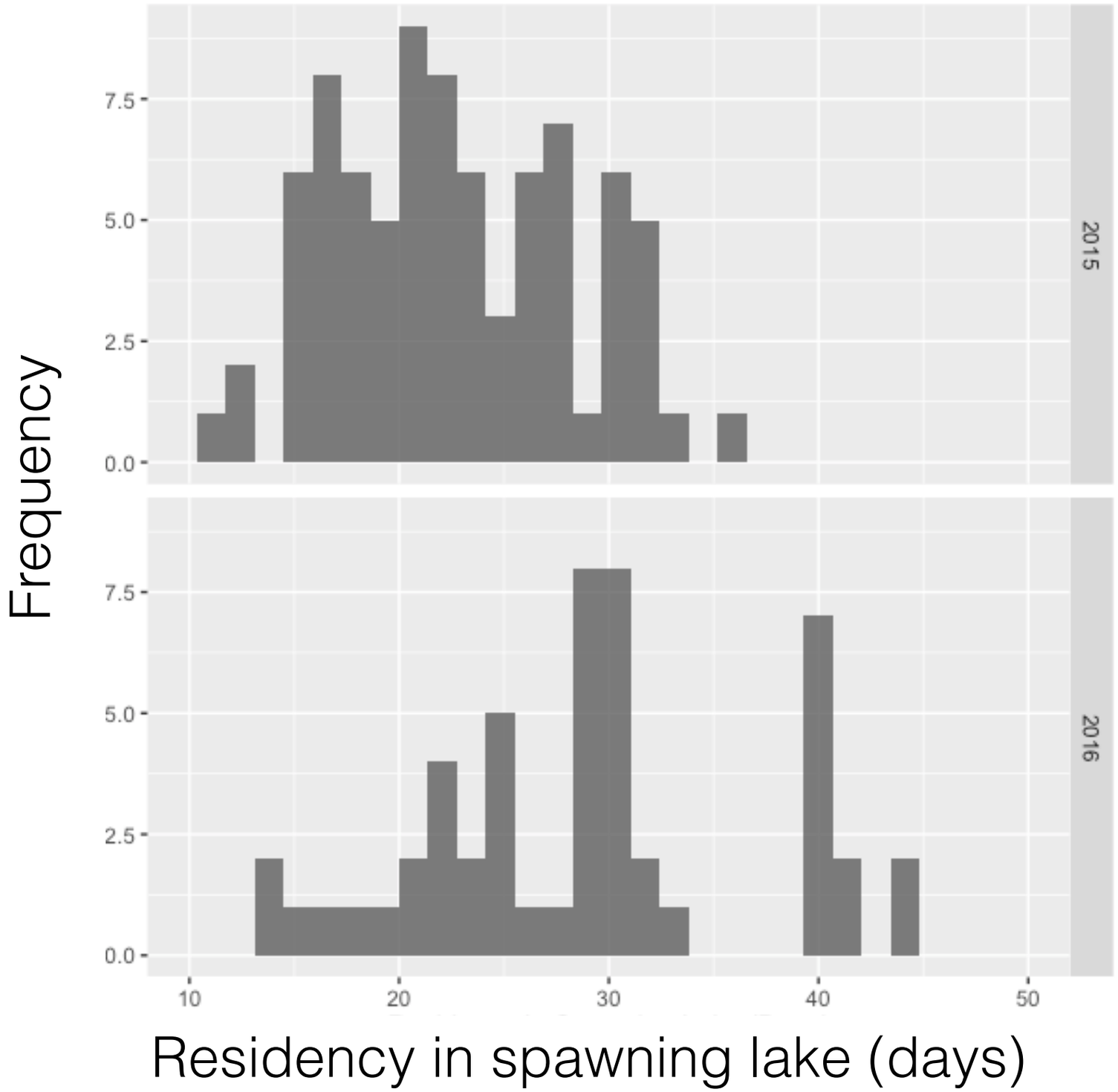
~5,000 movements

If we drill down to specific fish





Significant period spent in lakes



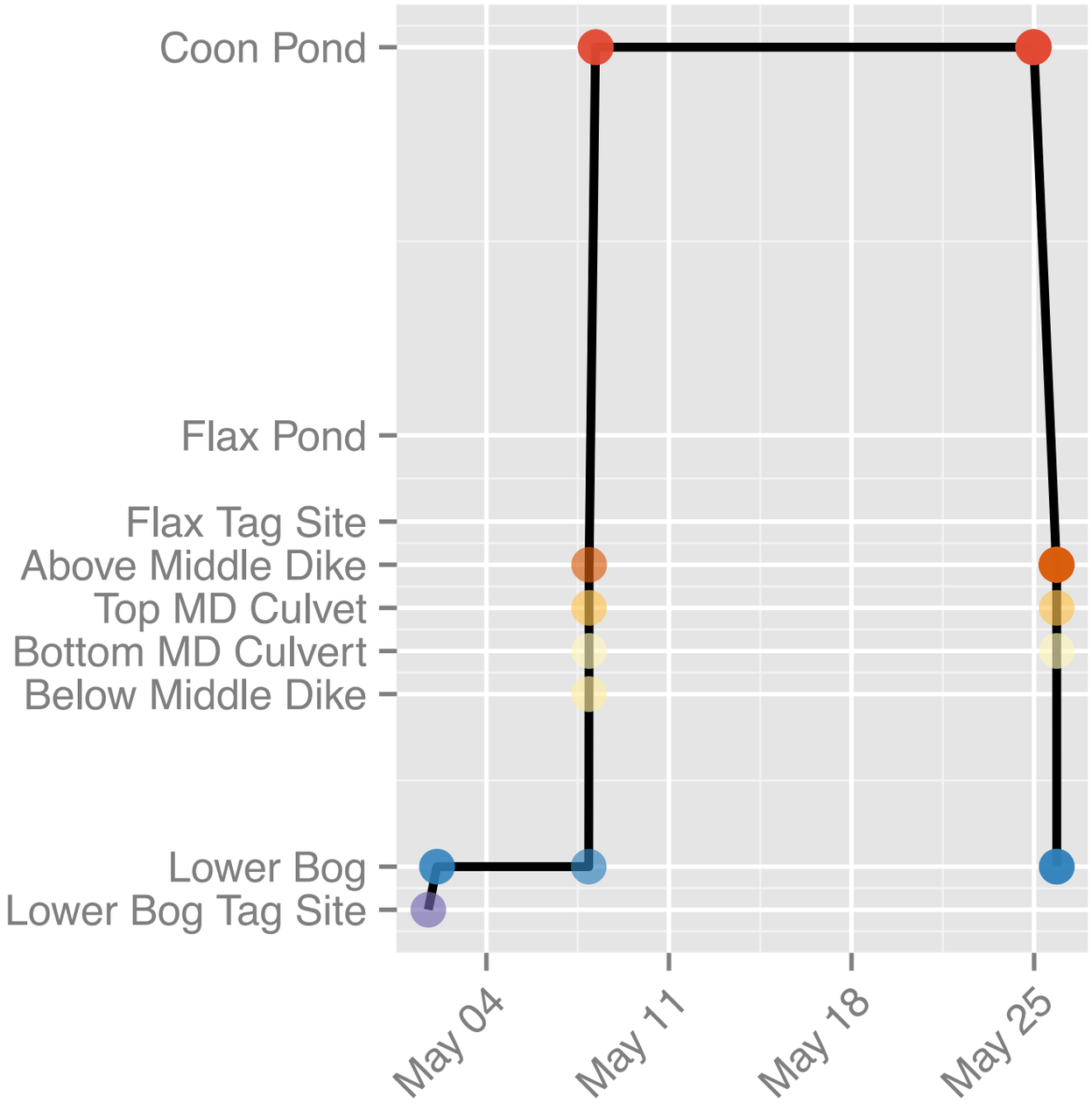
2015: On average ~22 days

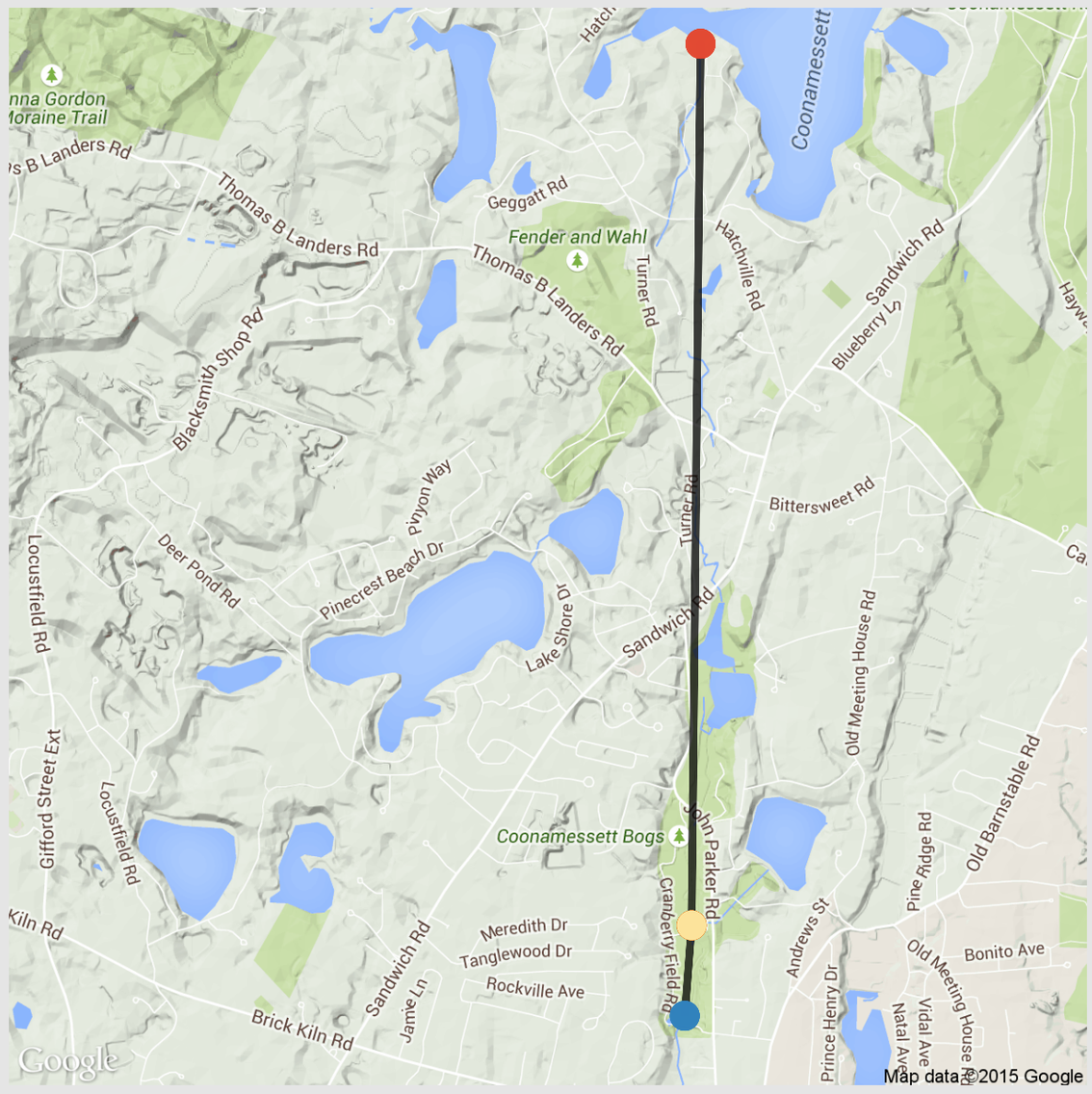
2016: On average ~30 days

50% - 100% > than previously thought

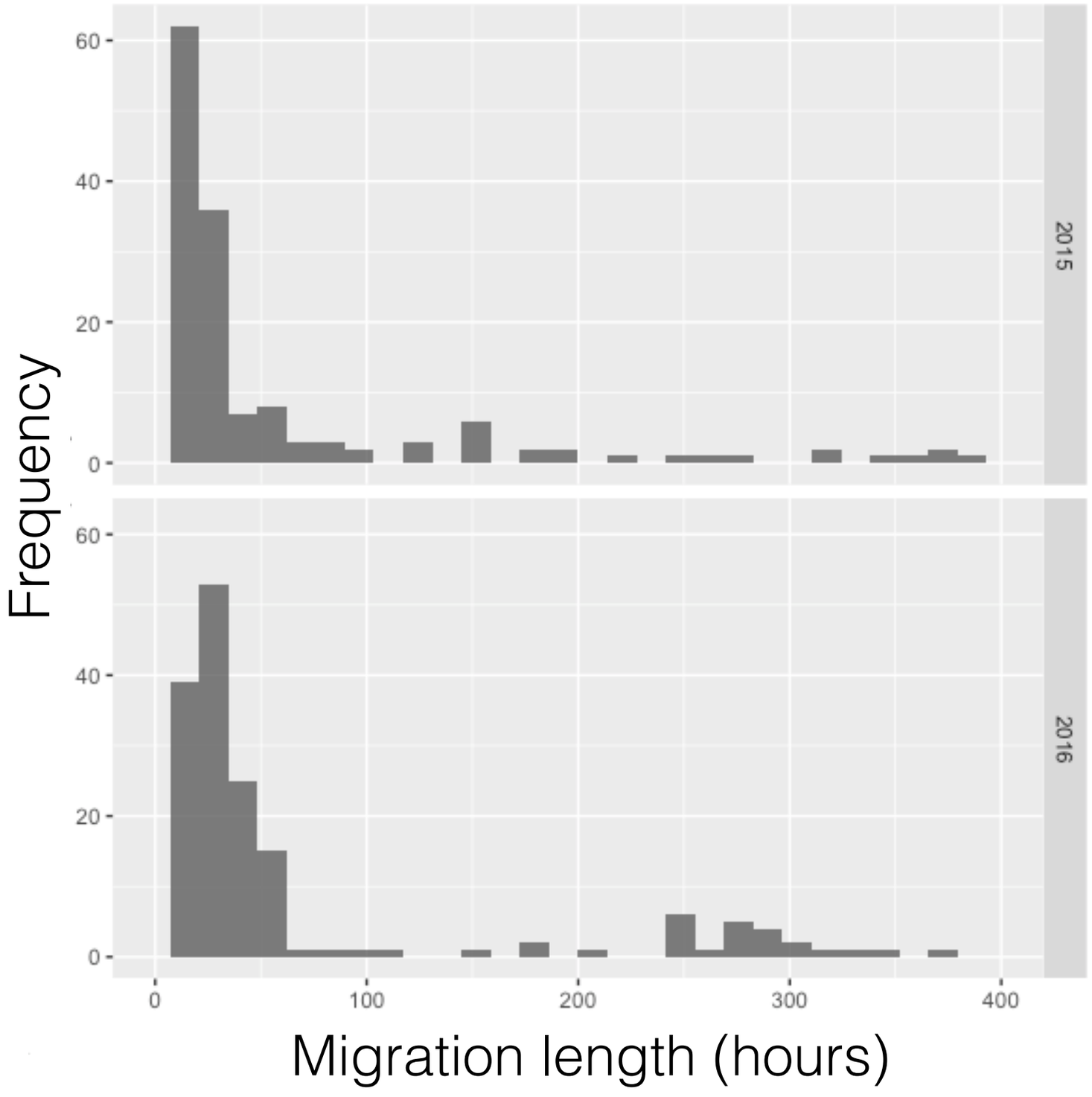
Potentially important for nutrient loading and life history

Another feature if individual tracks





Some migrations were longer



Longer tail esp. in 2016

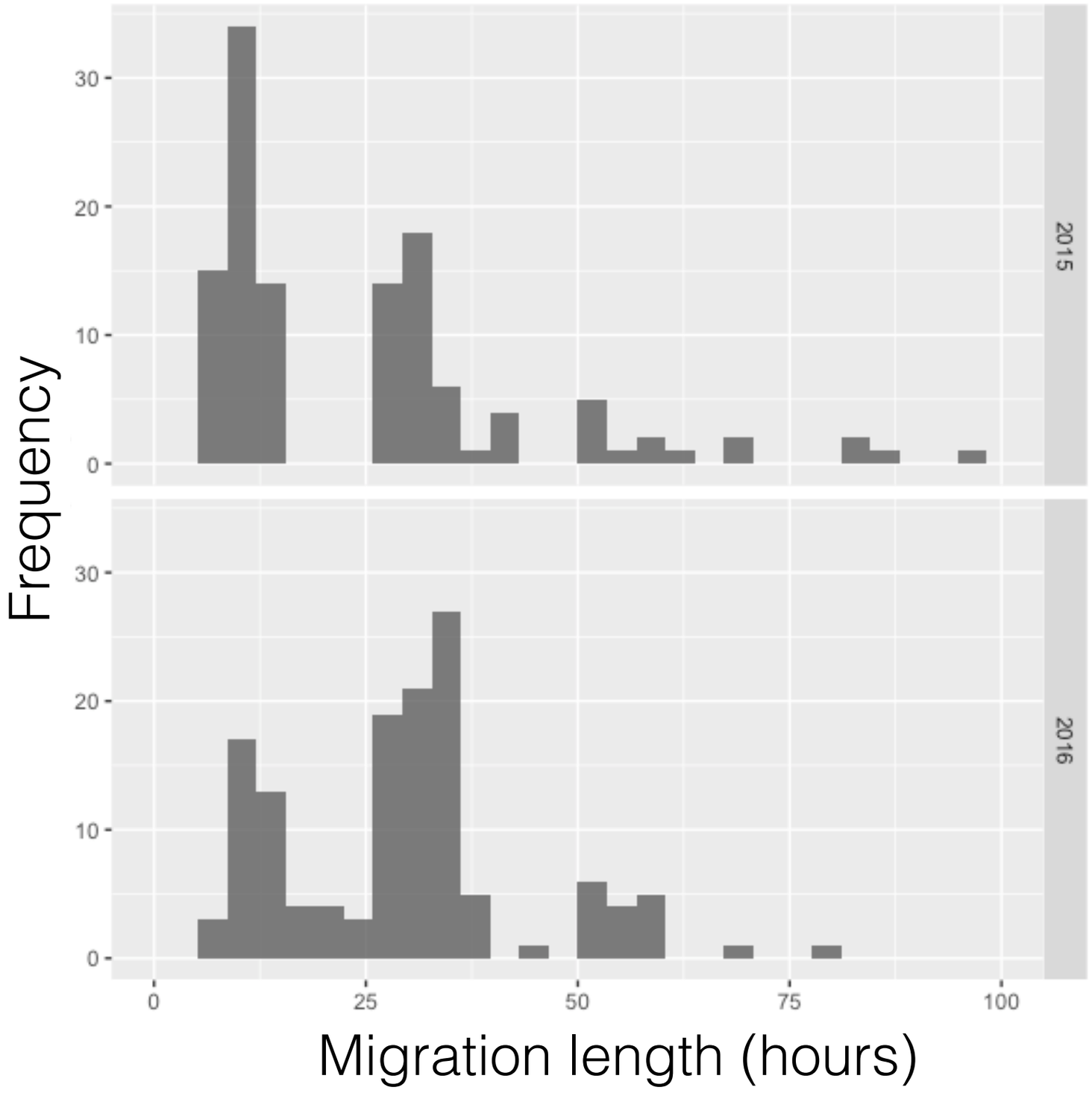
~50% in <10 hours

A second peak at ~ 24 hours

Interesting patterns suggest migration may not be continuous

Fastest fish made it in ~ 5 hrs

But generally, migrations were quick



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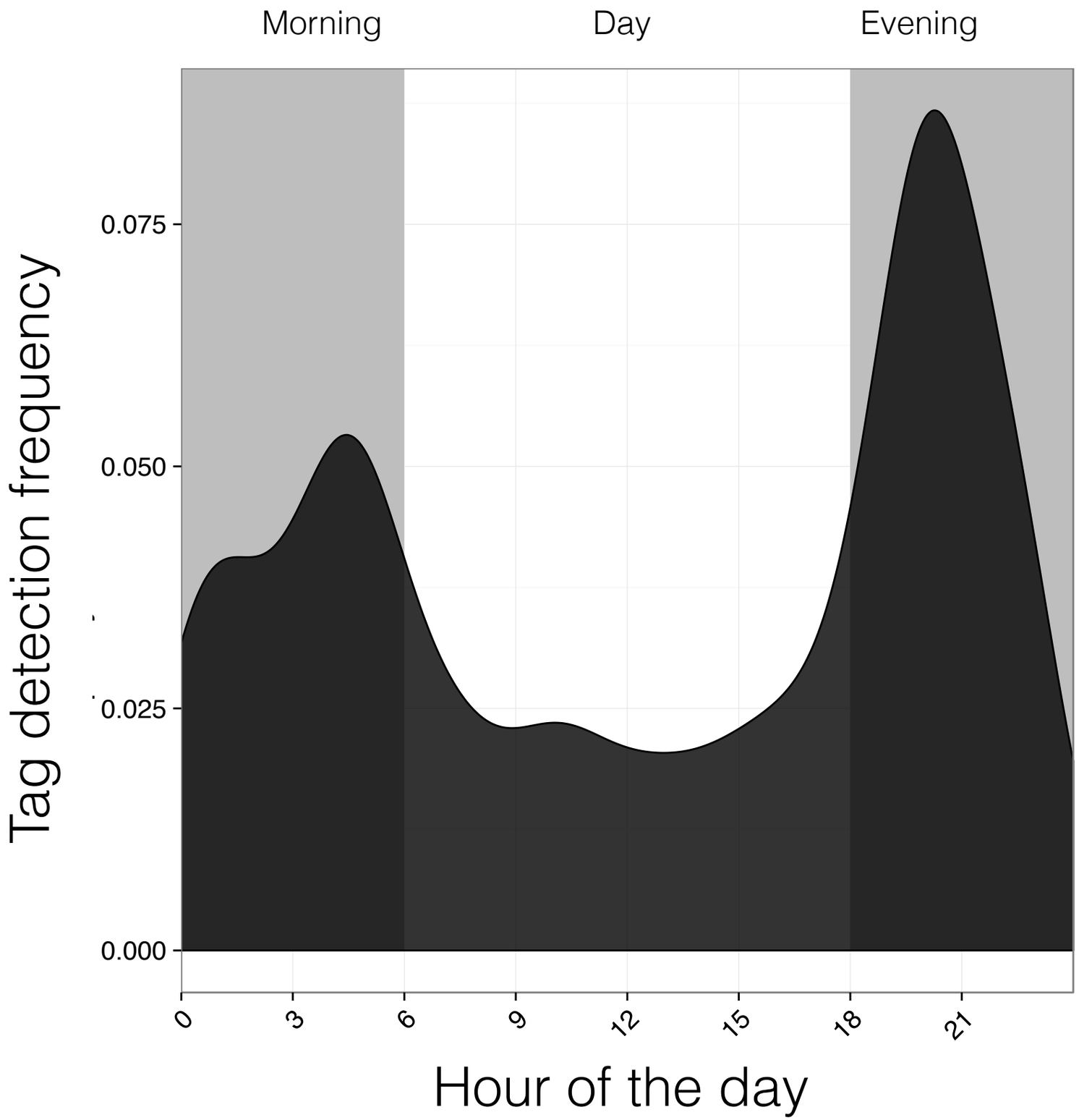
Pattern of crepuscular movement



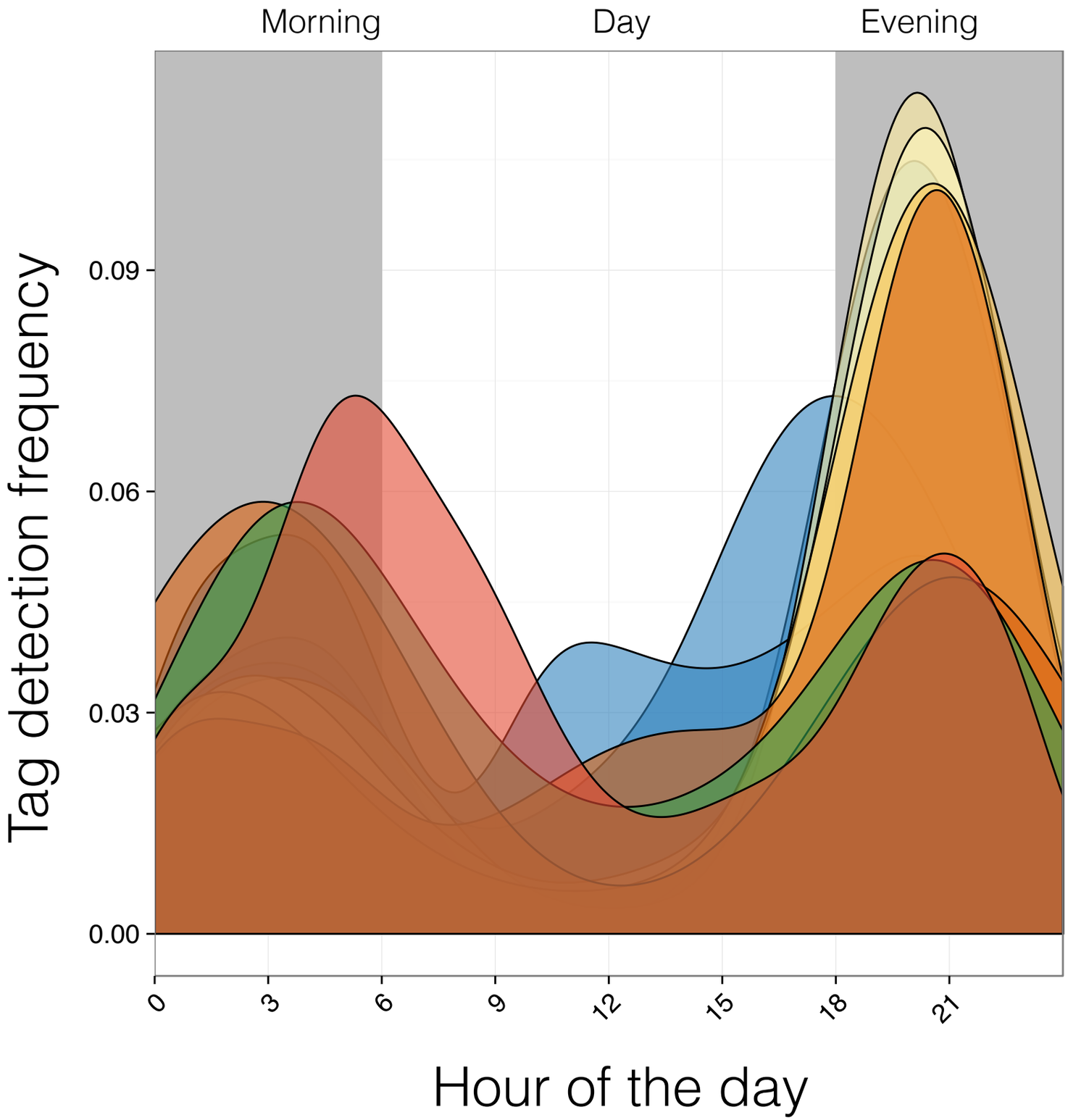
Bimodal pattern

Similar pattern for all antennas

Similar pattern through the season

Pattern observed for both species & years

Pattern of crepuscular movement



Bimodal pattern

Similar pattern for all antennas

Similar pattern through the season

Pattern observed for both species & years

Ponds use was similar in both years

2015: 90% Coon & 10% Flax

2016: 88% Coon & 12% Flax

Percents were similar among species

But many more alewives reached ponds

85--90% of bluebacks remained in Lower Bog in both years

Few fish made it to spawning ponds

Pattern initially though to be result of low detection rate

But observed for both years

~ 45 - 50% of alewives

~10 - 15% of of blueback

Many potential drivers…

Summary CRT study

- Movement primarily occurred under the cover of darkness, with peak periods of movement occurring immediately following sunset and just prior to sunrise

- Movement through the river was typically rapid, with many fish covering the 5 km stream length in a single night (and as little as 5 hours)

- Surprisingly few fish that entered the watershed made it to a spawning pond

Summary CRT study

- Movement primarily occurred under the cover of darkness, with peak periods of movement occurring immediately following sunset and just prior to sunrise

- Movement through the river was typically rapid, with many fish covering the 5 km stream length in a single night (and as little as 5 hours)

- Surprisingly few fish that entered the watershed made it to a spawning pond

- Some repeat spawning, but limited between 2015 and 2016 for the Coonamessett

- Evidence that existing culverts do delay migration, may impact survival or success

- Most fish avoided the steeppass ladder on the way up, but utilized it on the way down

Implications and importance

Generated valuable (novel) scientific data for relatively little $

More importantly generated enthusiasm for the river and restoration among those involved

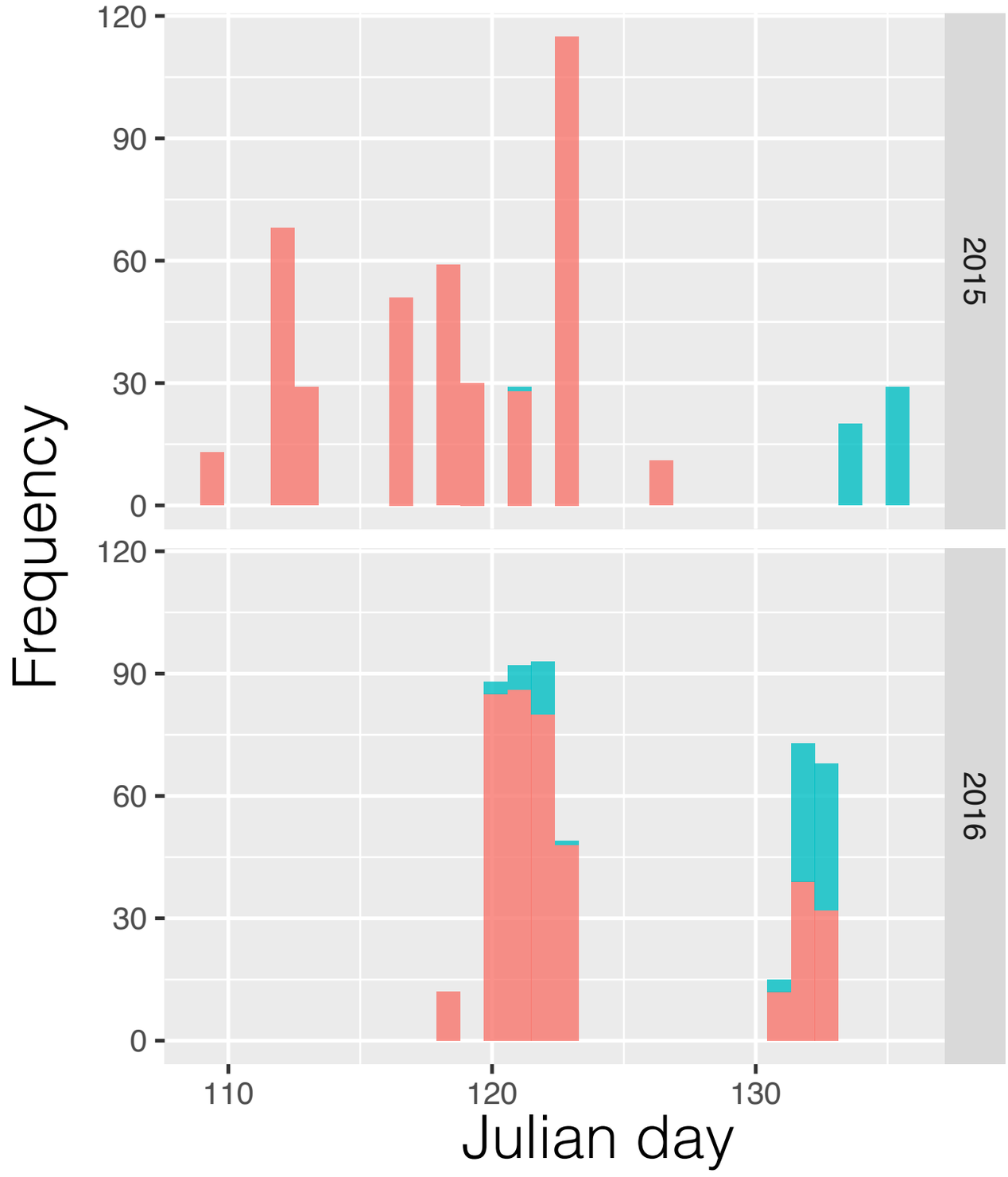
News stories in different media also raised awareness more broadly

Our success suggests volunteer groups could play a larger role in enhancing our understanding of basic biology

Questions?

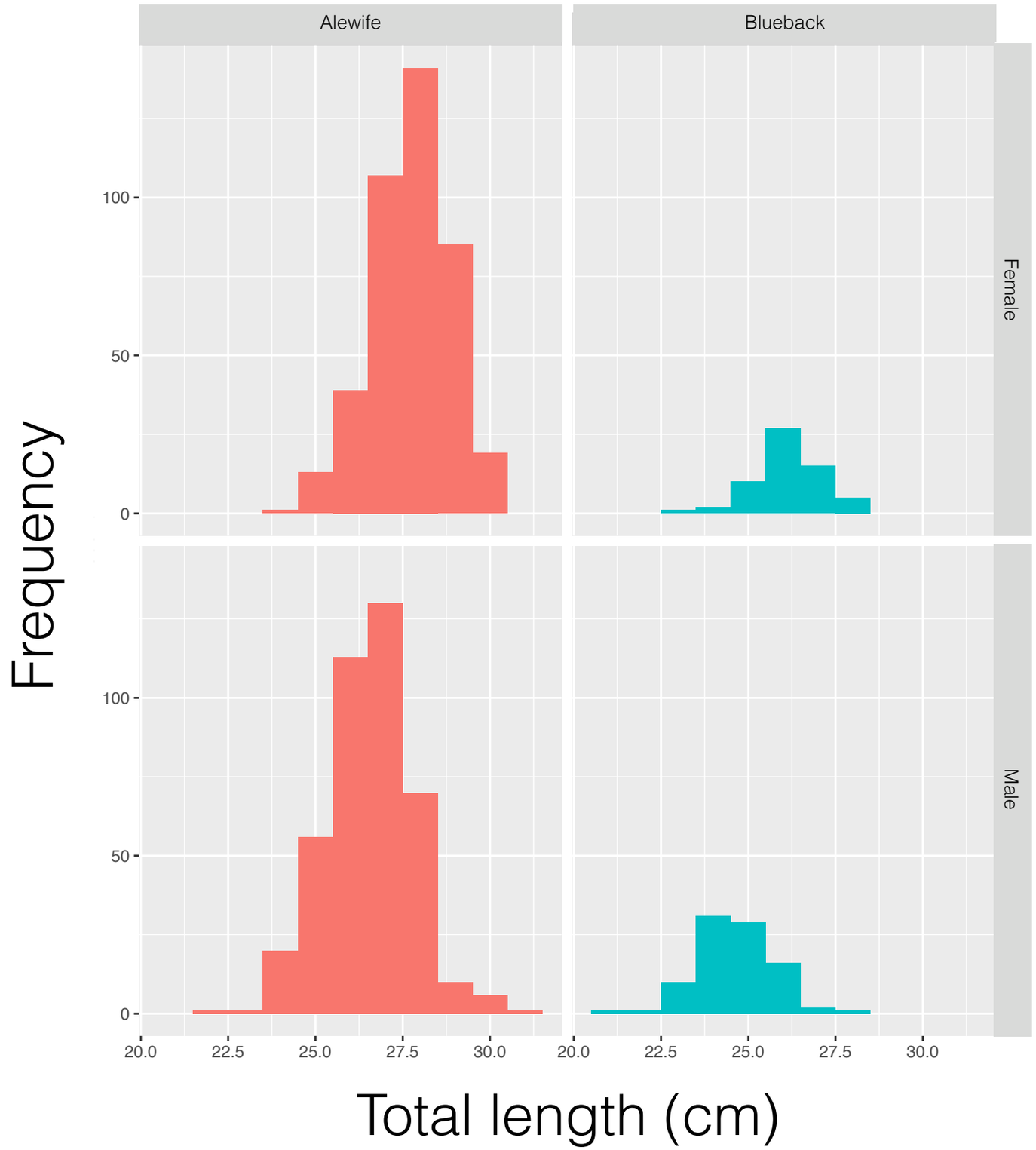
Alewives a little earlier

Photo: Andrea Carter Falmouth Enterprise

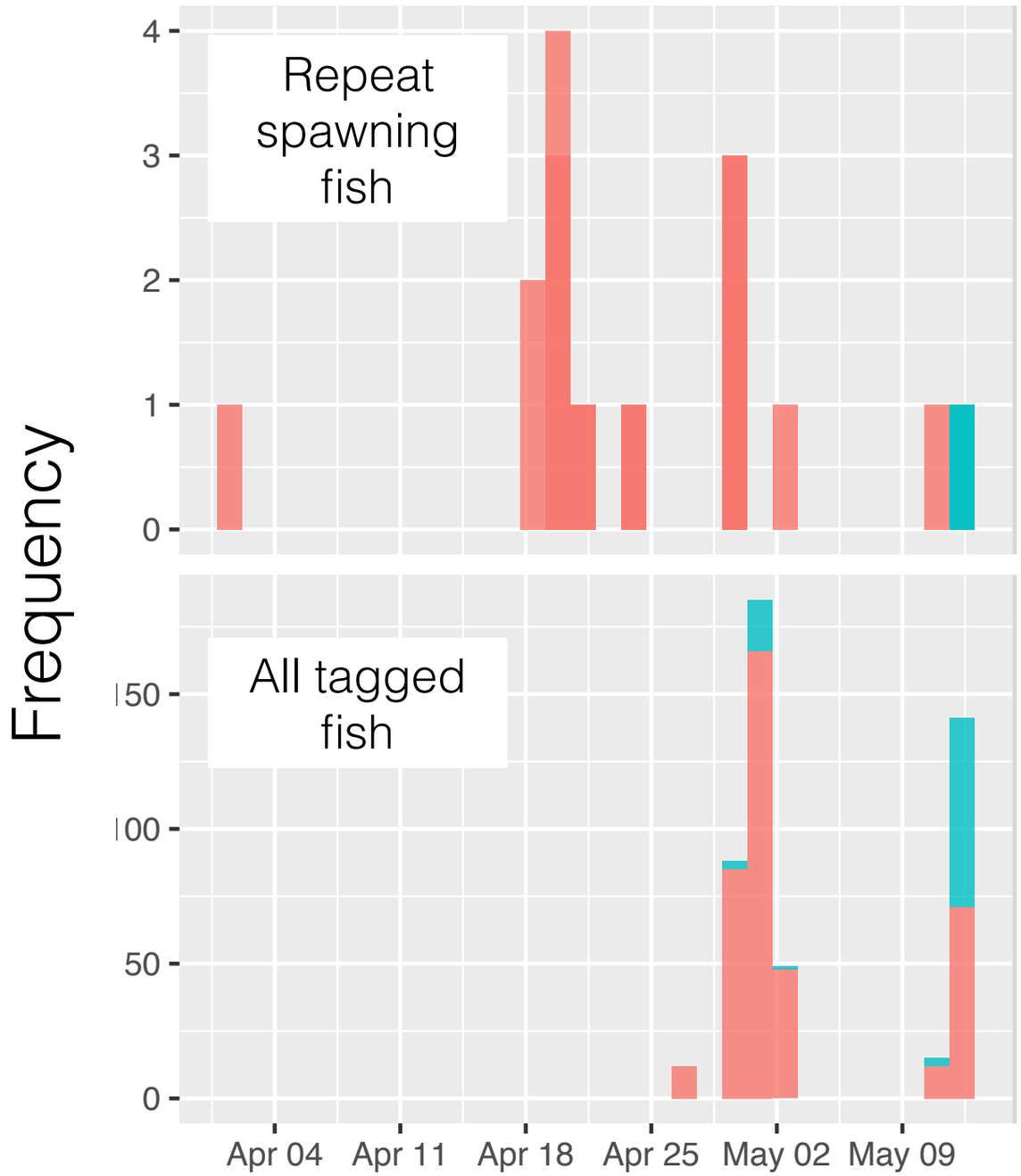


Alewives and females larger

Photo: Andrea Carter Falmouth Enterprise



Some repeat spawning



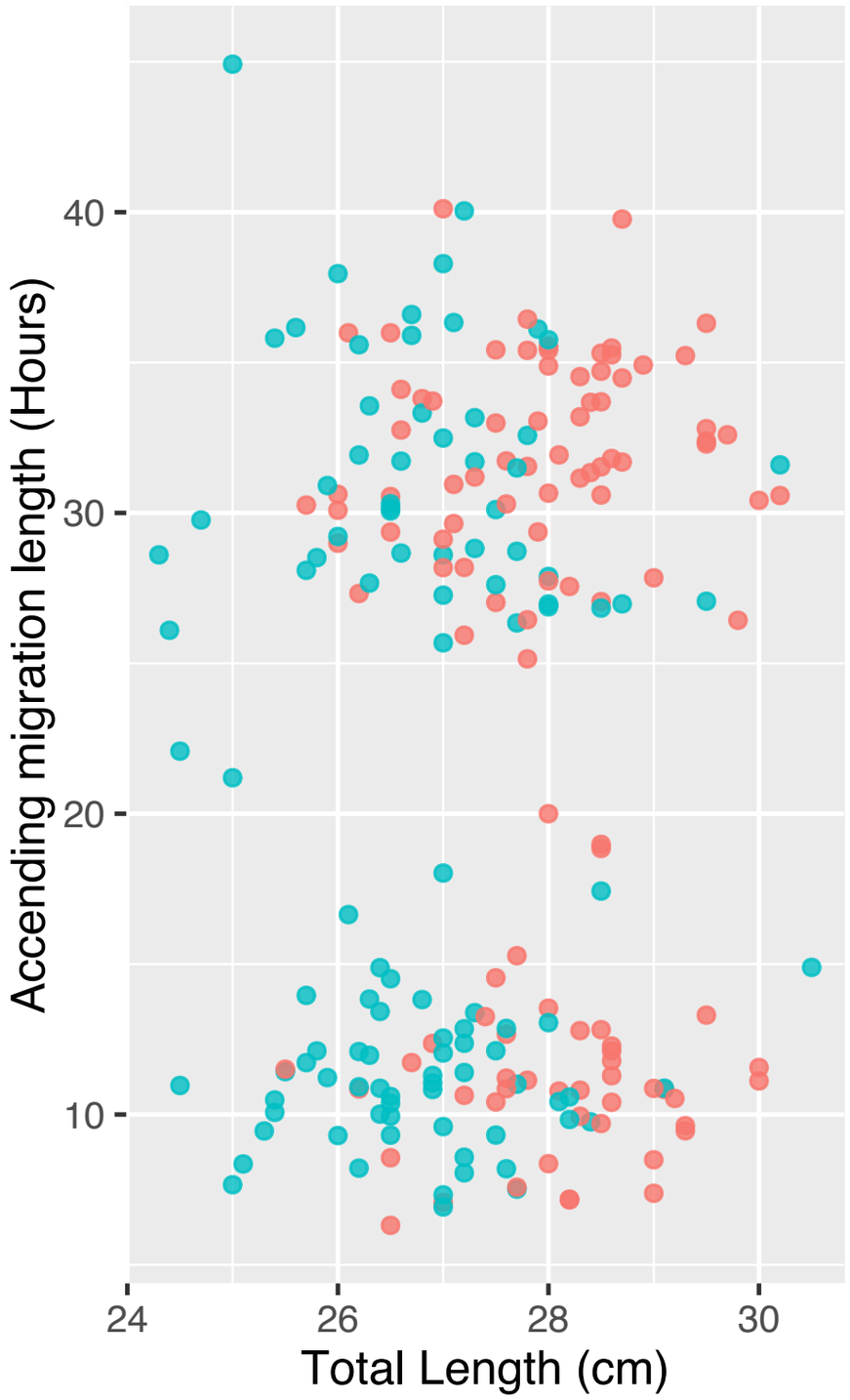
~ 25% of individuals seen leaving in 2015 returned in 2016

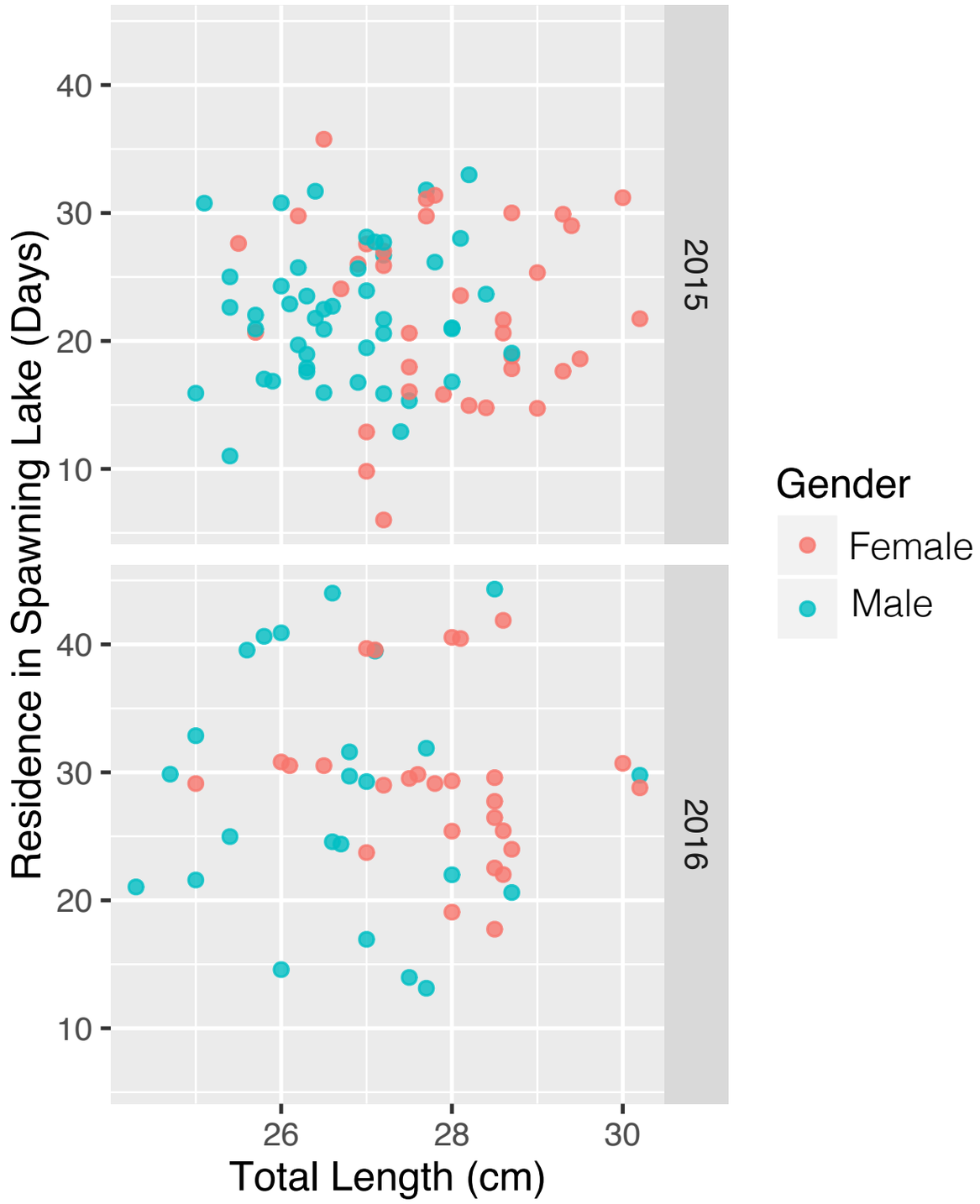
Most arrived early in the season

Moved rapidly upstream

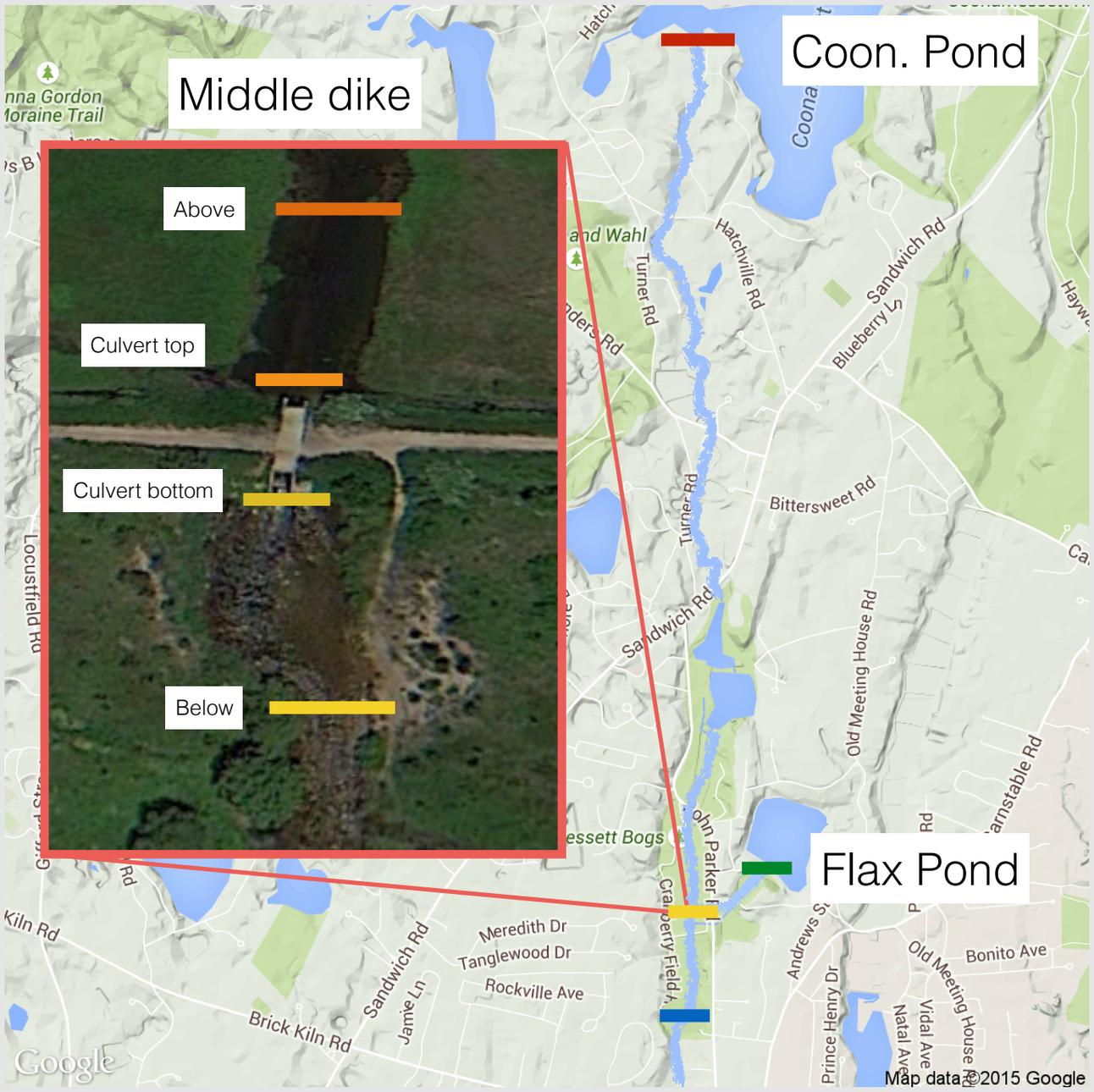
Tracks from last year suggest limited time in freshwater

No link between size and movement patterns

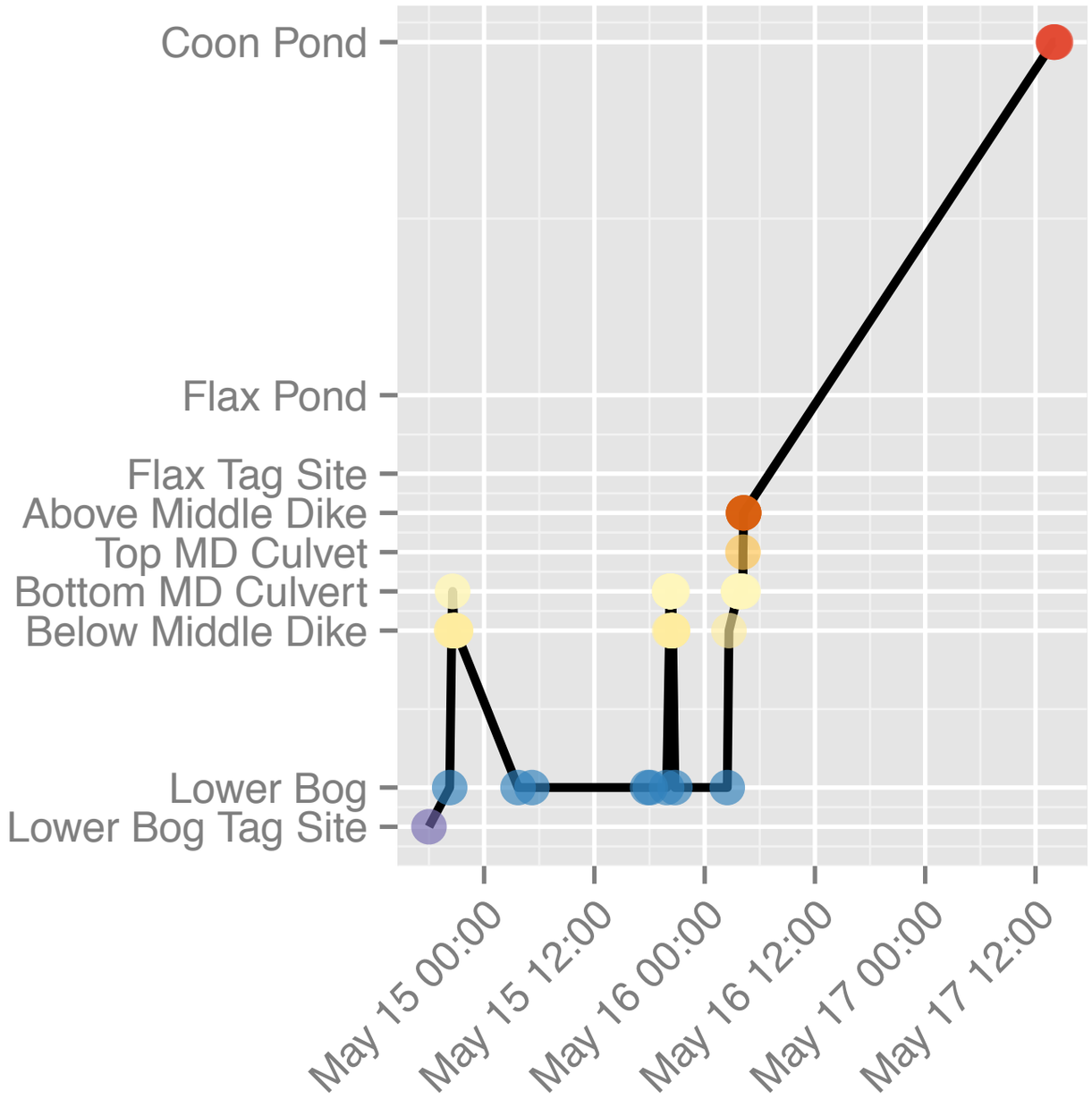




Other antennas in the watershed: 2015



Culvert delayed many individuals



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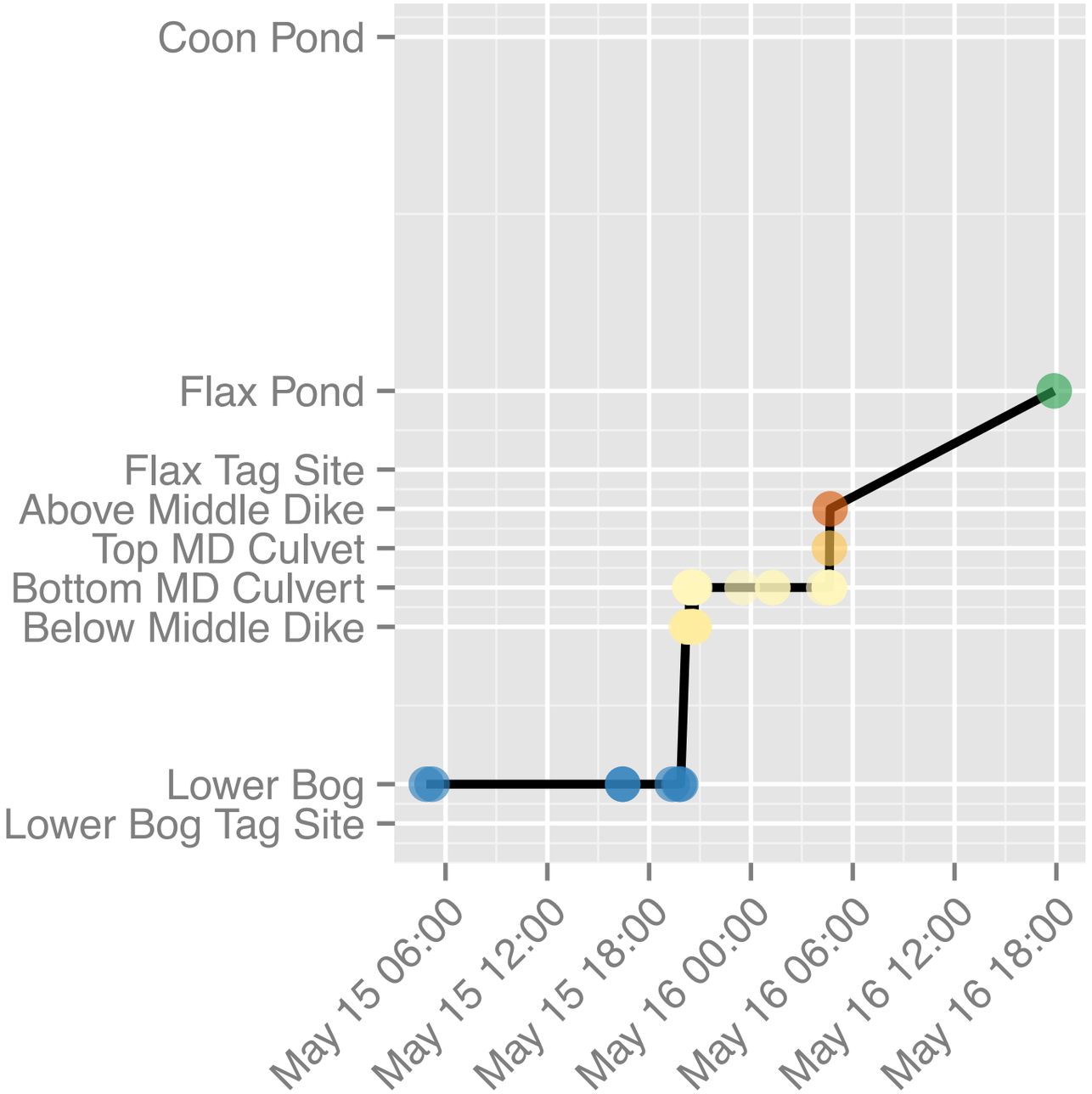
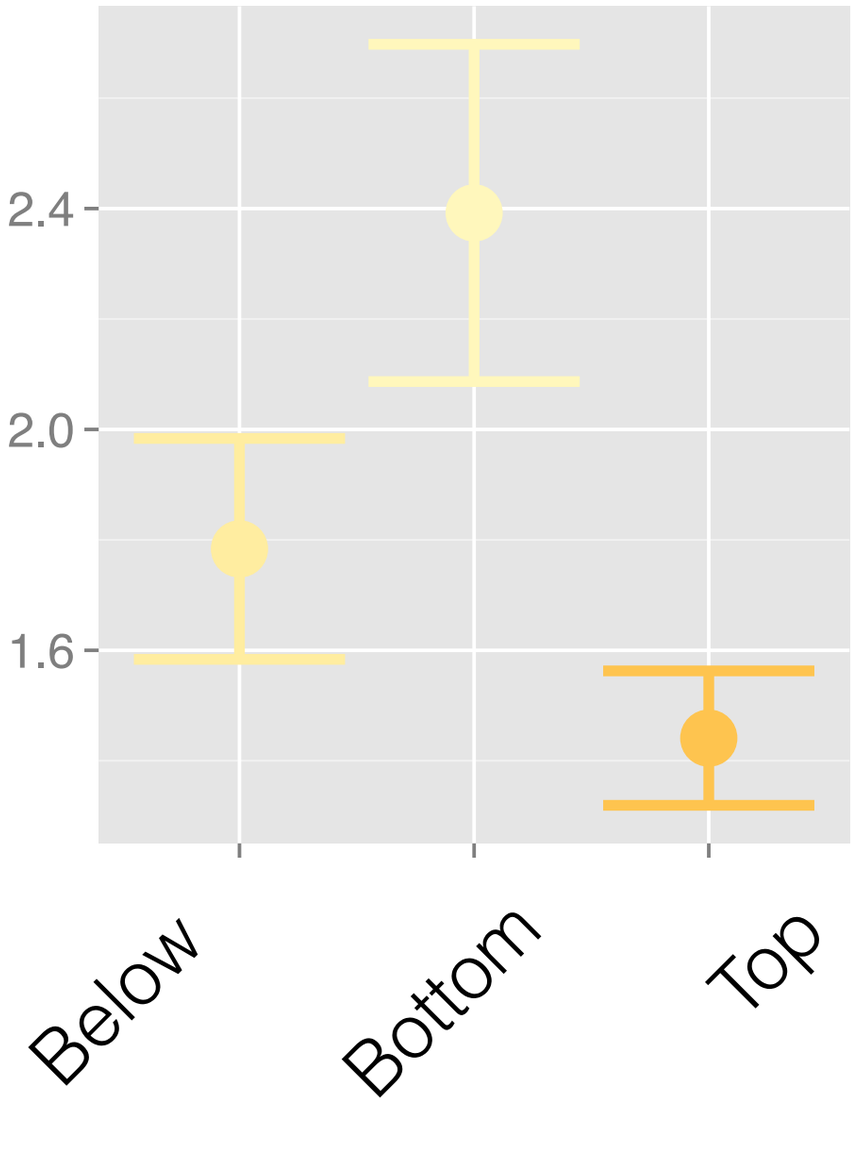
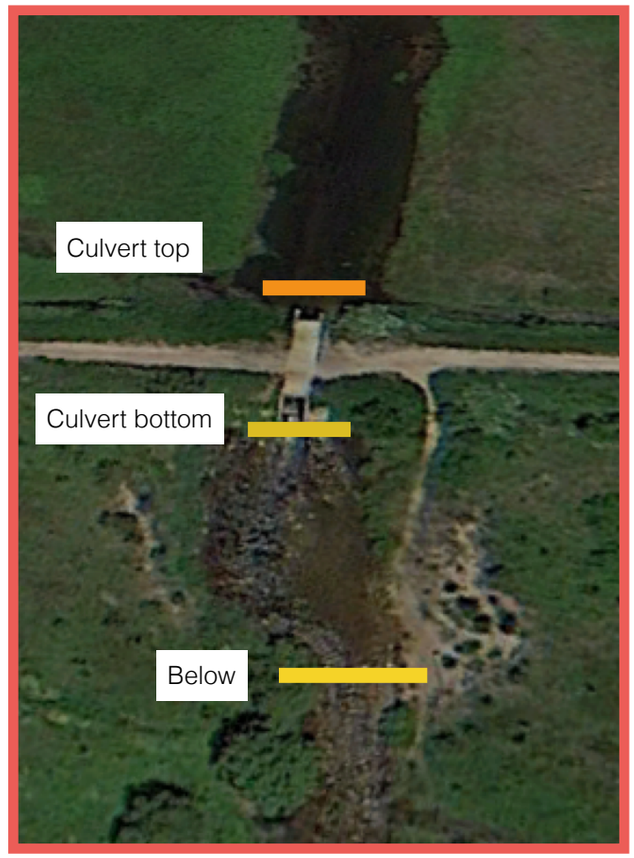


Preliminary metric for a delay

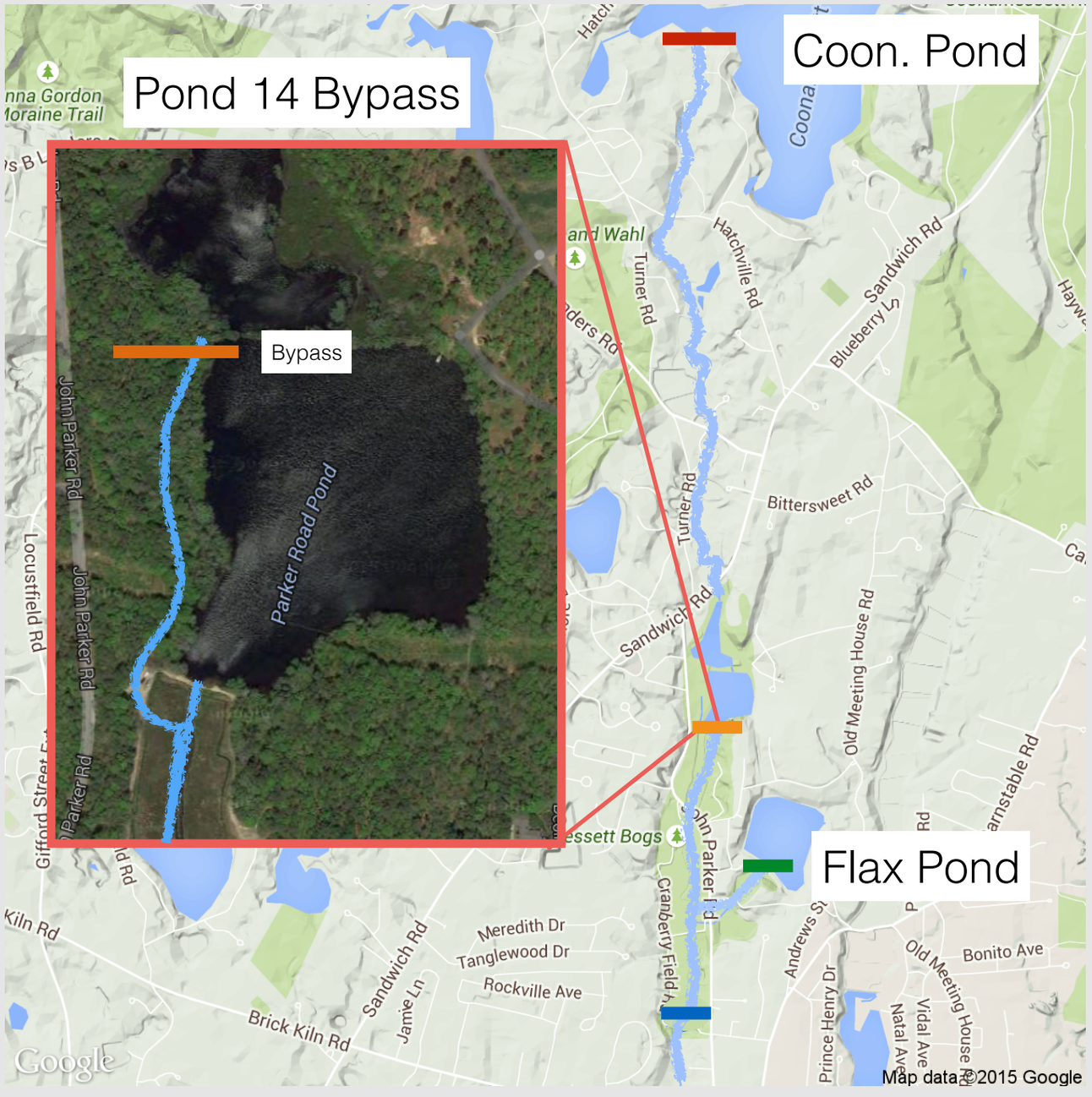
Detections per individual (mean ± 95% CI)



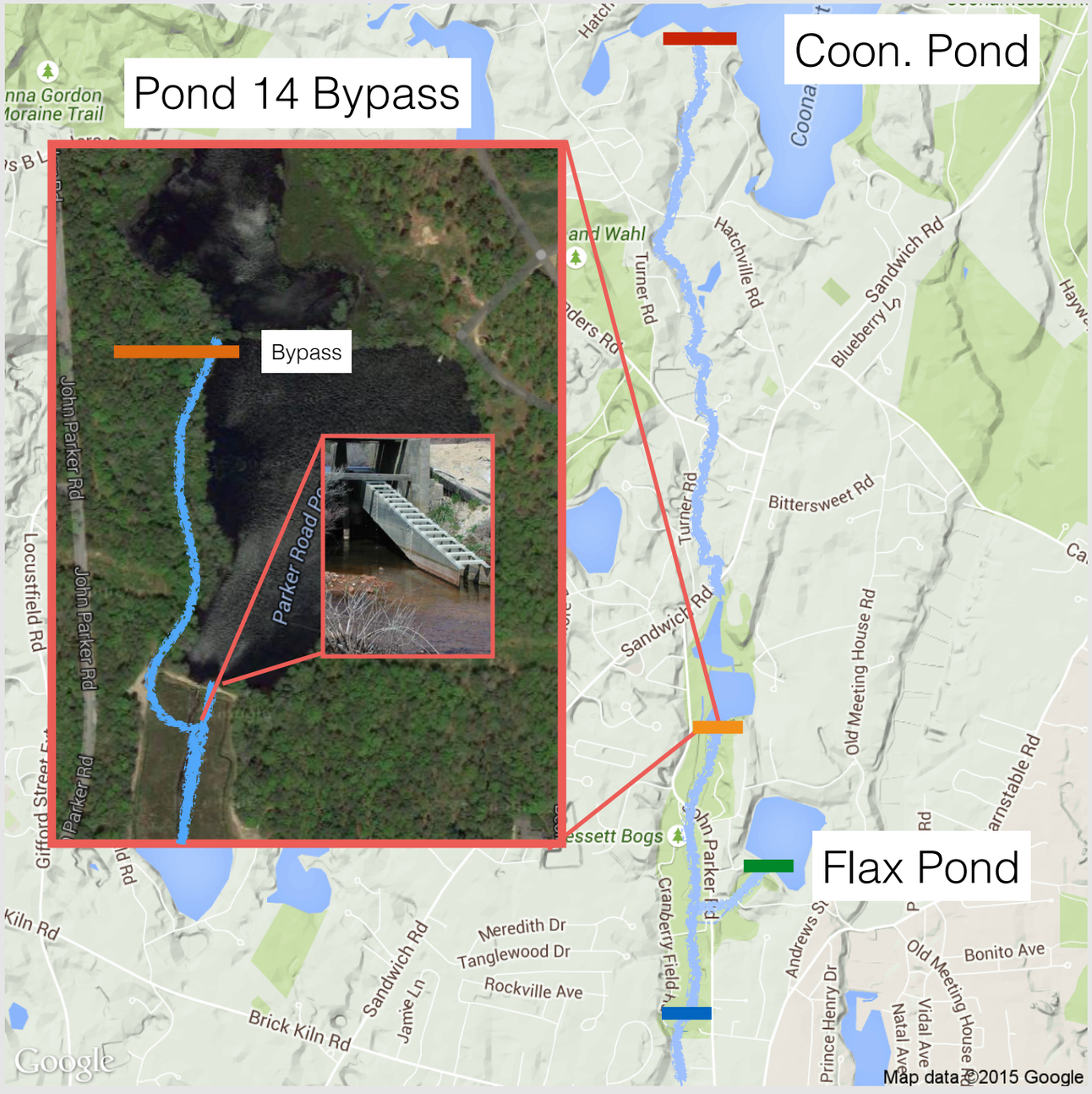


Middle dike culvert antenna

Other antennas in the watershed: 2016



Fish utilized steeppass later



~60% alewives upstream via bypass

~30% blueback upstream via bypass

Changing flow levels & preference may play a role

> 95% out migrating fish used steep pass