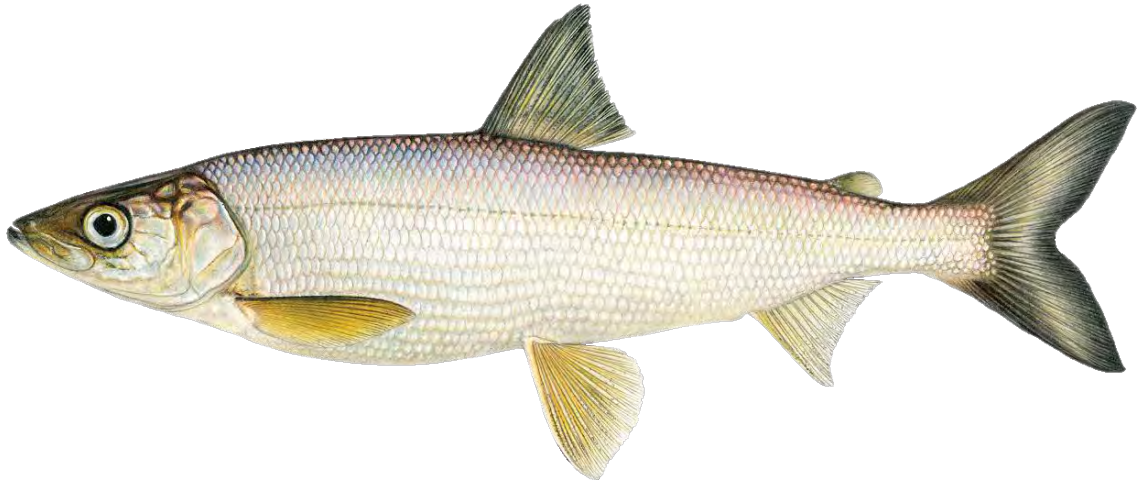
Movement, habitat use and survival of a reintroduced fish: bloater (*Coregonus hoyi*) in Lake Ontario

Tim Johnson[1], Natalie Klinard[2], Aaron Fisk[2]

[1]Ontario Ministry of Natural Resources and Forestry, Glenora Fisheries Station, Picton, ON
[2]Great Lakes Institute for Environmental Research, University of Windsor, Windsor, ON

tim.johnson@ontario.ca

Bloater (*Coregonus hoyi*)



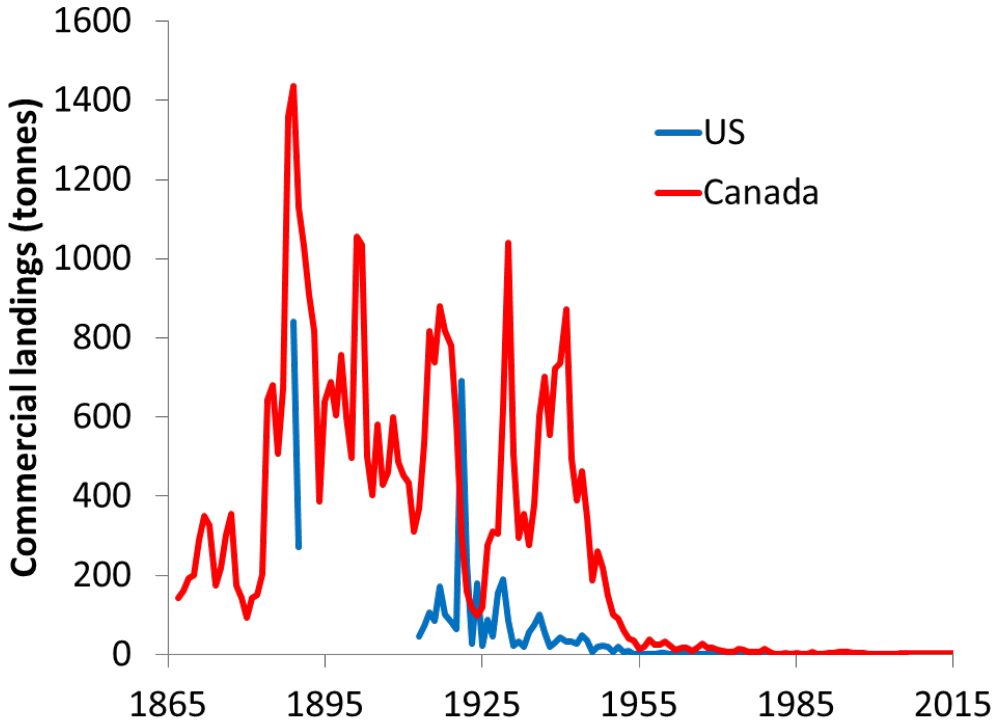
Small-bodied coregonid (avg. adult ~255 mm, 200 g)

Prefer depths of 30 – 190 m

Feed primarily on invertebrates – *Mysis* and *Diporeia*

Once an abundant prey fish supporting commercial fisheries

Extirpated – last seen in Lake Ontario in 1983



Restoration Goal

- 2012: Bi-national effort to establish self-sustaining population of deepwater ciscoes in Lake Ontario

- Focus has been on developing culture practices and capacity to produce 500,000 juvenile bloater annually for stocking

What happens after they are released?

Objectives

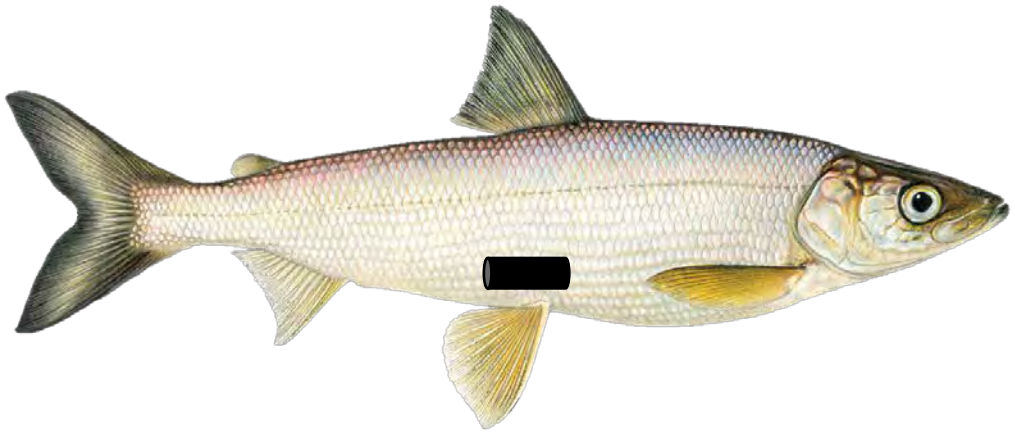
- Characterize short- and long-term movement and habitat use of stocked bloater.
- Determine survival and sources of bloater mortality following release.

Acoustic telemetry

Transmission of sound signals through water (20-500 kHz)

Transmitter – small electronic device implanted or externally attached to an individual

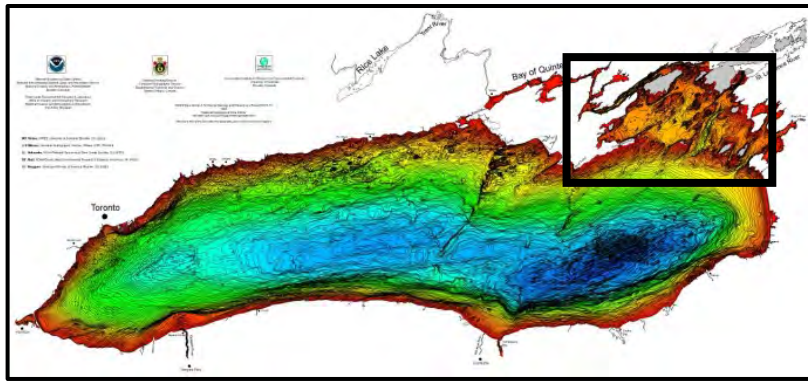
Receiver – detects, decodes, and records transmissions from acoustic tags

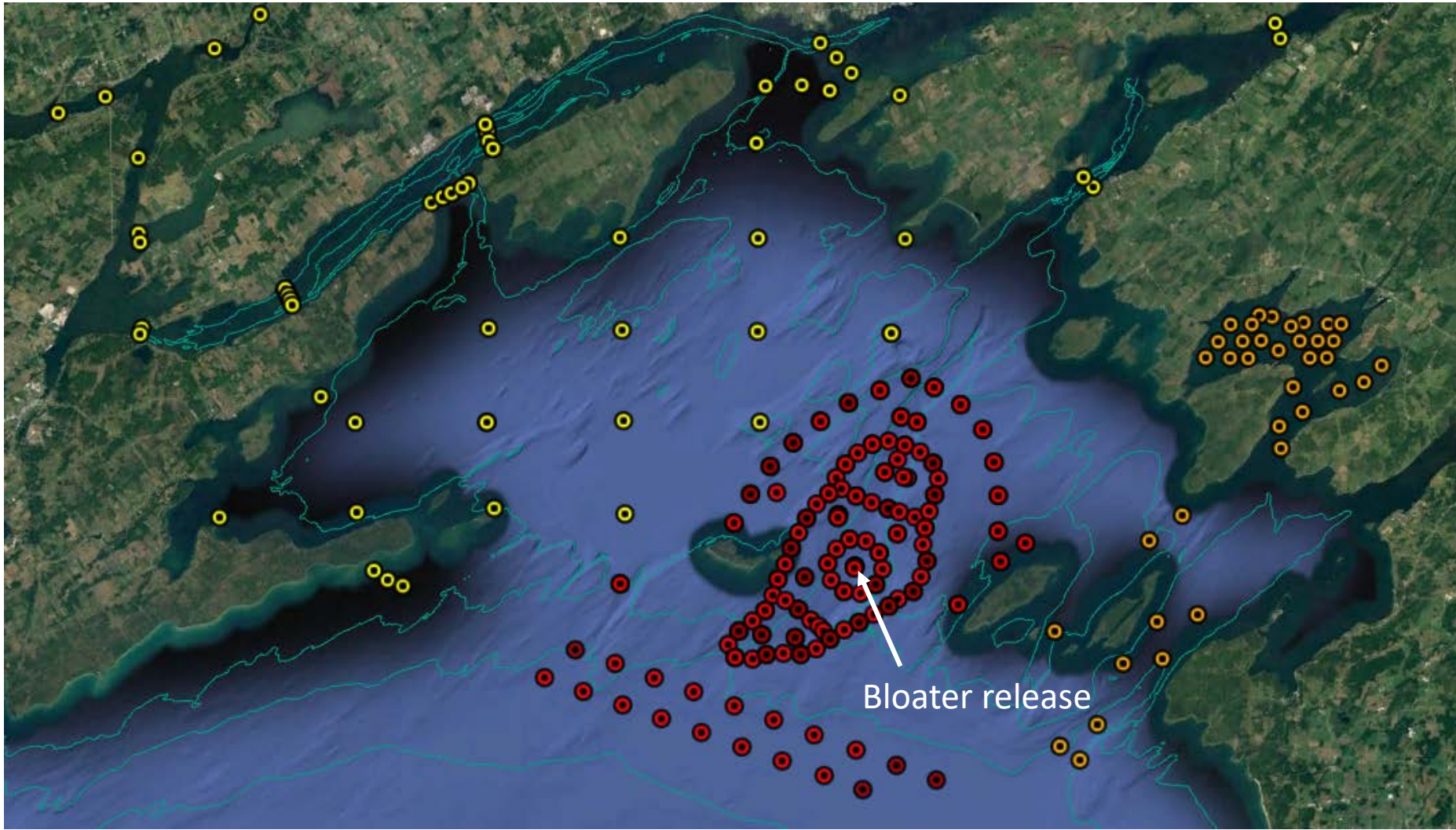


- Movement patterns
- Habitat preference
- Survival
  - Predation

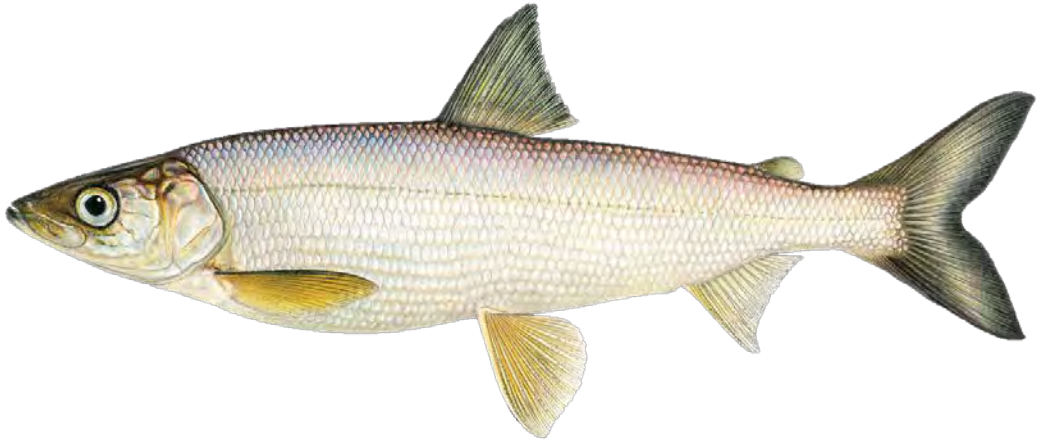
Receiver Array

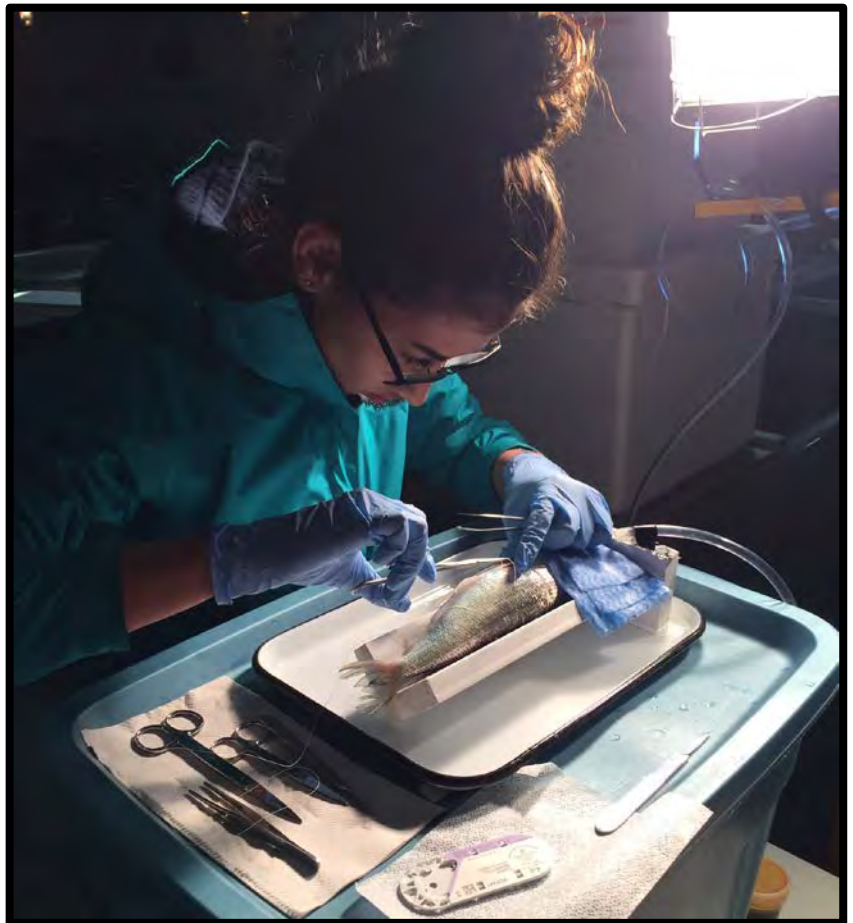
Year	Tags
2015 fall	70
2016 fall	28 pt
2017 spr	22 pt
2017 fall	109 pt
2018 spr	45
2018 fall	90 predation





Results

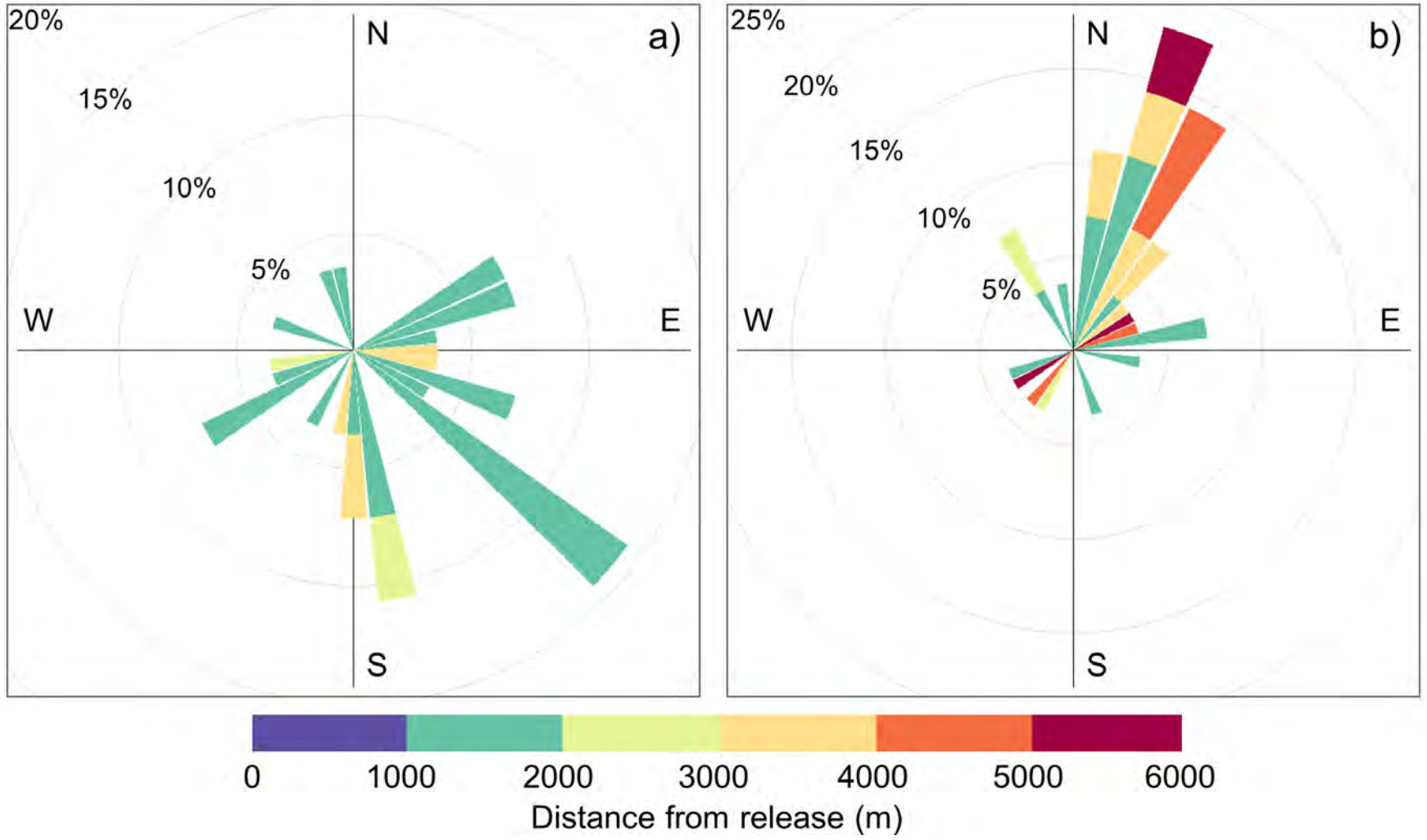




24 hour movement

1st position following release

Position 24 hours following release

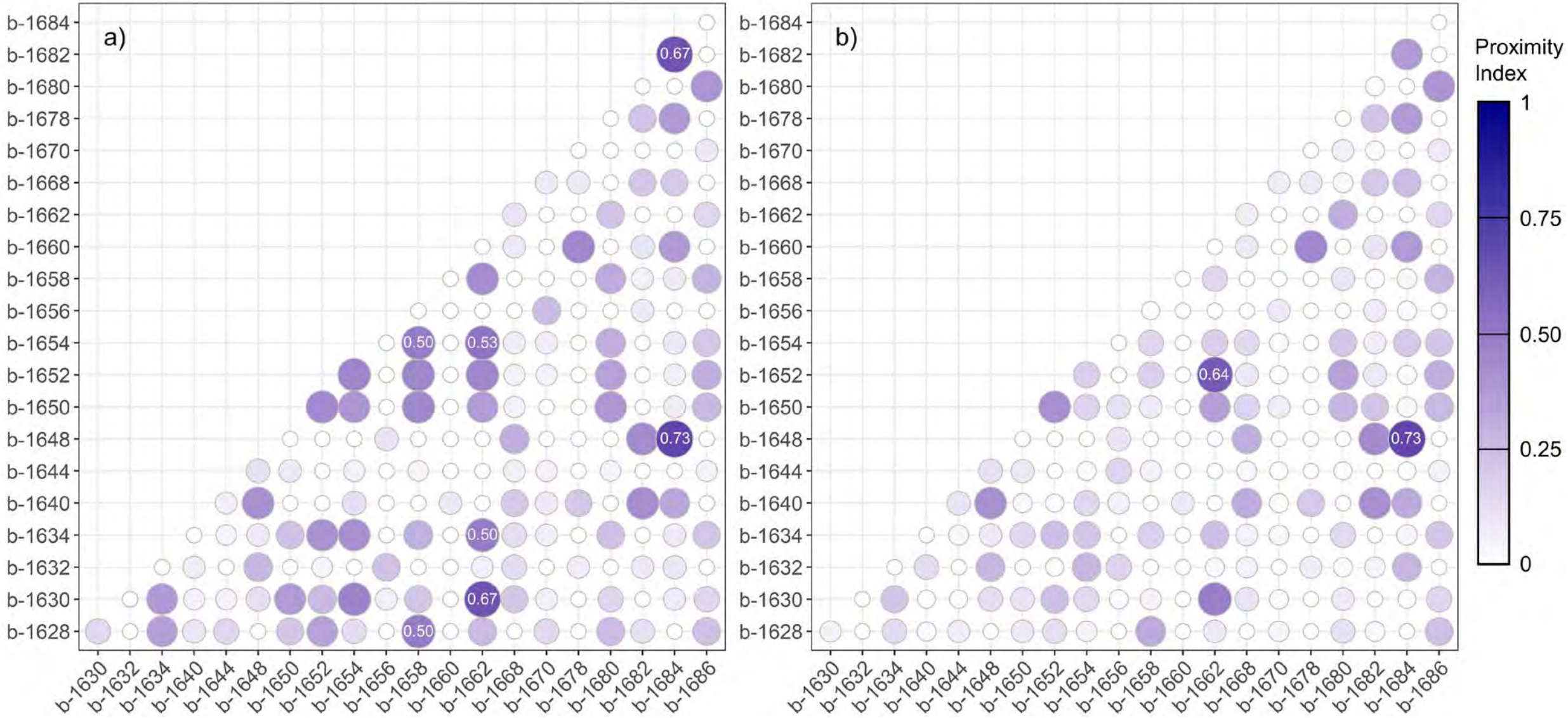


- Further distance travelled
- Northeast direction
- Following deep bathymetry

Schooling behaviour

First 24 hours

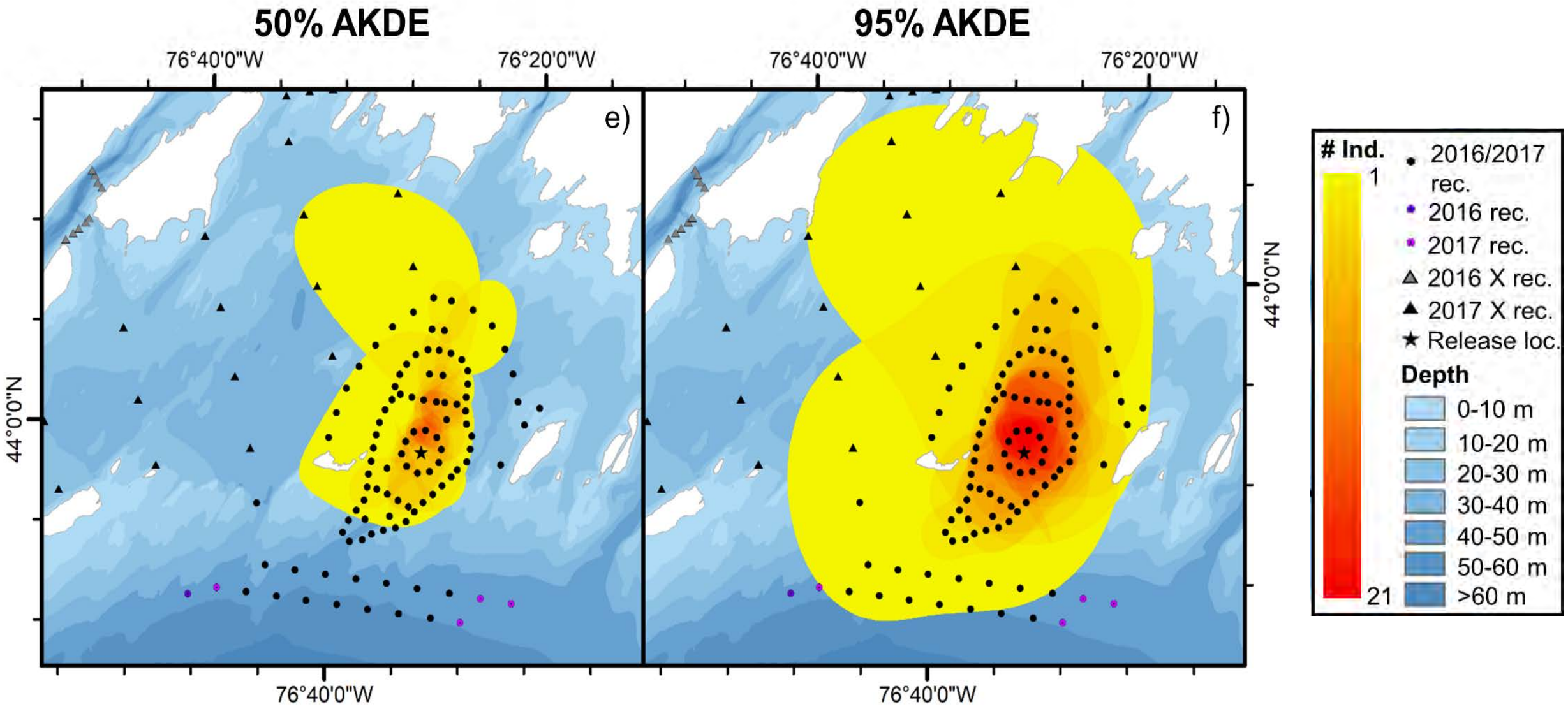
2-week detection period



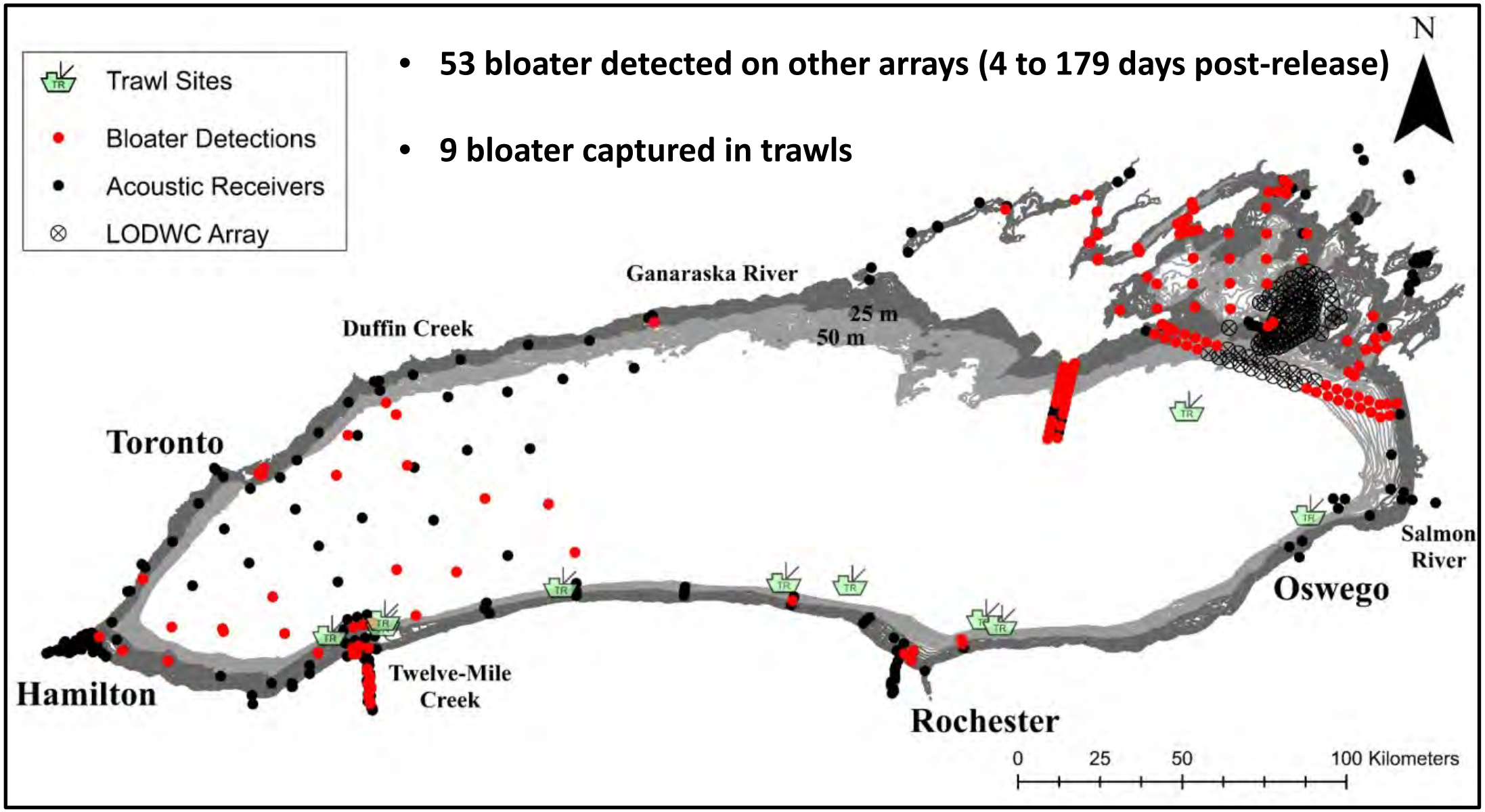
Horizontal space use

Core activity space

Extent of activity space

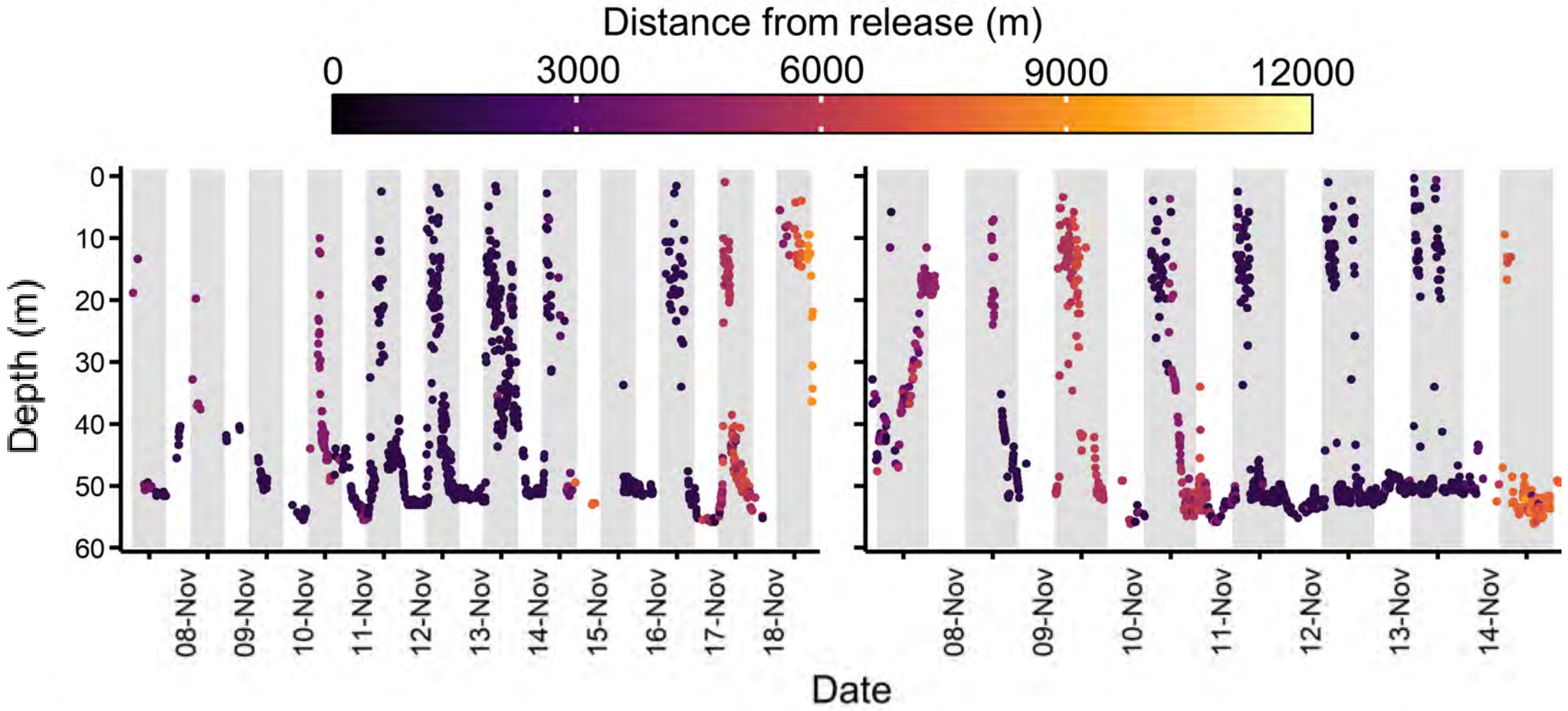


Larger scale movement



- 53 bloater detected on other arrays (4 to 179 days post-release)
- 9 bloater captured in trawls

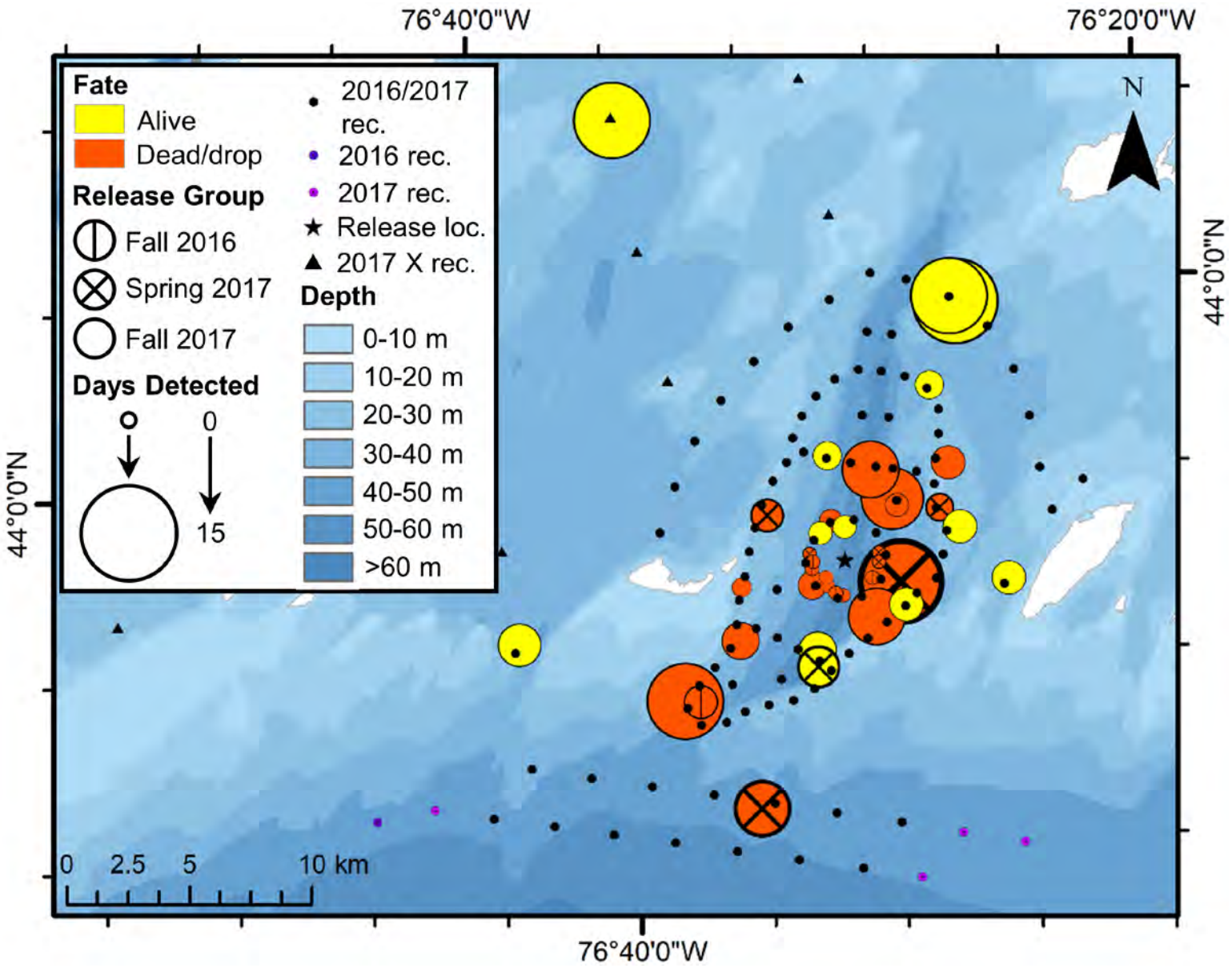
Vertical space use



Fish 1631

Fish 1657

Fate of tagged bloater



Location of last position for fish still alive

Location of death for fish confirmed dead

Two week survival is 34%

Several fish last detected alive on outer receivers, suggesting they may have left and survived elsewhere in the lake

Predation?


© William Roston

0
Depth (m)
60
distrelease
9000
6000
3000
Nov 7
2017
Date
Nov 16
2017

Predation tags

n = 19 non-predated

n = 28 predated

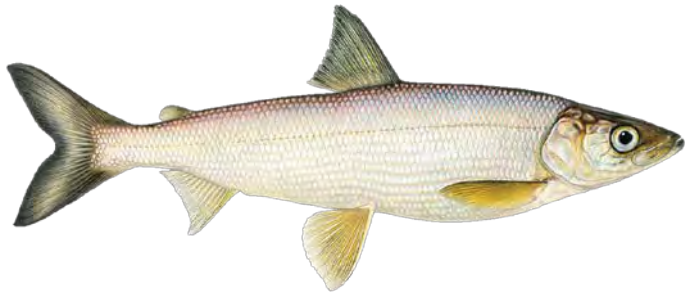
- alive
- predated
- excreted
- dead
- triggered

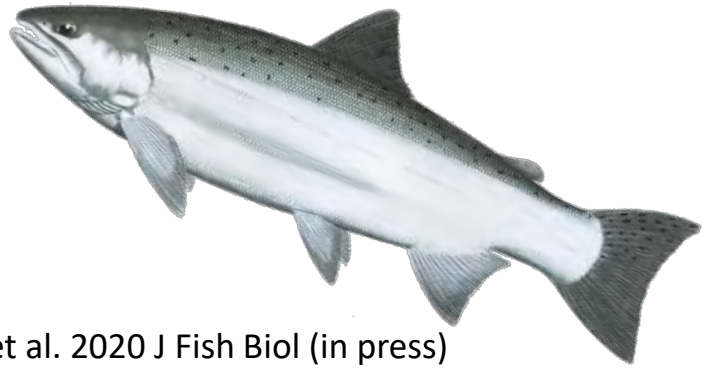
Fish ID

Date

Dec-18 Jan-19 Feb-19 Mar-19 Apr-19 May-19 Jun-19

Who ate the bloater?





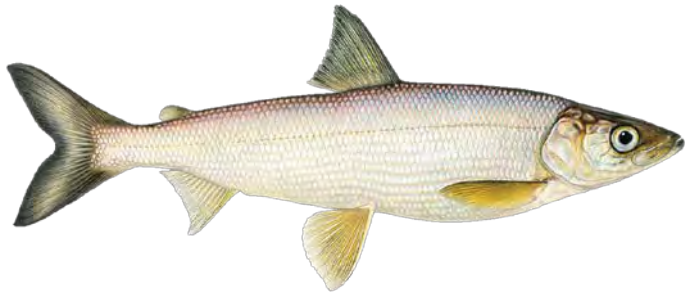
Klinard et al. 2020 J Fish Biol (in press)

Who ate the bloater?

50%

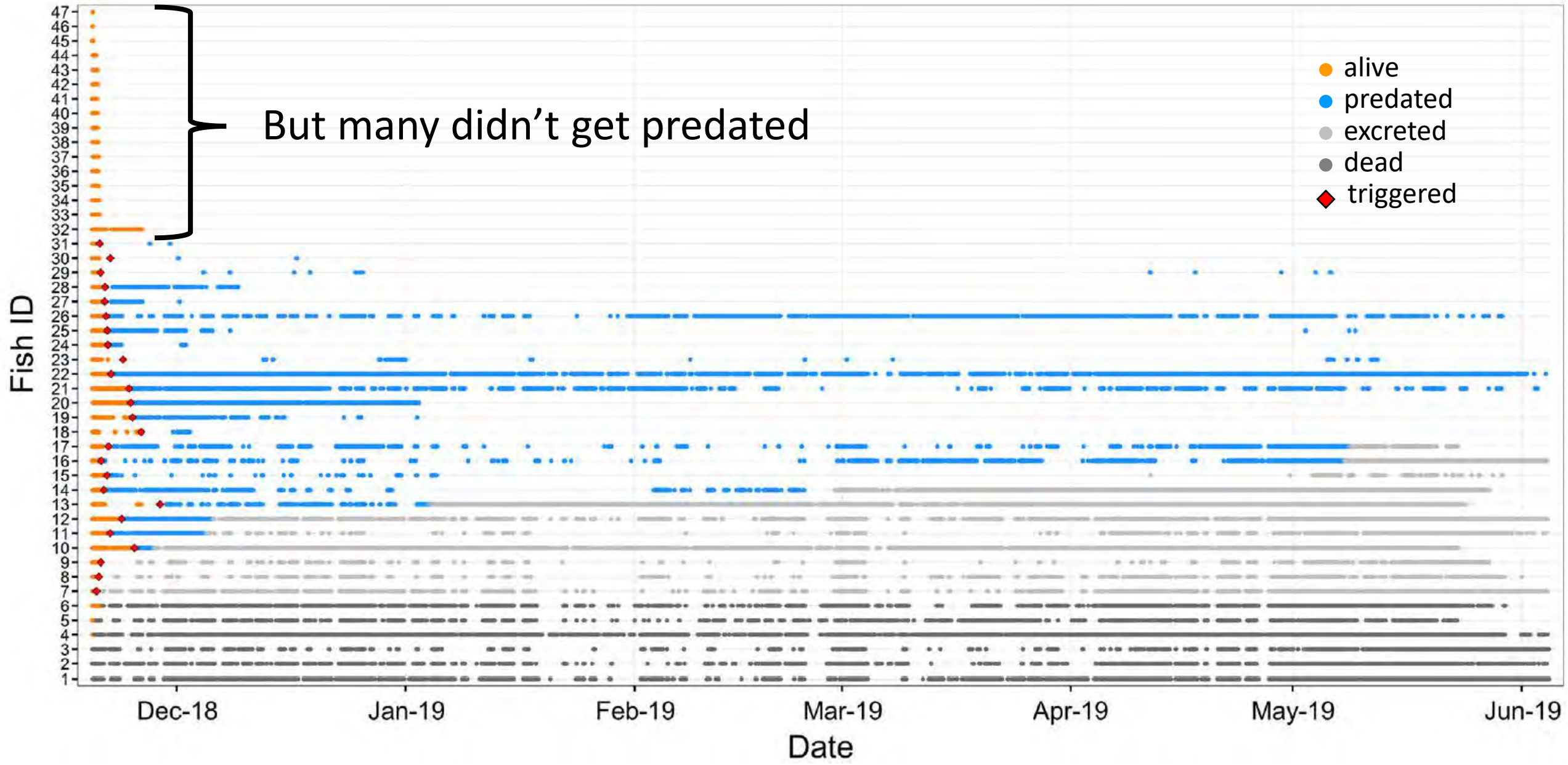
5%

40%



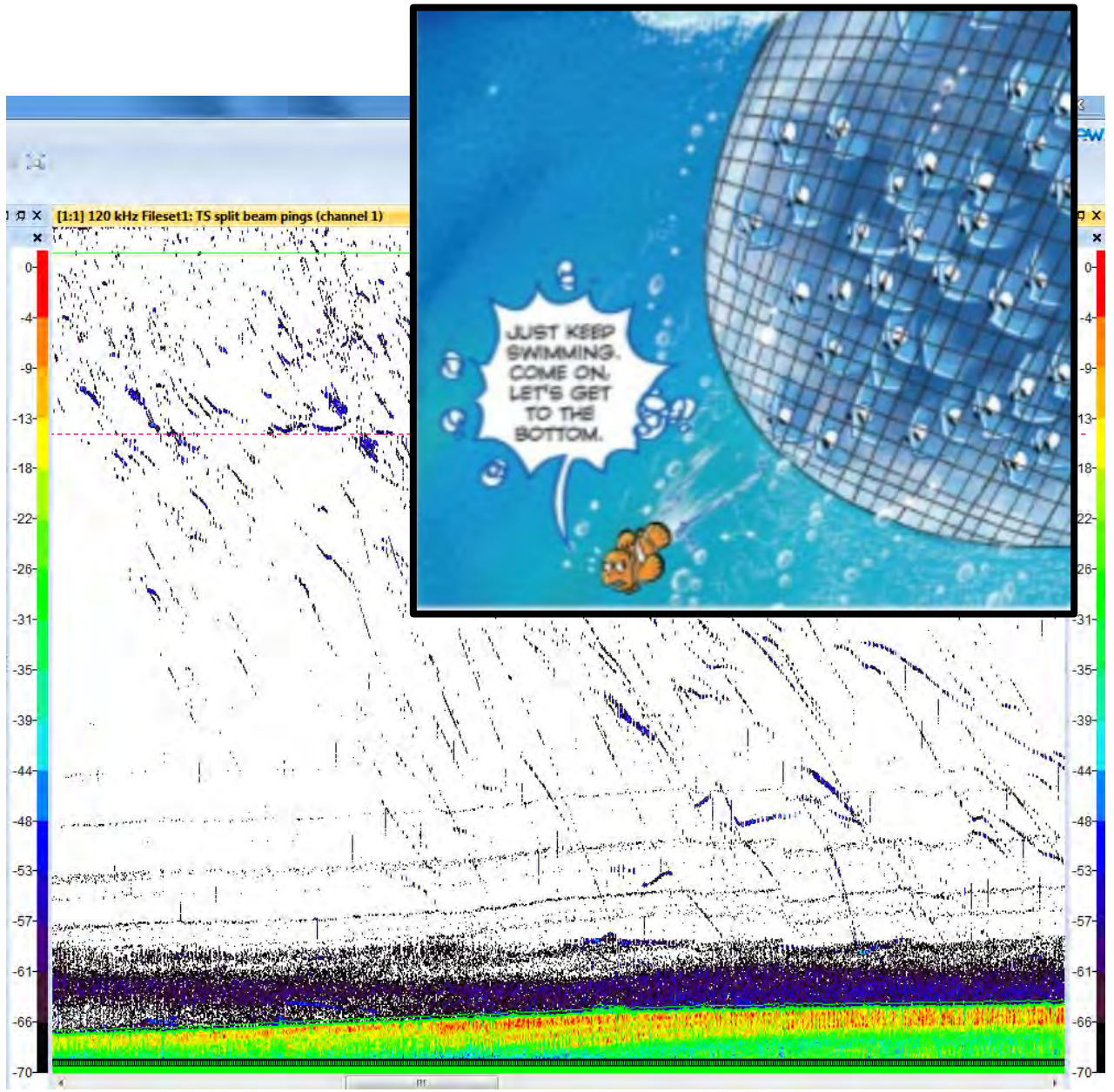
5%

Klinard et al. 2020 J Fish Biol (in press)


But many didn’t get predated
alive
predated
excreted
dead
triggered
Fish ID
Date
Dec-18
Jan-19
Feb-19
Mar-19
Apr-19
May-19
Jun-19

The stocking strategy

- Juvenile fish (100-160mm) are stocked during daytime, in the fall, over deepwater (50-100m)
- It is assumed that this approach reduces predation mortality (same approach is used for stocking yearling lake trout)
- Acoustics show that the fish swim downward to the lake bottom after release – averaging 15m per minute



Echoview Plot: Jeremy Holden, OMNRF

Compression barotrauma??

Owen Gorman (USGS)

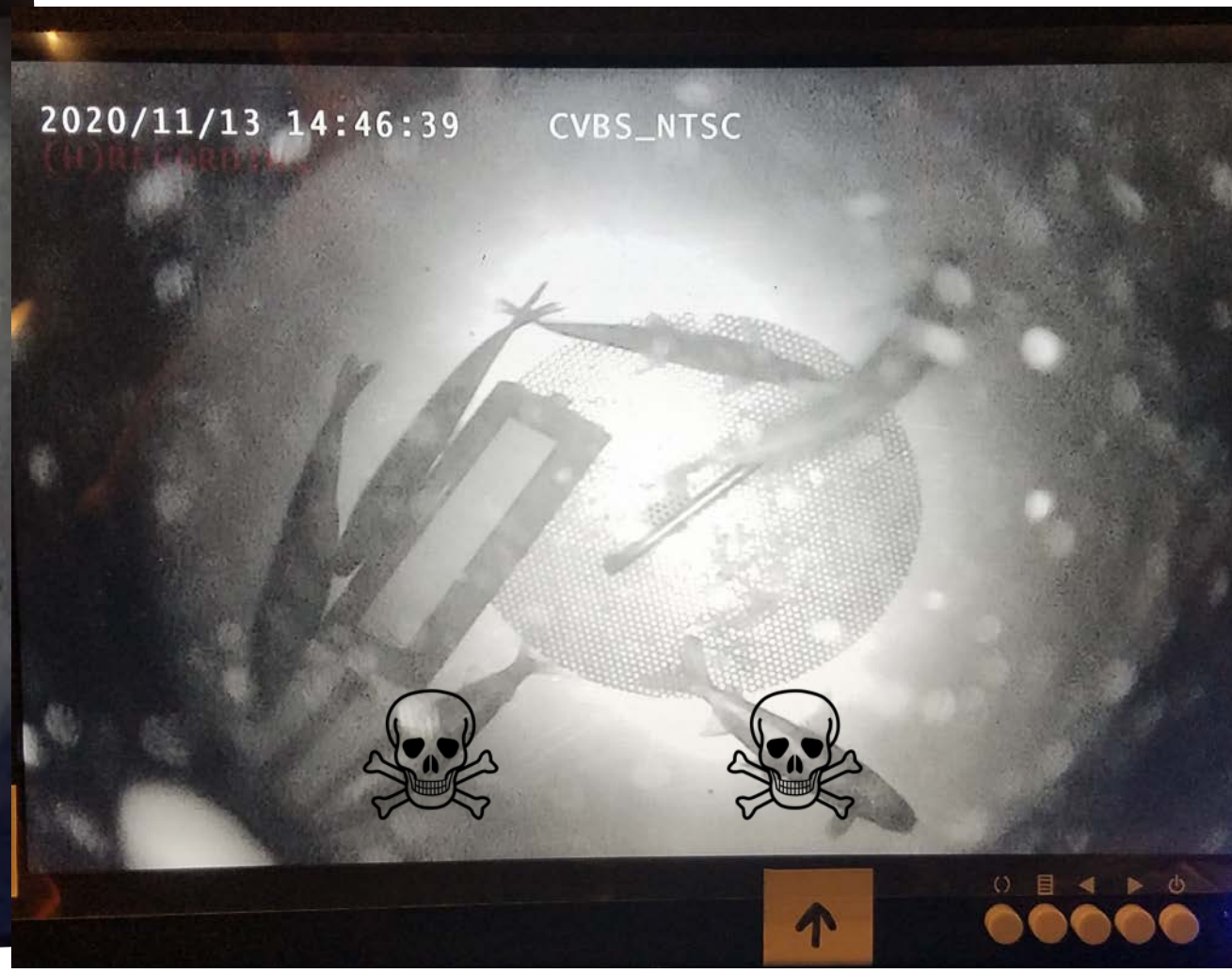
- Bloater exhibited acute stress when compressed
- 44% of fish exhibited disequilibrium, lying motionless on bottom at 5 atm (50 m)
  - 22% moribund
- Decompression alleviated some symptoms but 19% died within 48 hrs
  - 86% of mortalities had ruptured swim bladders

Evidence of compression barotrauma in hatchery fish

Control

All fish calm, slow respiration
swimming slowly

50 m simulated depth



All fish very active, rapid respiration
> 40% eventually on bottom

Conclusions

- Significant and novel value of acoustic telemetry in restoration studies and determining the post-release ecology of stocked fishes
- Bloater disperse rapidly following release with a general preference for deeper waters
- Bloater undergo extensive diel vertical movements within metres of the surface inferred but never confirmed due to gear limitations
- Despite overlap in activity space, there was no evidence of schooling behaviour
- Low 2-week survival (34%) with individuals dying immediately after release and several days afterwards – *high predation rate based on predation tags*
- Results being used to modify culture, stocking and assessment practices

Management Recommendations

- Modify stocking practices
  - Transport, loading and release
  - Not over deep water
  - Nighttime stocking
  - Soft release

- Restoration strategy
  - Older life stages (spawners or near-spawners)
  - Pre-conditioning

Acknowledgements

- **MNRF Fish Culture Section** especially White Lake FCS, Tim Drew and George Bluett
- **Lake Ontario Management Unit** especially Jon Chicoine, Tim Dale, Brandon Perry, Cody Adams, Ben Maynard, Steve McNevin, Al McIntosh, Tyson Schulz
- **Other MNRF -** Meaghan Brennan, Jeff Buckley, Mary Hanley, Megan Murphy, Brent Metcalfe, Brent Nawrocki, Adam Rupnik
- **U Windsor -** Scott Colborne, Silviya Ivanova, Sarah Larocque, Jordan Matley

Ontario

GLATOS Great Lakes Acoustic Telemetry Observation System

University of Windsor

NSERC CRSNG

NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

Protecting Our Fishery · Great Lakes Fishery Commission · Science · Sea Lamprey Control · Partnerships

U.S. Fish & Wildlife Service · Department of the Interior