

The image shows two Atlantic sturgeon in shallow, muddy water. The sturgeon in the foreground is larger and has several small, glowing yellow tracking tags attached to its back. A yellow line is visible near its tail. The sturgeon in the background is smaller and also has tracking tags. The water is brown and murky, and the background shows a rocky shoreline.

Project 4.6

Atlantic sturgeon movement, behaviour and habitat use

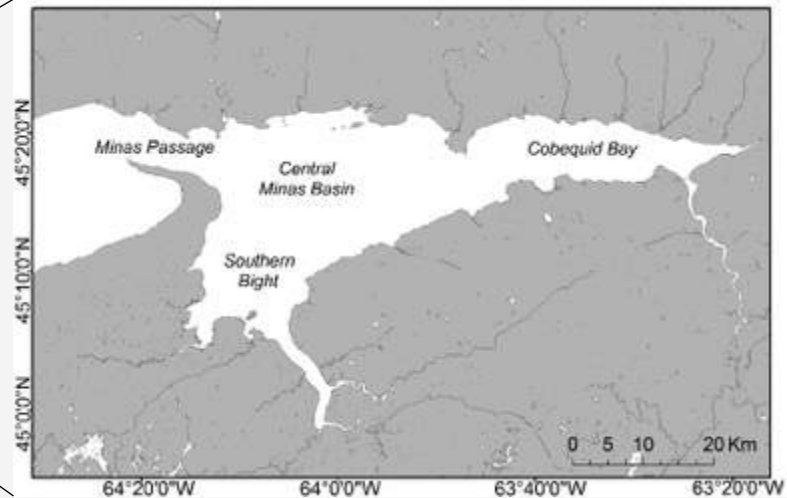
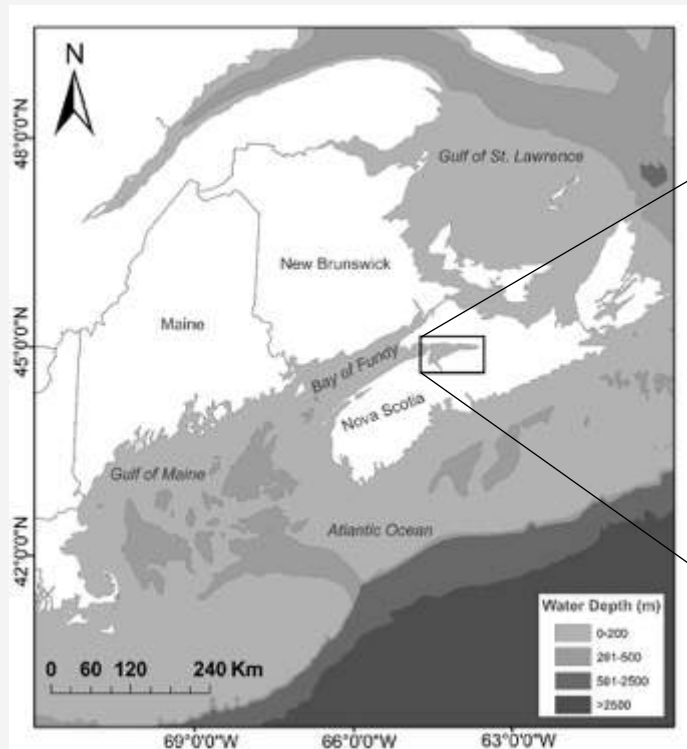
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J. W. Beardsall, J. W. W. Bell, M. J. Dadswell, M. K. Litvak, M. F.
McLean, N. D. Stewart, M. J. W. Stokesbury, and A. D. Taylor**

Introduction

- Anadromous fish
- Canadian spawning populations in SJR and SLR
- Commercial fisheries for caviar and meat
- Slow-growing, late-maturing and long-lived
- Designated as threatened by COSEWIC
- Minas Basin hosts an annual summer feeding aggregation



Coastal Ecology Lab: Acadia U.



- Main research focus: Understanding Atlantic sturgeon interactions with coastal developments (eg. tidal turbines)
- But... also little known about several basic natural history characteristics (feeding, spawning, marine migration, overwintering, etc.)

Feeding

McLean, M. F., Dadswell, M. J., and Stokesbury, M. J. W. 2013. Feeding ecology of Atlantic sturgeon, *Acipenser oxyrinchus* Mitchill, 1815 on the infauna of intertidal mudflats of Minas Basin, Bay of Fundy. J. Appl. Ichthyol. 1-7.



- Benthic tube-dwelling polychaetes were the main prey item

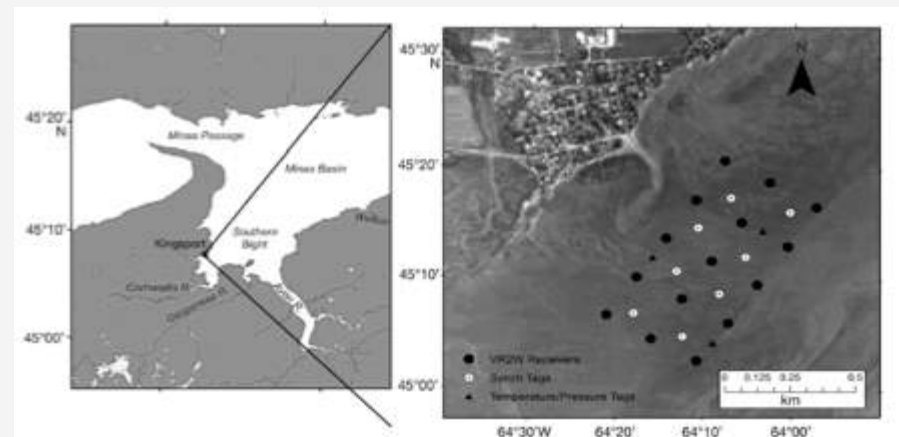
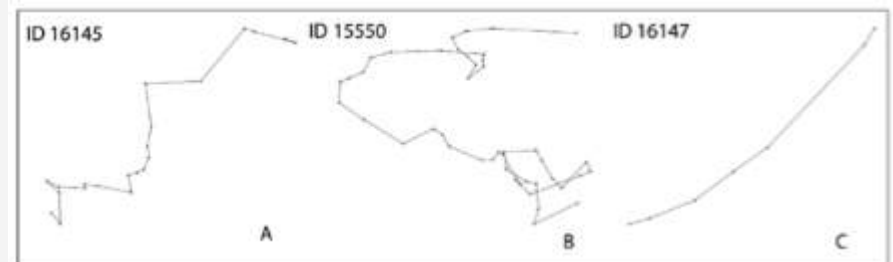


- Opportunistic predators
- Feeding mainly over sandy substrates

Fine-scale movement patterns

McLean, M. F., Simpfendorfer, C. A., Heupel, M. R., Dadswell, M. J., and Stokesbury, M. J. W. 2014. Diversity of behavioural patterns displayed by a summer feeding aggregation of Atlantic sturgeon in the intertidal region of Minas Basin, Bay of Fundy, Canada. *Mar. Ecol. Prog. Ser.* 496: 59-69.

- Three different movement patterns (feeding, searching, directional travel)
- Increased crepuscular activity possibly related to prey availability
- Intertidal zone off Kingsport, NS an important foraging area



Stress from bycatch

Beardsall, J. W., McLean, M. F., Cooke, S. J., Wilson, B. C., Dadswell, M. J., Redden, A. M., and Stokesbury, M. J. W. 2013. Consequences of incidental otter trawl capture on survival and physiological condition of threatened Atlantic sturgeon. *T. Am. Fish. Soc.* 142: 1202-1214.

- High minimum post-release survival rate (97%)
- Resilience to capture and tagging stress
- Increased blood lactate with increased handling time
- Capture as bycatch in MB weir and trawl fisheries not a major concern



Marine depth and temp. occupancy

Beardsall, J. W., Stokesbury, M. J. W., and Dadswell, M. J. Submitted. Atlantic sturgeon *Acipenser oxyrinchus* Mitchill, 1815 seasonal marine depth and temperature occupancy and movement in the Bay of Fundy. J. Appl. Ichthyol.

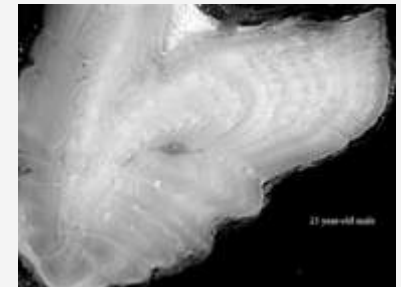
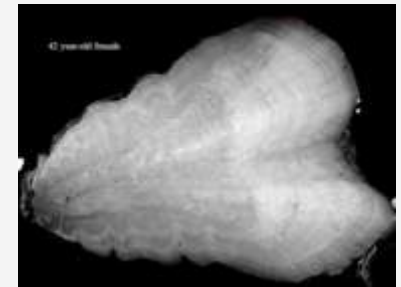
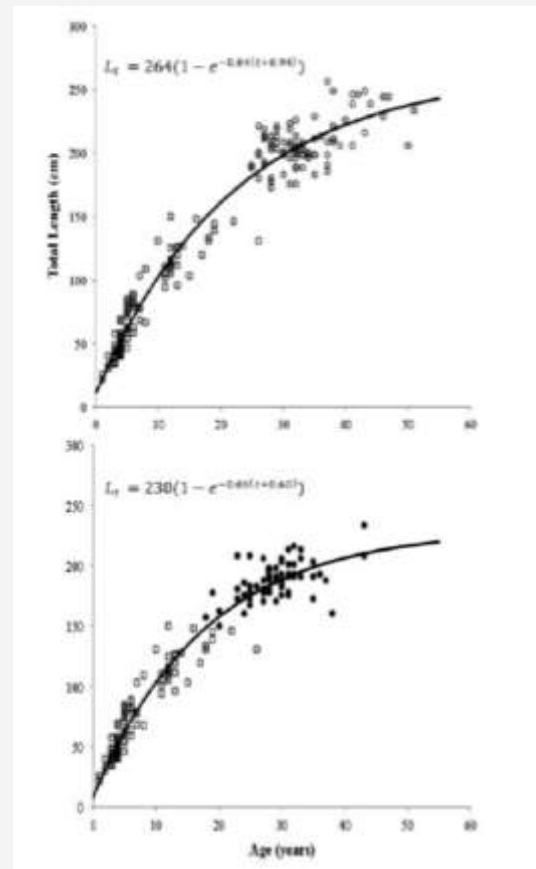
- Depth variation low during summer (MB) but high during fall, winter and spring (BoF)
- Deepest depth occupancy in Dec. (60-90 m)
- Coldest temp. occupancy in March (0-4°C)



Age and growth

Stewart, N. D., Dadswell, M. J., Leblanc, P., Bradford, R. G., Ceapa, C., and Stokesbury, M. J. W. 2015. Age and growth of Atlantic sturgeon from the Saint John River, New Brunswick, Canada. *N. Am. J. Fish. Manage.* 35: 364-371.

- Males reached maximum length sooner than females
- Females continue to grow as adults
- VB growth curves developed for females (top) and males (bottom)
- Essential to sustainable management



Population estimate

Dadswell, M. J., Wehrell, S. A., Spares, A. D., McLean, M. F., Beardsall, J. W., Logan-Chesney, L. M., Nau, G. S, Ceapa, C., Redden, A. M., and Stokesbury, M. J. W. Submitted. The annual marine feeding aggregation of Atlantic sturgeon in the inner Bay of Fundy: population characteristics and movement. J. Fish Biol.

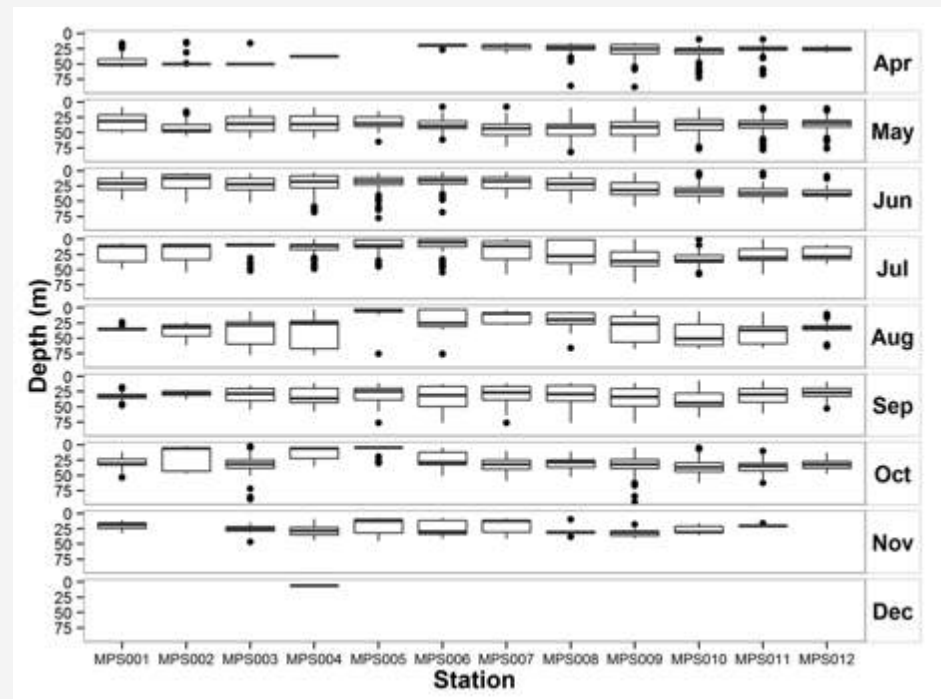
- N = 1453 floy tags deployed from 2004-2015
- Tag returns from Quebec to New Jersey
- Modified Schnabel population estimate for MB aggregation ranged from 10 700 to 37 500 (2010-2015)



Minas Passage occupancy

Stokesbury, M. J. W., Logan-Chesney, L. M., McLean, M. F., Buhariwalla, C. F., Redden, A. M., Beardsall, J. W., Broome, J. E., and Dadswell, M. J. Submitted. Atlantic sturgeon spatial and temporal distribution in Minas Passage, Nova Scotia, Canada, a region of future tidal energy extraction. PLoS One.

- Greater use of southern portion of MP than northern portion
- Pelagic swimming through MP
- Narrow depth range (15-45 m)
- Potential for overlap with tidal turbines



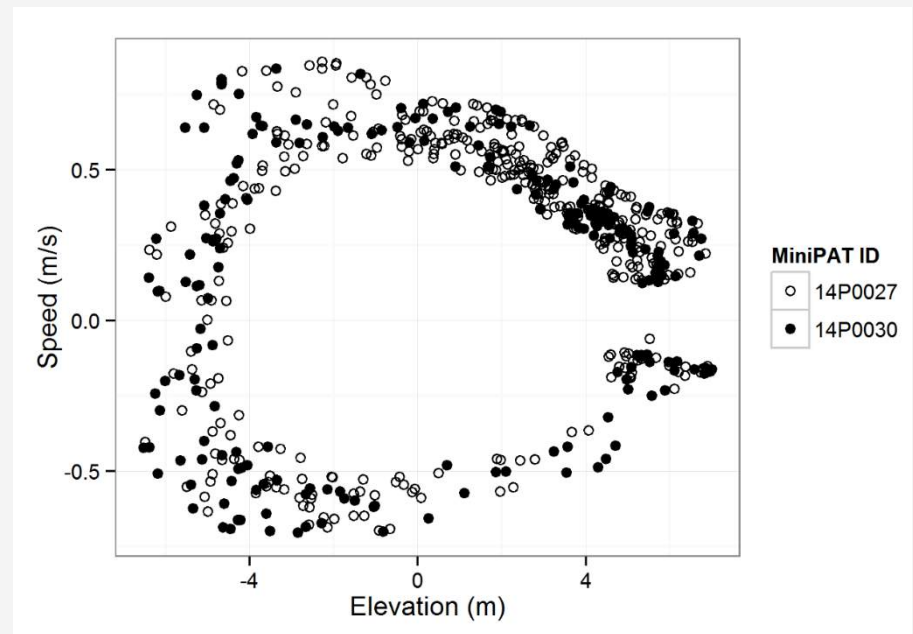
Breaching behaviour

(In progress)

Poster session

Logan-Chesney, L. M., Stokesbury, M. J. W., Karsten, R. H., and Dadswell, M. J. Atlantic sturgeon breaching behaviour in Minas Basin, inner Bay of Fundy, Canada.

- Breaching very common in Minas Basin during summer
- Tidal cycle had biggest influence on breaching frequency
- Main purpose likely buoyancy control, via regulation of air in the gas bladder



Population-specific movement patterns

(In progress)

Logan-Chesney, L. M., McLean, M. F., Beardsall, J. W., Stokesbury, M. J. W., and Dadswell, M. J. Atlantic sturgeon population-specific movement patterns and residency in Minas Basin, inner Bay of Fundy, Canada.

- Genetically identified population of origin for 103 acoustically tagged AS (42% KR, 58% SJR)
- Timing of arrival and departure (Minas Basin)
- Schooling behaviour
- Residency index
- Roaming index



Looking ahead...

Many aspects of Atlantic sturgeon natural history in Minas Basin and the Saint John River have now been studied.

Future work:

- Determining whether Atlantic sturgeon can detect and/or avoid tidal turbines placed in Minas Passage
- Expanding our current acoustic receiver array to identify other important habitats



<http://www.nationalobserver.com/2016/05/19/news/long-awaited-tidal-power-turbine-enter-bay-fundy-next-month>

Fish Ecology and Aquaculture Lab: Mount Allison University

- Overwintering habitat of Atlantic sturgeon (Taylor et al. 2016)
- Developed and tested manual triangulation technique for ultrasonic tracking (Taylor and Litvak 2015)
- Developed accelerometer tagging methods for sturgeon (Broell et al. 2016)
- Captured five Atlantic sturgeon larvae and described potential spawning habitat (Taylor and Litvak 2016, in review)
- River distribution of Atlantic sturgeon (Taylor and Litvak, 2015)
- Preliminary work on juvenile Atlantic sturgeon (Bell, 2014)

Spatial Ecology of Juvenile Atlantic Sturgeon

Project goal: Investigate patterns of movement at large- and fine-scales, identify aggregation sites, and investigate overwintering ecology

- Passive tracking for large-scale pattern (VR2W)
- Active tracking and triangulation to identify aggregation sites
- Passive array to investigate movement within aggregation sites (VR2TX)



Study Site: Saint John River Basin

- Saint John River below Mactaquac Dam (RKM 145)
- Kennebecasis River below confluence with Hammond River (RKM 30)
- Study area covers over 170 RKM

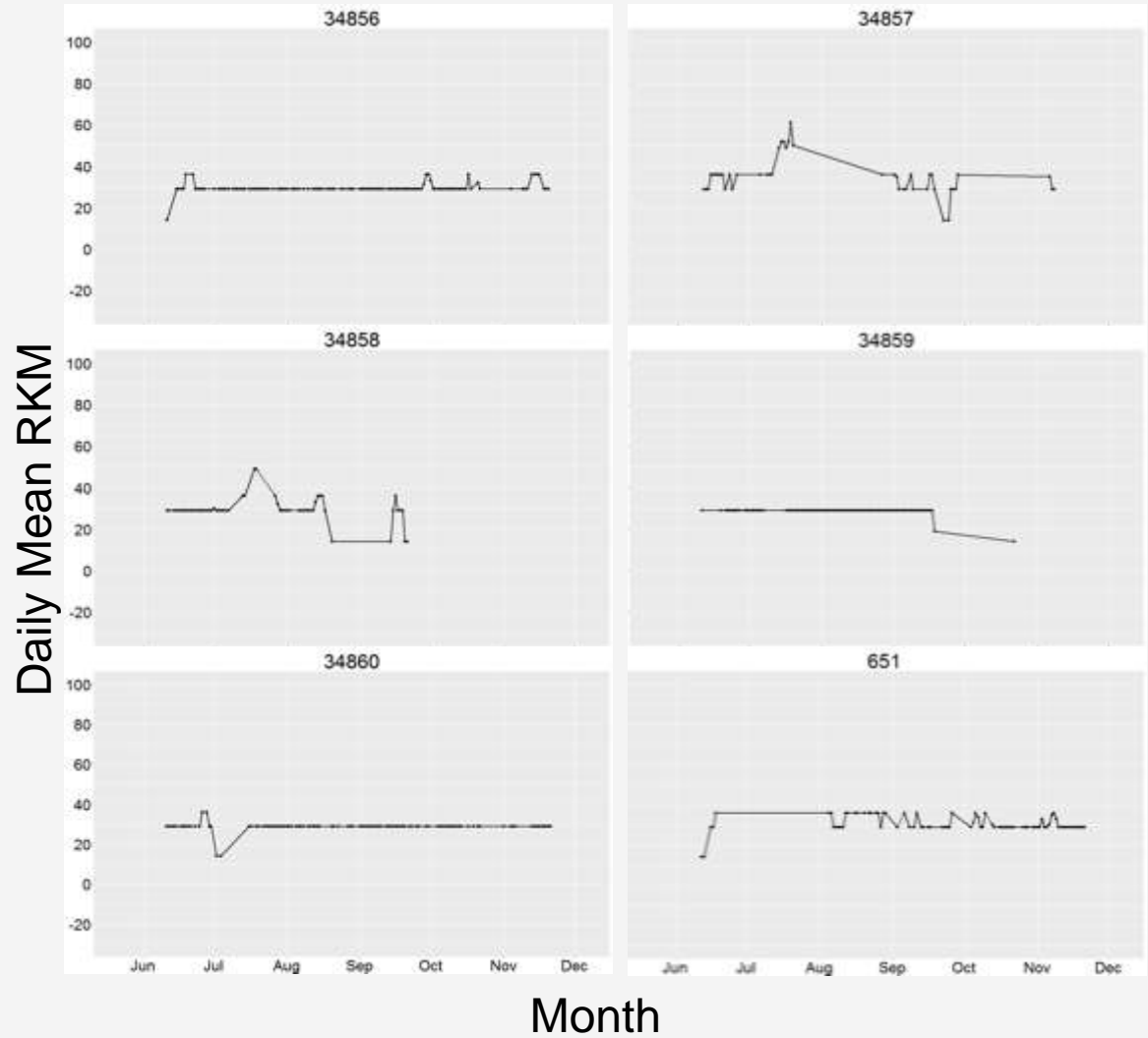
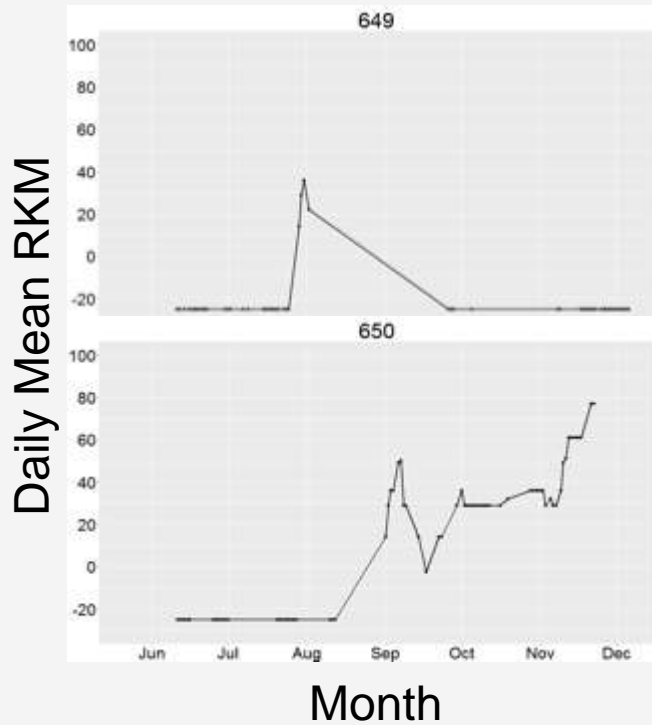


2015 Field Season

- 12 juveniles tagged with Vemco V13 and V13P ultrasonic tags
- Sizes ranged from 62 cm to 90 cm total length
- Passive tracking:
 - 19 Vemco VR2W receivers
- Active tracking and triangulation:
 - Vemco VR-100 receiver with omni-directional and directional attachments

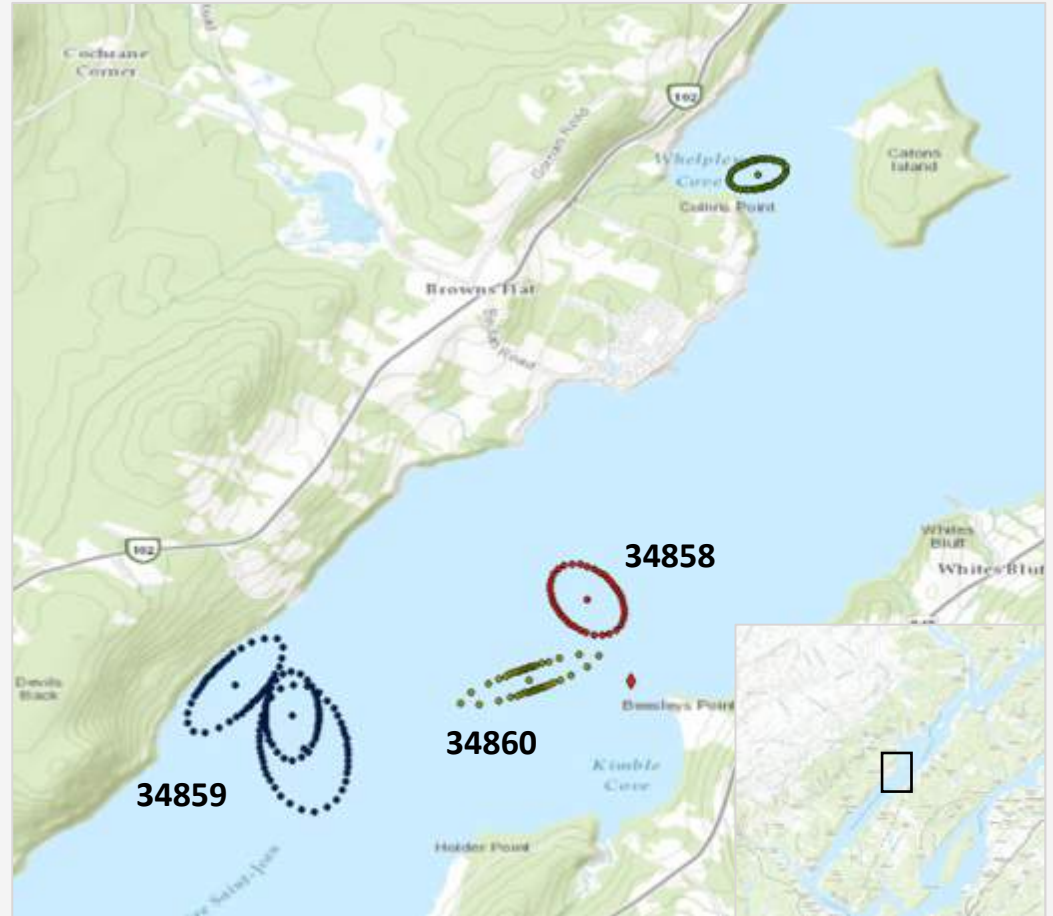


Preliminary Results



Summer Aggregation Sites

- Triangulation reveals positions within RKM 29
- Repeated detections of multiple individuals indicative of aggregation site



Next Steps

- Currently deploying receivers and tagging juvenile Atlantic sturgeon for the 2016-17 field season
- Tag smaller fish to determine upriver movement and habitat use
- Locate new summer and winter aggregation sites via active tracking
- Investigate aggregation sites and launch VR2TX array

Acknowledgements

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Questions?

