Using Telemetry to Understand Gulf of Maine Atlantic Salmon Marine Ecology

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Northeast Fisheries Science Center

John F. Kocik, James P. Hawkes, Graham Goulette, Timothy F. Sheehan, and Mark D. Renkawitz




3rd International Conference on Fish Telemetry Halifax, NS Canada 16 July 2015

Atlantic Salmon Life Cycle

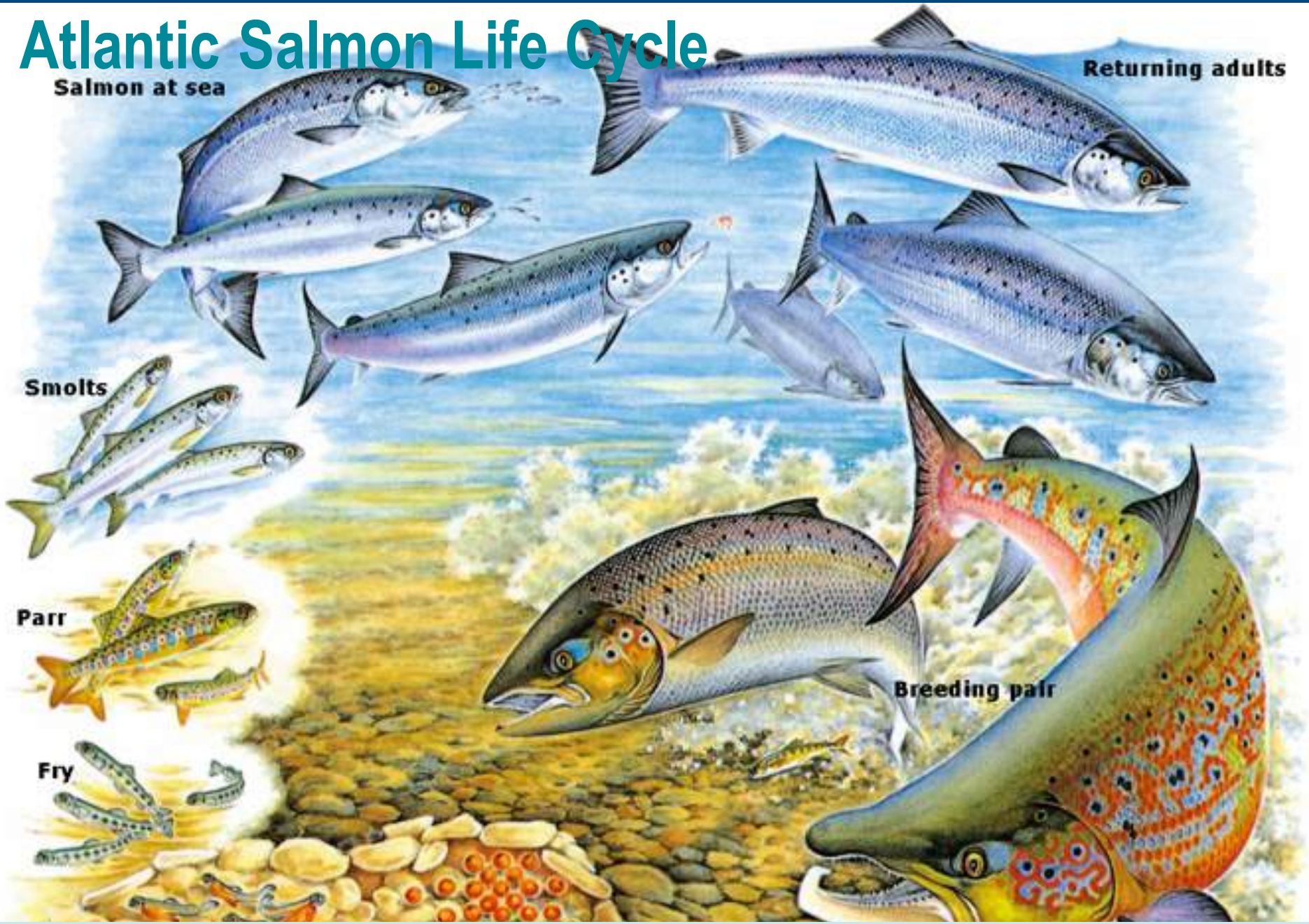

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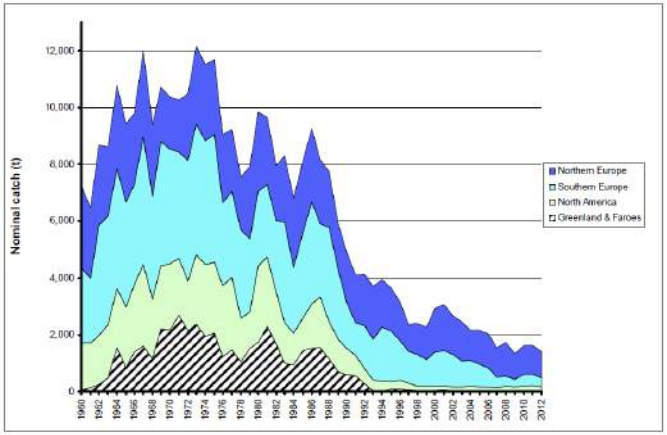
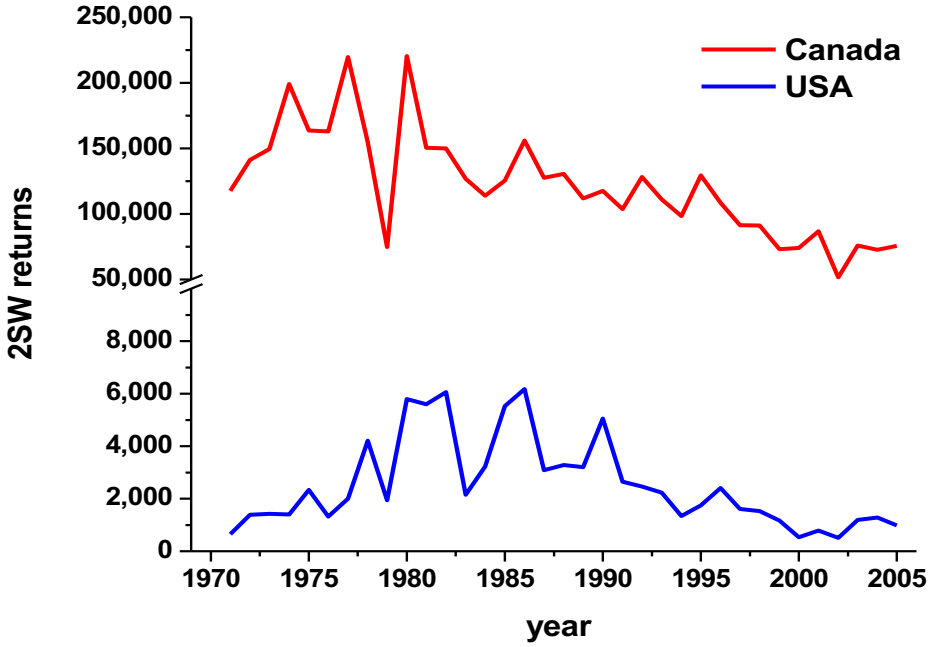
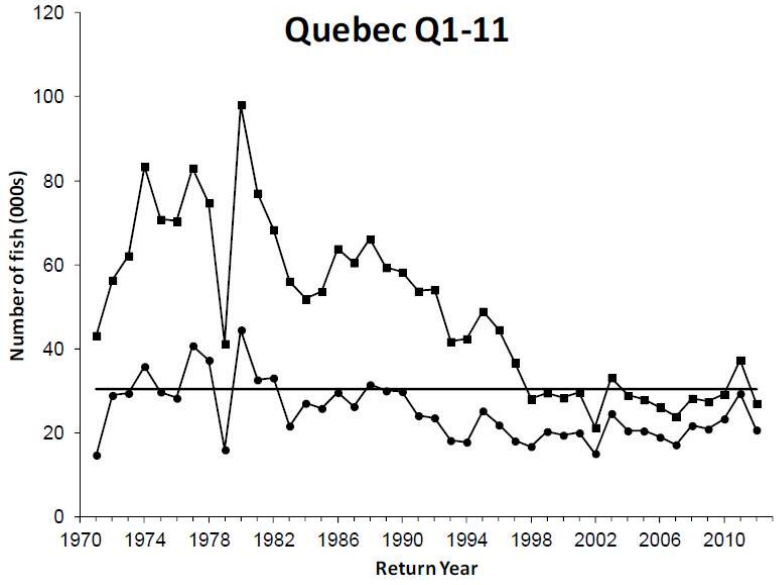
Illustration Courtesy of the Atlantic Salmon Trust and Robin Ade

Global Declines in Salmon Abundance

- Declines in global nominal catch
- Declines in regional stock complexes
- 1989 to 1991 regime/phase shift – in marine survival







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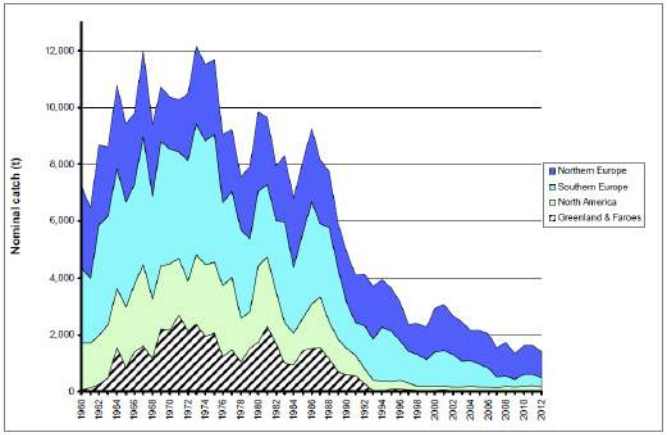
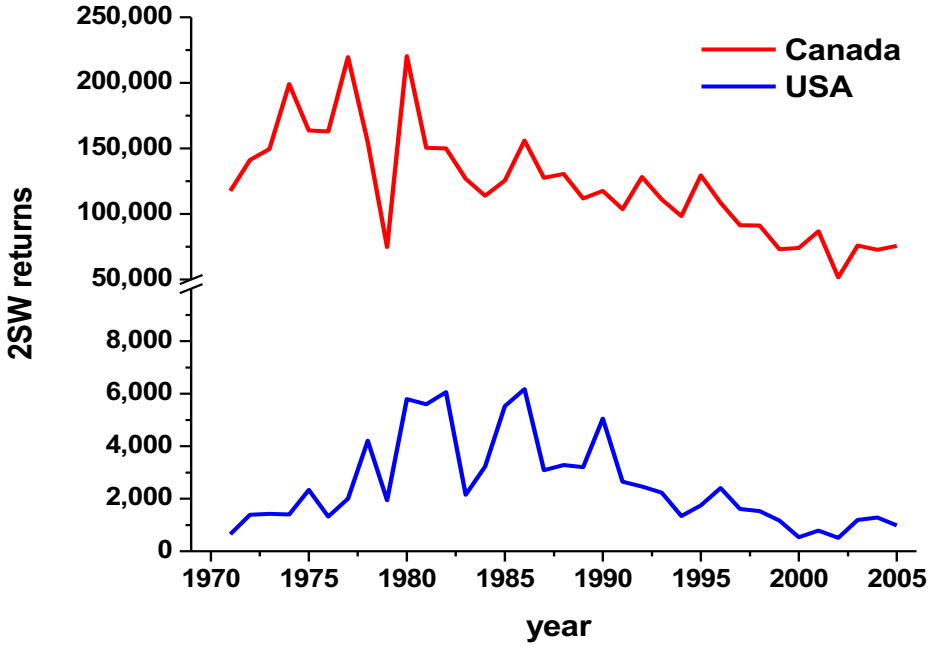
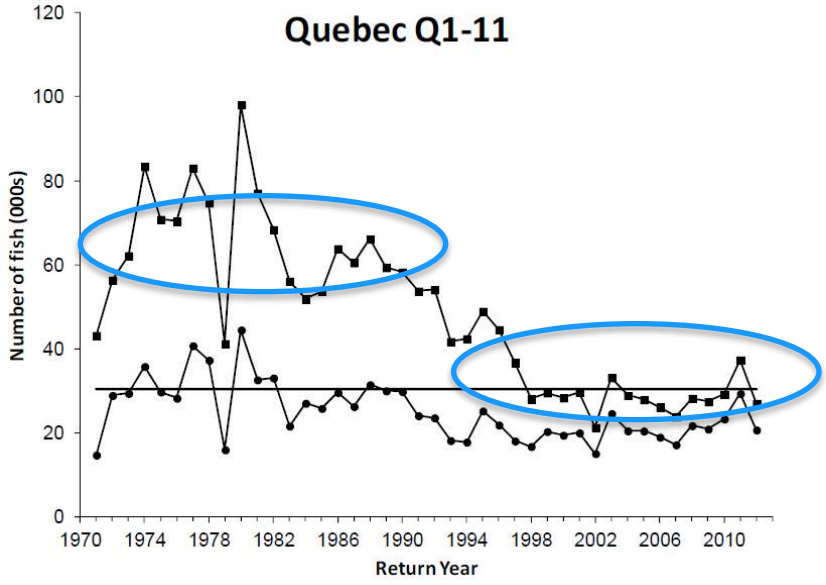
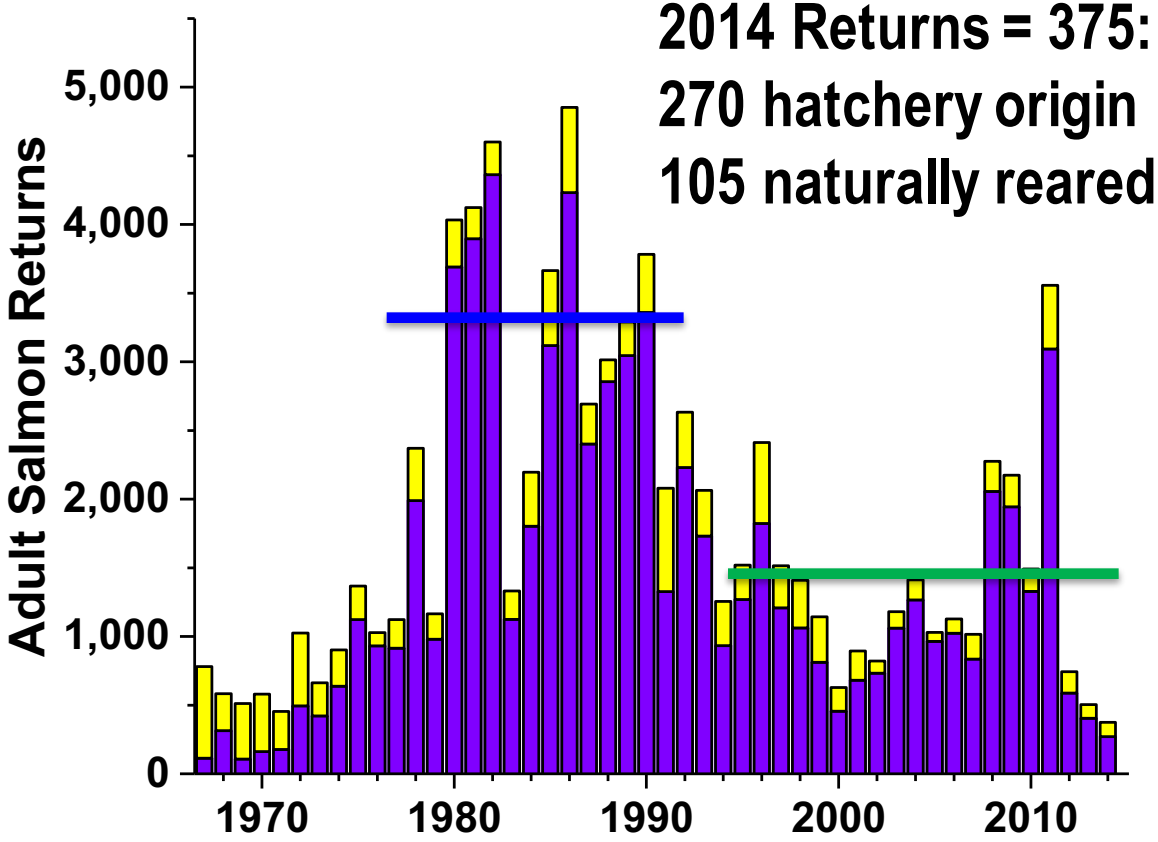




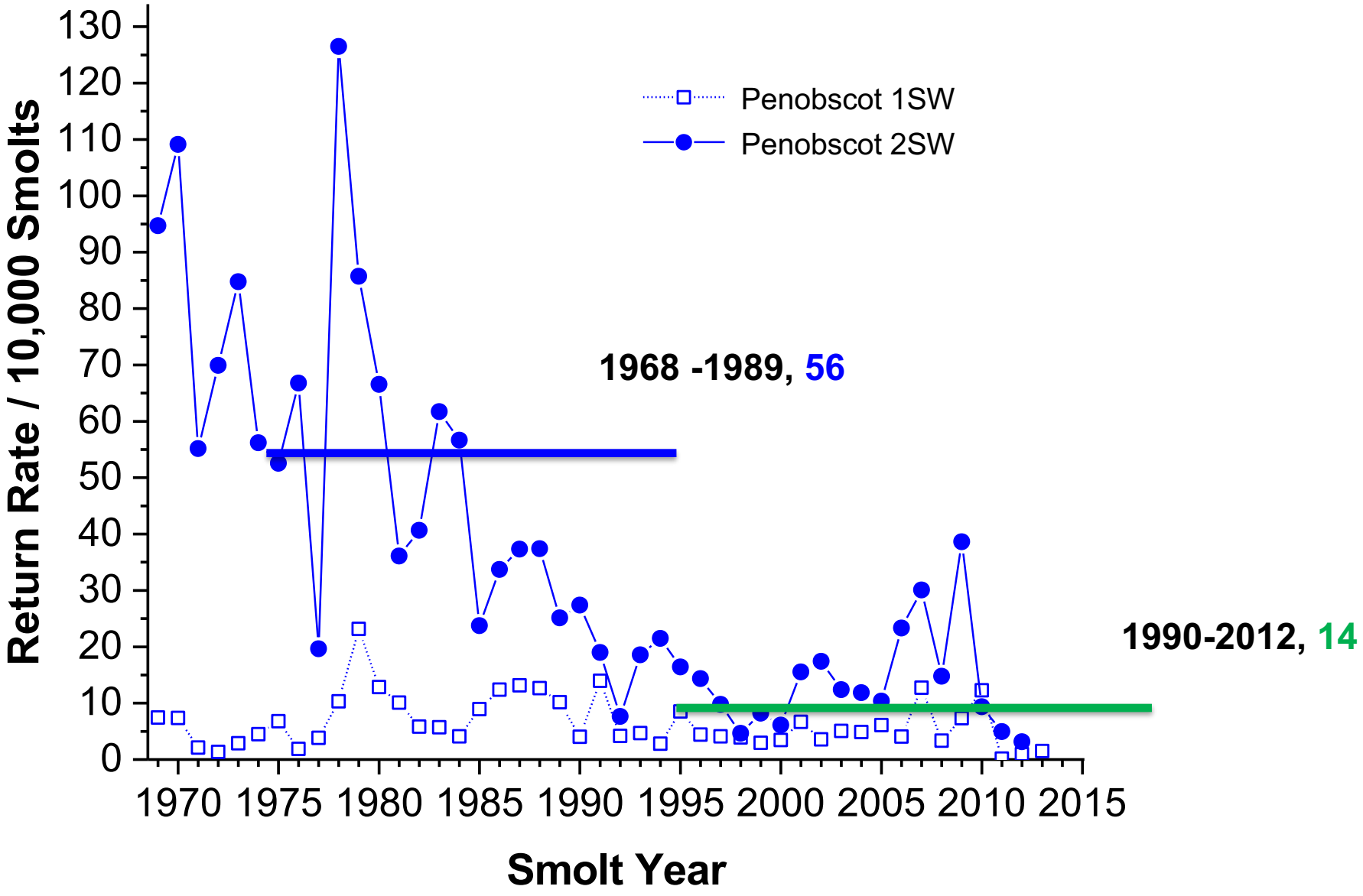


Endangered Gulf of Maine Salmon

- Hatchery-smolt (purple) returns dominate Penobscot time series
- Naturally-reared (yellow) returns dominate smaller rivers



Smolt – Adult Return Rate (SAR)



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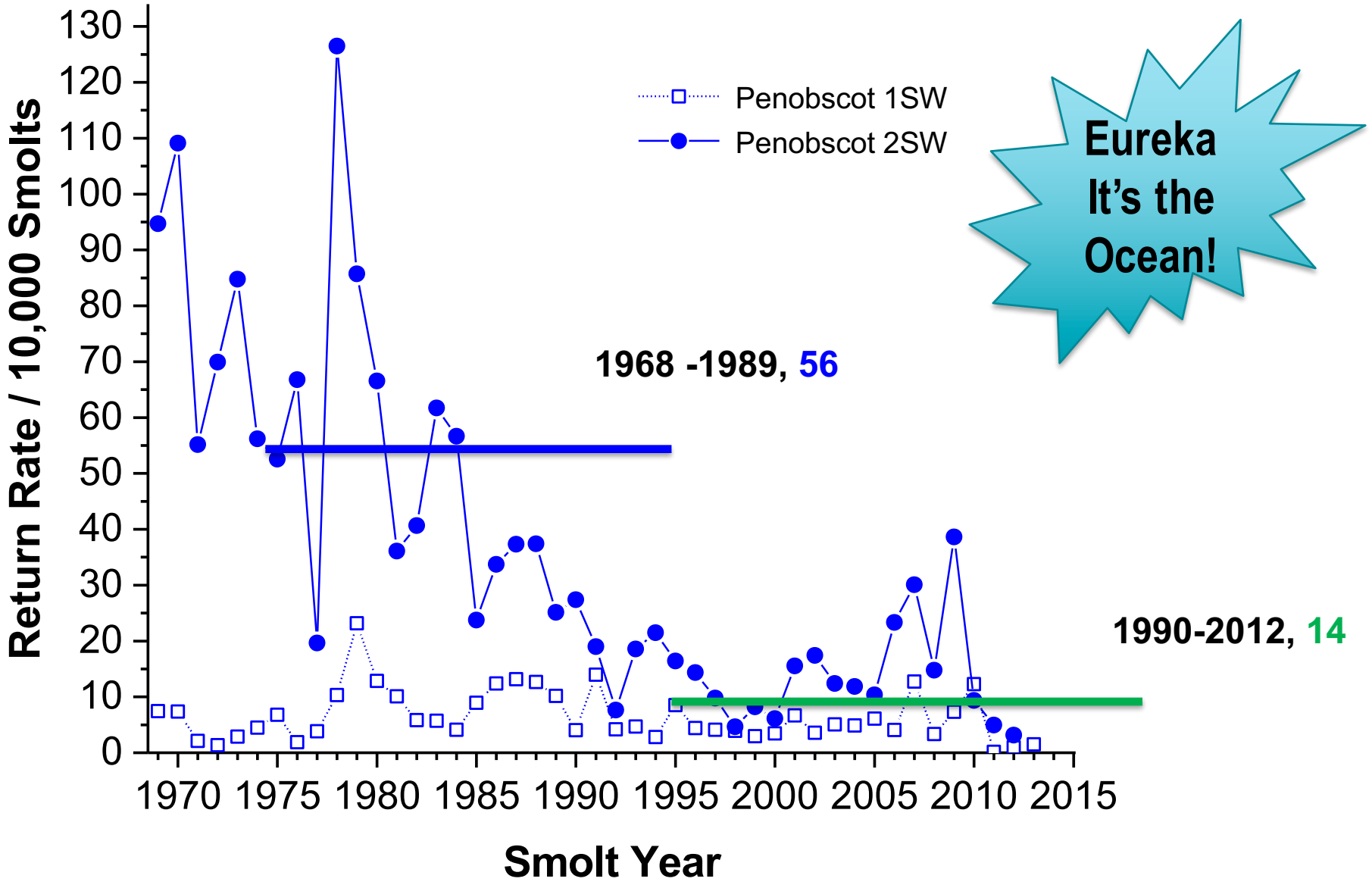
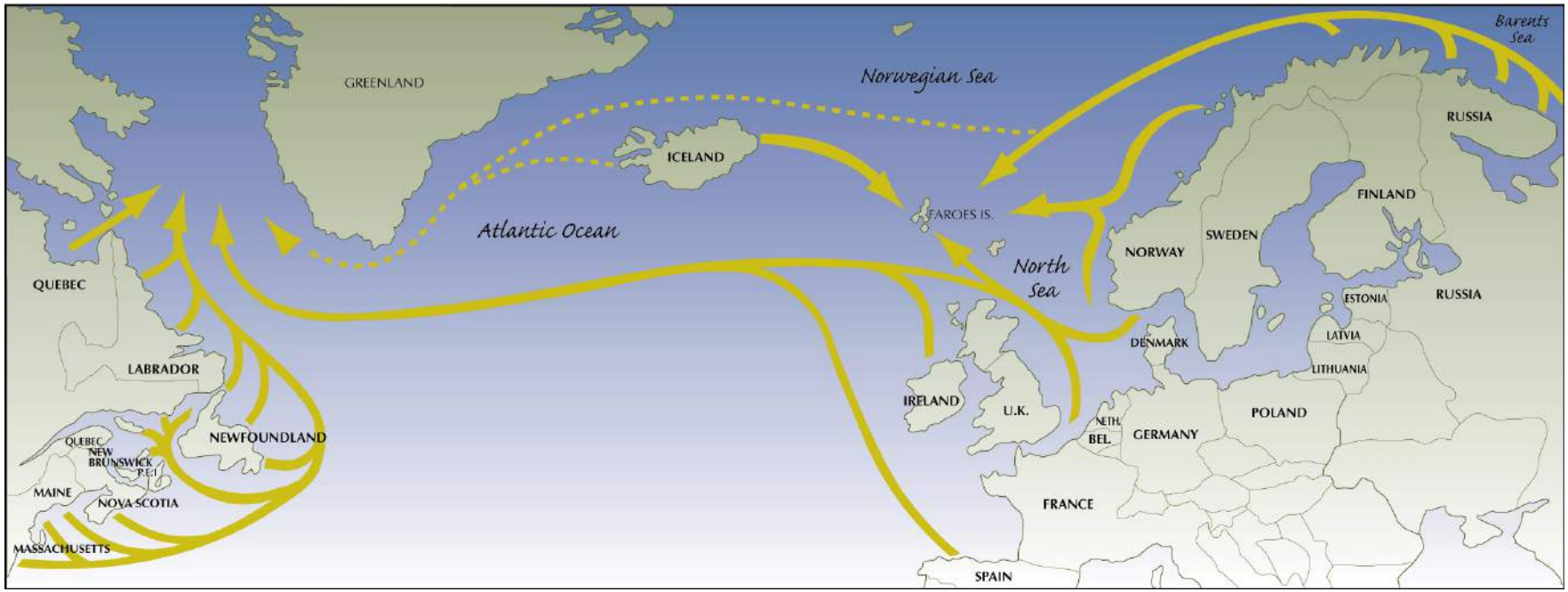


So the Problem is In the Ocean?

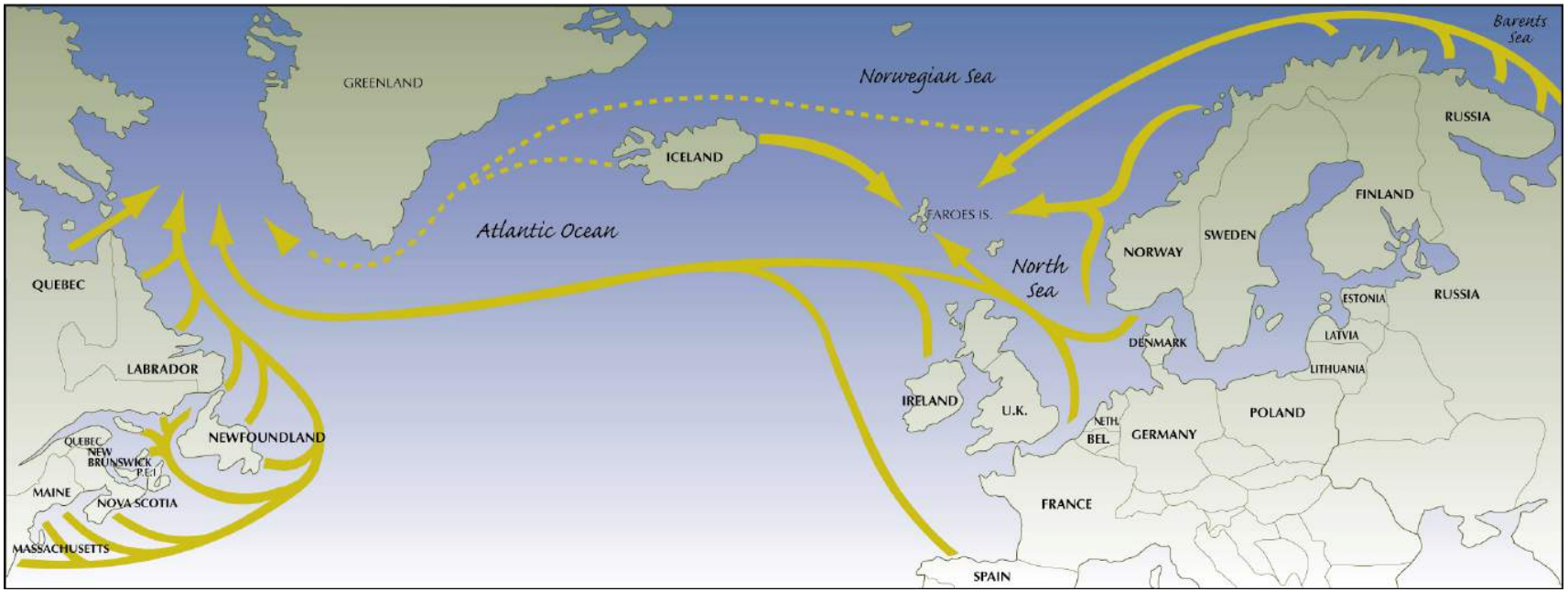
- Doesn't Exactly Narrow it Down
  - Broad Area
  - Two + Years



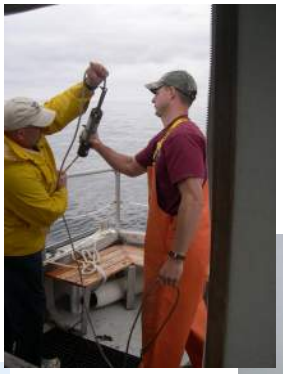
So the Problem is In the Ocean?

- Divide and Understand
  - Partition Life at Sea
  - Telemetry a Key Tool

- Start in Lower River & Work Seaward
- Start in Coastal Rivers & Expand to Largest River Systems



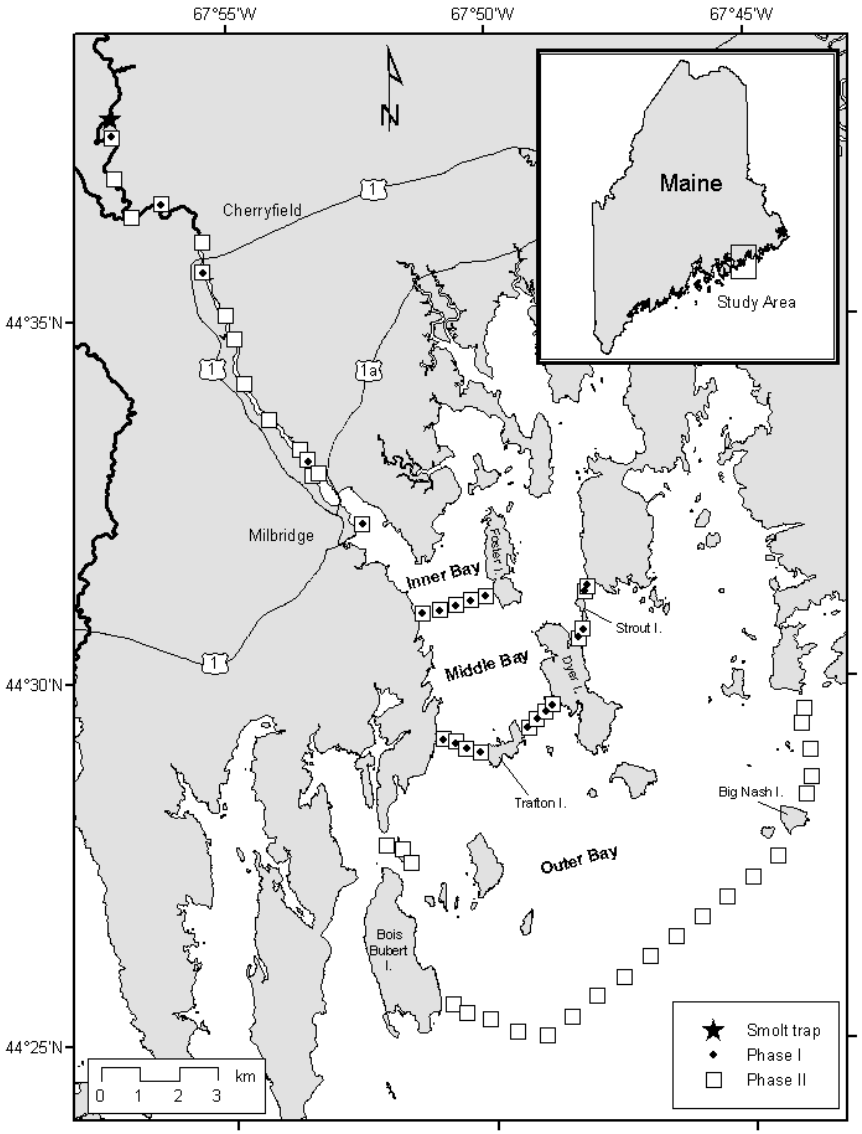
NOAA NEFSC Telemetry Tools of the Trade



Narraguagus River
Where it All Began…

	Receivers Deployed				
Year	Type	River	Estuary	Marine	Total
1997	VR-20	5	1	11	17
1998	VR-20	4	1	18	23
1999	VR-20	5	1	19	25
2002	VR-2	5	5	35	45
2003	VR-2	6	8	40	54
2004	VR-2	6	8	46	60

Transmitters			
Tag Type	Pingers	Frequency (kHz)	Weight (g)
V8SC	109	67.3, 69, 72, 75, 76.8, 78	4
V8SC	95	67.3, 69, 72, 75, 76.8, 79	4
V8SC	102	67.3, 69, 72, 75, 76.8, 80	4
V8SC	100	69	3.1
V8SC	101	69	3.1
V8SC	74	69	3.1



Survival

Narraguagus Survival 1997-2004

- 1,000 smolts exit the river
- 410-540 reached Middle Bay

American Fisheries Society Symposium 69:293–310, 2009

Assessing Estuarine and Coastal Migration and Survival of Wild Atlantic Salmon Smolts from the Narraguagus River, Maine Using Ultrasonic Telemetry

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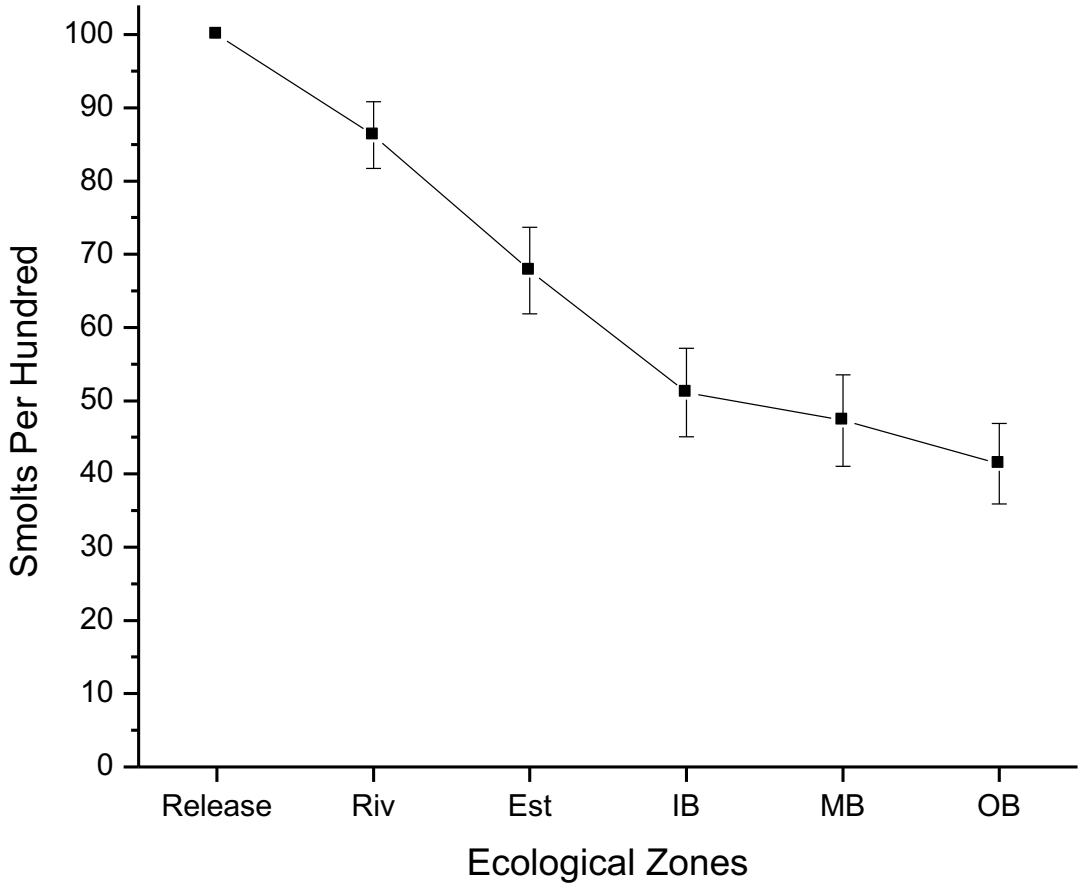
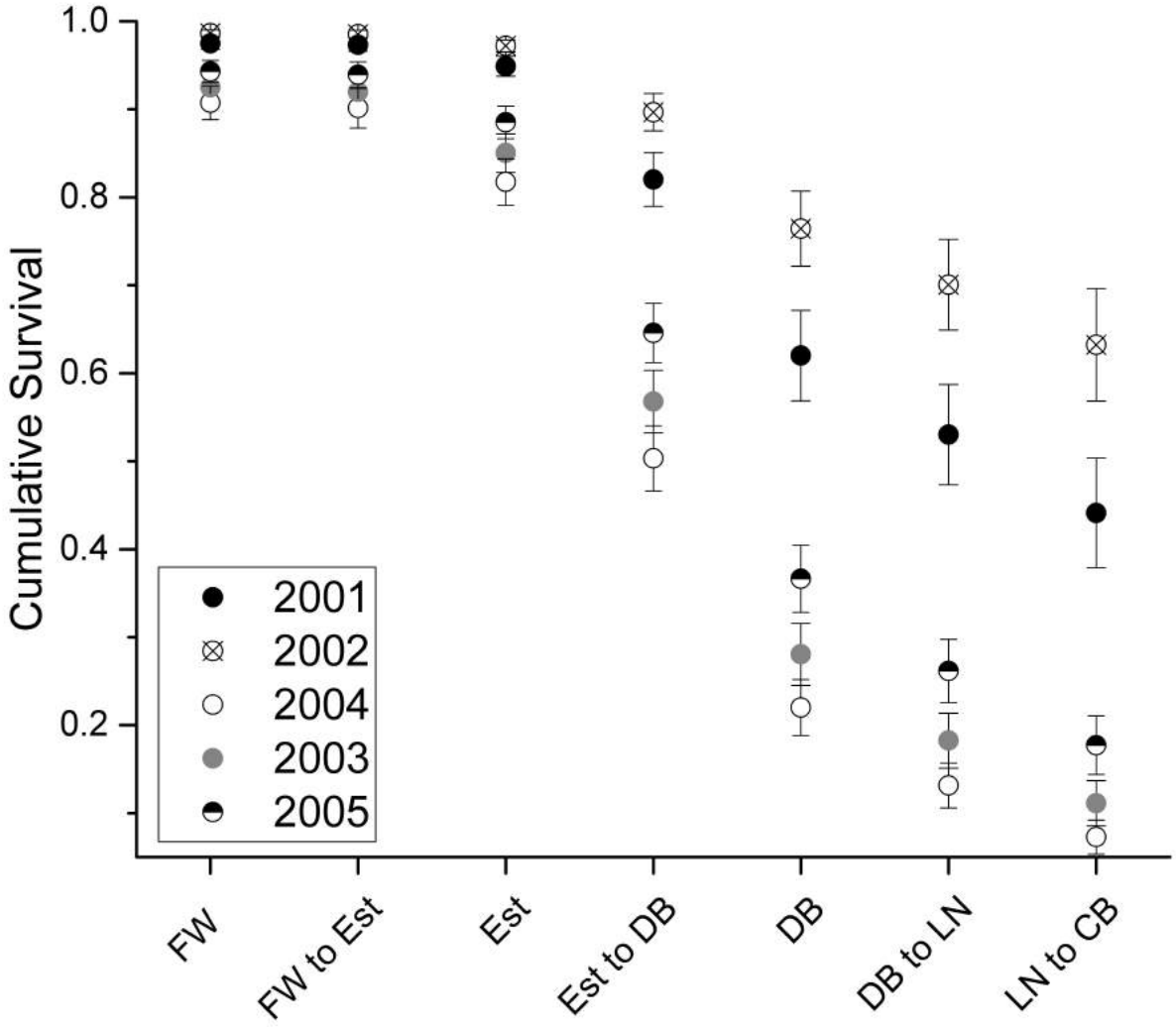


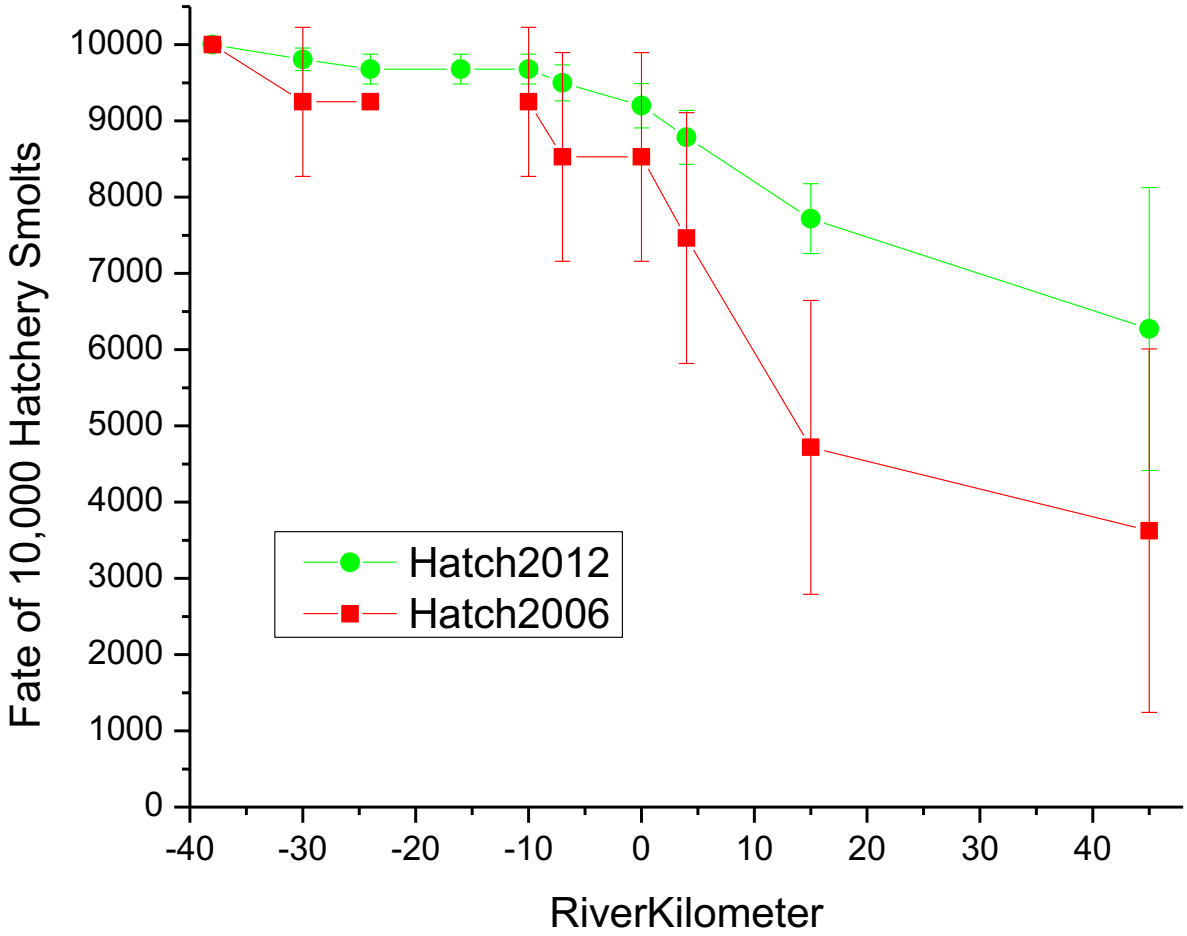
Dennvs River Survival 2001-2005



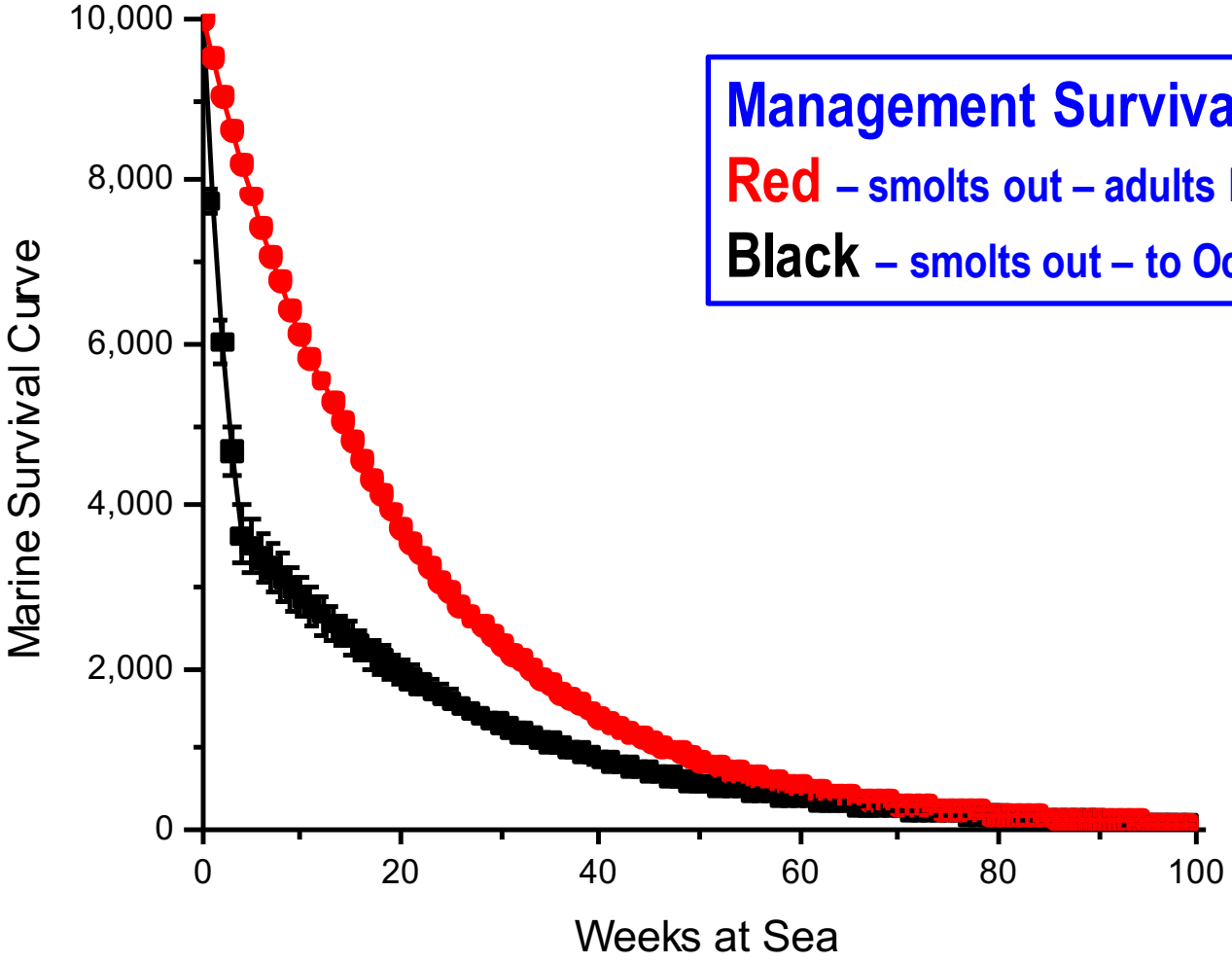
Penobscot Survival 2005 - 2014

- MARK results
- Apply to 10K smolts
- 2006 lowest survival
- 2012 highest survival

- Why the difference?



Weekly Marine Survival Models-
Bottom Line of Estuary to Headland Telemetry Work



Management Survival Curve :

Red – smolts out – adults back

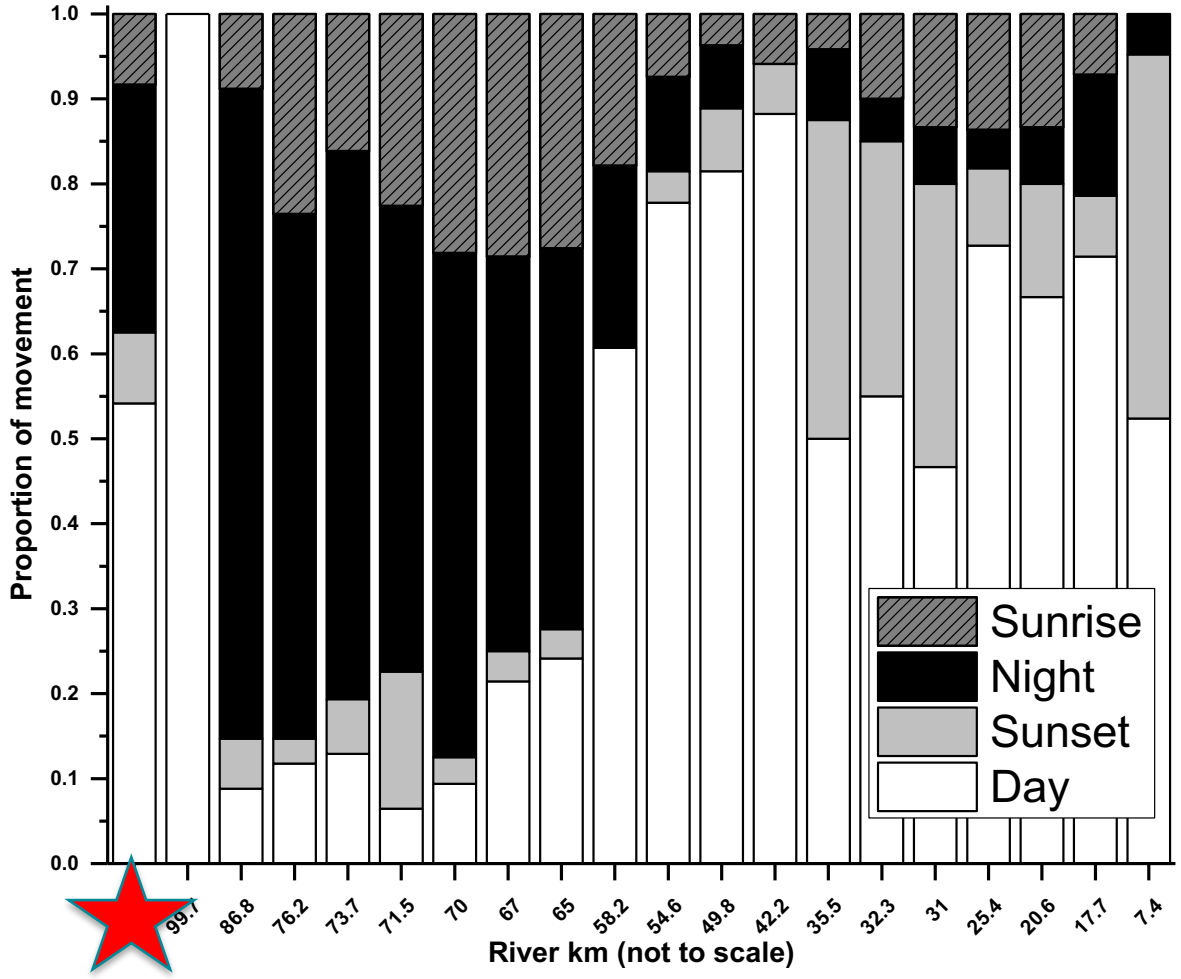
Black – smolts out – to Ocean - adults back

Behavior and Timing

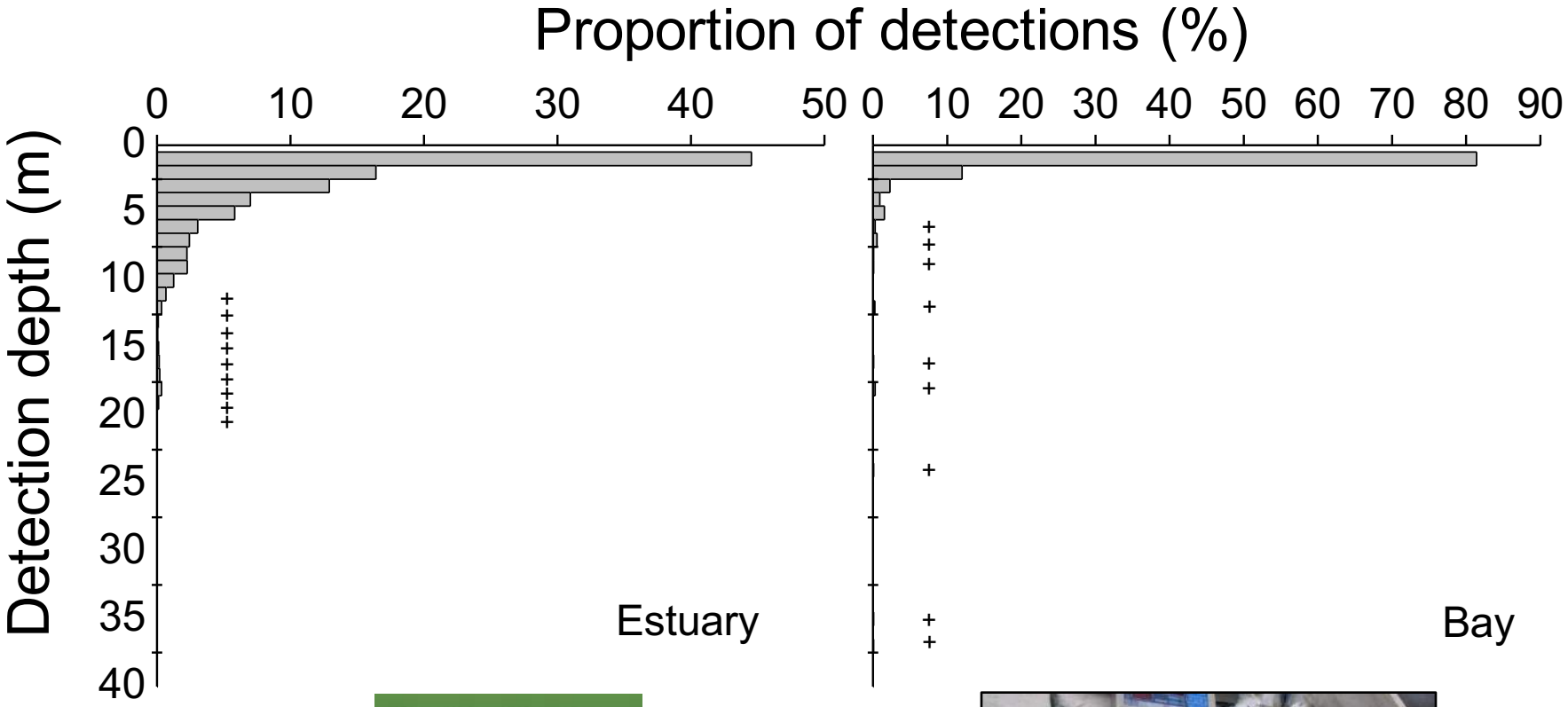
Active Movements

- Kennebec River 2014

- Rivers – night
- Estuary – day
- Bay – mirror daylength



Surface Validation – Depth Tags



Transactions of the American Fisheries Society 141:1219–1229, 2012
American Fisheries Society 2012
ISSN: 0002-8487 print / 1548-8659 online
DOI: 10.1080/00028487.2012.688916

Transactions of the American Fisheries Society

ARTICLE

Swimming Depth, Behavior, and Survival of Atlantic Salmon Postsmolts in Penobscot Bay, Maine

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Graham S. Goulette
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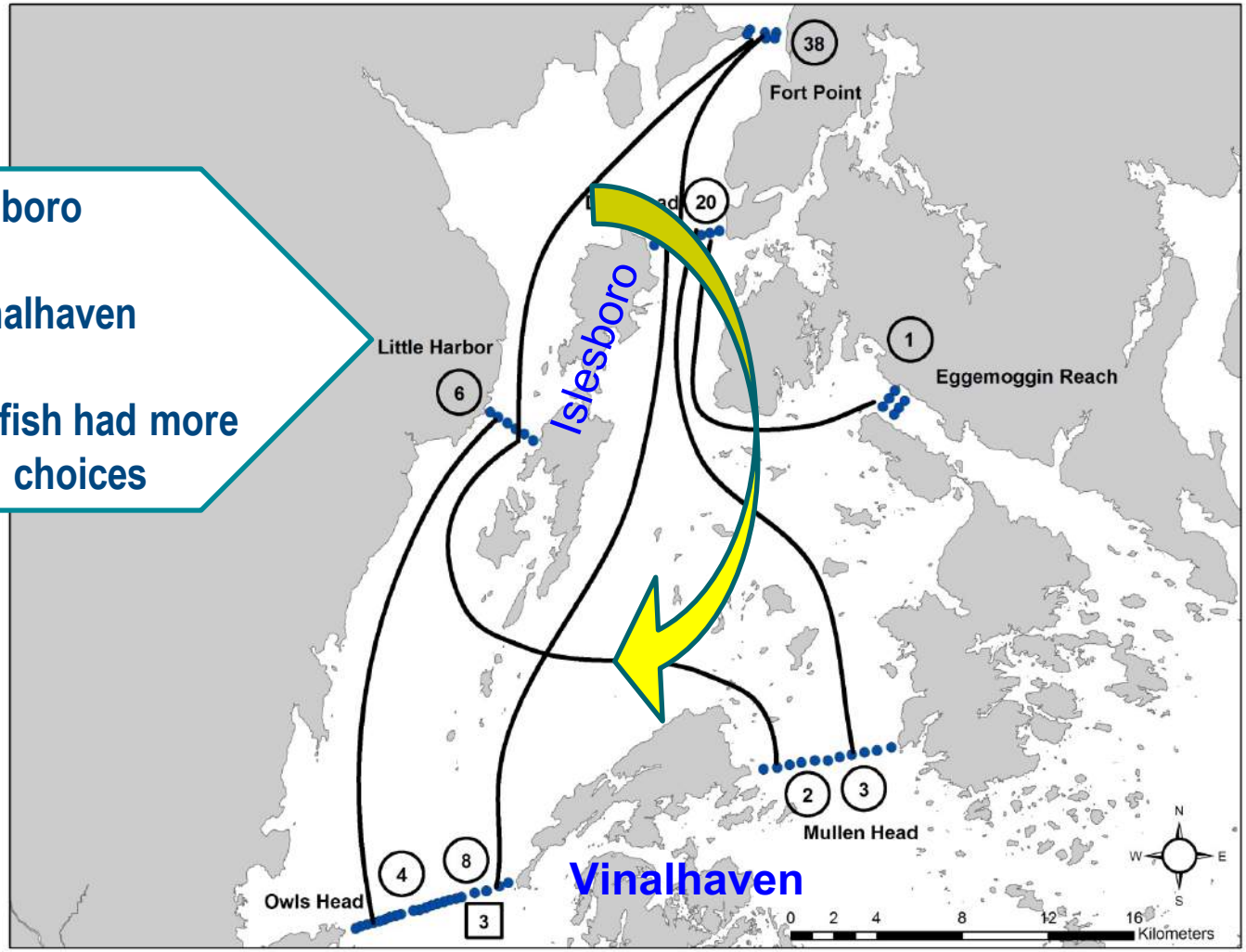
Identify Primary Migration Corridors

>75% east of Islesboro

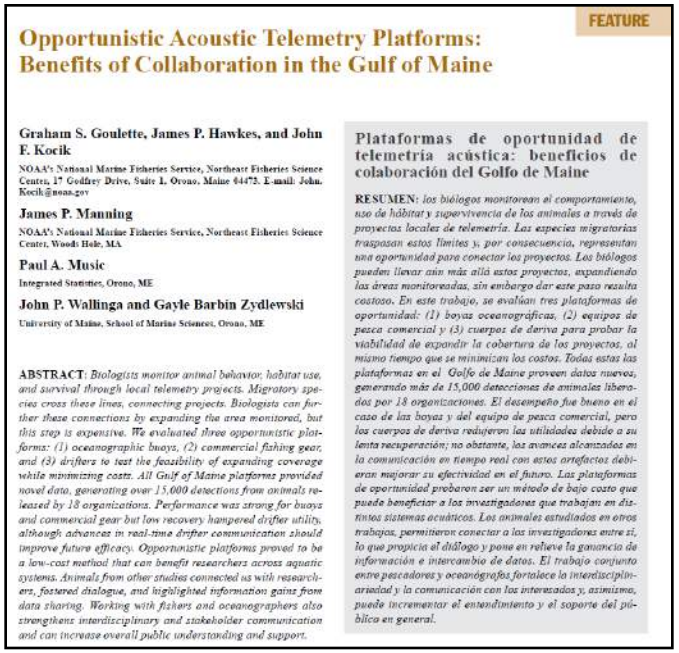
> 75% West of Vinalhaven

• naturally-reared fish had more most diverse path choices



Smolt and Postsmolt "Neighborhoods"

- Estuary, Coastal, and Gulf Arrays and Receivers
  - More Species Encountered
    - Atlantic salmon
    - Atlantic sturgeon
    - Shortnose sturgeon
    - Alewife
    - American eel
    - White shark
    - Cod



FEATURE

Opportunistic Acoustic Telemetry Platforms: Benefits of Collaboration in the Gulf of Maine

Graham S. Goulette, James P. Hawkes, and John F. Kocik

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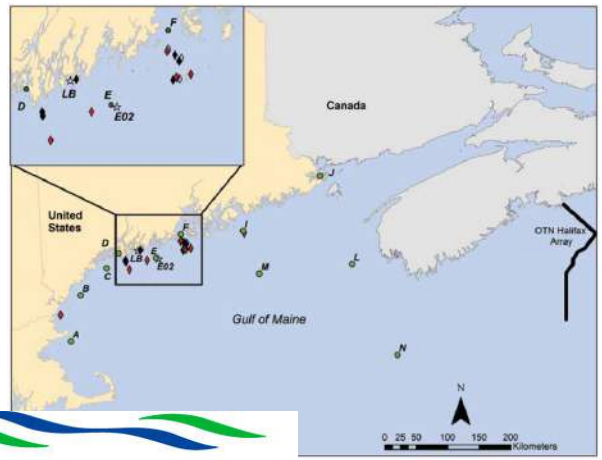
ABSTRACT: *Biologists monitor animal behavior, habitat use, and survival through local telemetry projects. Migratory species cross these lines, connecting projects. Biologists can further these connections by expanding the area monitored, but this step is expensive. We evaluated three opportunistic platforms: (1) oceanographic buoys, (2) commercial fishing gear, and (3) drifters to test the feasibility of expanding coverage while minimizing costs. All Gulf of Maine platforms provided novel data, generating over 15,000 detections from animals released by 18 organizations. Performance was strong for buoys and commercial gear but low recovery hampered drifter utility, although advances in real-time drifter communication should improve future efficacy. Opportunistic platforms proved to be a low-cost method that can benefit researchers across aquatic systems. Animals from other studies connected us with researchers, fostered dialogue, and highlighted information gains from data sharing. Working with fishers and oceanographers also strengthens interdisciplinary and stakeholder communication and can increase overall public understanding and support.*

Plataformas de oportunidad de telemetría acústica: beneficios de colaboración del Golfo de Maine

RESUMEN: *los biólogos monitorean el comportamiento, uso de hábitat y supervivencia de los animales a través de proyectos locales de telemetría. Las especies migratorias traspasan estos límites y, por consecuencia, representan una oportunidad para conectar los proyectos. Los biólogos pueden llevar aún más allá estos proyectos, expandiendo las áreas monitoreadas, sin embargo dar este paso resulta costoso. En este trabajo, se evalúan tres plataformas de oportunidad: (1) boyas oceanográficas, (2) equipos de pesca comercial y (3) cuerpos de deriva para probar la viabilidad de expandir la cobertura de los proyectos, al mismo tiempo que se minimizan los costos. Todas estas las plataformas en el Golfo de Maine proveen datos nuevos, generando más de 15,000 detecciones de animales liberados por 18 organizaciones. El desempeño fue bueno en el caso de las boyas y del equipo de pesca comercial, pero los cuerpos de deriva redujeron las utilidades debido a su lenta recuperación; no obstante, los avances alcanzados en la comunicación en tiempo real con estos artefactos debieran mejorar su efectividad en el futuro. Las plataformas de oportunidad probaron ser un método de bajo costo que puede beneficiar a los investigadores que trabajan en distintos sistemas acuáticos. Los animales estudiados en otros trabajos, permitieron conectar a los investigadores entre sí, lo que propicia el diálogo y pone en relieve la ganancia de información e intercambio de datos. El trabajo conjunto entre pescadores y oceanógrafos fortalece la interdisciplinariedad y la comunicación con los interesados y, asimismo, puede incrementar el entendimiento y el soporte del público en general.*



POSTER #41

OCEAN TRACKING NETWORK

Early Marine Postsmolts

- Marine migration dynamics >600km
- Modelling Gulf of Maine migration

FISHERIES OCEANOGRAPHY
FISHERIES OCEANOGRAPHY Fish. Oceanogr. 23:2, 172–189, 2014

Migration model of post-smolt Atlantic salmon (*Salmo salar*) in the Gulf of Maine

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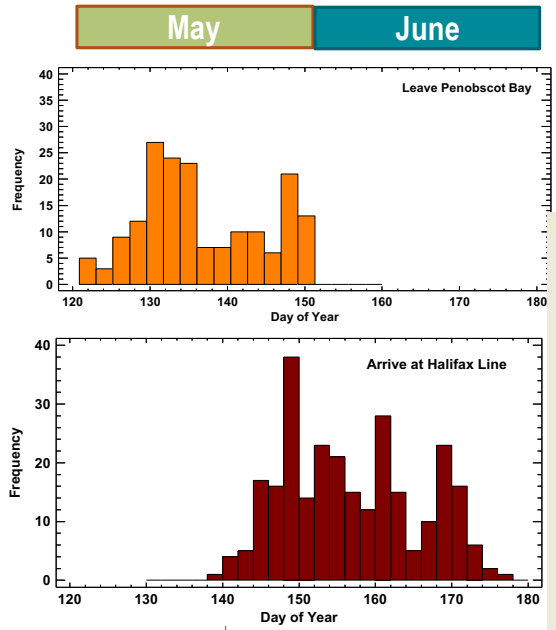
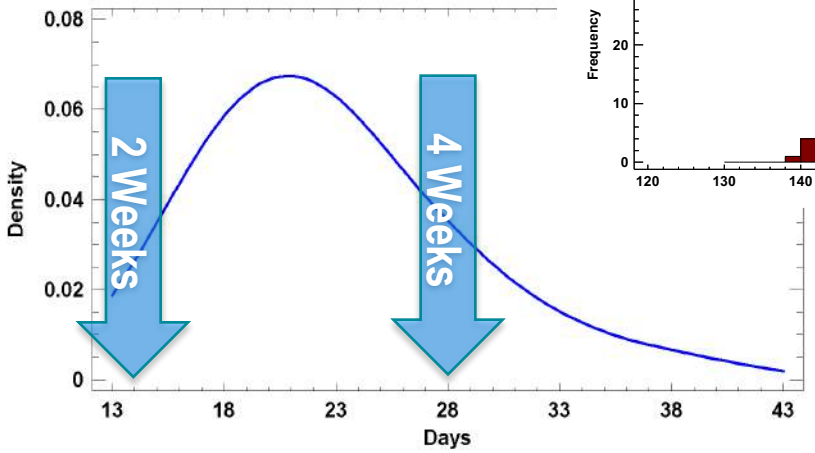
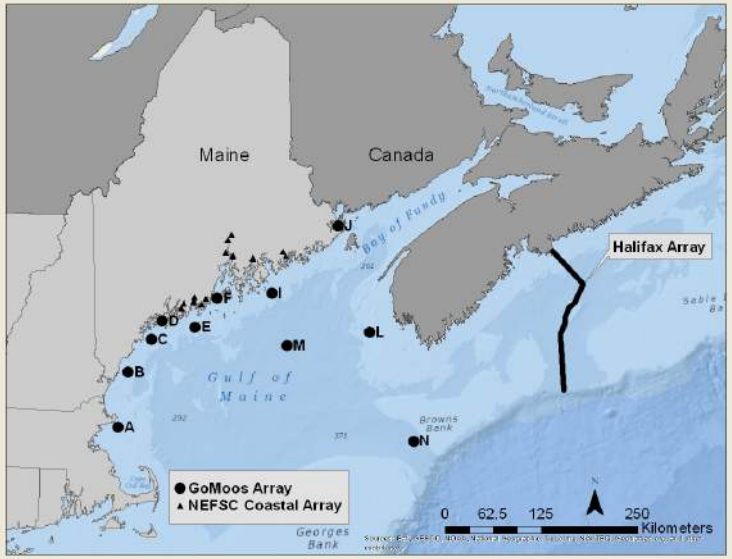
dramatically influenced post-smolt salmon migration success. There was a trade-off between arriving at the destination quickly but at a small size and not arriving at the destination at all. Fish that took a long time to migrate had more opportunities to feed and encountered warmer summer waters, increasing their overall growth.

Key words: bioenergetics, coastal currents, individual-based model, oceanographic variability, sea surface temperature

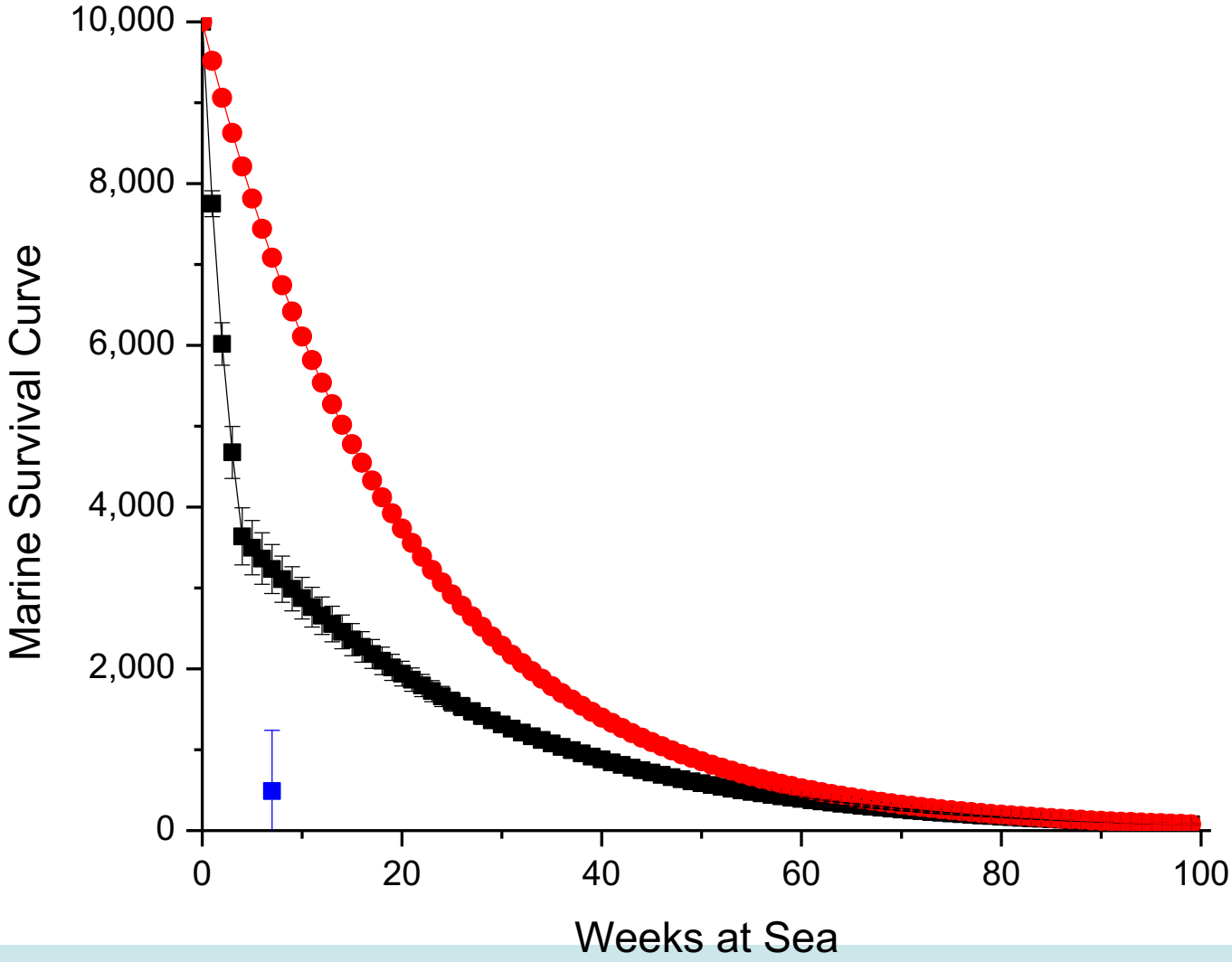
OCEAN TRACKING NETWORK





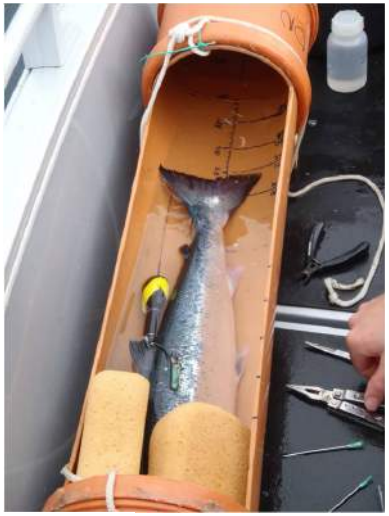


Weekly Marine Survival Models- Hint of Mortality in Second Month???



Headed Home. . .

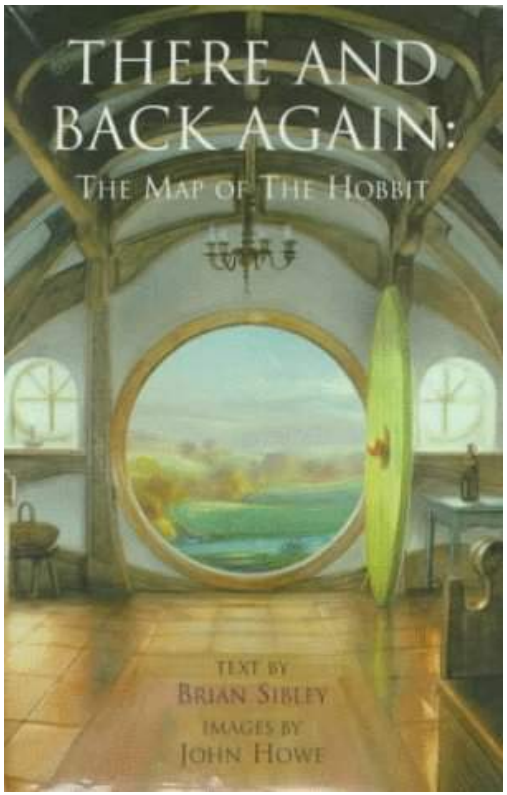
Satellite Tagging at West Greenland

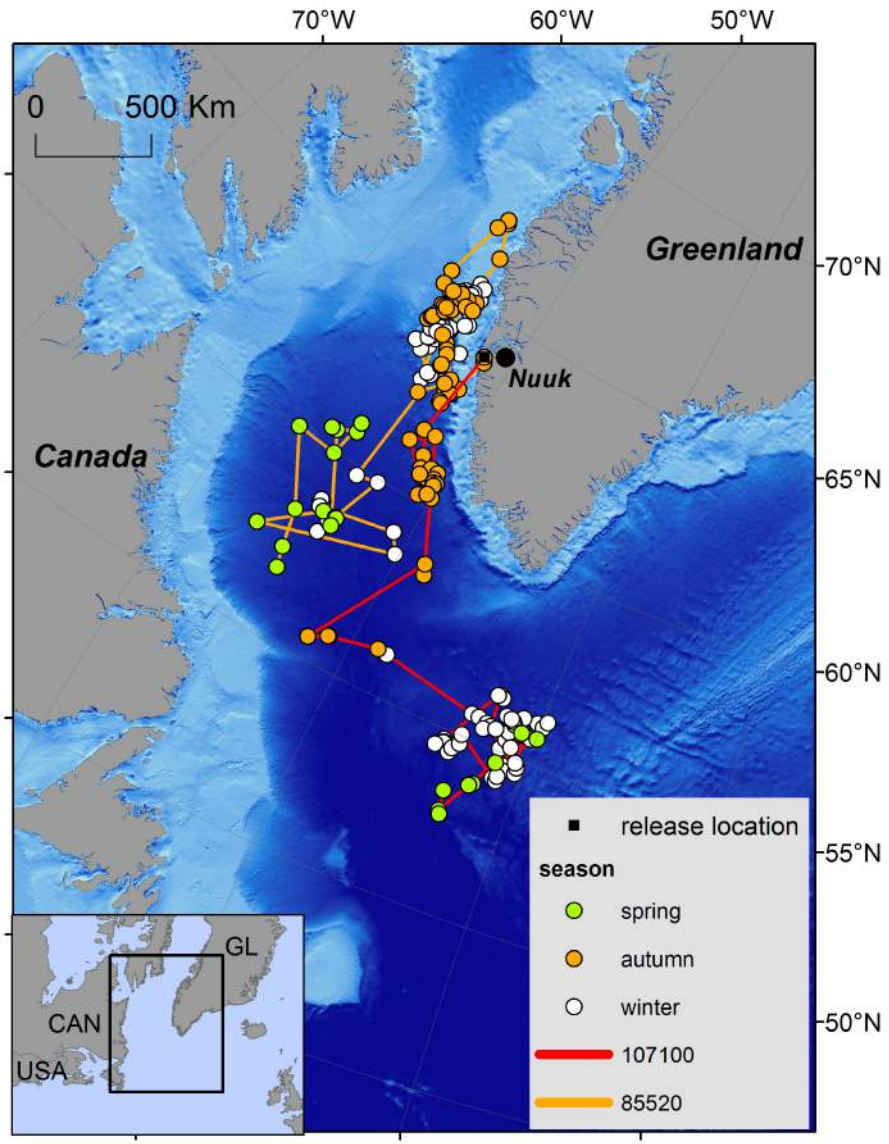


Audun Rikardsen
Norway
University of Tromso

Rasmus Nygaard
Greenland
Greenland Institute of Natural Resources

There And Back Again



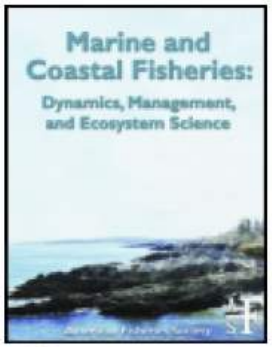


David Righton, CEFAS
-the tracks based on release location, pop off location, temp, depth, light, swimming speed…

Telemetry Informed Lessons

- Riverine Migration - Mostly at night in freshwater
  - Use info to minimize bycatch of river herring
- River – Estuary – Bay
  - Estuaries – Greatest Losses per kilometer
  - Variable Between Systems
    - Narraguagus among lowest survival in literature
    - Denny River even worse survival (pub coming soon)
    - Penobscot – interannual variability + latent dam impacts
- Survival During Smolt Emigration Process
  - 2-4 fold lower than monthly at-sea survival
- Travel Corridors and Timing
  - Nearshore – channel preferences
  - Offshore – more rapid movements than expected
  - Homeward Bound . . . Stay Tuned

Questions?



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Linking Behavior, Physiology, and Survival of Atlantic Salmon Smolts During Estuary Migration

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