

Applications of Coastal Ocean Acoustic Telemetry Arrays for Marine Fisheries: Making Research Cost-Effective & Policy Relevant

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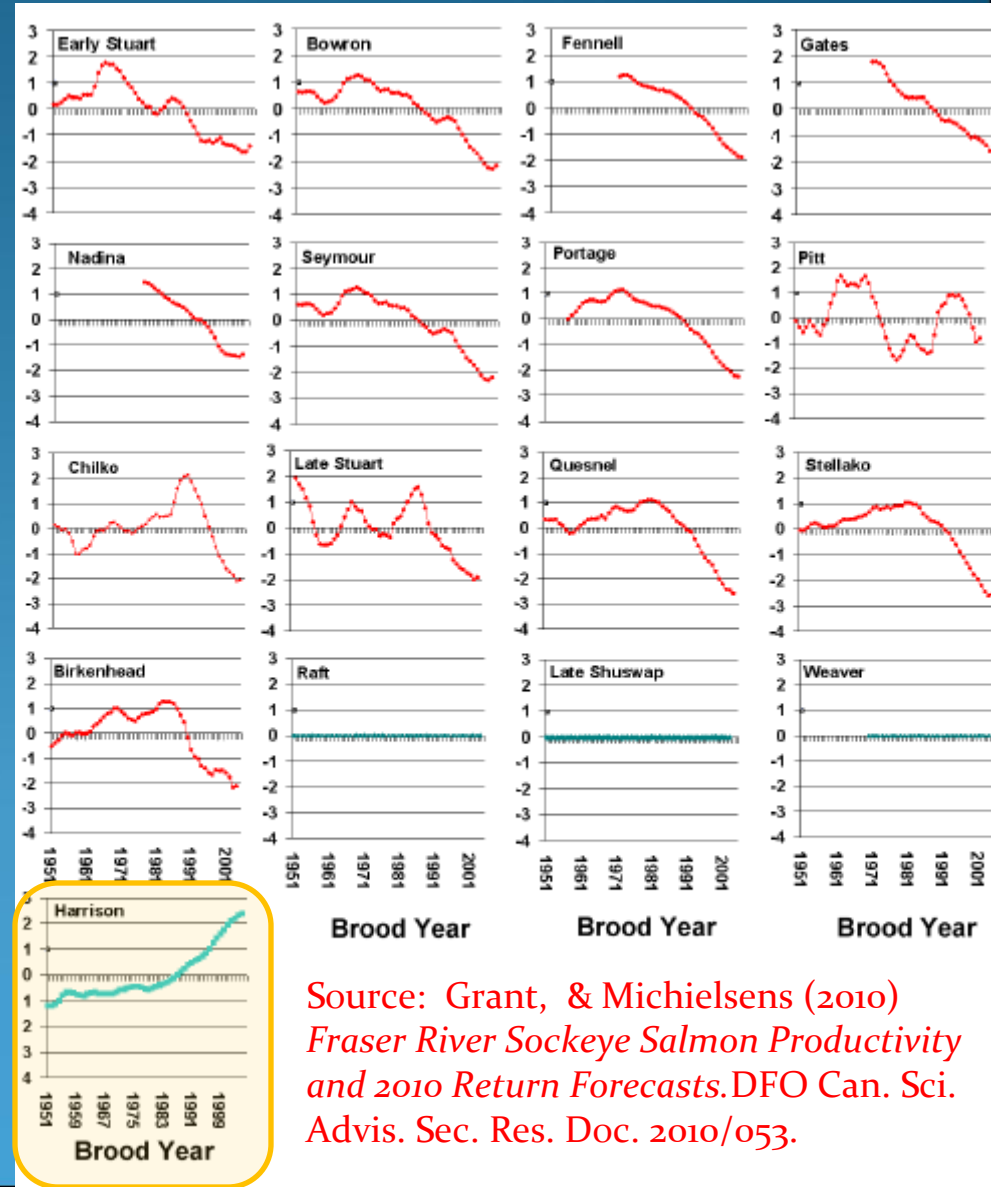
Kintama Research Services Ltd

POST Pilot-Phase Array: Scale








Fraser Sockeye Trends in Productivity: Harrison River vs All "Others"

- In 2009, Fraser sockeye returns suffered a catastrophic failure triggering a judicial inquiry
- Figure shows time trend of Kalman-filtered productivity since 1951.
- Of 19 stocks, only Harrison Lake shows increased productivity in the last 20 years
- Where is the declining marine survival determined?

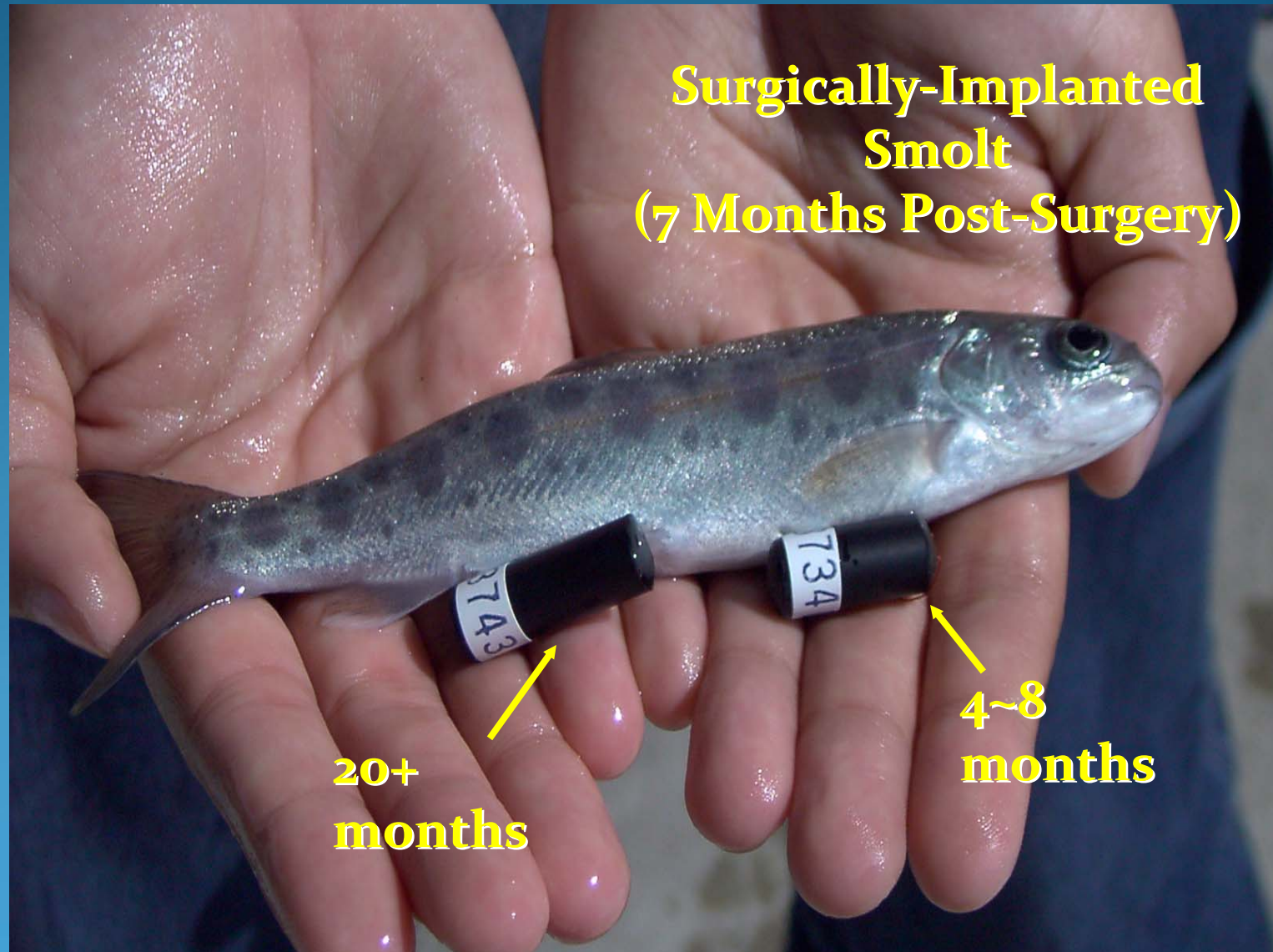


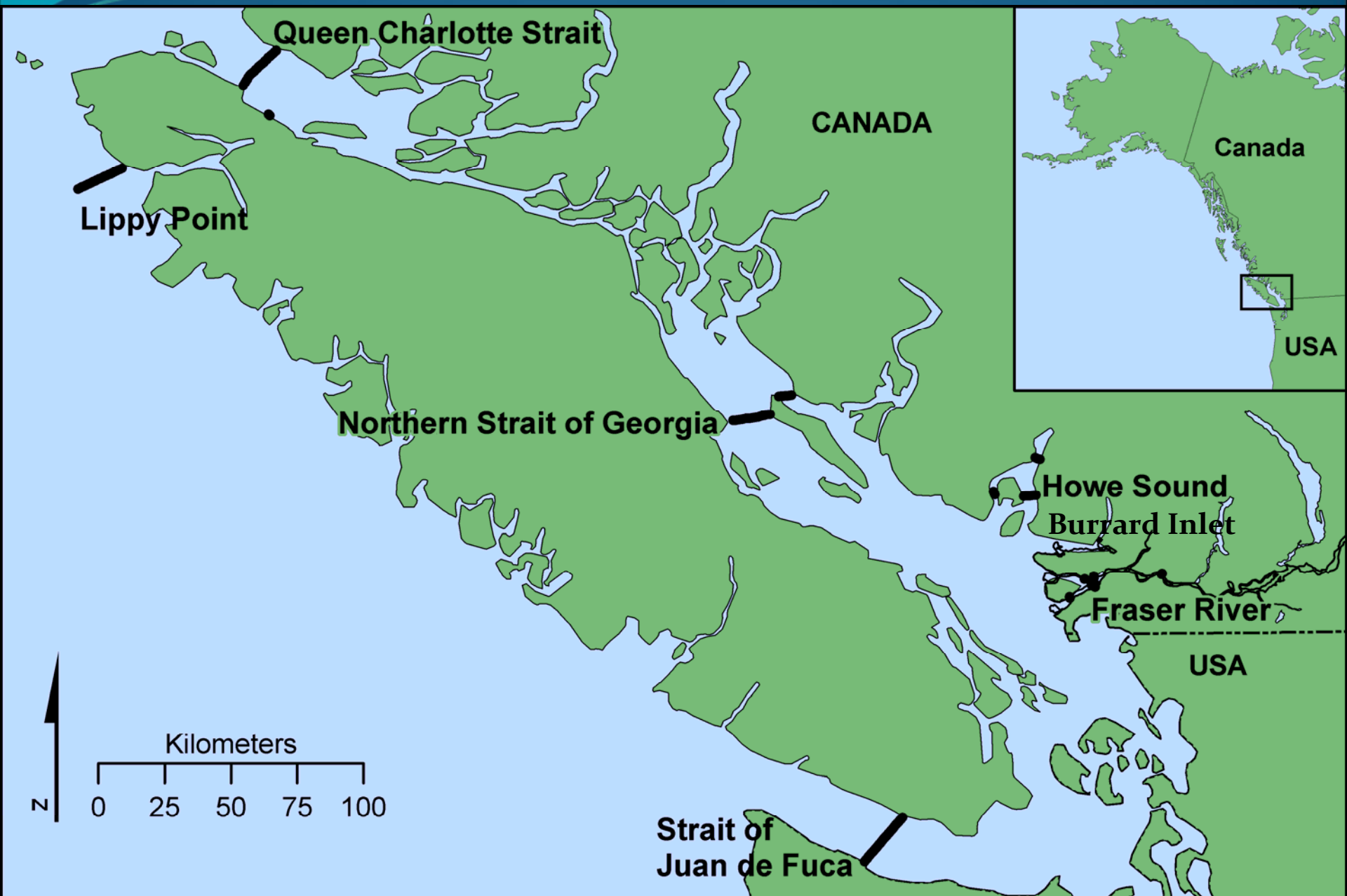
Acoustic Tags

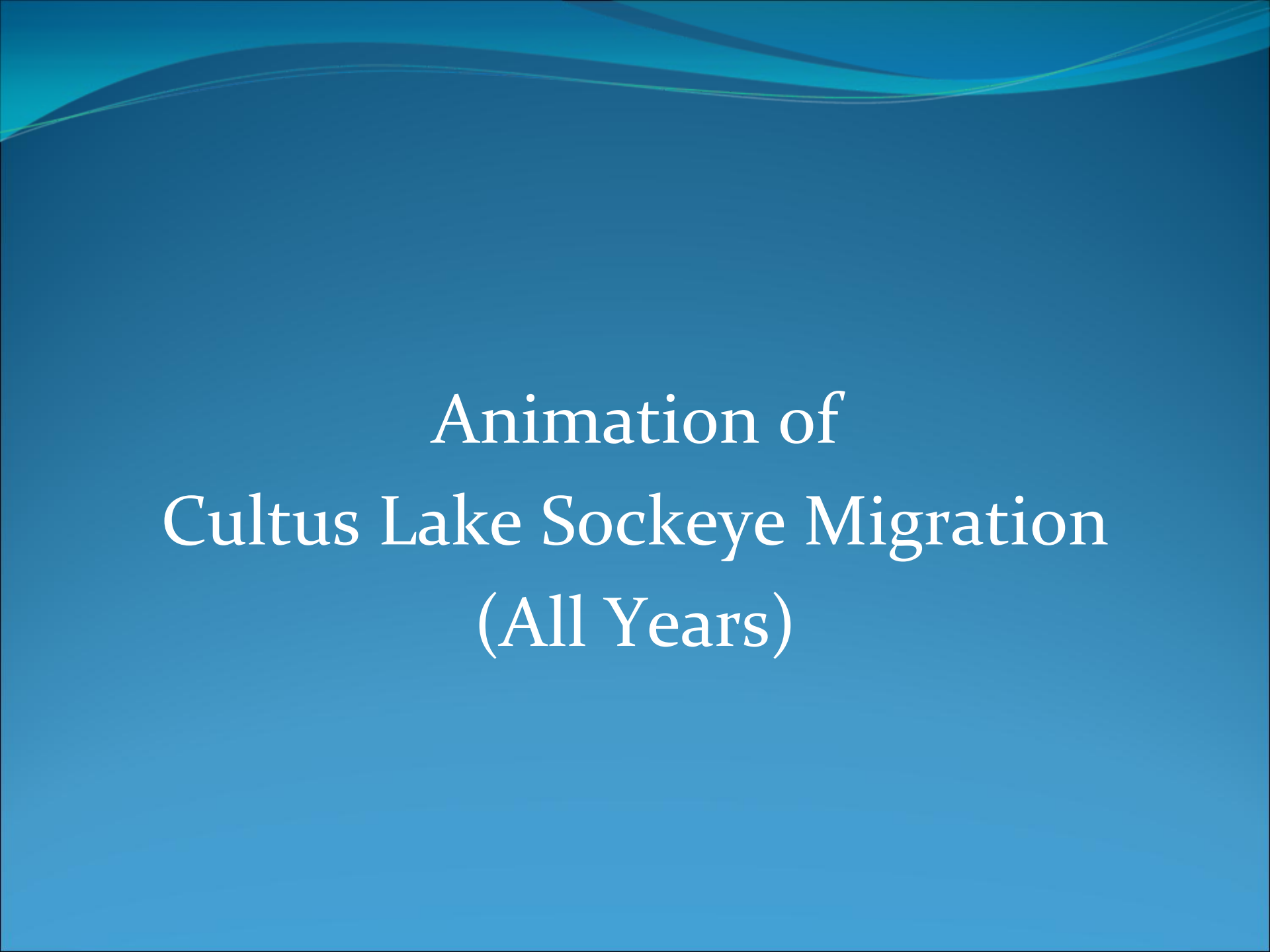


≥ 140 mm FL		V9	69 kHz
≥ 130 mm FL		V7	
≥ 100 mm FL		V6	180 kHz
$> \approx 90$ mm FL		V5	
		PIT Tag	

Acoustic Tags for Small Fish







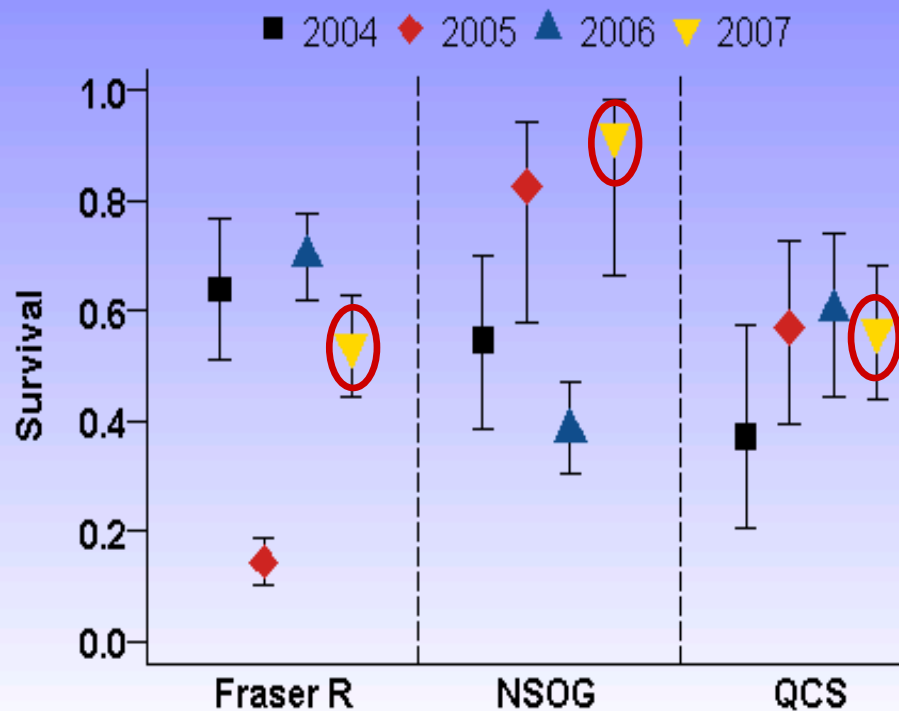
Animation of Cultus Lake Sockeye Migration (All Years)

Animation of Cultus Lake Sockeye Migration

A: All Years

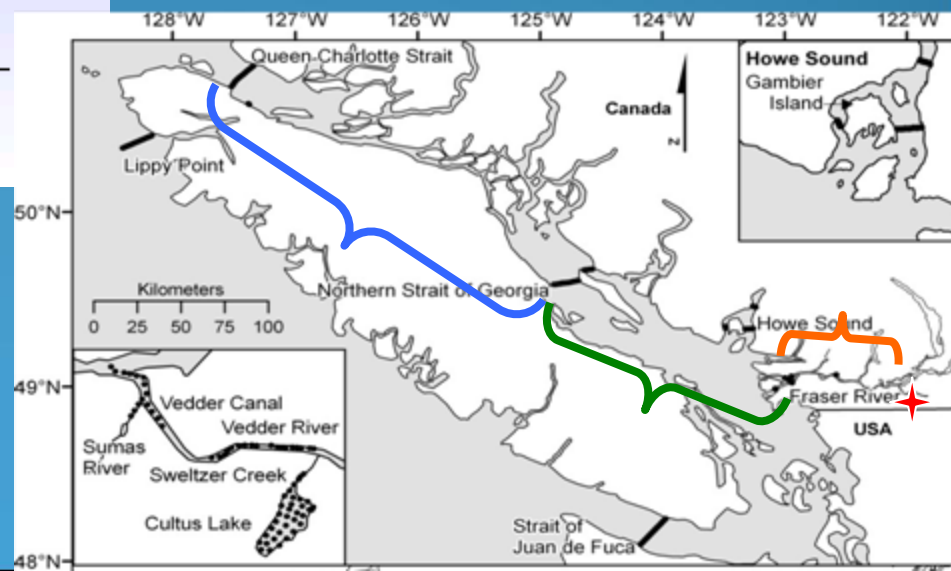
B: 2007 Smolt Release & 2009 Adult Return

Cultus Lake Sockeye & 2009 Fraser River Sockeye Collapse



2007 Outmigrating Smolt Survival ($\pm 95\%$ Confidence Intervals)
Survival as high or higher than in prior years~ So where did the 2009 adult sockeye fail to survive?

Welch et al (2009). "Freshwater and marine migration and survival of endangered Cultus Lake sockeye salmon smolts using POST, a large-scale acoustic telemetry array".
Can. J. Fish. Aquat. Sci. 66(5):736-750.



Fraser Sockeye Math

200 acoustic-tagged smolts released in 2007

28% Survive to Leave SOG/Johnstone St. (~1 in 4)

Welch et al (2009) Can J Fish Aquat Sci 66(5):736-750

1.5% of all wild smolts survive to return in 2009

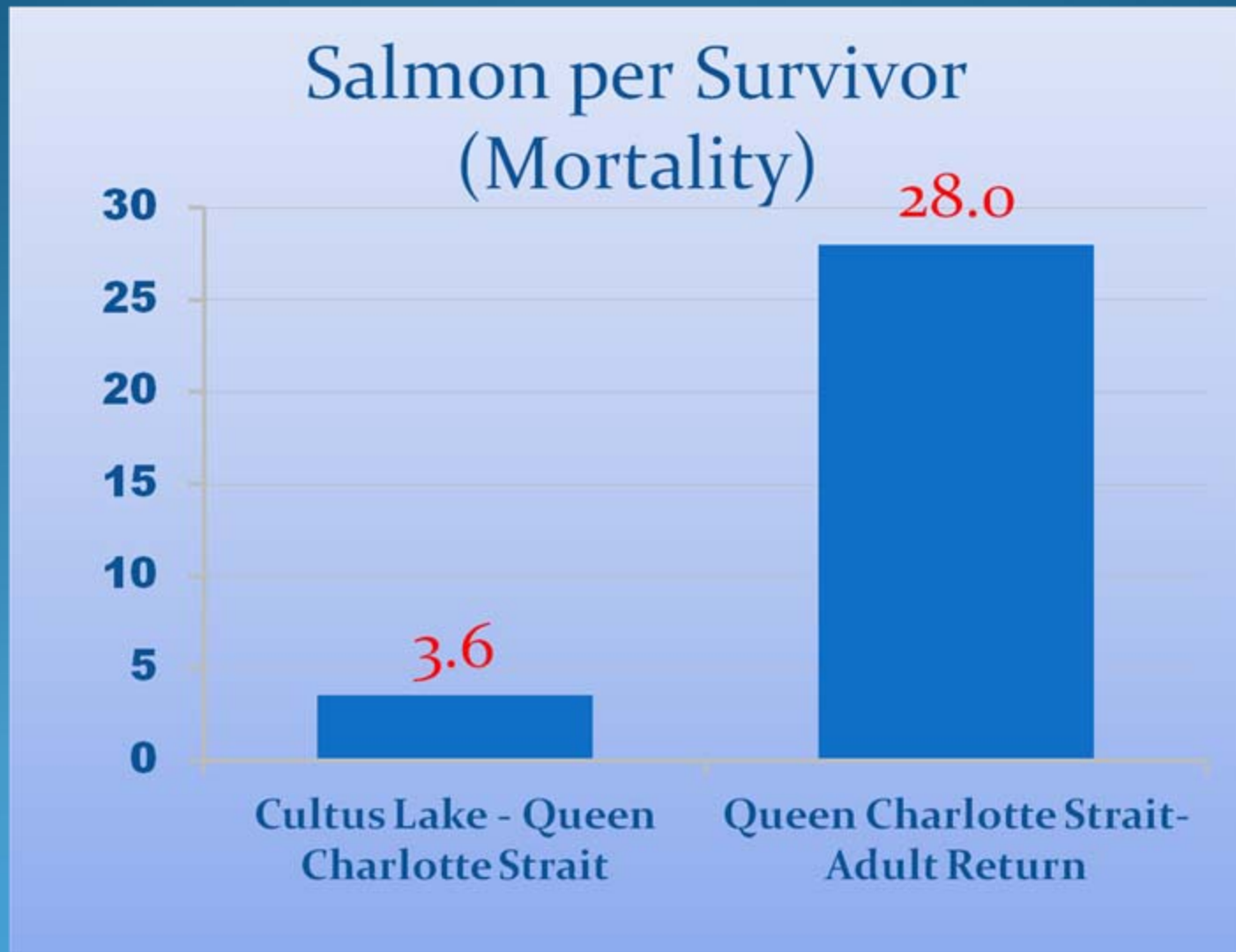
1% of tagged smolts survive to return in 2009, so:

$$\frac{1}{100} \text{ SAR} = \frac{1}{4} \times \frac{1}{25}$$

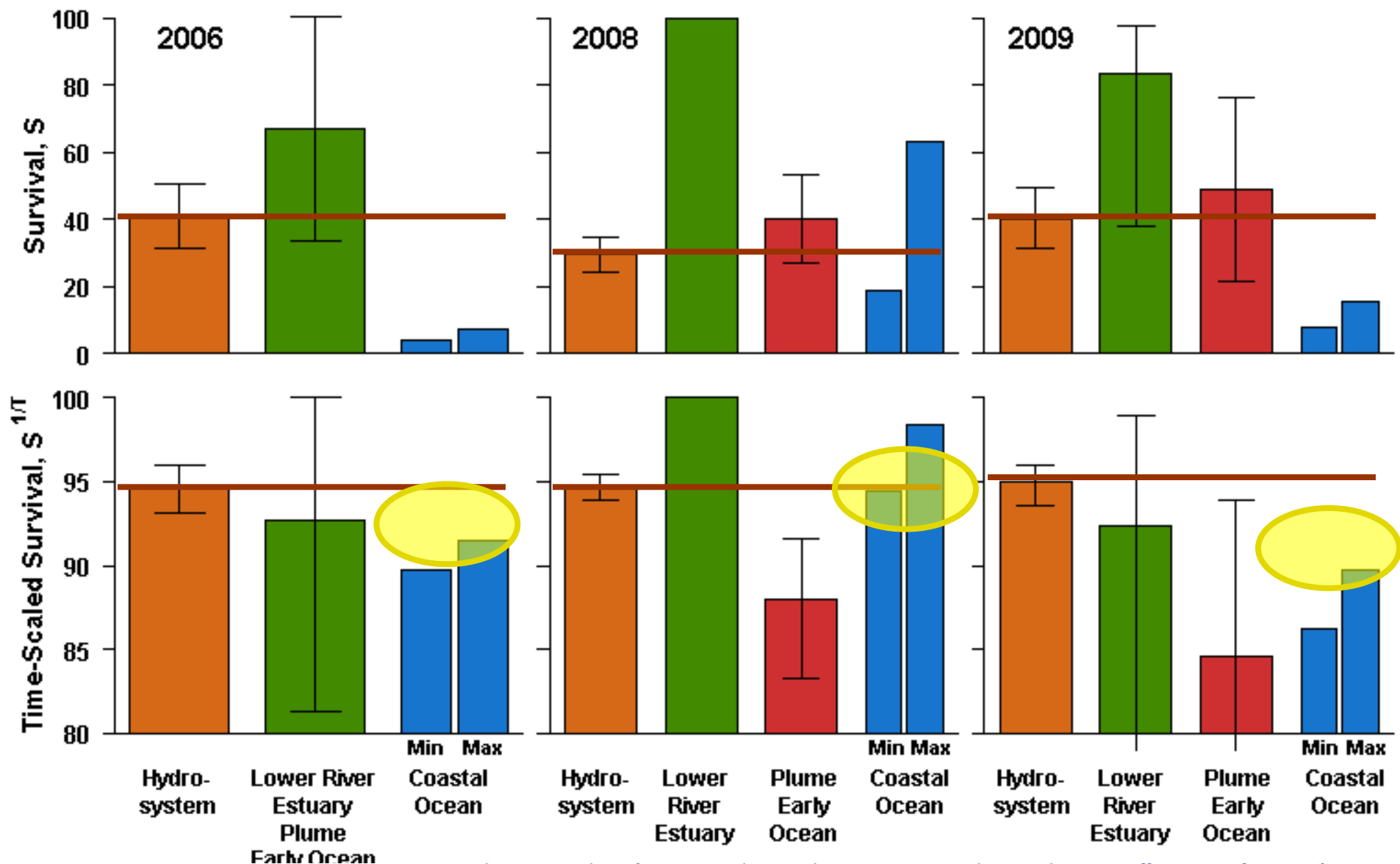
Smolt to Adult Fraser R & "Salish Sea" Survival *Outside "Salish Sea" Survival*
(28% & Stable)

Mortality "beyond" Salish Sea ~7.8 times mortality in
Fraser River & Salish Sea

Most Mortality of Tagged Smolts Occurred After Leaving Queen Charlotte Strait



4 Ecosystems: Monitoring Survival of Columbia (Snake) River Spring Chinook



Estimated CJS survival \pm 95% CI; Coastal survivals assume NWVI sub-array detection efficiencies of 50 & 100%

Summary

- 1) The pilot phase POST array has demonstrated technical feasibility & useful scientific results
- 2) One of its more important legacies will be an observational baseline of survival rates for juvenile BC & Columbia River salmon stocks as climate change (aka Global Warming) intensifies.
- 3) There is a tendency to assume that events early in the life history determine adult returns (this makes the research easier, by allowing a narrower (& simpler) focus)
- 4) Though a common assumption, there is little data to support it & it is almost never tested. Our data (for multiple species) shows little evidence that it is true.

A Philosophical Note

- Beyond the obvious monitoring function, a highly efficient array can change marine fisheries science from an observational to an experimental science
- Marine telemetry provides an unprecedented tool, allowing direct tests of hypotheses → Conceive of an idea, test the hypothesized effect relative to a control,... and advance to the next round of testing directly in the ocean
- The history of science shows that this shift from an “observational science model” to an “experimental science model” leads to rapid progress through direct testing and rejection of hypotheses.