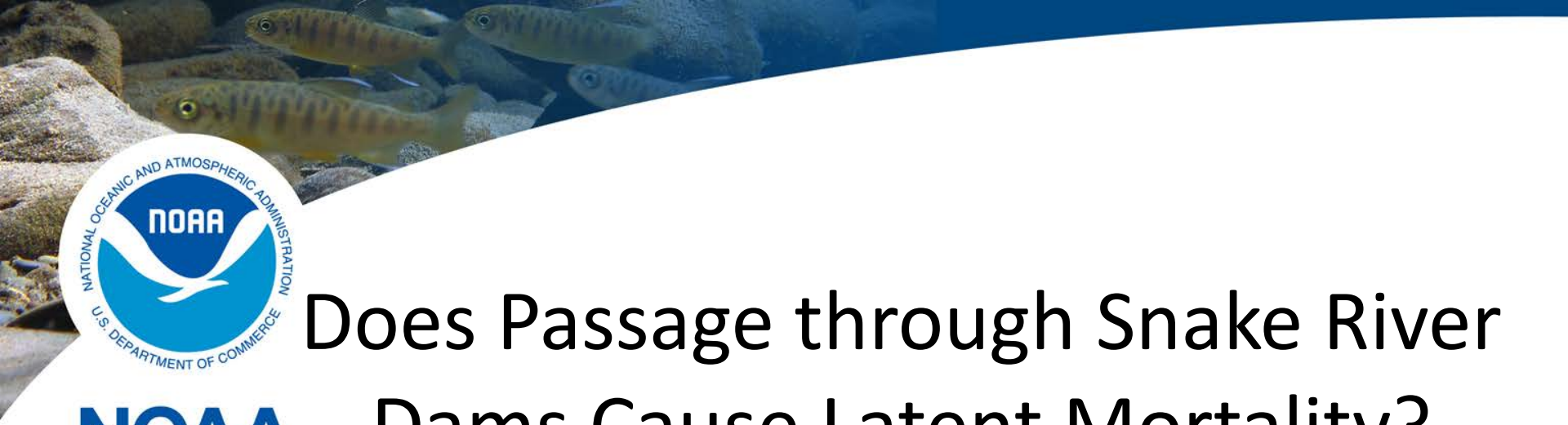


Does Passage through Snake River Dams Cause Latent Mortality?

NOAA FISHERIES

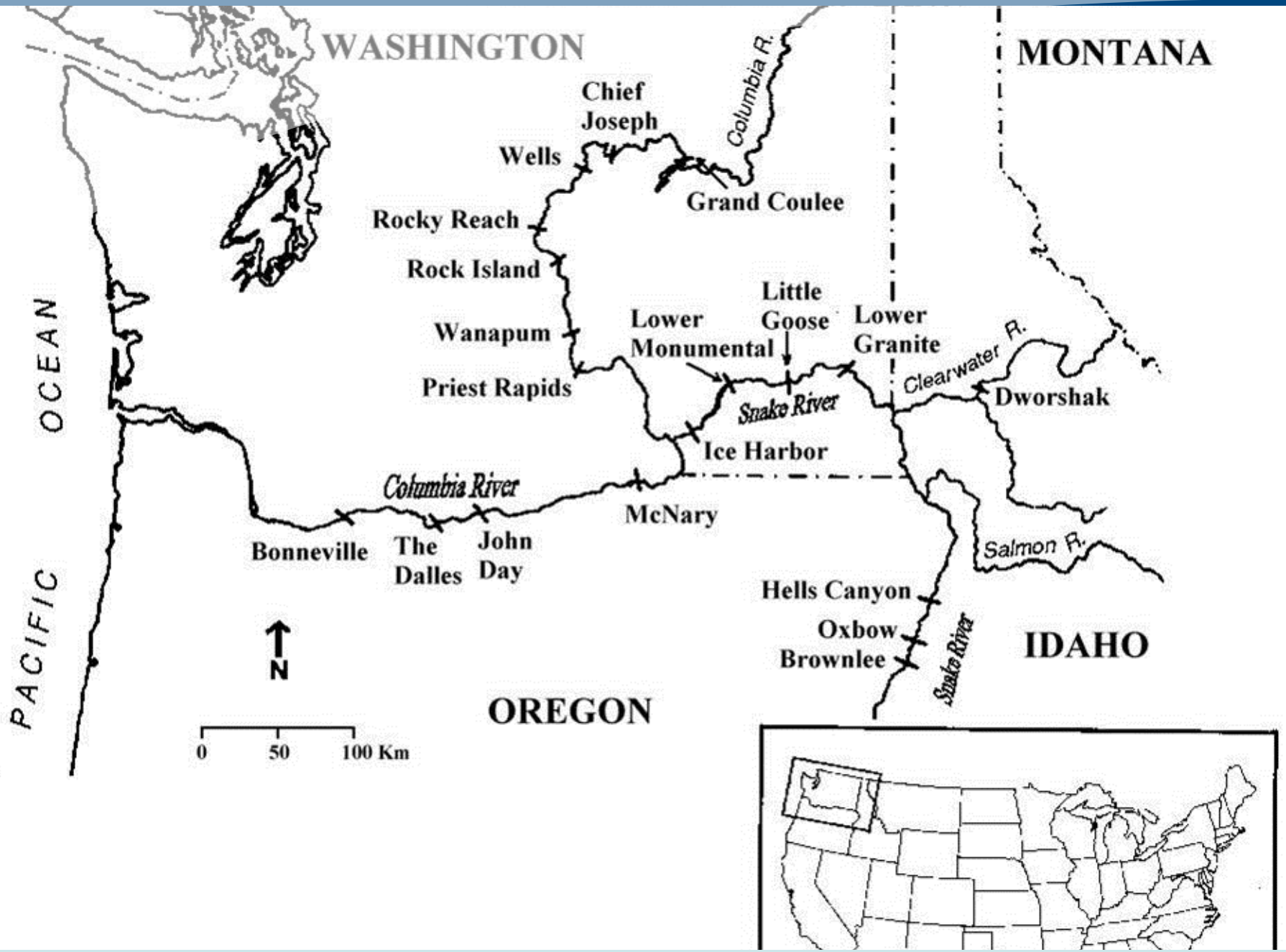
- Northwest Fisheries Science Center

Tiffani Marsh, Steven G. Smith, and Benjamin Sandford

18 August 2015

Latent Mortality

- Background
- Study design
- Analysis


WASHINGTON
MONTANA
Columbia R.
Chief Joseph
Wells
Grand Coulee
Rocky Reach
Rock Island
Wanapum
Priest Rapids
Little Goose
Lower Monumental
Lower Granite
Clearwater R.
Dworshak
Snake River
Ice Harbor
Columbia River
McNary
Bonneville
The Dalles
John Day
Salmon R.
Hells Canyon
Oxbow
Brownlee
Snake River
IDAHO
OREGON
PACIFIC OCEAN
N
0
50
100 Km

Latent Mortality

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  - Plan for Analyzing and Testing Hypotheses (PATH)
    - Decrease in SARs was greater than direct mortality
    - Must be due to passage through the dams and reservoirs; estimated to be 59-64% (4 dams)
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  - Goal
    - Determine whether migration as smolts through Snake River dams and reservoirs causes latent mortality

Latent Mortality

- Study design
  - Hatchery Spring/Summer Chinook Salmon

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    - 20-25 April to mid-May

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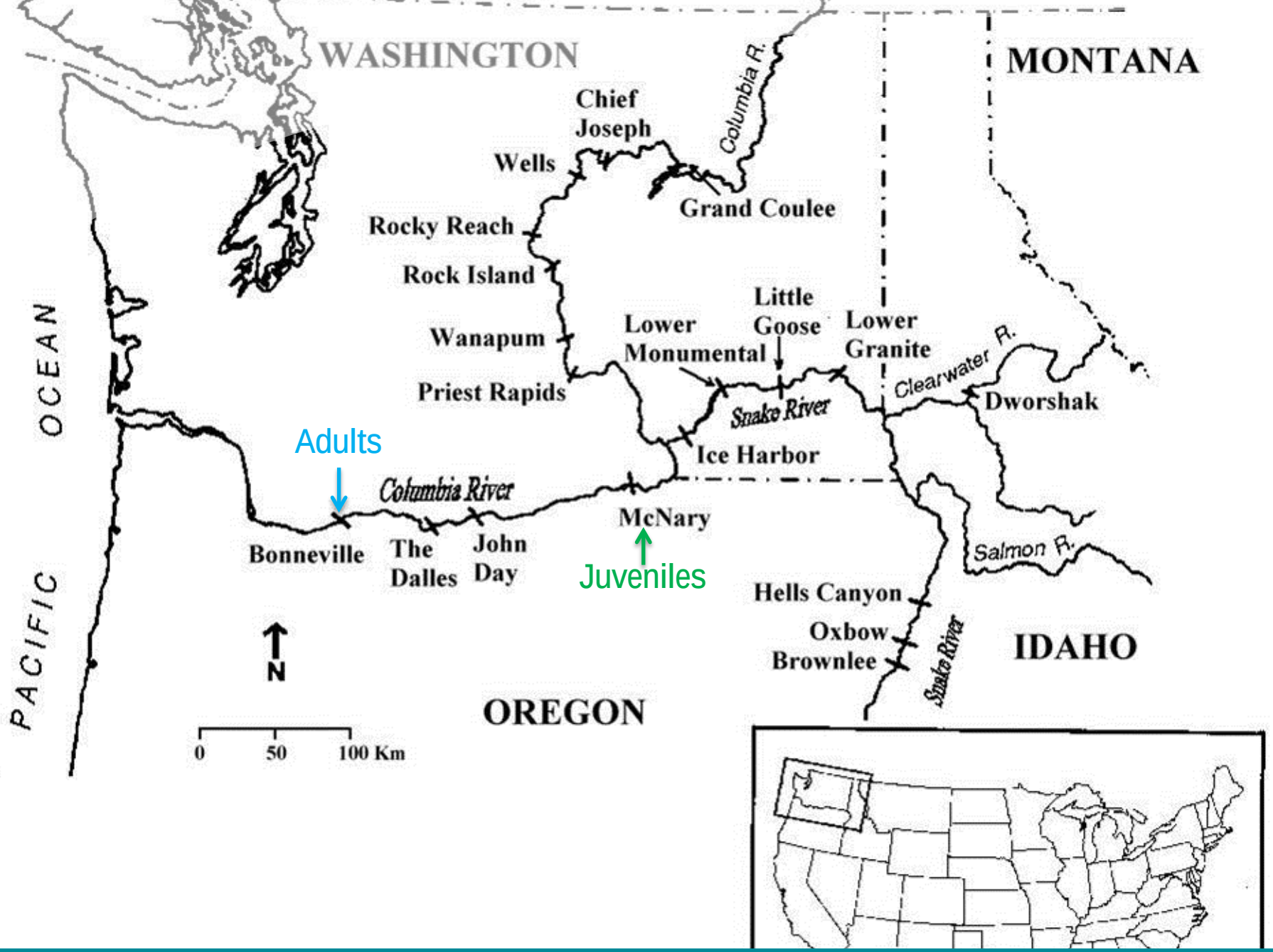
  - Tag fish at Lower Granite Dam
    - 20-25 April to mid-May
    - 10 replicates, with each replicate tagged over 2 days

1. Ice Harbor (IH)
2. Lower Granite (LG)
3. Truck effects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Latent Mortality

- Analysis
  - Study years 2005-2011

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    - <10 replicates released in 2005 (construction; 7) and 2007 (change in river operations; 6)

Latent Mortality

- Analysis
  - Study years 2005-2011
    - <10 replicates released in 2005 (construction; 7) and 2007 (change in river operations; 6)
    - Lowest SARs in 2005 and 2011; Highest SARs in 2008

Latent Mortality

- One-sided hypothesis test:
  - $H_0: SAR_{LG} \geq SAR_{IH}$ vs. $H_A: SAR_{LG} < SAR_{IH}$
    - Rejection of Null Hypothesis Means:
      - There is evidence that SAR *after leaving McNary Dam* was lower for group released in Lower Granite tailrace than for group released in Ice Harbor tailrace
        - McNary-to-Bonneville SARs
        - 3 dams, not 4 dams
        - Extant river and operations conditions, with dams

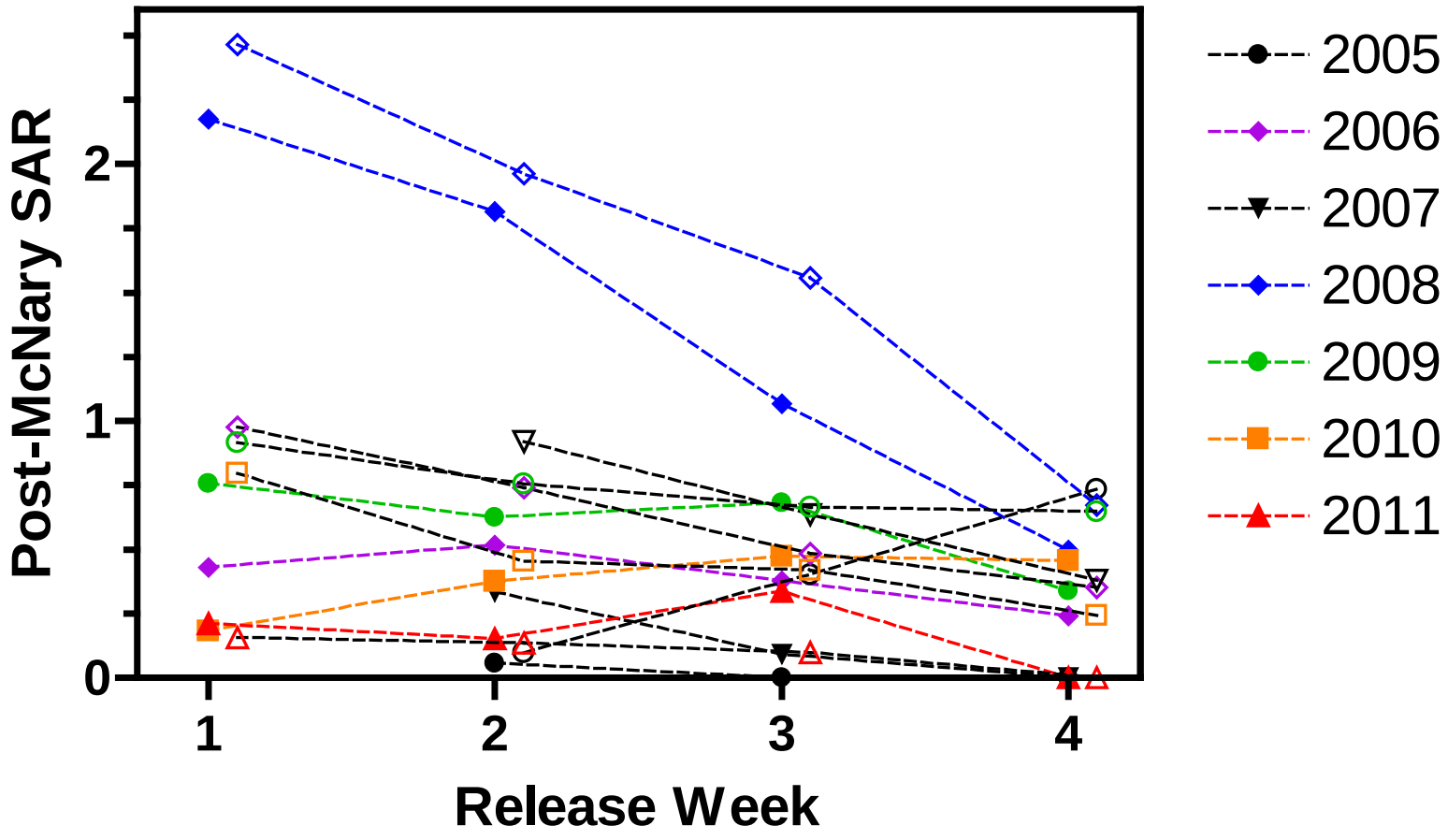
Latent Mortality

- Method: "Bootstrap Everything"
  - Bootstrap at level of release group
  - From bootstrap sample, construct one-sided 95% confidence intervals and calculate P values

Example of Data

				Trucked and Released in LG tailrace				Trucked and Released in IH tailrace		
Year	Week	Rep		Released	Detected at McNary	Adults		Released	Detected at McNary	Adults
2009	1	1		873	370	3		846	304	3
		2		4,496	1,788	19		2,353	907	6
		3		6,902	2,722	15		3,884	1,737	18
	2	4		5,812	2,218	12		3,499	1,630	15
		5		5,008	1,878	13		3,772	1,667	13
		6		5,445	2,152	14		3,488	1,468	8
	3	7		4,295	1,824	15		2,717	1,107	14
		8		2,953	1,179	7		2,110	899	6
		9		6,321	1,691	10		3,487	1,313	2
	4	10		3,406	888	3		2,722	1,083	7
		Total		45,511	16,710	111		28,878	12,115	92

Smolt-to-Adult Return % - Pooled across replicates each week



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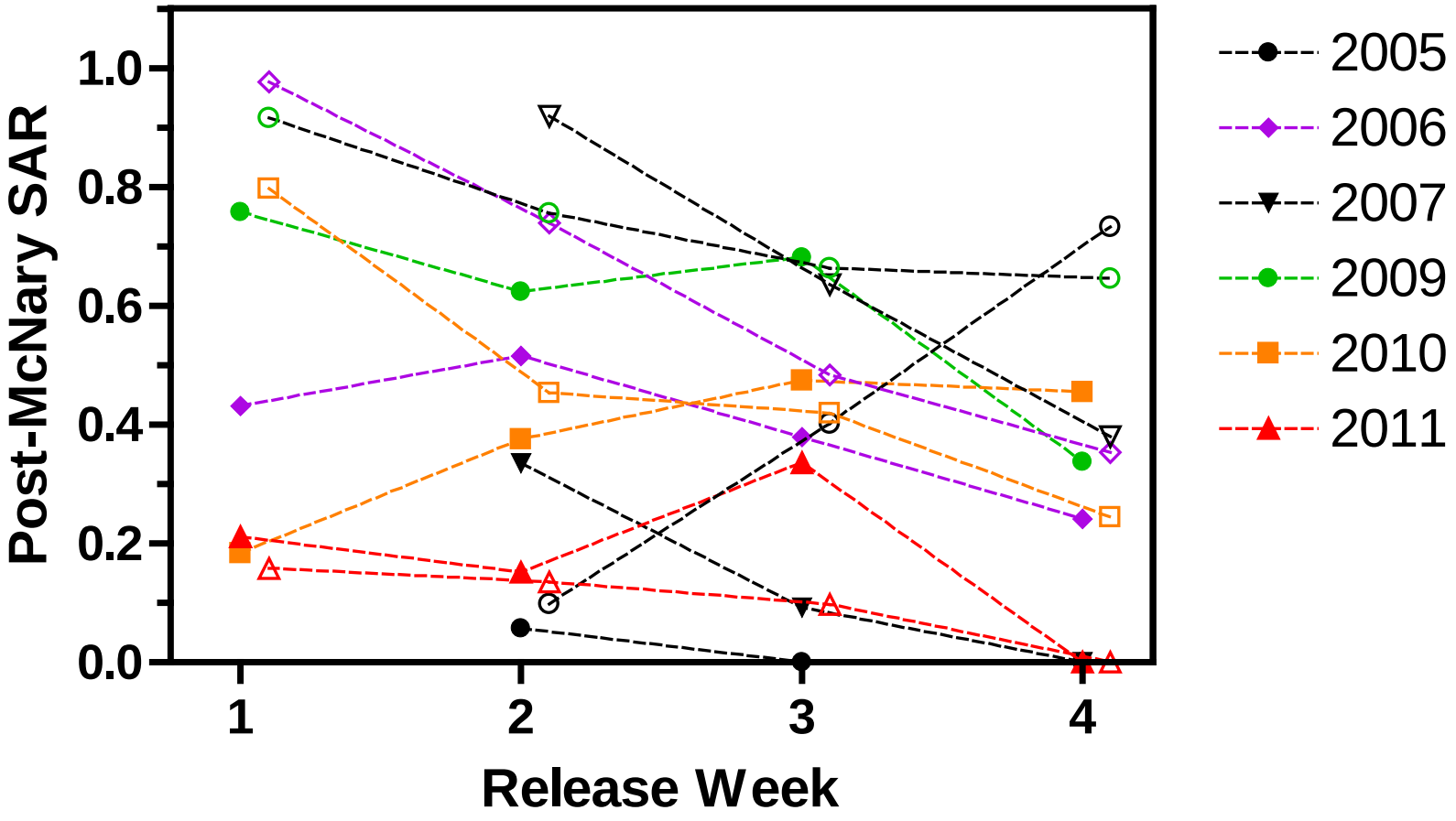
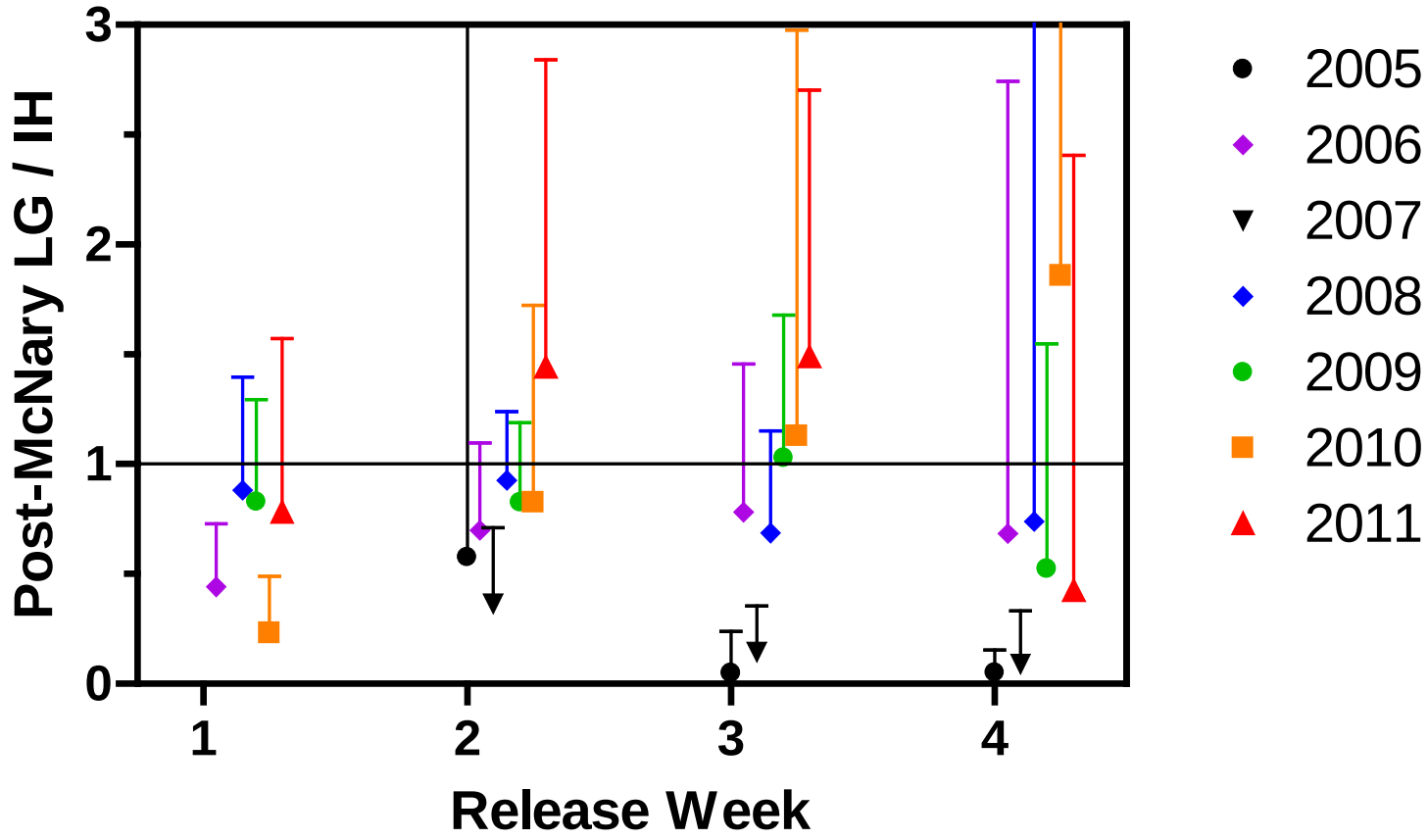


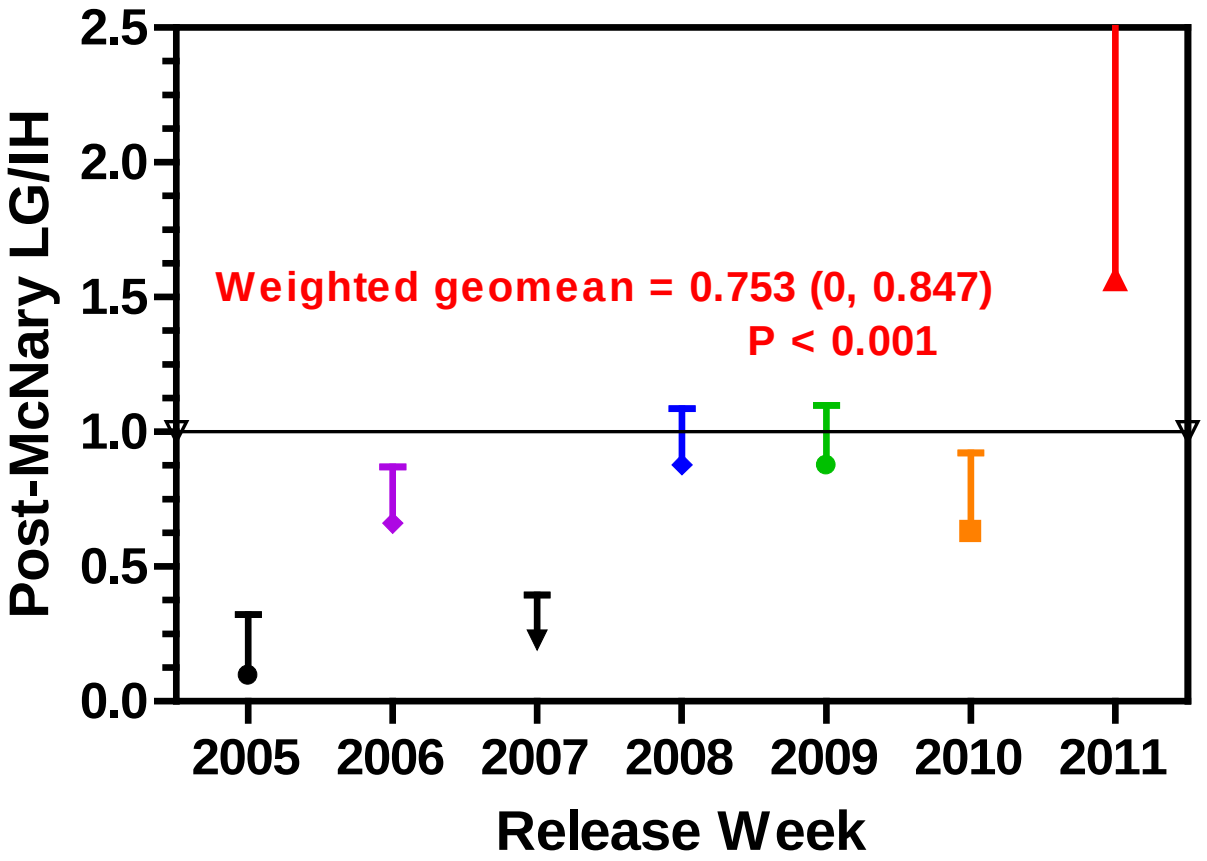
Estimated SAR ratios LG/IH – Pooled across replicates each week

Matched by Release Date

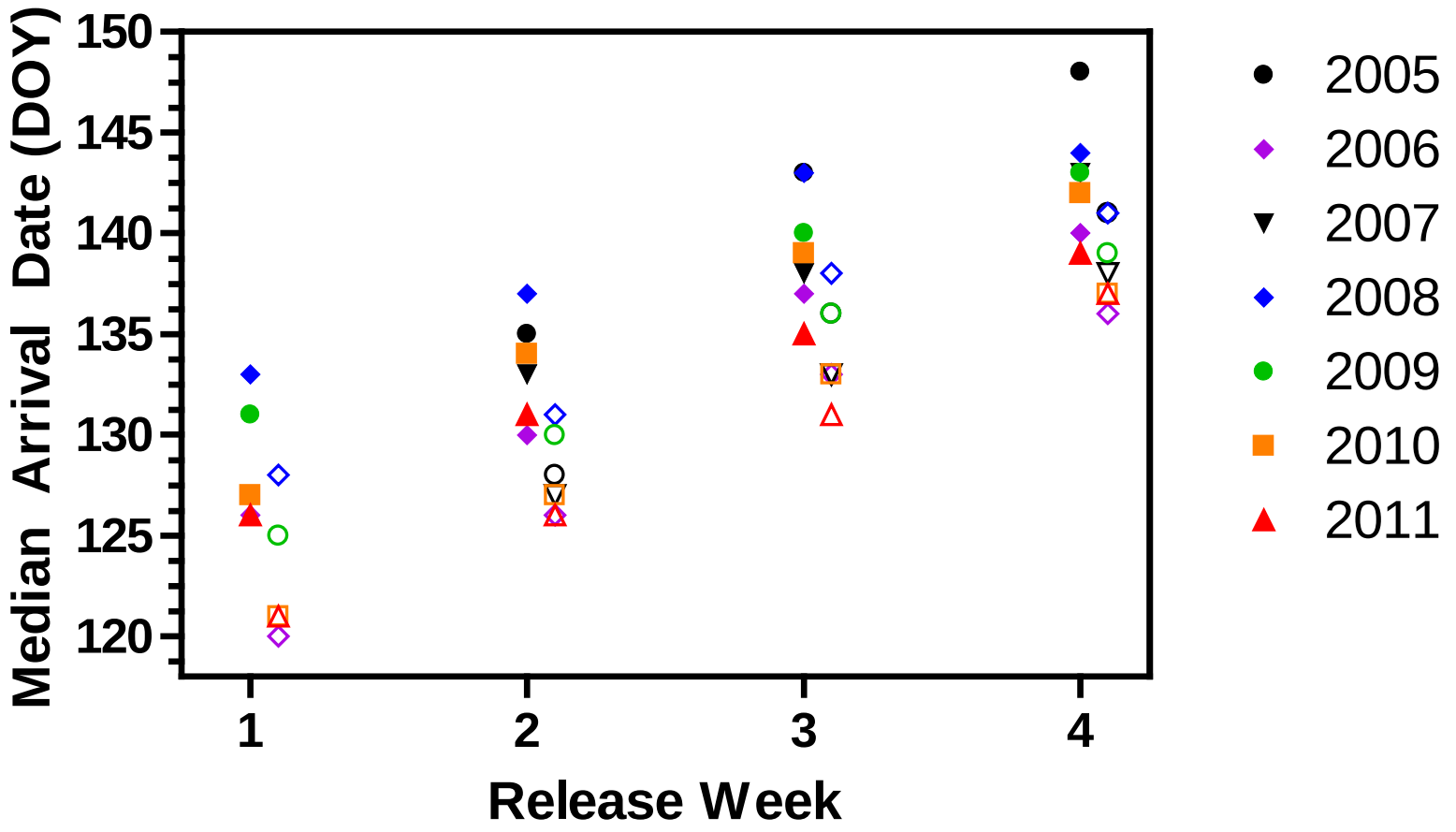


Estimated SAR ratios LG/IH – Reps pooled across years

Matched by Release Date



Median arrival date at McNary - Pooled across replicates each week

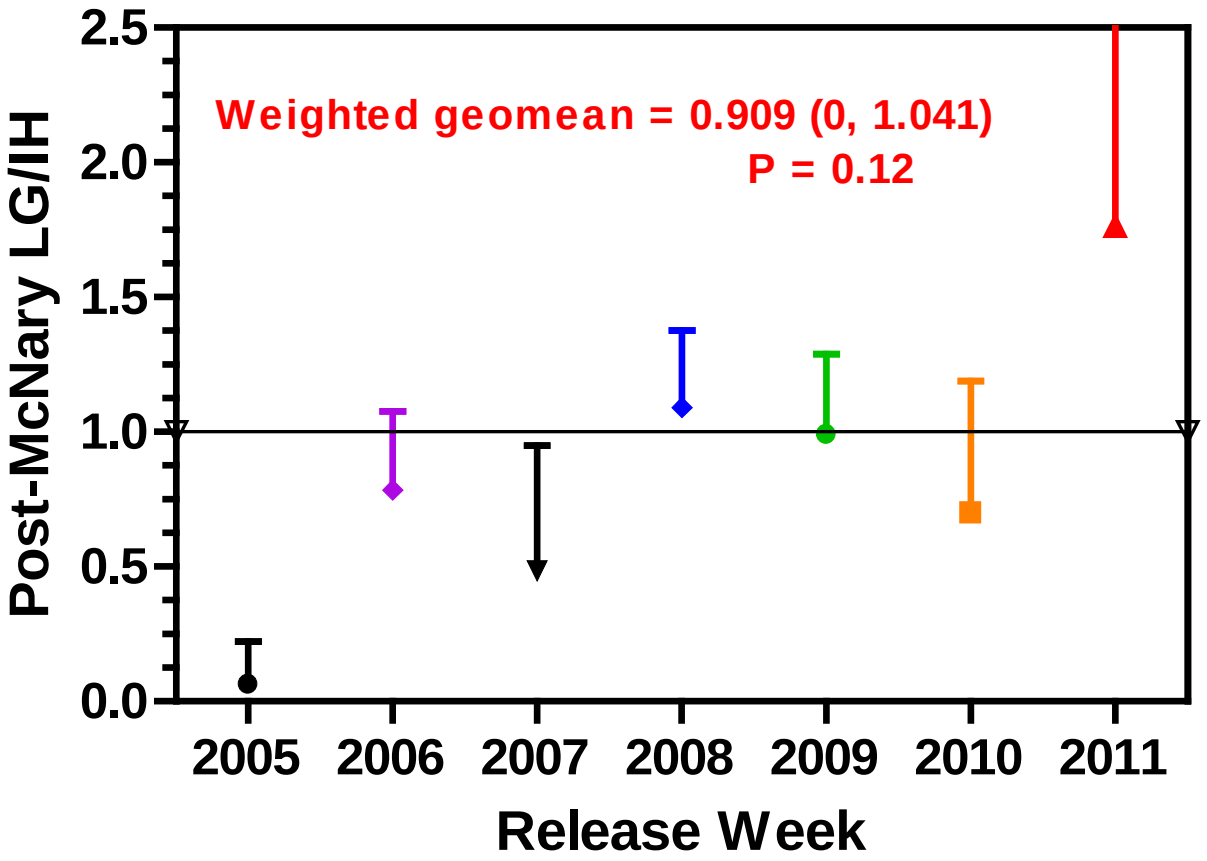


Latent Mortality

- Match by McNary Date, by using:
  - LGR tailrace replicates 1 through 7
  - IHR tailrace replicates 4 through 10

Estimated SAR ratios LG/IH – Reps pooled across years

Matched by McNary Date



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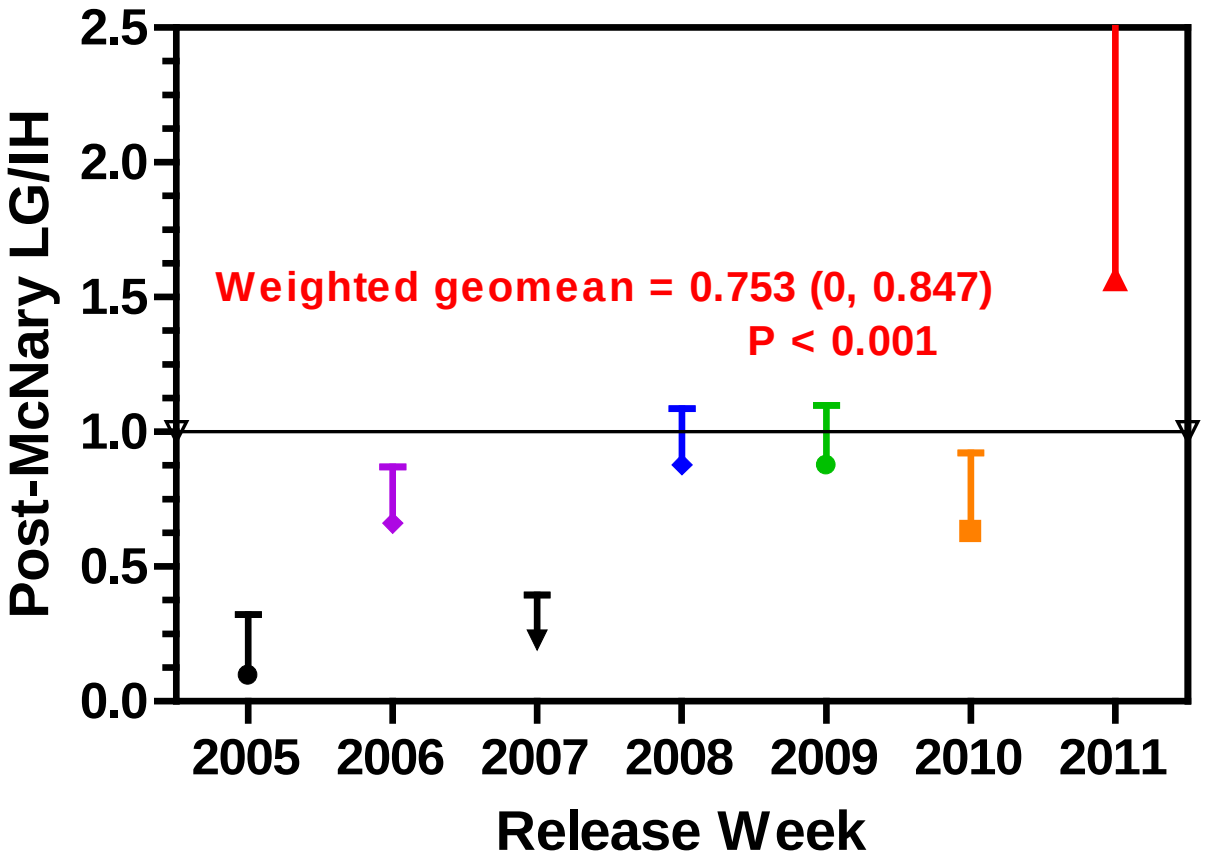

Latent Mortality

- Logistic Regression on individuals detected at McNary
  - Predict adult return using predictors:
    - Year
    - Release date
    - McNary date
    - Length at Tagging
    - Release location

Latent Mortality

- Summary of Logistic Regression results
  - Significant variation among years
  - McNary date a better predictor than release date
  - Larger at tagging = more likely to return

Latent Mortality

- Logistic Regression summary of results
  - Adjusting for McNary date and length at tagging:
    - Release location not significant (P = 0.29)


Questions?