A Study To Determine Seasonal Effects of Transporting Fish From the Snake River To Optimize A Transportation Strategy

Anadromous Fish Evaluation Program
Annual Review
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How and Why Do SARs and SAR Ratios Vary Within Migration Seasons?

- Data – Caveats

- "Descriptive" Models – Estimated smooth curves describing SARs for transported (T) and bypassed (B) fish through time

  -- Derived curves for T:B ratios
  -- Alternative Standards for evaluating ratios

- Results – A Few Detailed, Mostly Summary

Caveats

- Analyses are:
  - Mostly based on available (adventitious) data
  - Restricted by dates of adventitious data
  - Descriptive of patterns in SARs through time within seasons
  - Based on in-river migrants that were bypassed (C1)
  - Subject to confounding of mortality and straying
  - Limited by small numbers of adult returns for some years

- Analyses are not:
  - Based on planned, designed experiments
  - Able to shed much light on transport early in the season, 2006-2012
  - Prescriptive for transport on particular dates or under particular conditions
  - Based on non-bypassed in-river migrants fish (C0), because date of passage must be known
  - Able to determine effects of transport on straying

Data

- Daily estimates of smolt-to-adult return rates (SARs)
  - Four groups of smolts for each species/rear-type/MY:
    - Smolts collected and transported from LGR and smolts bypassed there and returned to the tailrace
    - Smolts tagged upstream from LGR or at LGR
  - Count numbers of PIT-tagged smolts at LGR in each group each day (J_i)
  - Count numbers of adults that return to LGR from each daily smolt group (A_i)
  - Estimated SAR for day *i*: $\hat{SAR}_i = A_i / J_i$

Descriptive Analysis

- Models describe patterns through time:
  - Fit a suite of Poisson log-linear regression models

    SAR is (potentially) a function of
    - Migration group (transported or bypassed at LGR)
    - Tagging location (upstream of LGR or at LGR)
    - Date of LGR passage (day of year)
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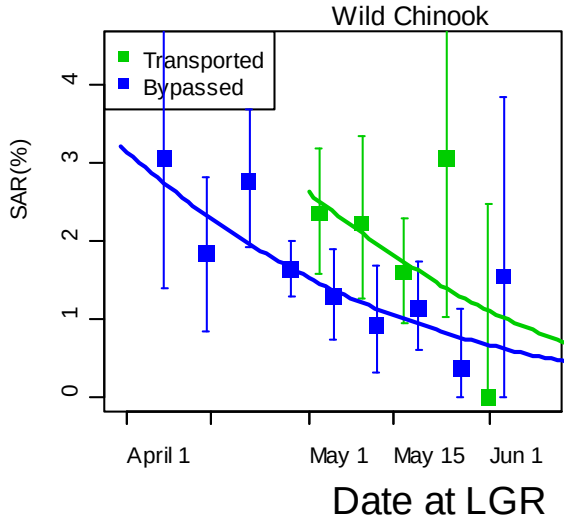
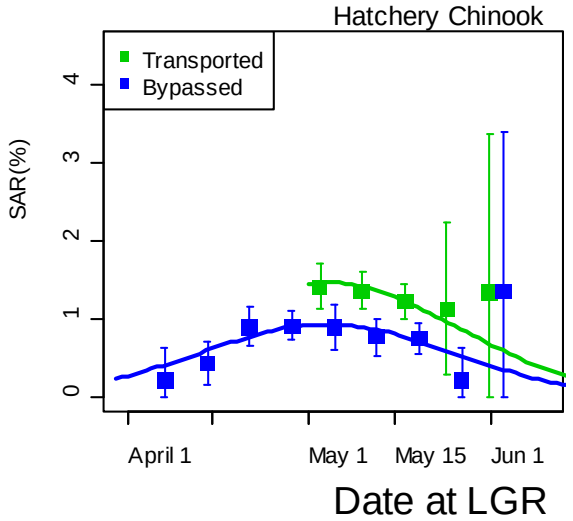
  - Assess model-averaged T:B relative to standards

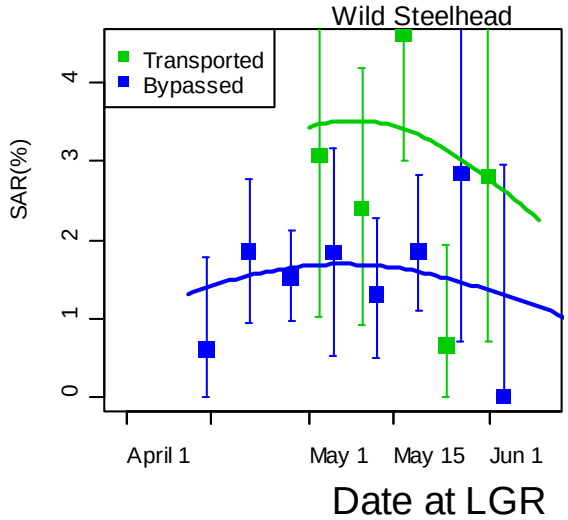
Results

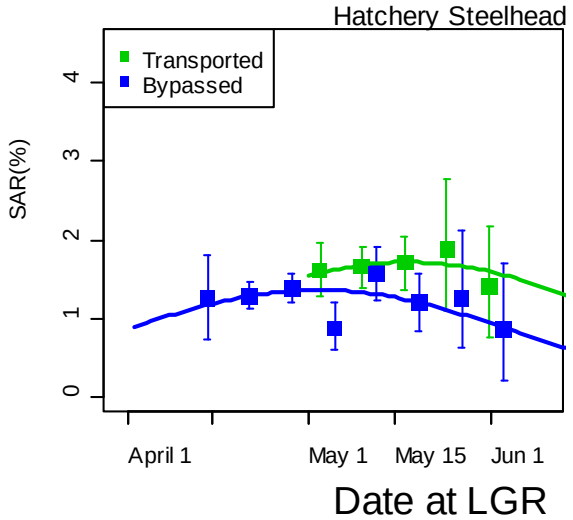
MY 2009 - Tagged Upstream of Lower

Transported or Bypassed at Lower Granite Dam









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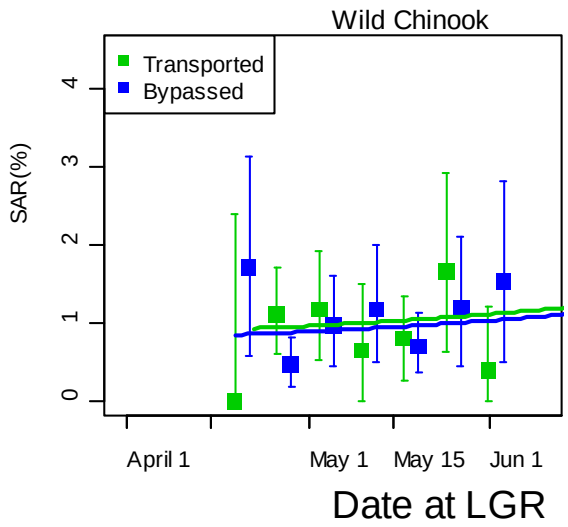

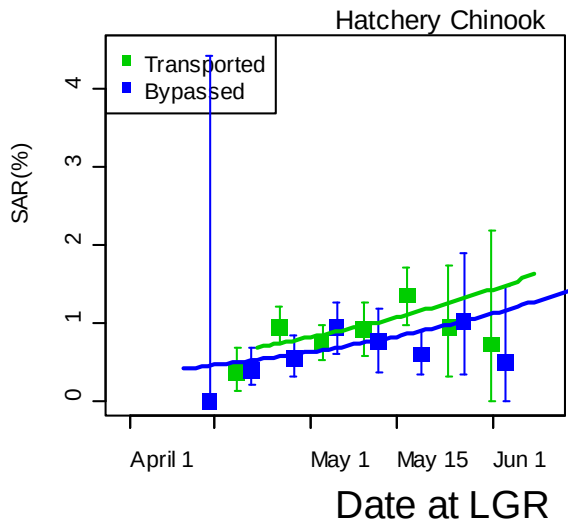

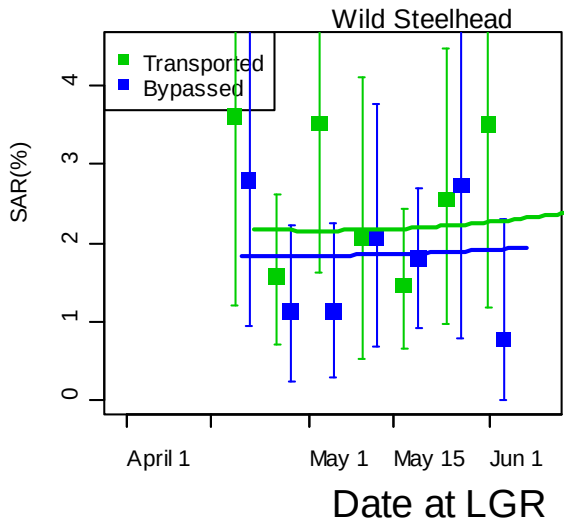

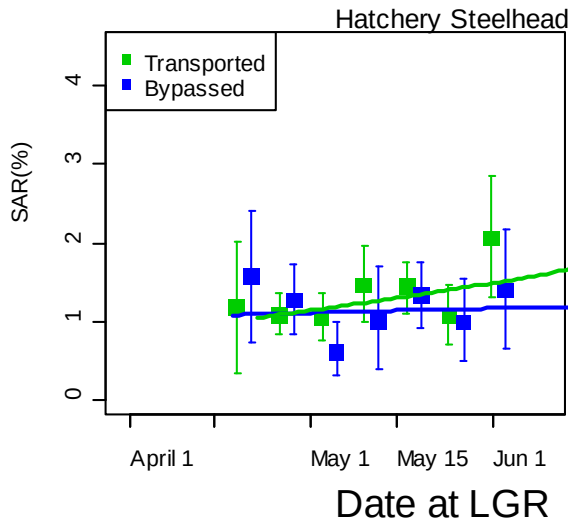

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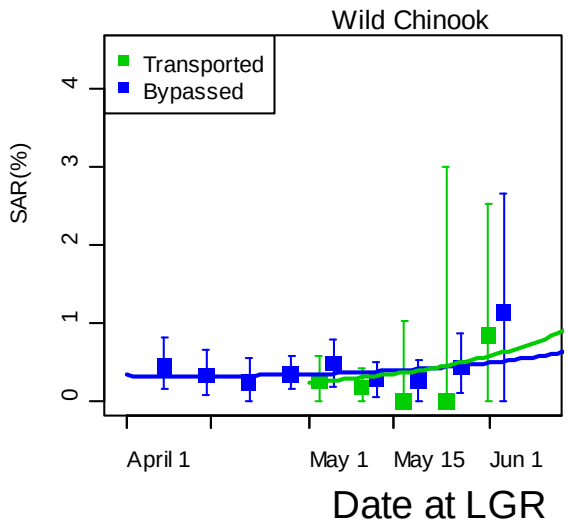

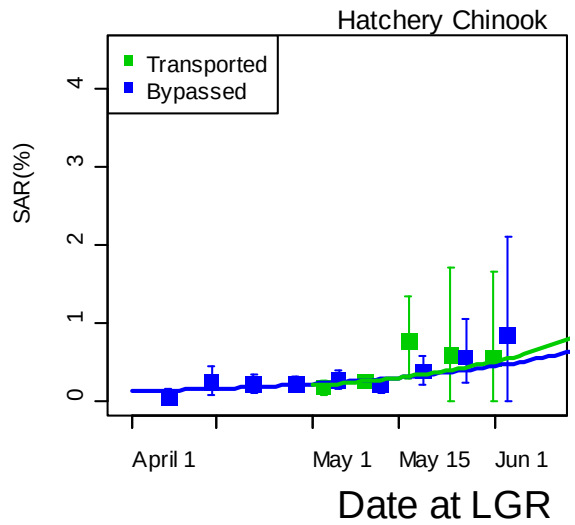

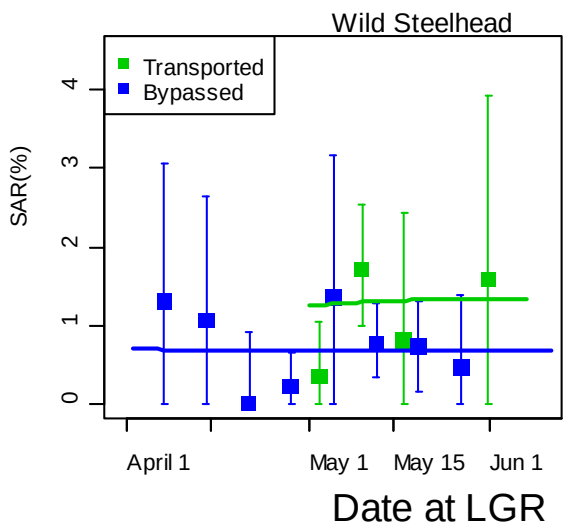

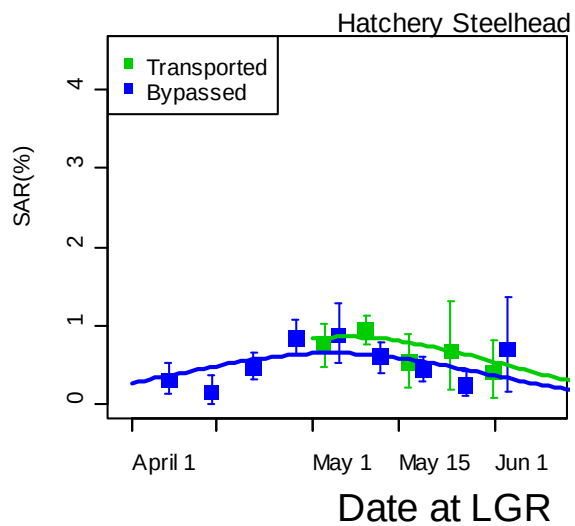

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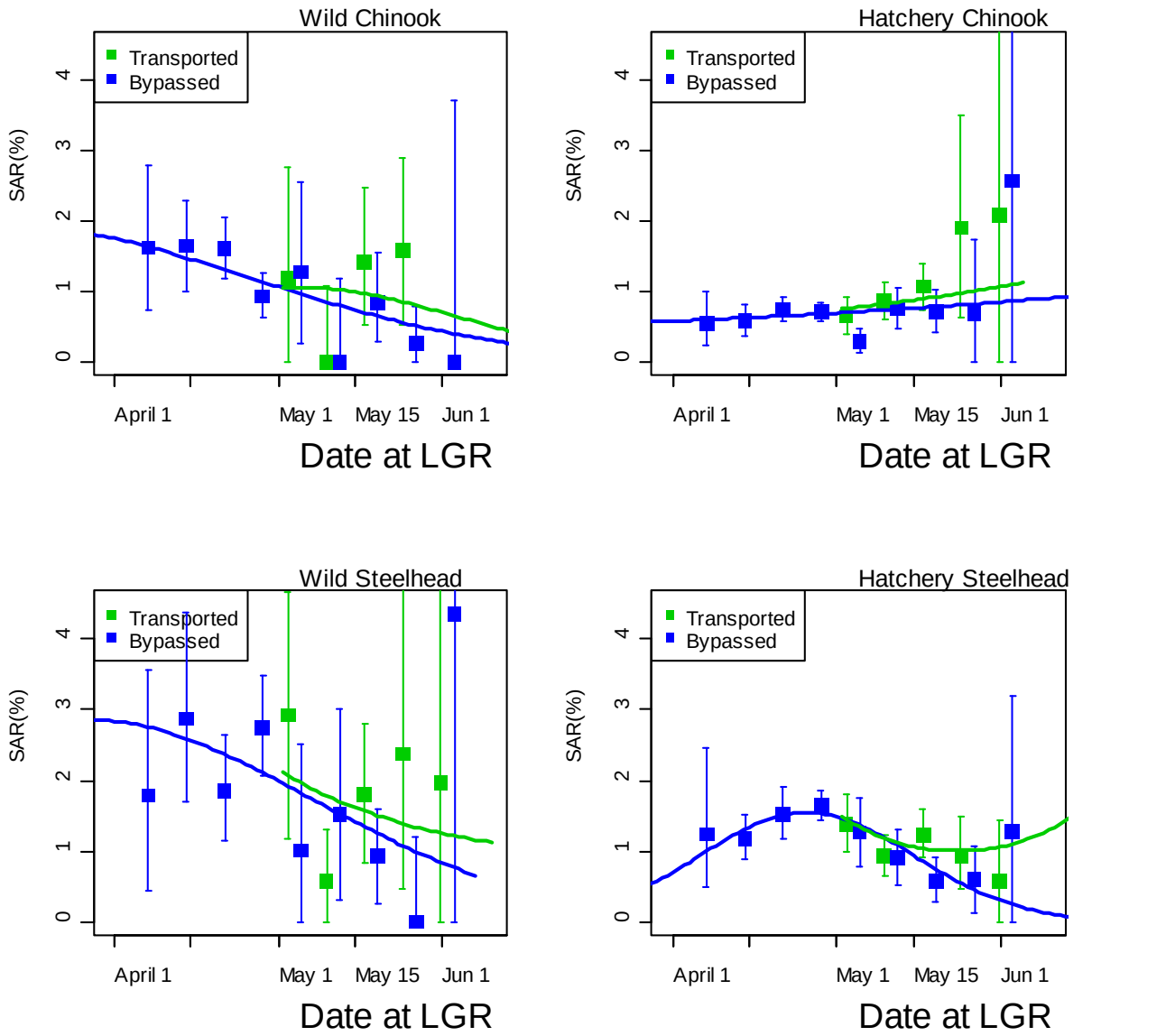

SAR Ratio Standards

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  - Alternative standards consider C0 group as well

    * Estimated SARs for C0 fish are usually higher than for C1 fish

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SAR Ratio Standards

Ratios of estimated annual *SAR* of PIT-tagged fish not detected at Lower Granite, Little Goose, or Lower Monumental Dams (includes detected and not-detected fish at McNary Dam) to estimated annual *SAR* of PIT-tagged fish bypassed at Lower Granite Dam with any subsequent downstream detection history.

Migration Year	Wild Chinook	Hatchery Chinook	Wild steelhead	Hatchery steelhead
1998	1.25	1.55	3.32	3.49
1999	1.10	1.07	1.40	1.89
2000	0.84	0.96	0.90	0.90
2002	1.40	1.09	0.79	1.10
2003	1.42	1.15	0.83	2.01
2004	2.11	2.14	NA	3.29
2005	0.44	1.67	NA	2.40
2006	1.54	1.19	1.70	1.33
2007	1.00	1.17	0.95	1.60
2008	1.07	0.90	1.33	1.20
2009	0.86	0.94	1.59	1.15
2010	1.51	1.42	1.11	1.51
2011	1.74	1.10	4.05	1.18
2012	0.79	1.06	1.12	1.01
Geometric means:				
2006-2012	1.17	1.10	1.50	1.27
1998-2012 (excl. 2001)	**1.14**	**1.21**		**1.57**
1998-2012 (excl. 2001,4,5)			**1.38**	

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Migration Year	Wild Chinook			Hatchery Chinook			Wild Steelhead			Hatchery Steelhead		
	SAR Ratio[a]	Prop. Nondet[b]	**Alt. Std.**	SAR Ratio[a]	Prop. Nondet[b]	**Alt. Std.**	SAR Ratio[c]	Prop. Nondet[b]	**Alt. Std.**	SAR Ratio[a]	Prop. Nondet[b]	**Alt. Std.**
1998-2005	1.14	0.39[d]	**1.05**[e]	1.21	0.57[d]	**1.12**[e]	1.38	0.40[d]	**1.15**[e]	1.57	0.41[d]	**1.23**[e]
2006	1.14	0.28	**1.04**	1.21	0.43	**1.09**	1.38	0.18	**1.07**	1.57	0.15	**1.08**
2007	1.14	0.54	**1.08**	1.21	0.69	**1.14**	1.38	0.54	**1.20**	1.57	0.39	**1.22**
2008	1.14	0.38	**1.05**	1.21	0.55	**1.11**	1.38	0.35	**1.13**	1.57	0.50	**1.28**
2009	1.14	0.30	**1.04**	1.21	0.56	**1.12**	1.38	0.25	**1.10**	1.57	0.31	**1.17**
2010	1.14	0.63	**1.09**	1.21	0.84	**1.17**	1.38	0.71	**1.27**	1.57	0.75	**1.43**
2011	1.14	0.28	**1.04**	1.21	0.46	**1.10**	1.38	0.38	**1.14**	1.57	0.36	**1.21**
2012	1.14	0.29	**1.04**	1.21	0.48	**1.10**	1.38	0.36	**1.14**	1.57	0.39	**1.22**

a. Geometric mean of annual ratio of SAR of “never-detected” fish to SAR of fish detected at Lower Granite Dam, 1998-2012 (excl. 2001).

b. Proportion of inriver migrants (LGR-equivalent) not detected at Snake River collector dams.

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  - Question 4: Which (if any) standard tells us about the advisability of transporting the (non-PIT-tagged) run at large?

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  - Question 4: Which (if any) standard tells us about the advisability of transporting the (non-PIT-tagged) run at large?
  - Transportation system On:

$$SAR_{population,On} = P_{C0} * SAR_{C0} + (1-P_{C0}) * SAR_T$$

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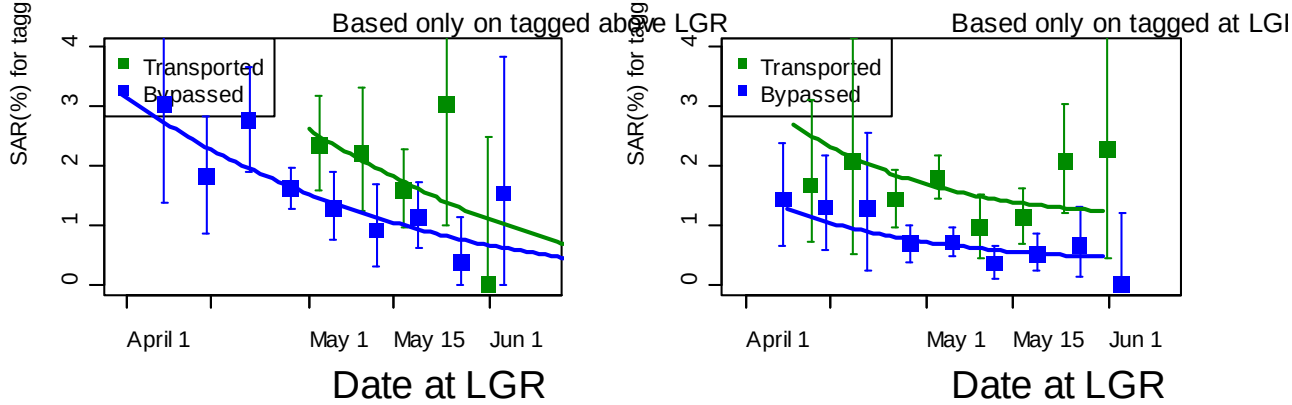
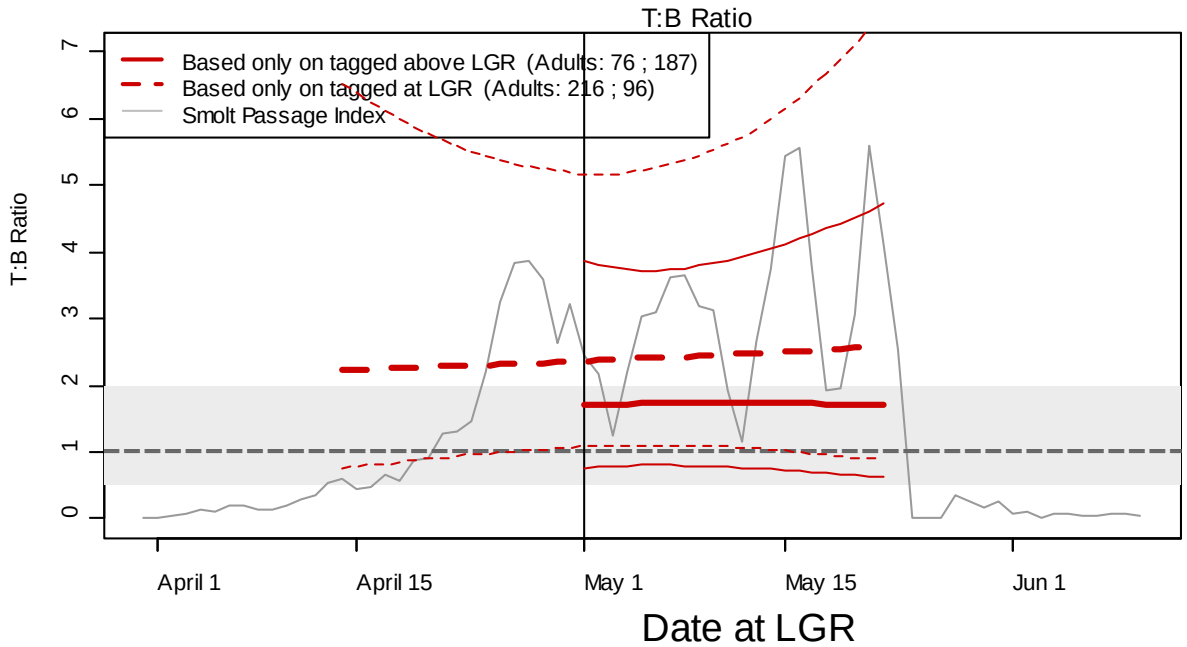
    Unless there is some way to appreciably increase P_{C0}, the answer depends on SARs of T vs. C1

Wild Chinook 2009

Transported or Bypassed at Lower Granite Dam





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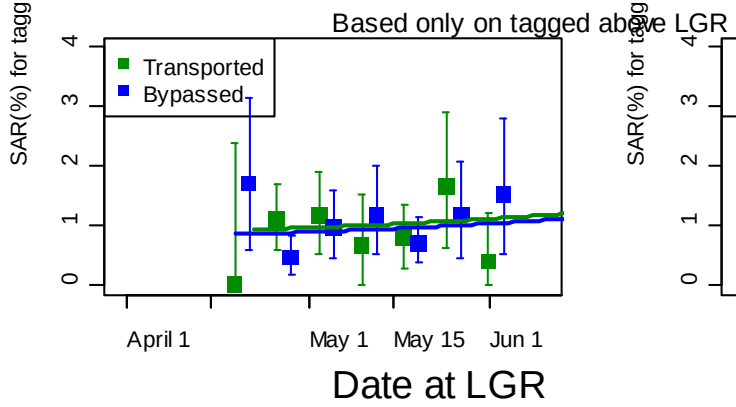

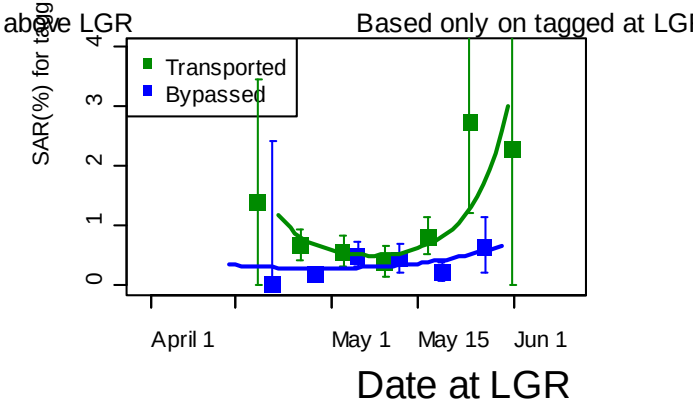

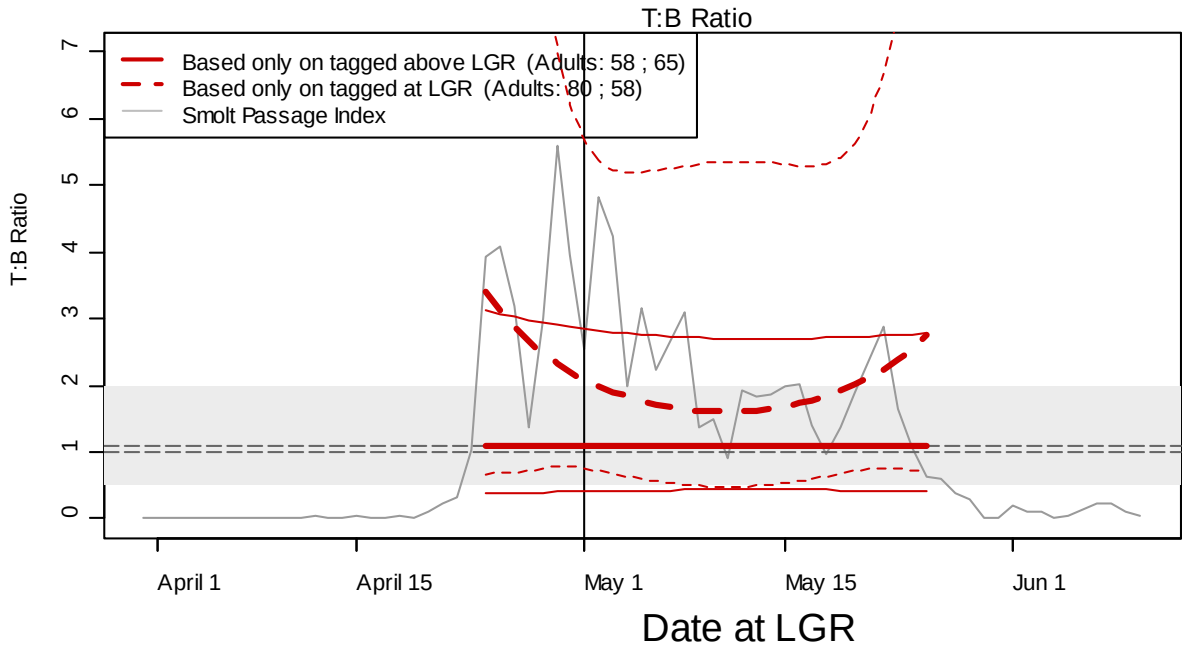

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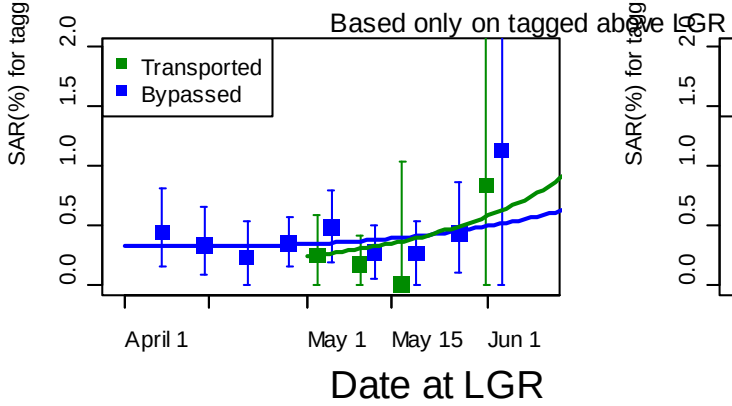

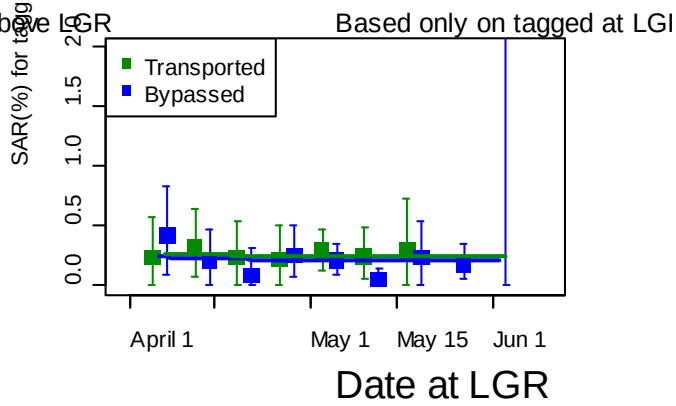

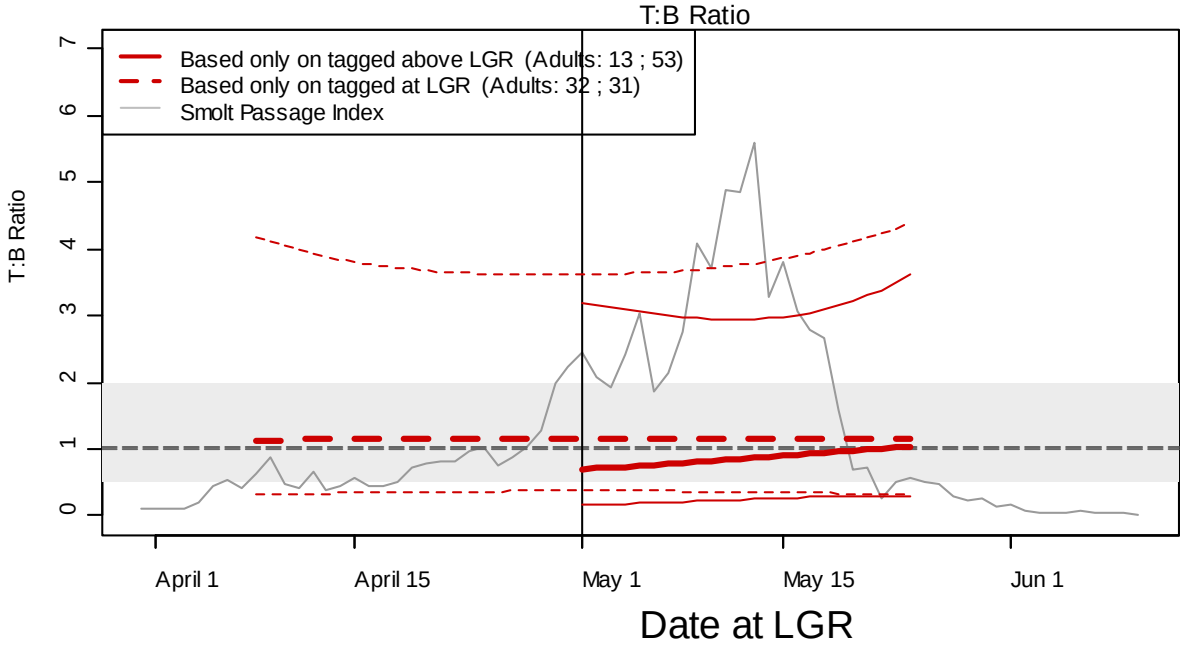

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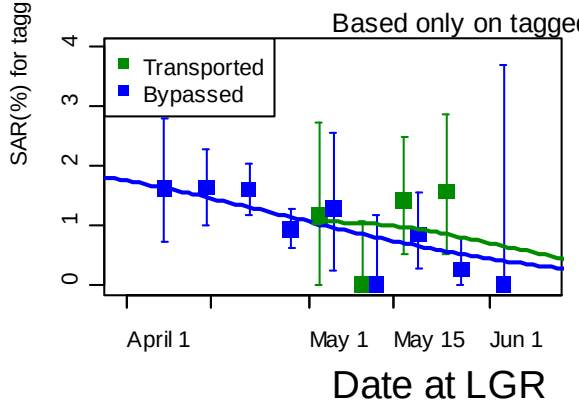
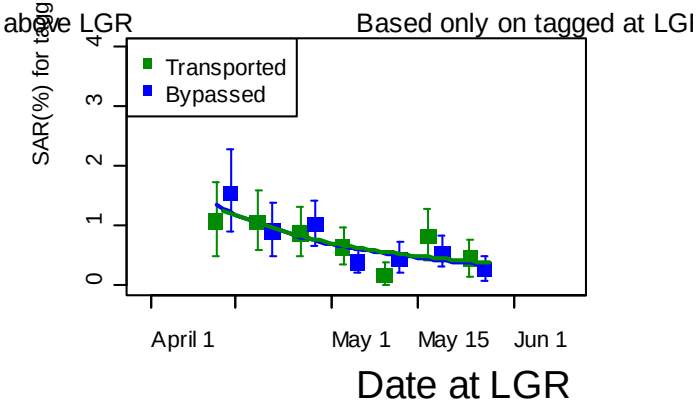
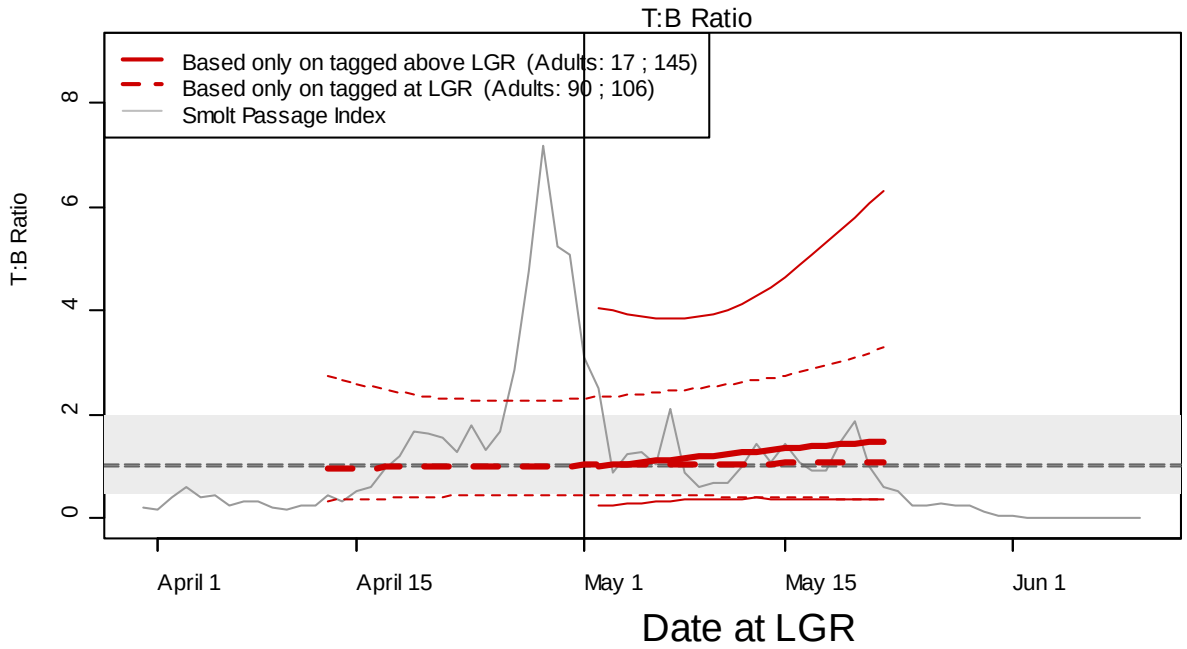


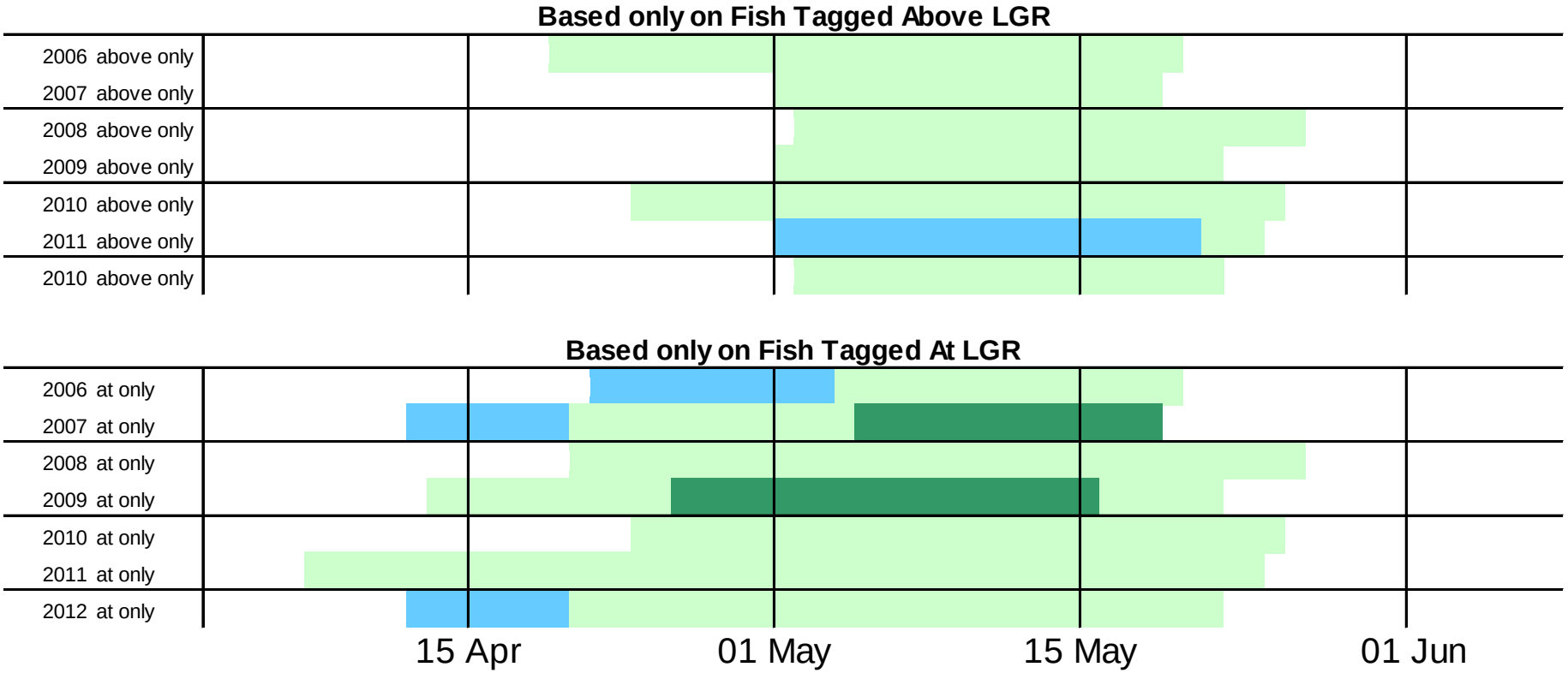




Wild Chinook Salmon - Lower Granite Dam

Summary of Model-Averaged T:B Values (Descriptive)

Standard = 1.0 (C1; Bypassed)



Wild Chinook Salmon - Lower Granite Dam

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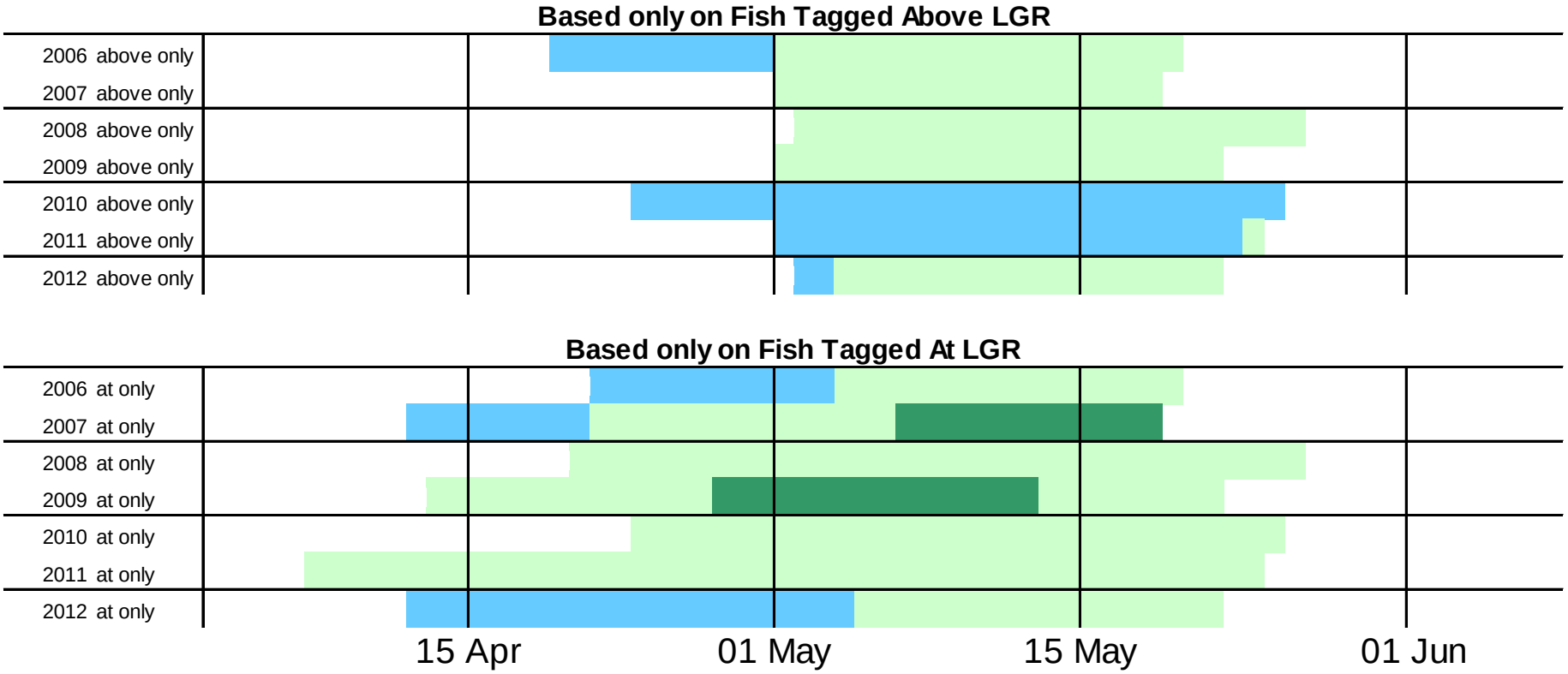
Standard = All Inriver (C0 & C1)



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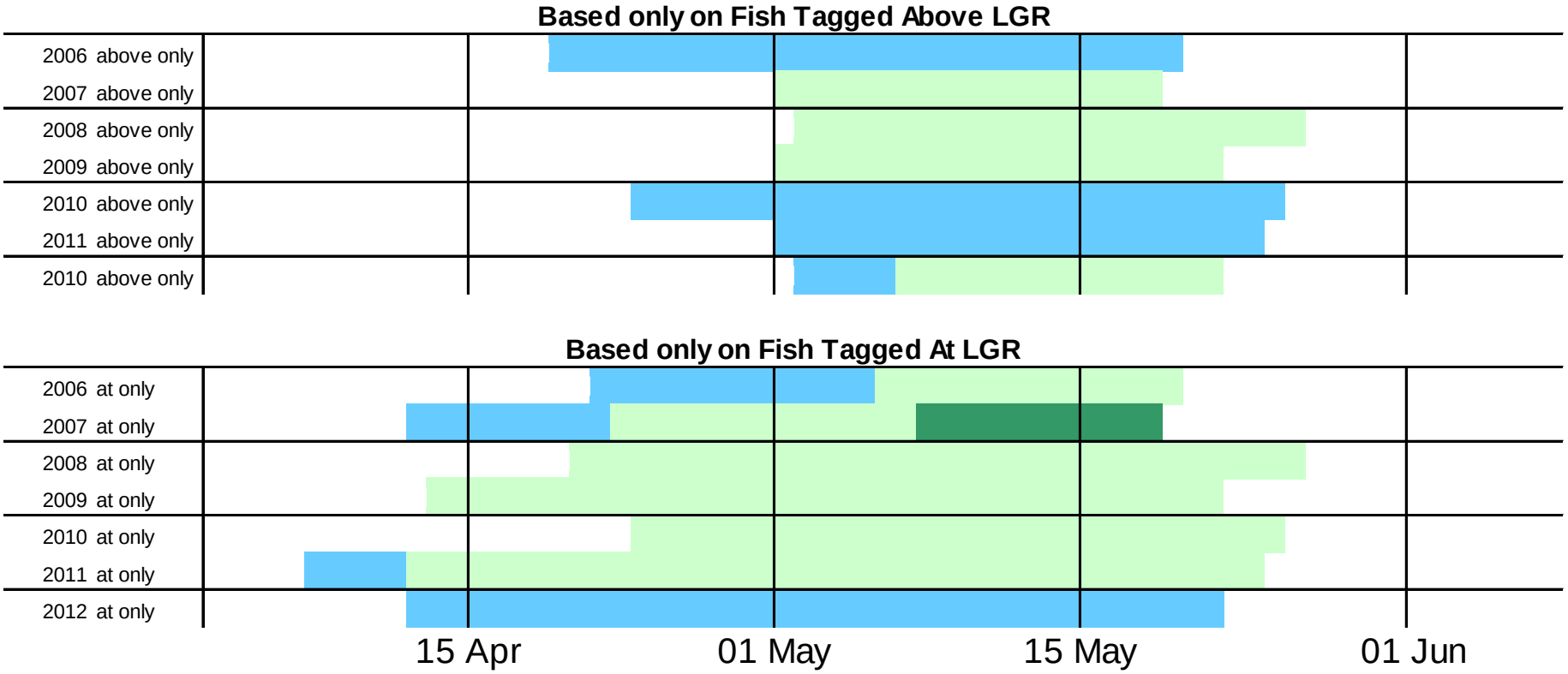
Standard = C0 (Never Bypassed)



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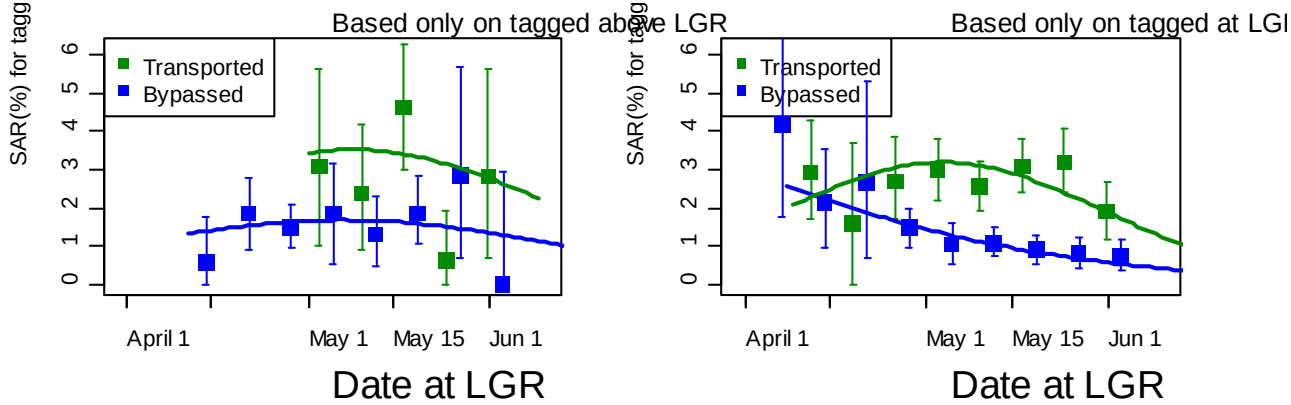

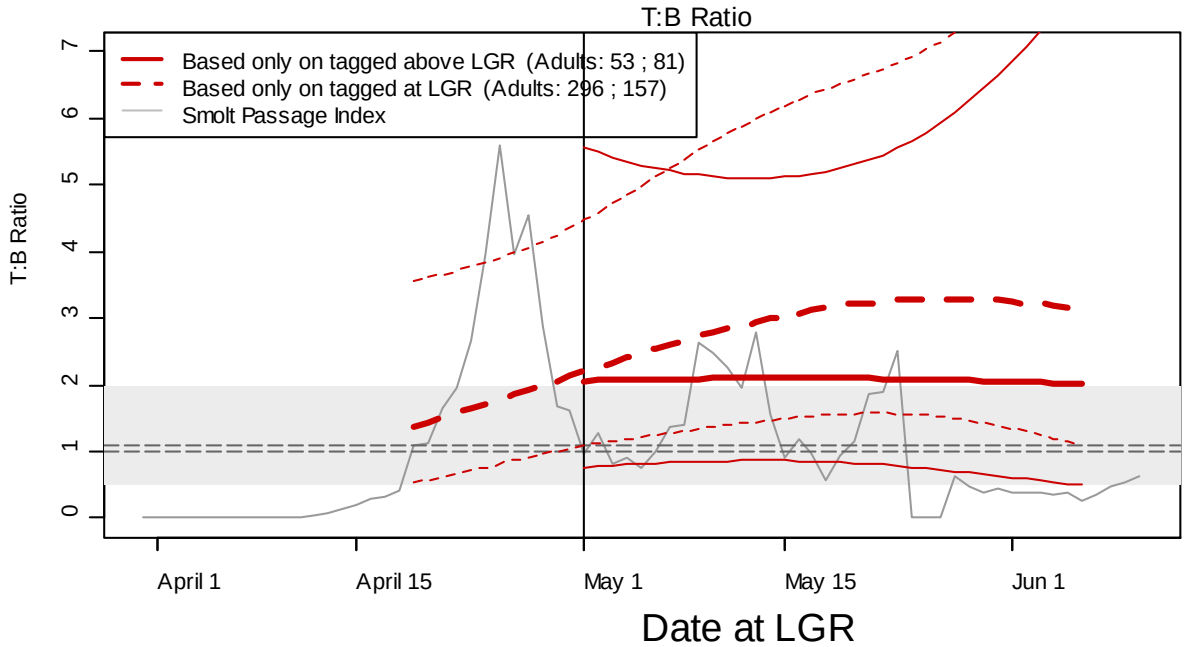

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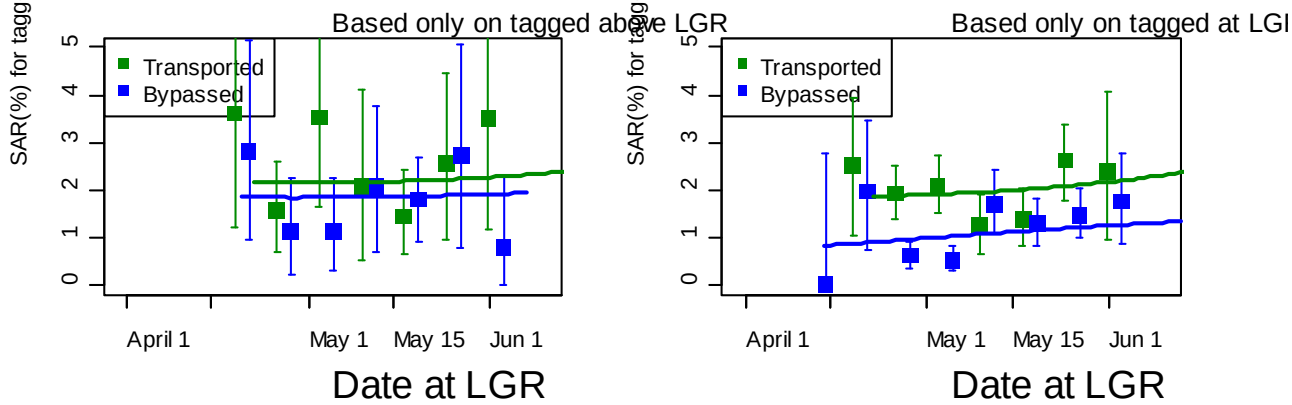

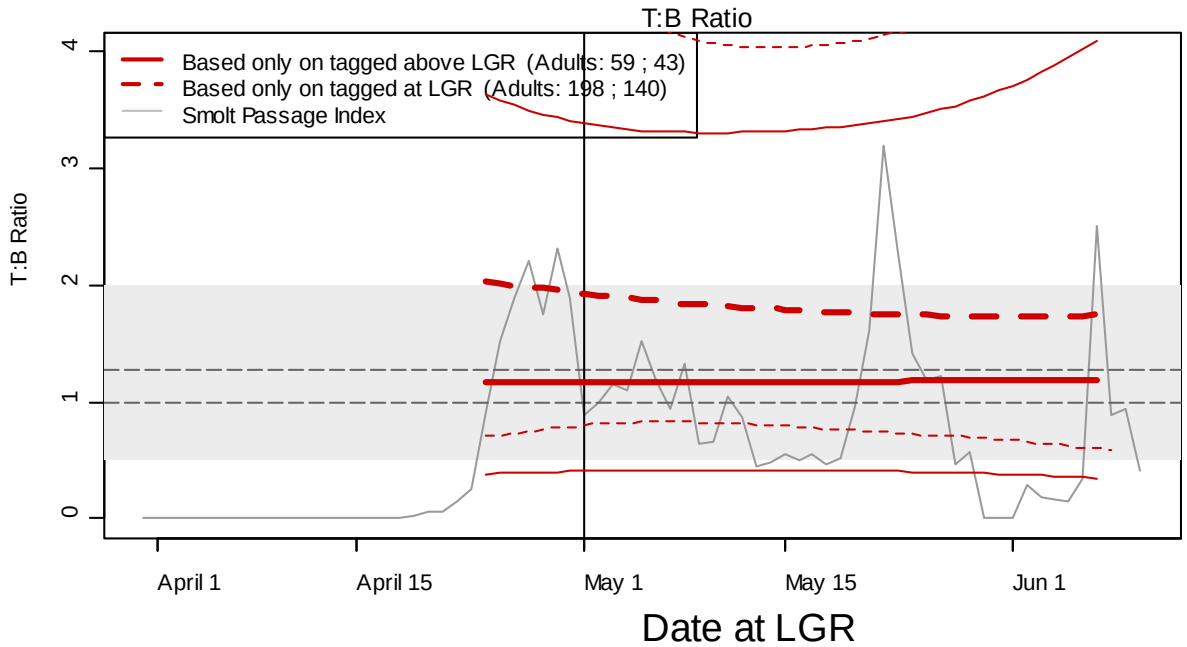

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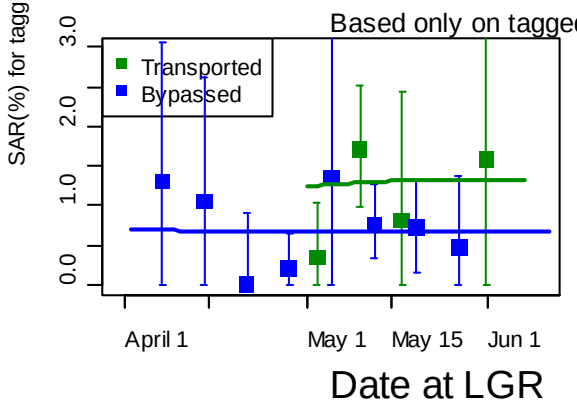
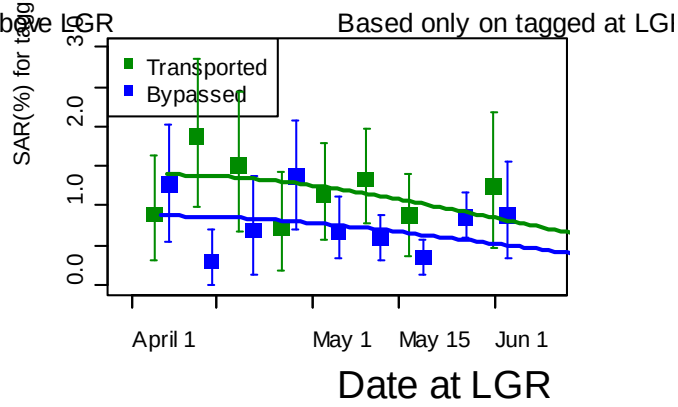
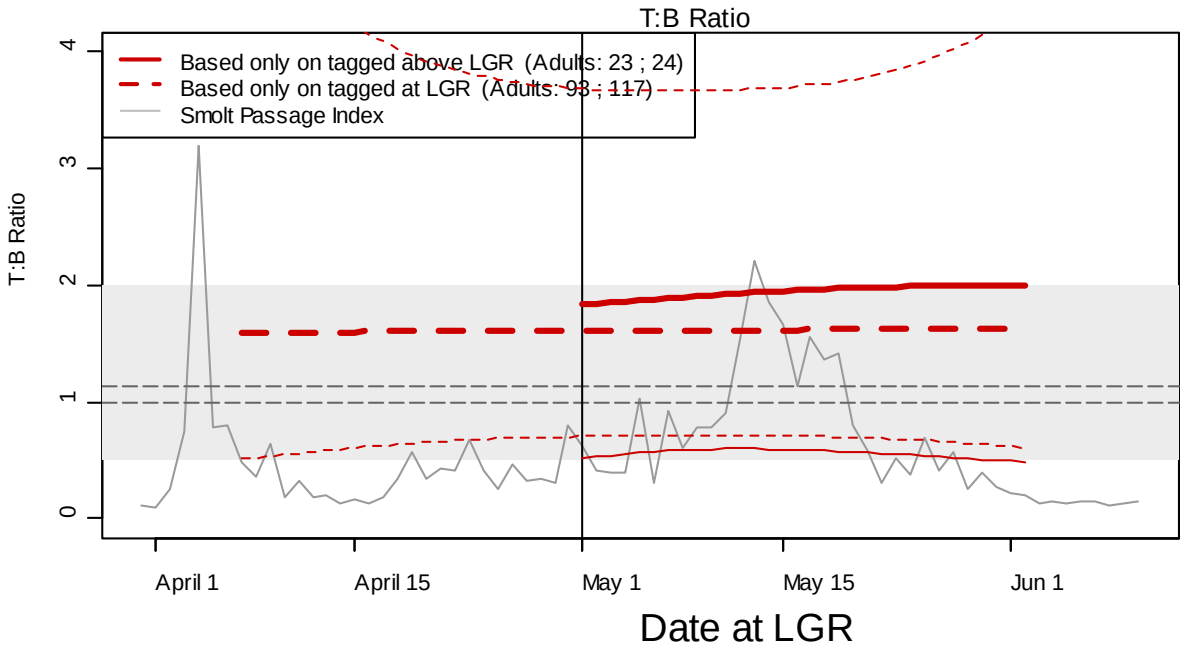
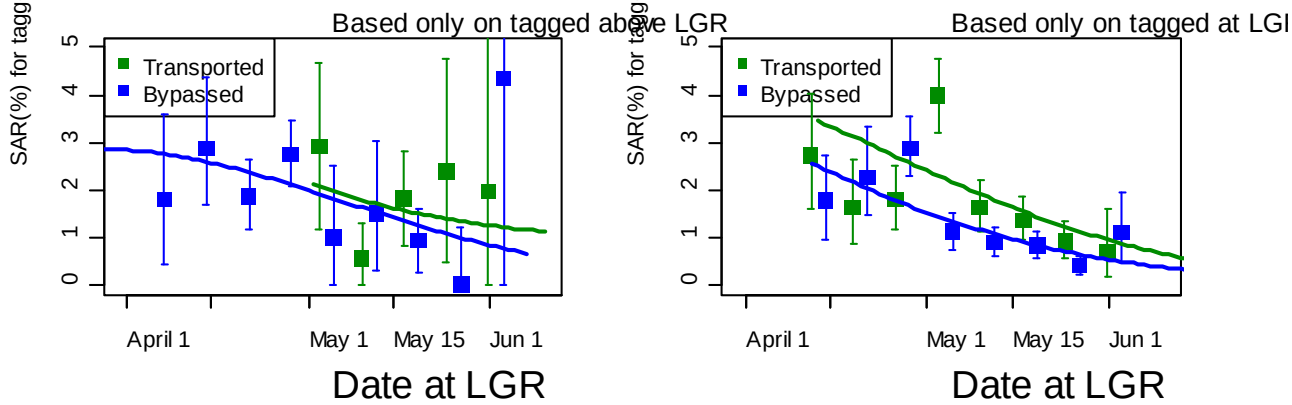


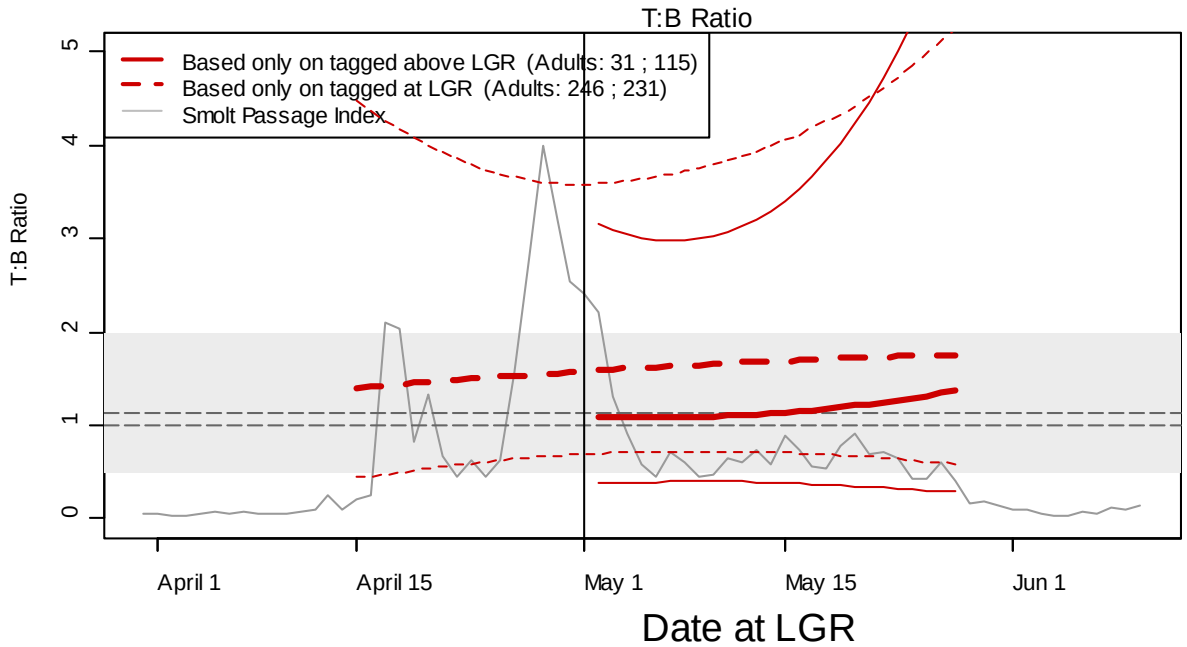




Wild Steelhead 2012

Transported or Bypassed at Lower Granite Dam

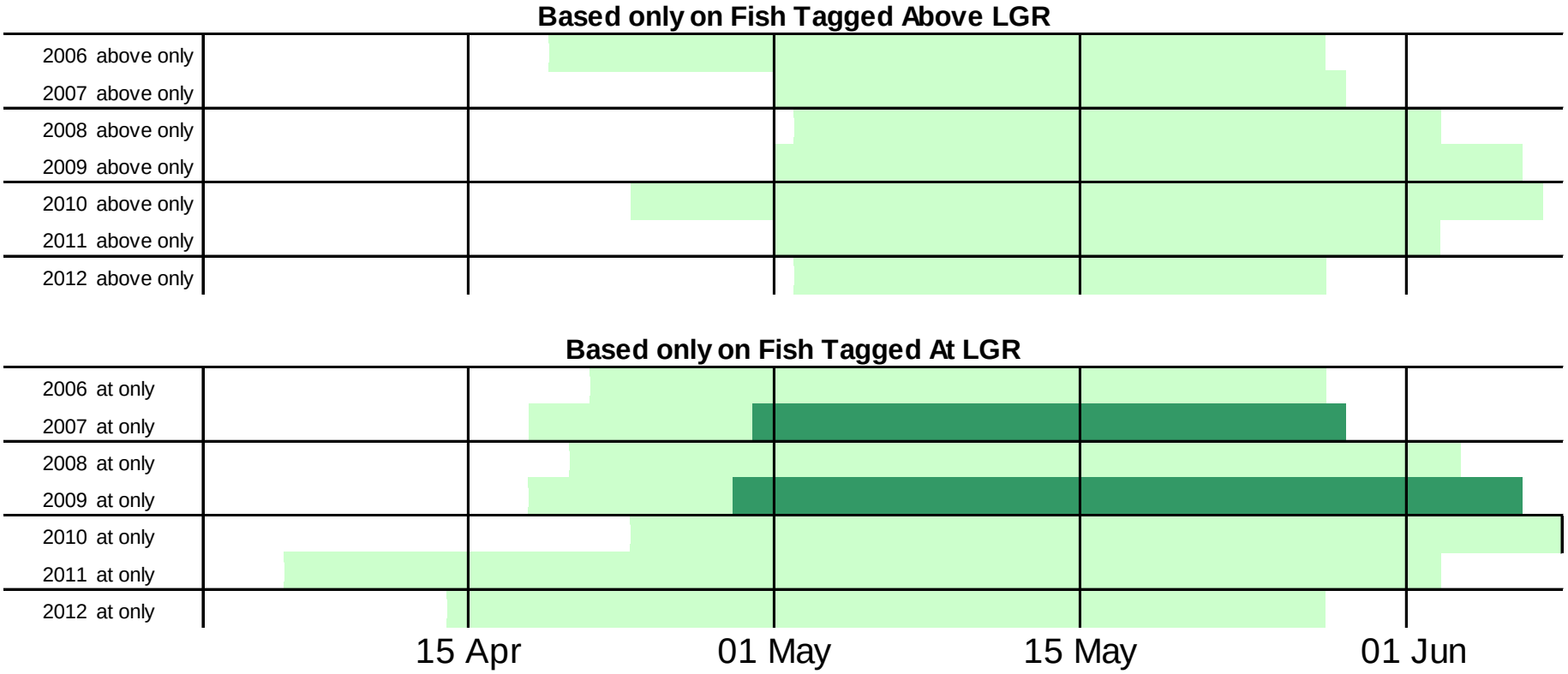




Wild Steelhead - Lower Granite Dam

Summary of Model-Averaged T:B Values (Descriptive)

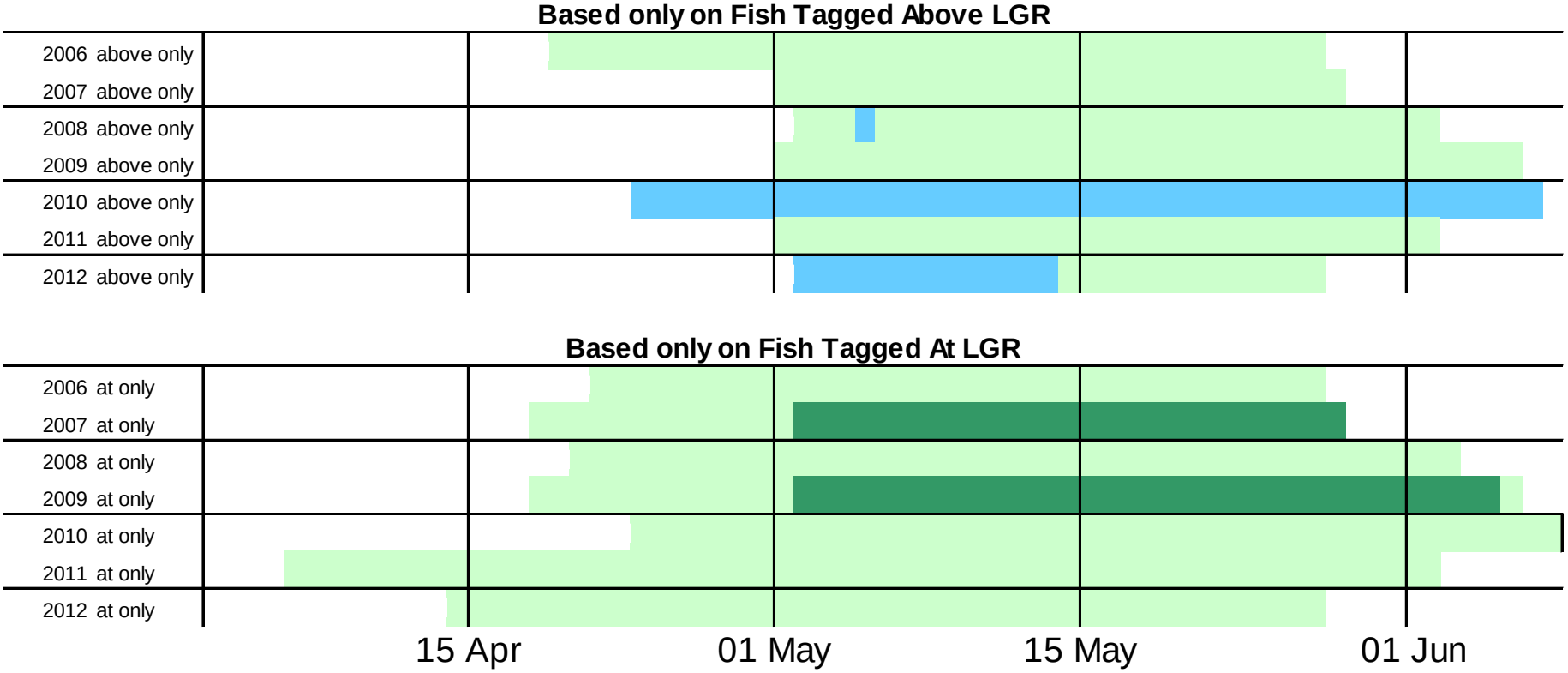
Standard = 1.0 (C1; Bypassed)



Wild Steelhead - Lower Granite Dam

Summary of Model-Averaged T:B Values (Descriptive)

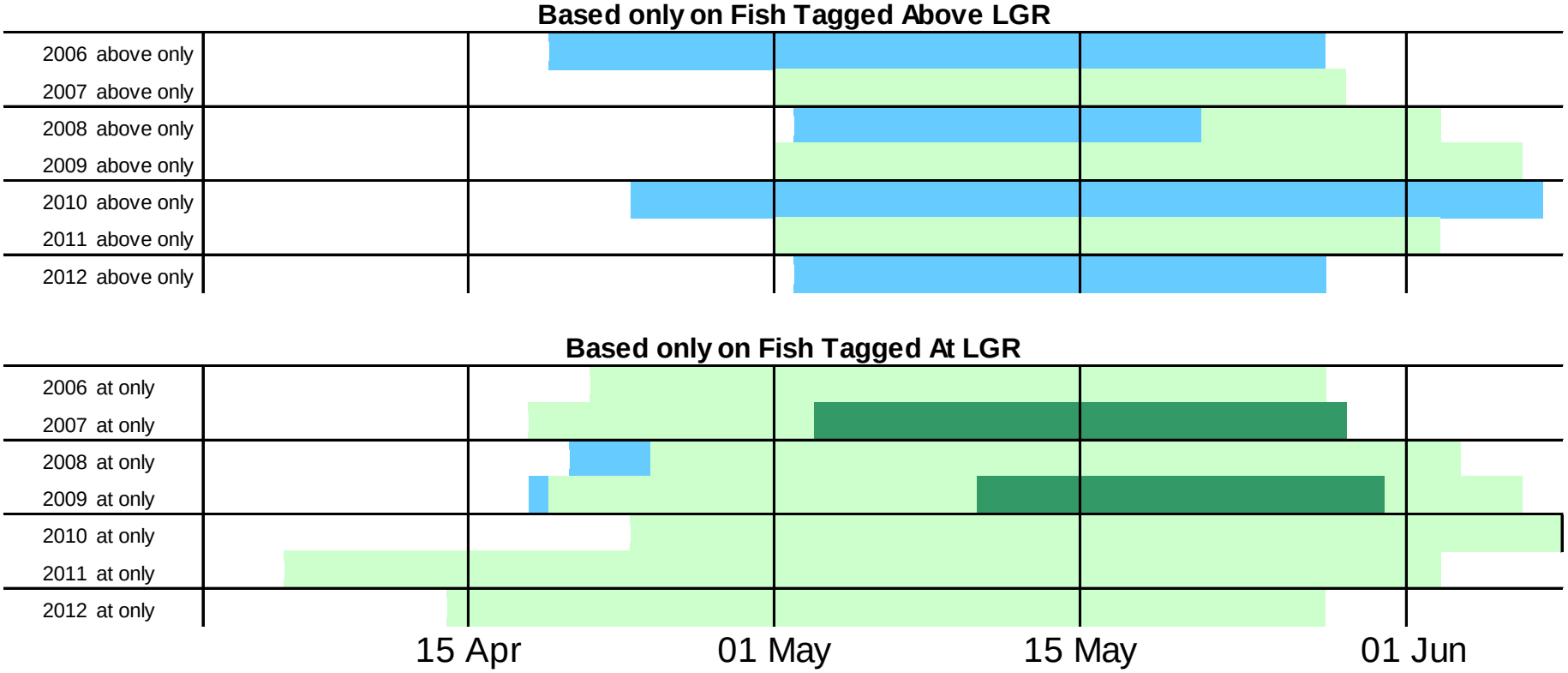
Standard = All Inriver (C0 & C1)



Wild Steelhead - Lower Granite Dam

Summary of Model-Averaged T:B Values (Descriptive)

Standard = C0 (Never Bypassed)



Next Steps

- Do All Analyses for Little Goose Dam and for Lower Monumental Dam, if sufficient data

- Report in first half of 2015, updating through juvenile migration year 2012 and adult returns through end of 2014

Next Steps

- Ultimate goal: Identify factors that can be used to make transport/in-river strategy in real time

  - Collect data on environmental covariates (freshwater, estuary, saltwater) that might affect T:B

  - Statistically evaluate models that *explain* patterns in SAR, not just describe

  - Develop decision criteria

Questions?