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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Steve Smith steven.g.smith@noaa.gov
Doug Marsh, Bob Emmett, Bill Muir, Rich Zabel
Northwest Fisheries Science Center
NOAA Fisheries

How and Why Do SARs and SAR Ratios Vary Within Migration Seasons?

- Data – Caveats

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  - Results – A Few Detailed, Mostly Summary
- Have New Operational Strategies Changed The Picture?

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  - Subject to confounding of mortality and straying
  - Limited by small numbers of adult returns for some years

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What to Call the SAR Ratio?

- Transported fish are definitely “T”
- “T” group is compared with group that migrated in-river, but not all migrants are in the group
- All were bypassed at LGR, so let’s call them “B”
- “T:B” compares SARs for transported and bypassed fish

  - (but some of these slides use “T:M”)

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)
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  - Assess model-averaged T:B relative to standards

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  - Alternative standards consider C0 group as well – returns of C0 fish are generally higher than of C1 fish

SAR Ratio Standards

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SAR Ratio Standards

Table 2. 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	1.01	1.18	2.23	1.32
2007	1.02	1.27	0.93	1.57
2008	1.05	0.95	1.54	1.15
2009	0.84	0.97		
Geometric means:				
2006-2009	0.98	1.08		
2006-2008			1.47	1.33
1998-2009 (excl. 2001)	**1.06**	**1.23**		
1998-2008 (excl. 2001)				**1.69**
1998-2008 (excl. 2001,4,5)			**1.31**	

SAR Ratio Standards

Table 3. Calculation of alternative baseline standard T:M for comparisons for fish transported from Lower Granite Dam. For migration years 2006-2009, components of the calculation are the *SAR* of PIT-tagged fish not detected at any of the collector Dams LGR, LGO, or LMO relative to the *SAR* of PIT-tagged fish bypassed at Lower Granite Dam with any subsequent downstream detection history, and the proportion of fish in the migrant population as a whole that were never detected. The average standard for years 2006-2009 was applied to migration years 1998-2005.

	Wild Chinook			Hatchery Chinook			Wild Steelhead			Hatchery Steelhead		
Migration Year	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[d]	Prop. Nondet[b]	**Alt. Std.**
1998-2005	1.06	0.37[e]	**1.02**[f]	1.23	0.55[e]	**1.13**[f]	1.31	0.33[e]	**1.10**[f]	1.73	0.34[e]	**1.24**[f]
2006	1.06	0.28	**1.02**	1.23	0.43	**1.10**	1.31	0.18	**1.03**	1.73	0.15	**1.11**
2007	1.06	0.54	**1.03**	1.23	0.68	**1.16**	1.31	0.54	**1.12**	1.73	0.39	**1.29**
2008	1.06	0.38	**1.02**	1.23	0.55	**1.13**	1.31	0.34	**1.09**	1.73	0.50	**1.37**
2009	1.06	0.30	**1.02**	1.23	0.56	**1.13**	1.31	0.26	**1.06**	1.73	0.30	**1.16**

a. Geometric mean of annual ratio of SAR of "never-detected" fish to SAR of fish detected at Lower Granite Dam, 1998-2009 (excl. 2001).

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

c. Geometric mean of annual ratio of SAR of "never-detected" fish to SAR of fish detected at Lower Granite Dam, 1998-2008 (excl. 2001, 2004, 2005).

d. Geometric mean of annual ratio of SAR of "never-detected" fish to SAR of fish detected at Lower Granite Dam, 1998-2008 (excl. 2001).

e. Arithmetic mean of 2006-2009 values.

f. Geometric mean of 2006-2009 values.

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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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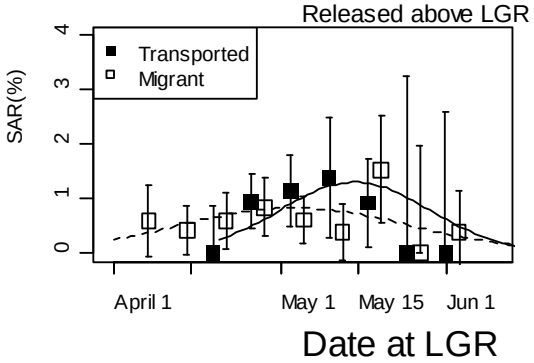
    $SAR_{population,Off} = P'_{C0} * SAR'_{C0} + (1-P'_{C0}) * SAR'_{C1}$

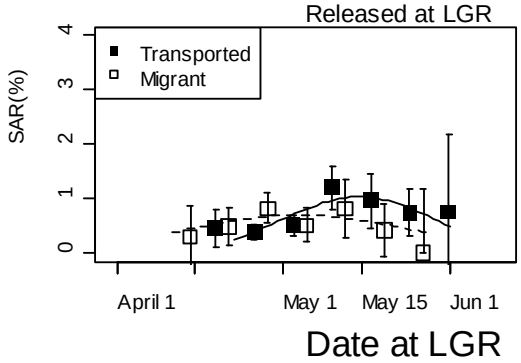
    Unless there is some way to appreciably increase P_{C0}, the answer depends on SARs of T vs. C1

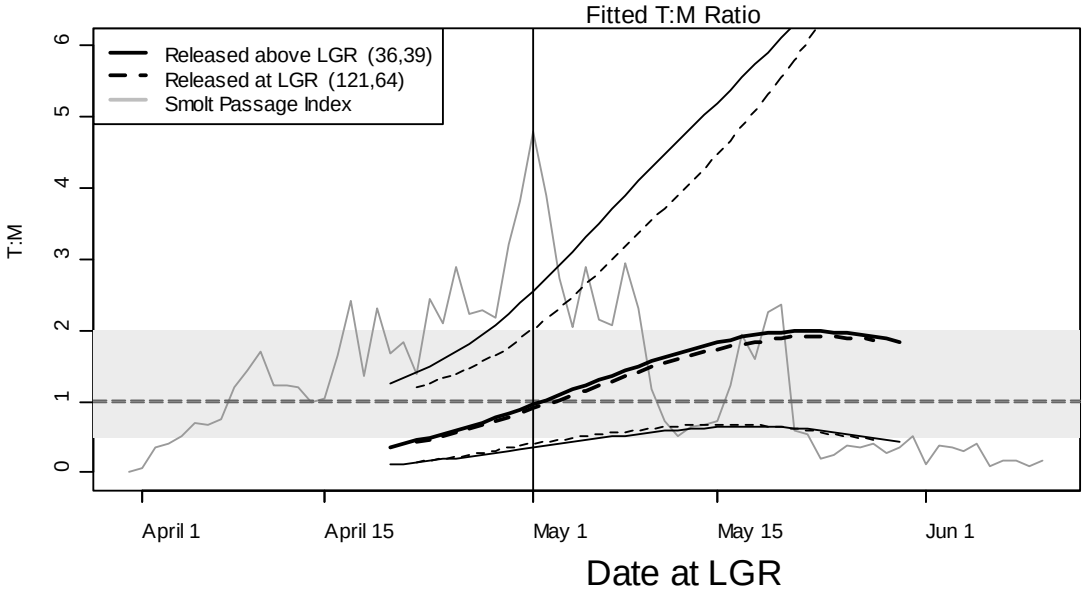
Results

Wild Chinook 2006

Model-Averaged - Descriptive







Wild Chinook 2008

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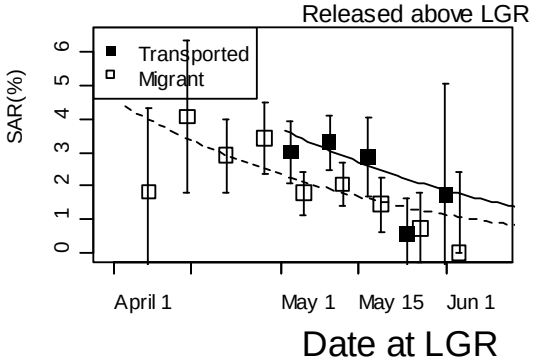

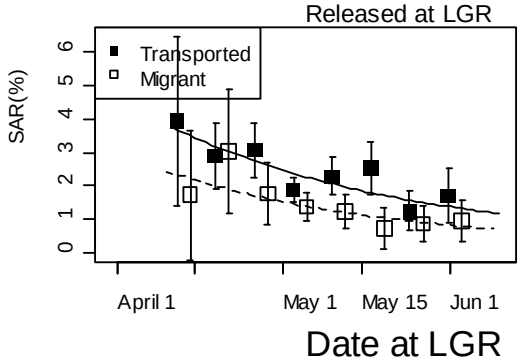

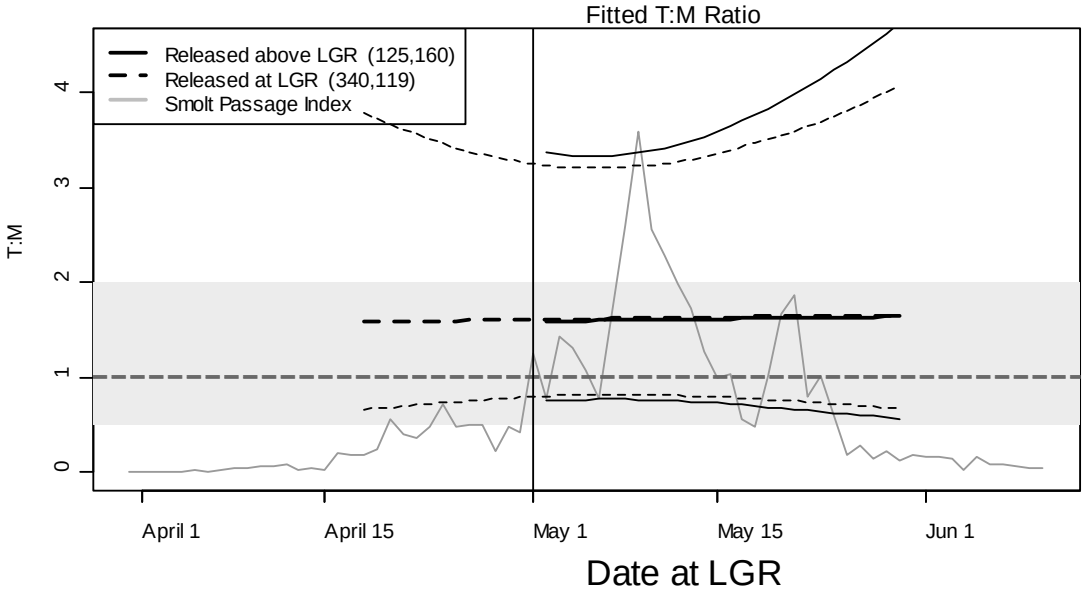

Wild Chinook 2002

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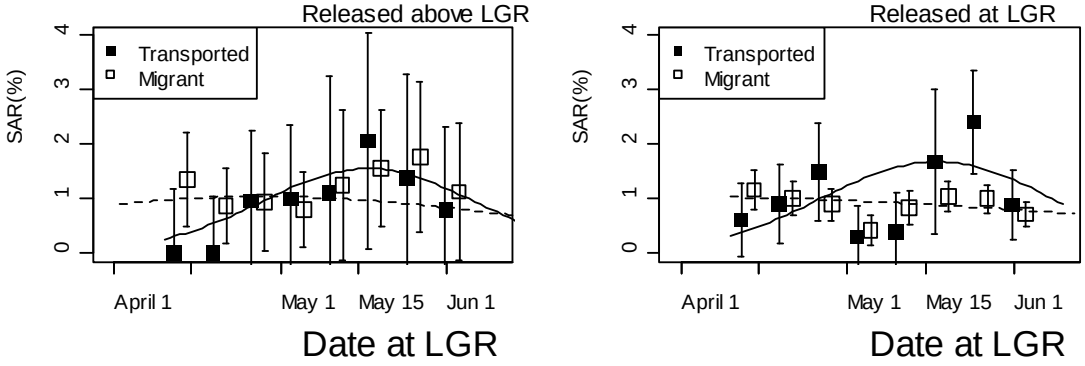

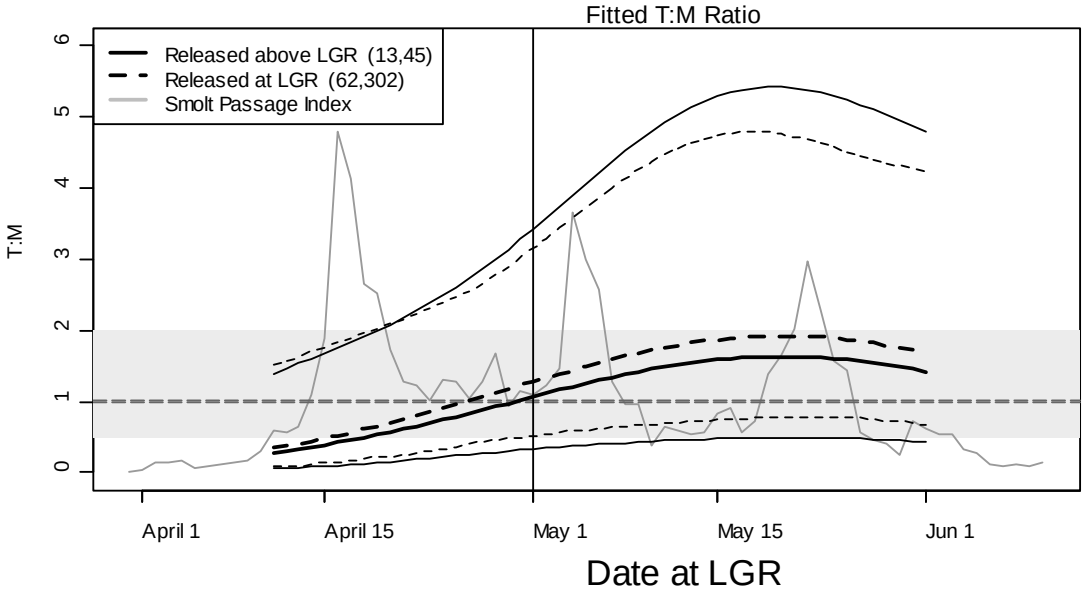

Wild Steelhead 2006

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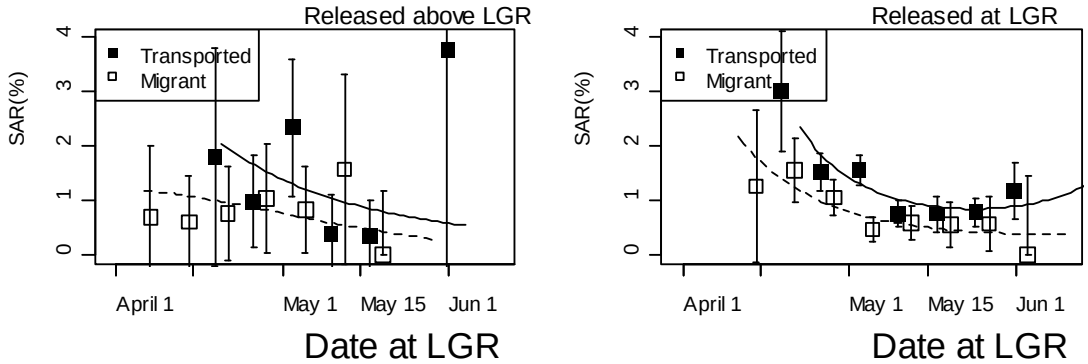

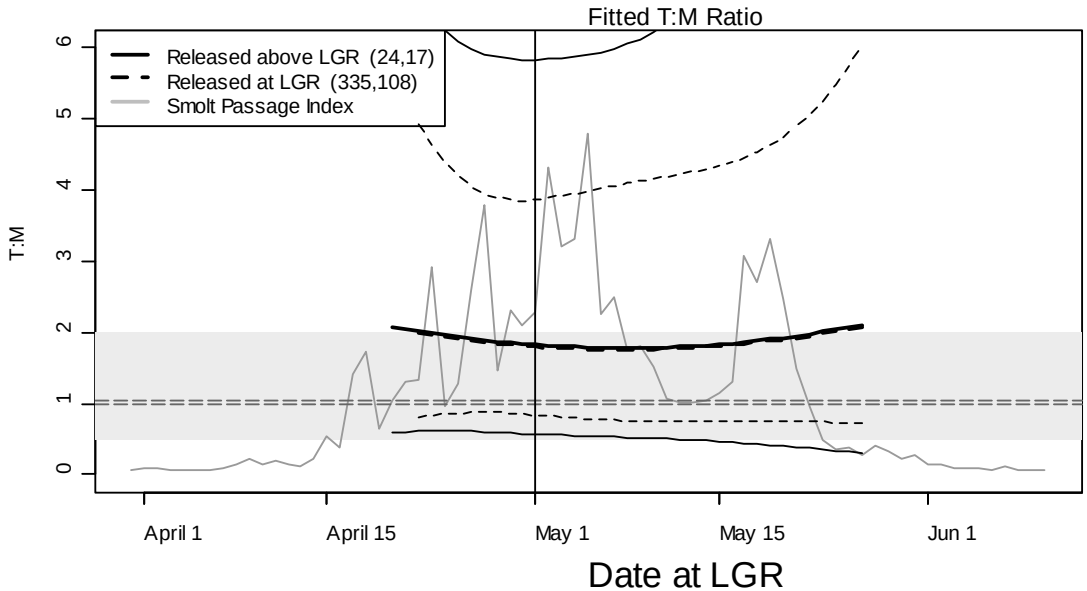

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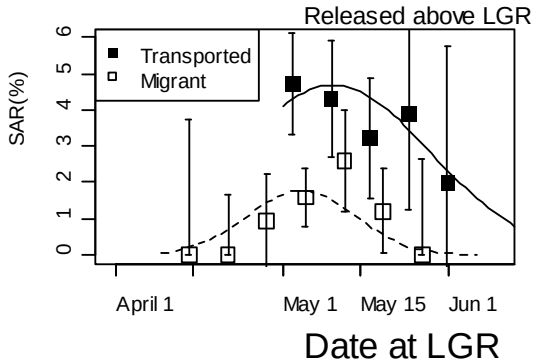

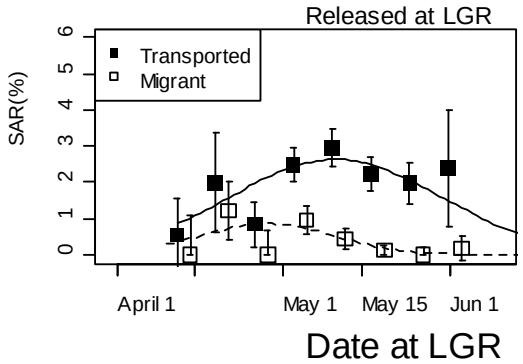

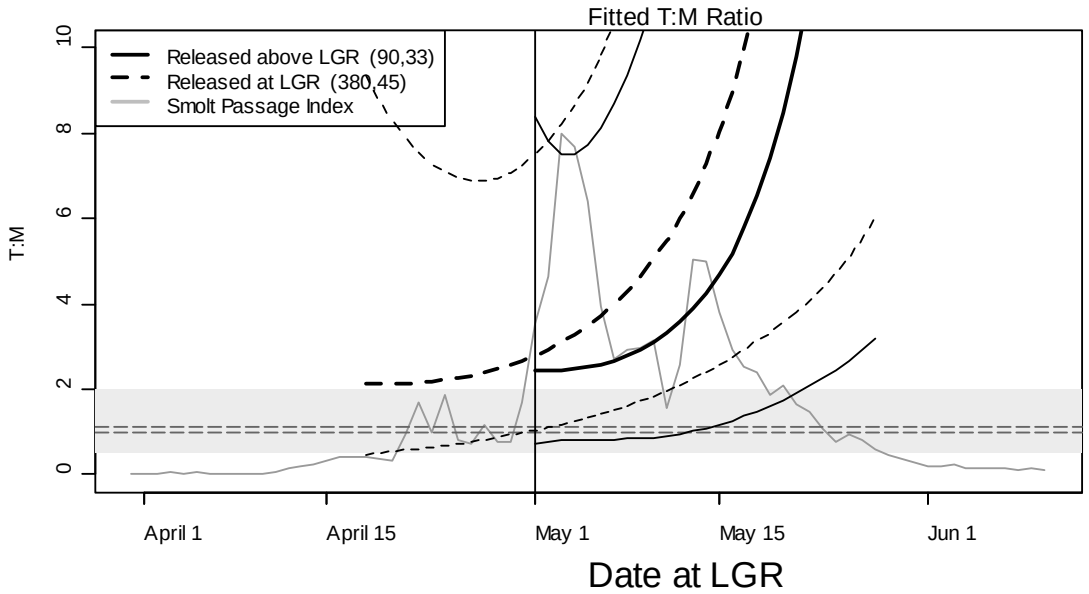

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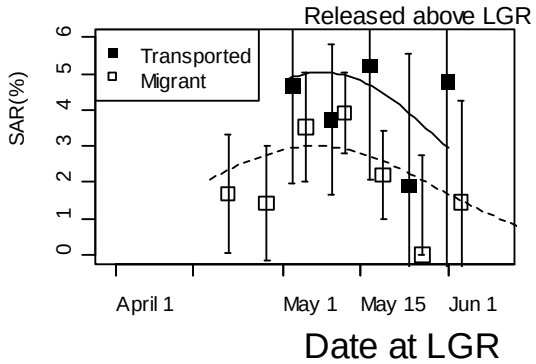
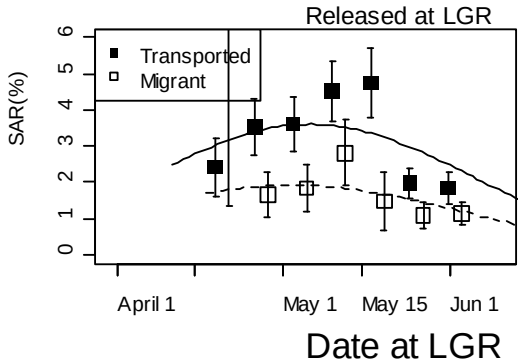
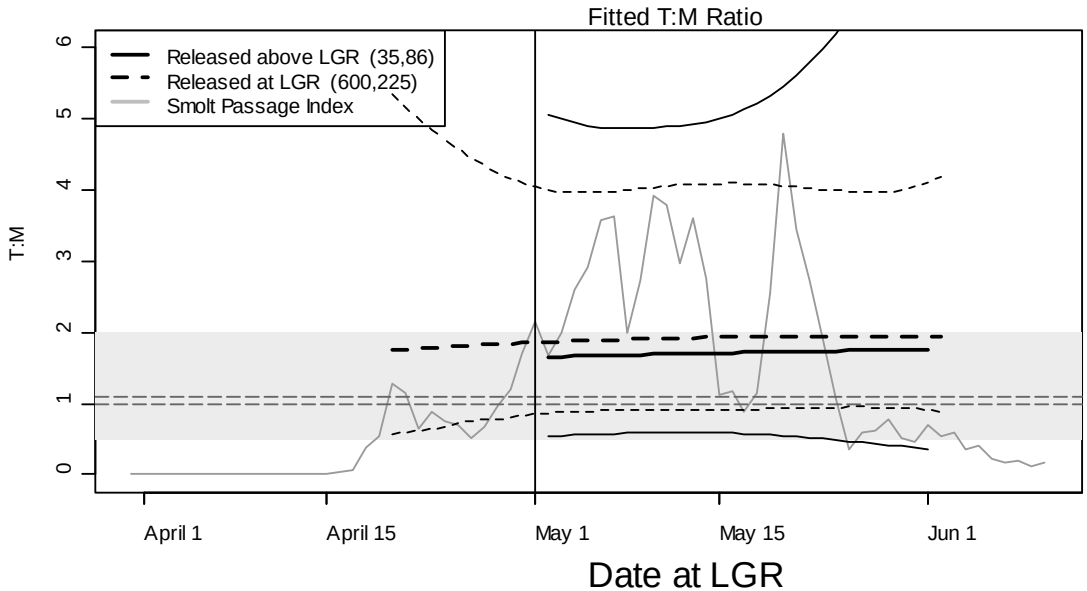
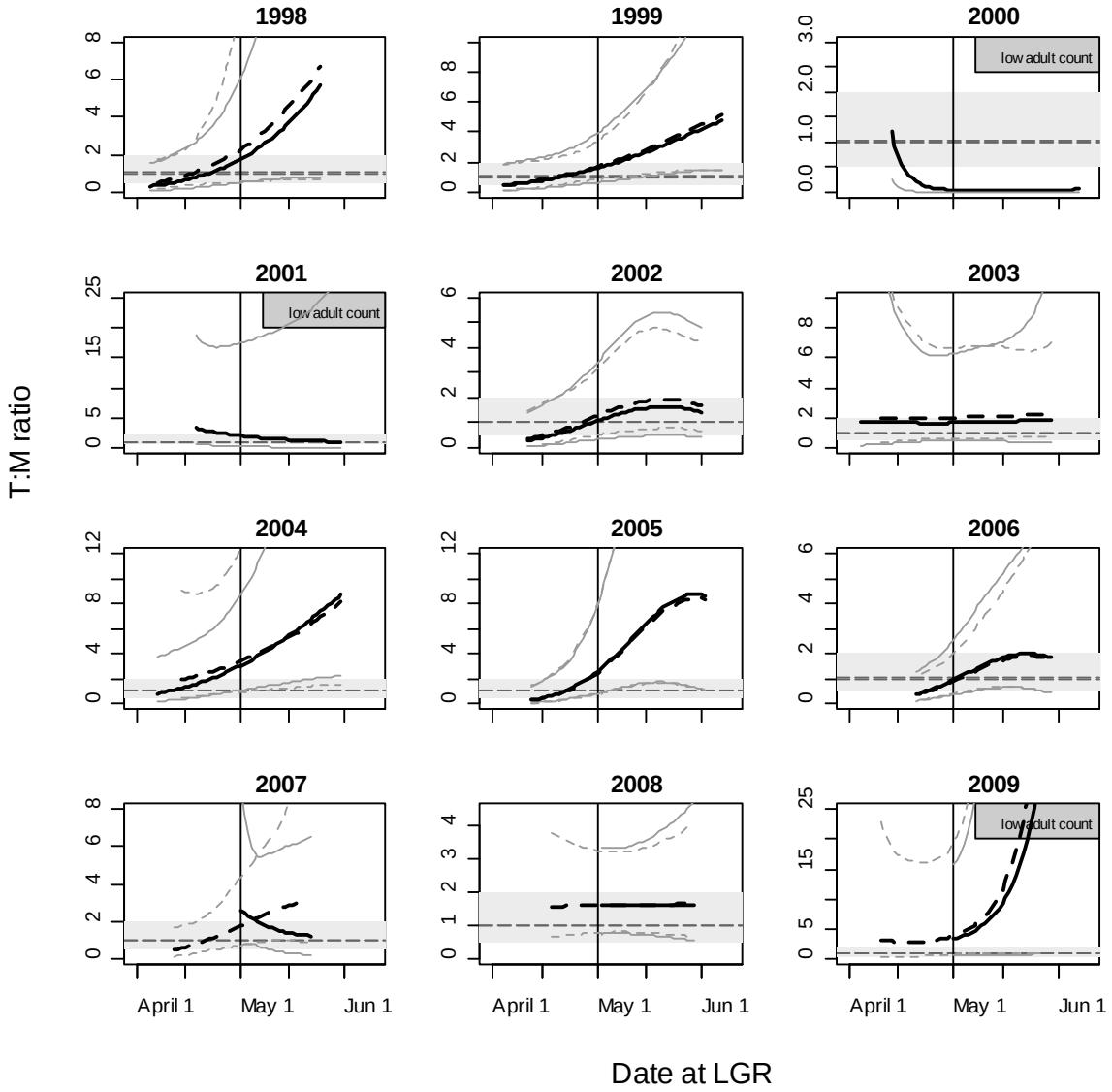






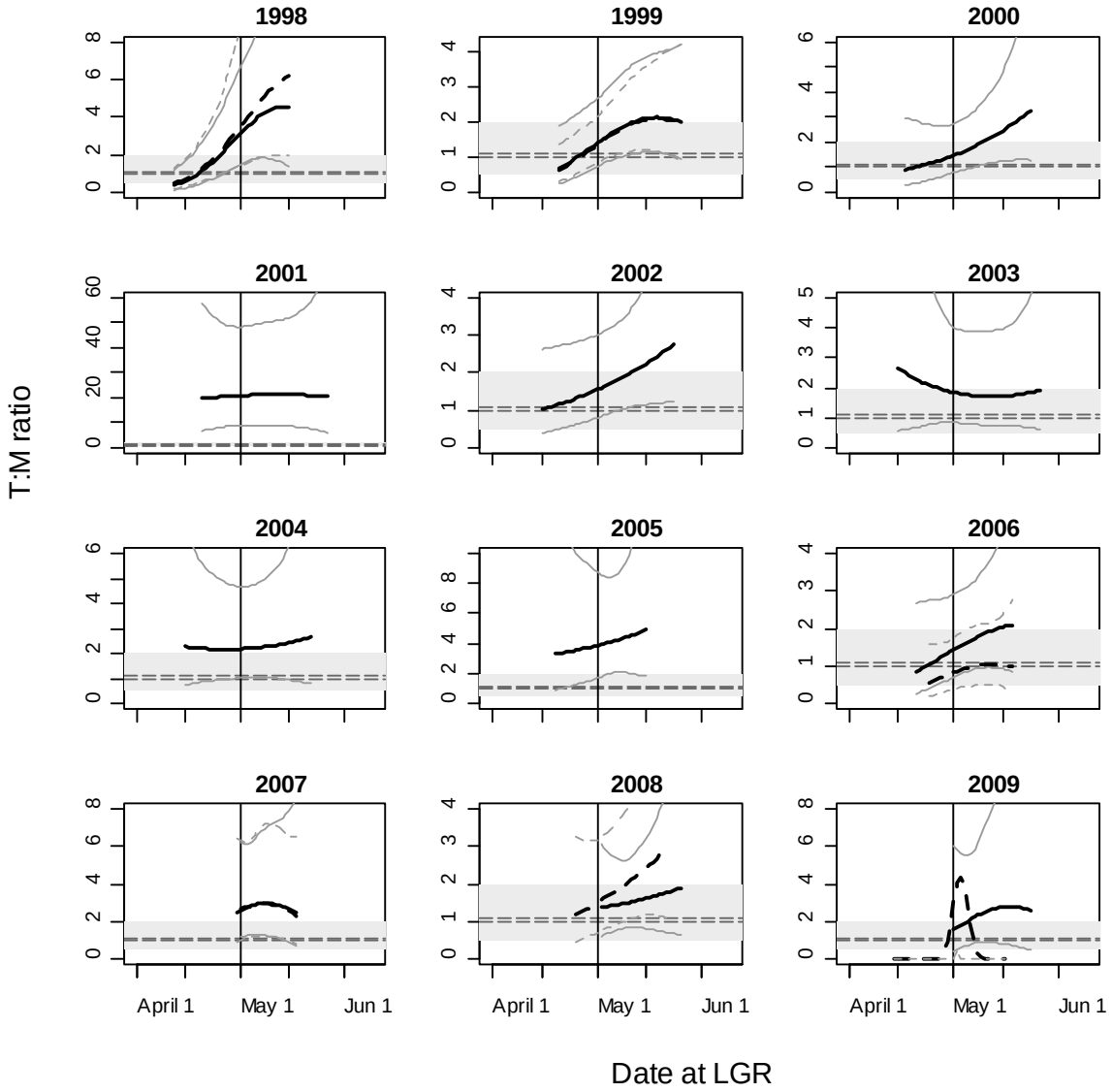
Wild Chinook

T:M Ratio-Descriptive



Hatchery Chinook

T:M Ratio-Descriptive



Wild Steelhead

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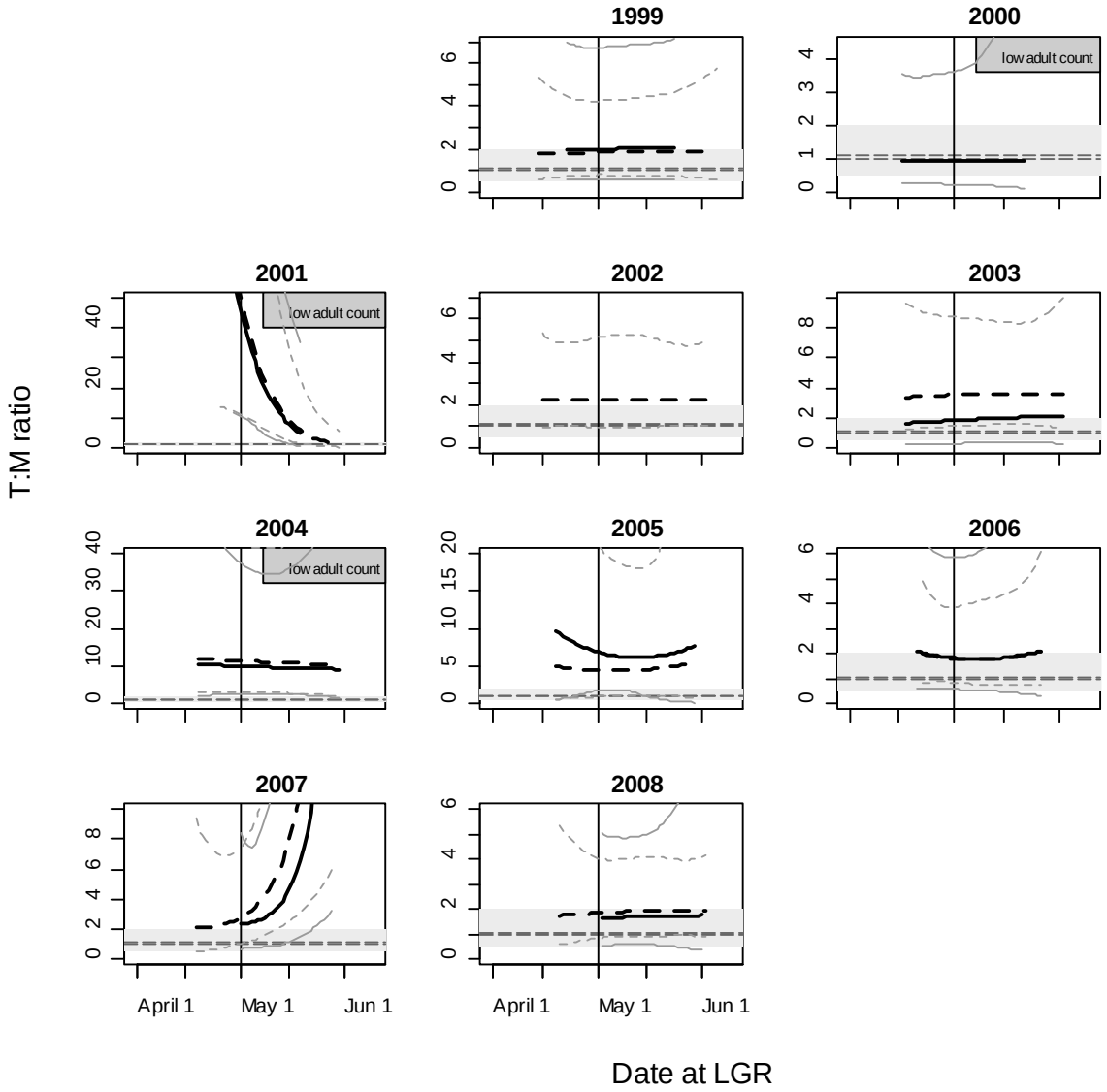

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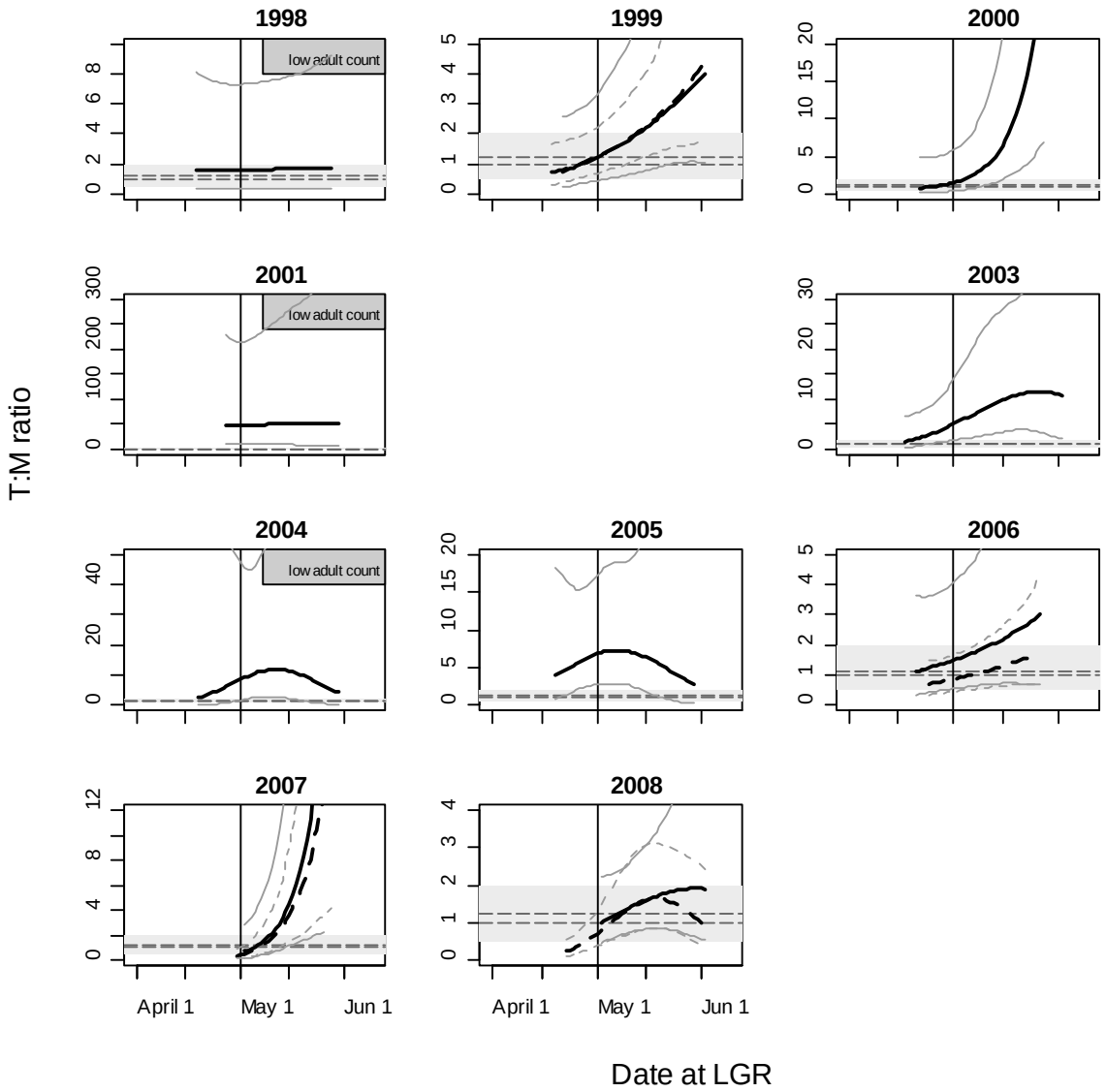
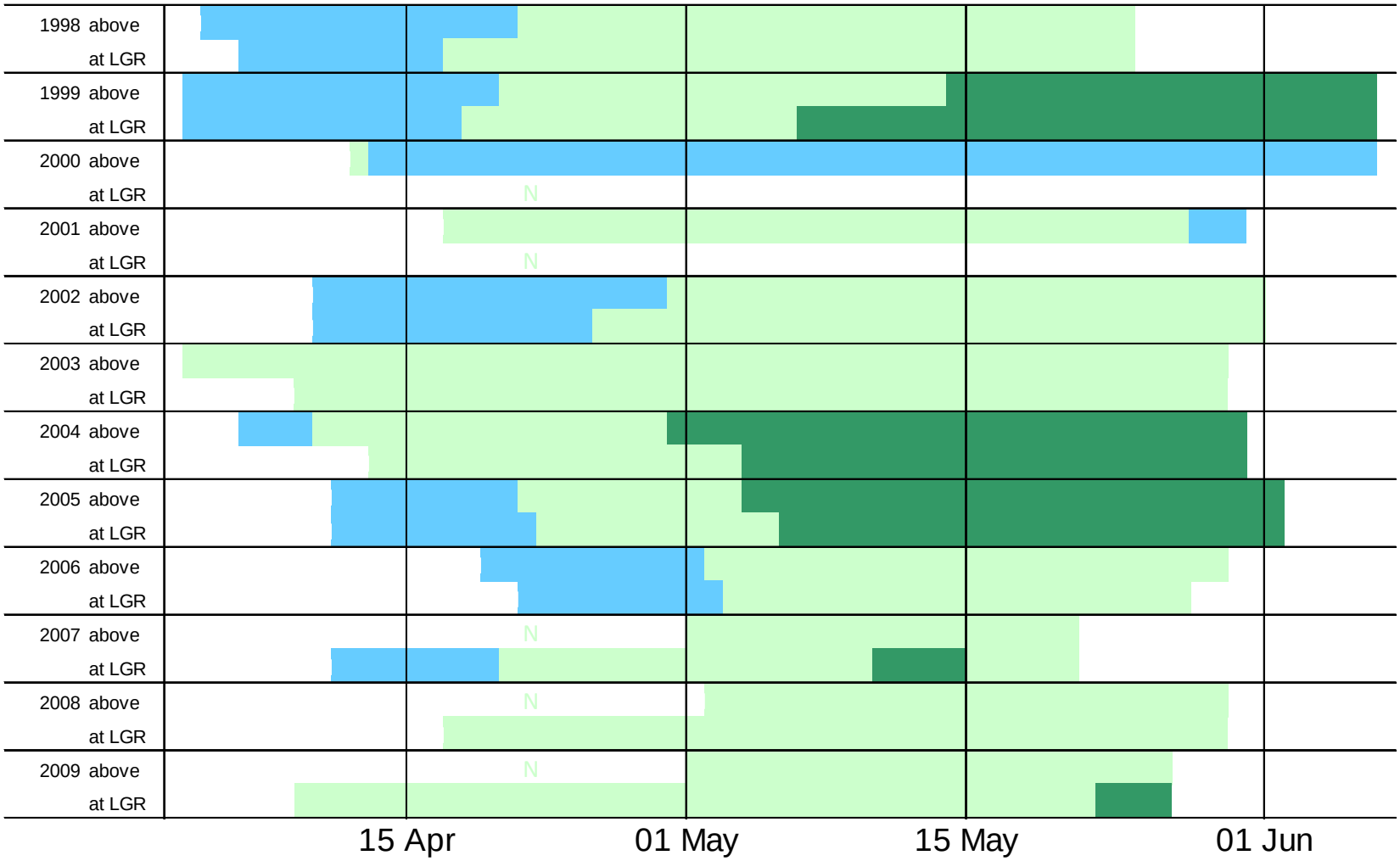


Wild Chinook Salmon - Summary of Model-Averaged T:M Values (Descriptive)

Standard = 1.0



Wild Chinook Salmon - Summary of Model-Averaged T:M Values (Descriptive)

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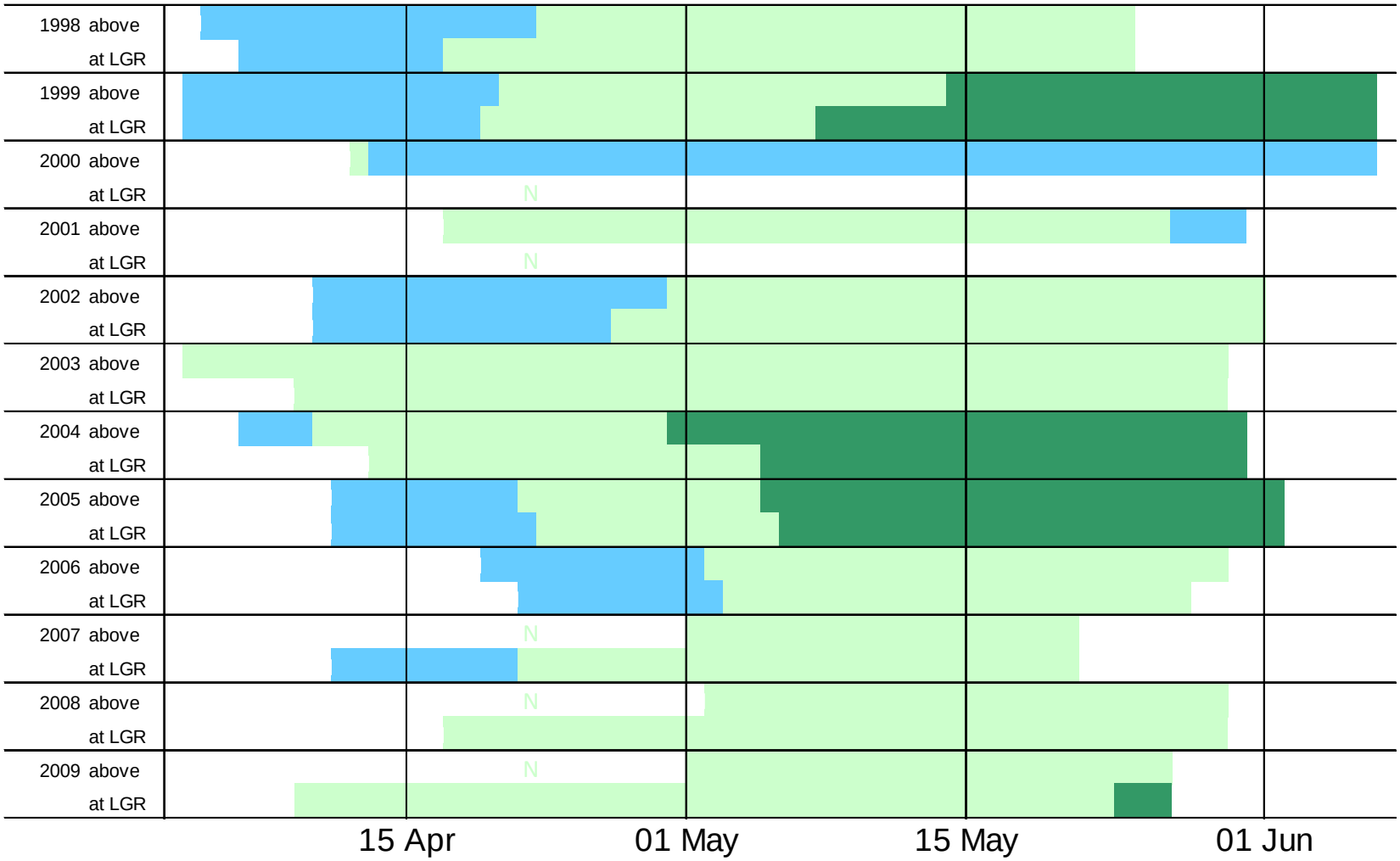
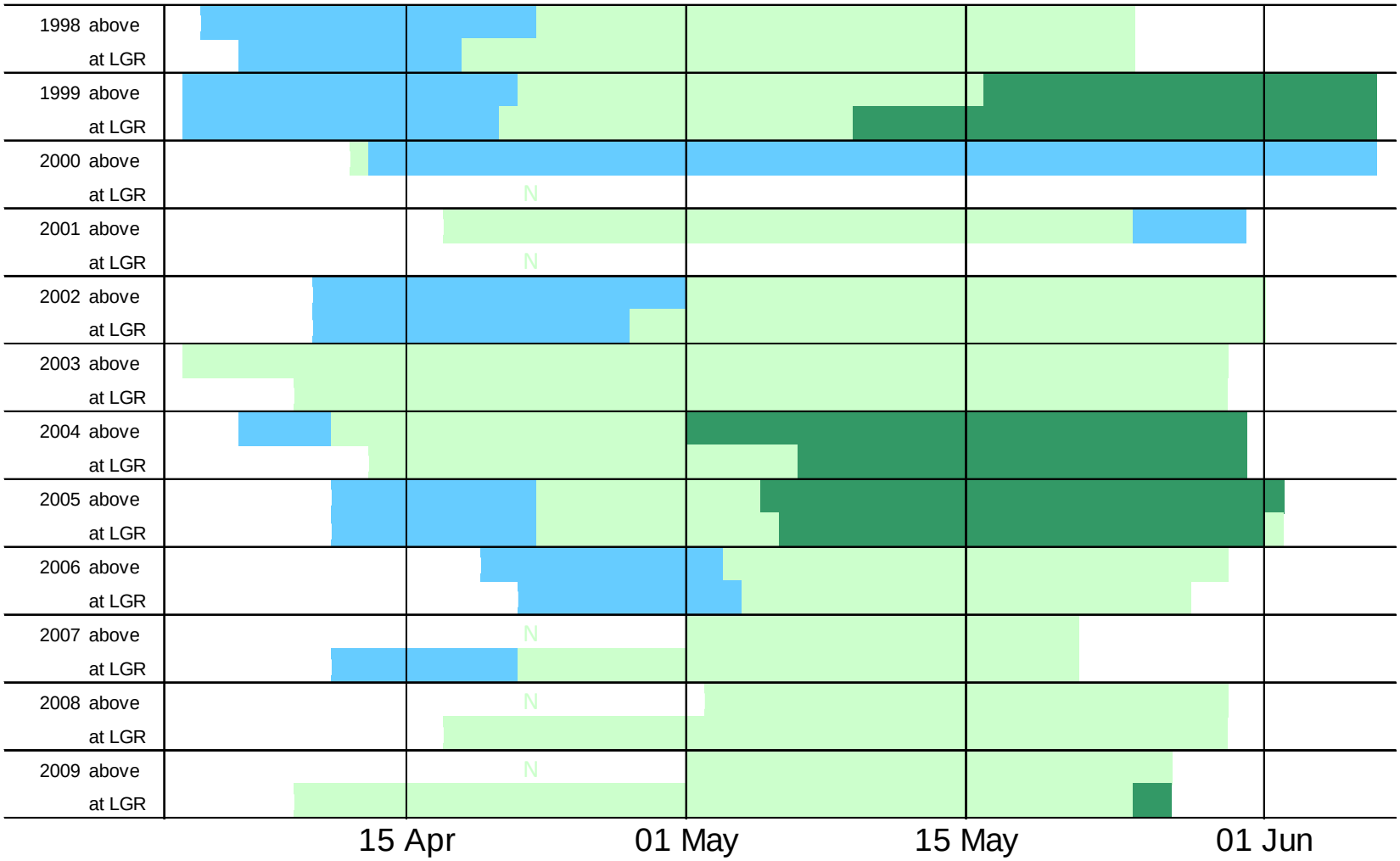


Wild Chinook Salmon - Summary of Model-Averaged T:M Values (Descriptive)

Standard = C0



Hatchery Chinook Salmon - Summary of Model-Averaged T:M Values (Descriptive)

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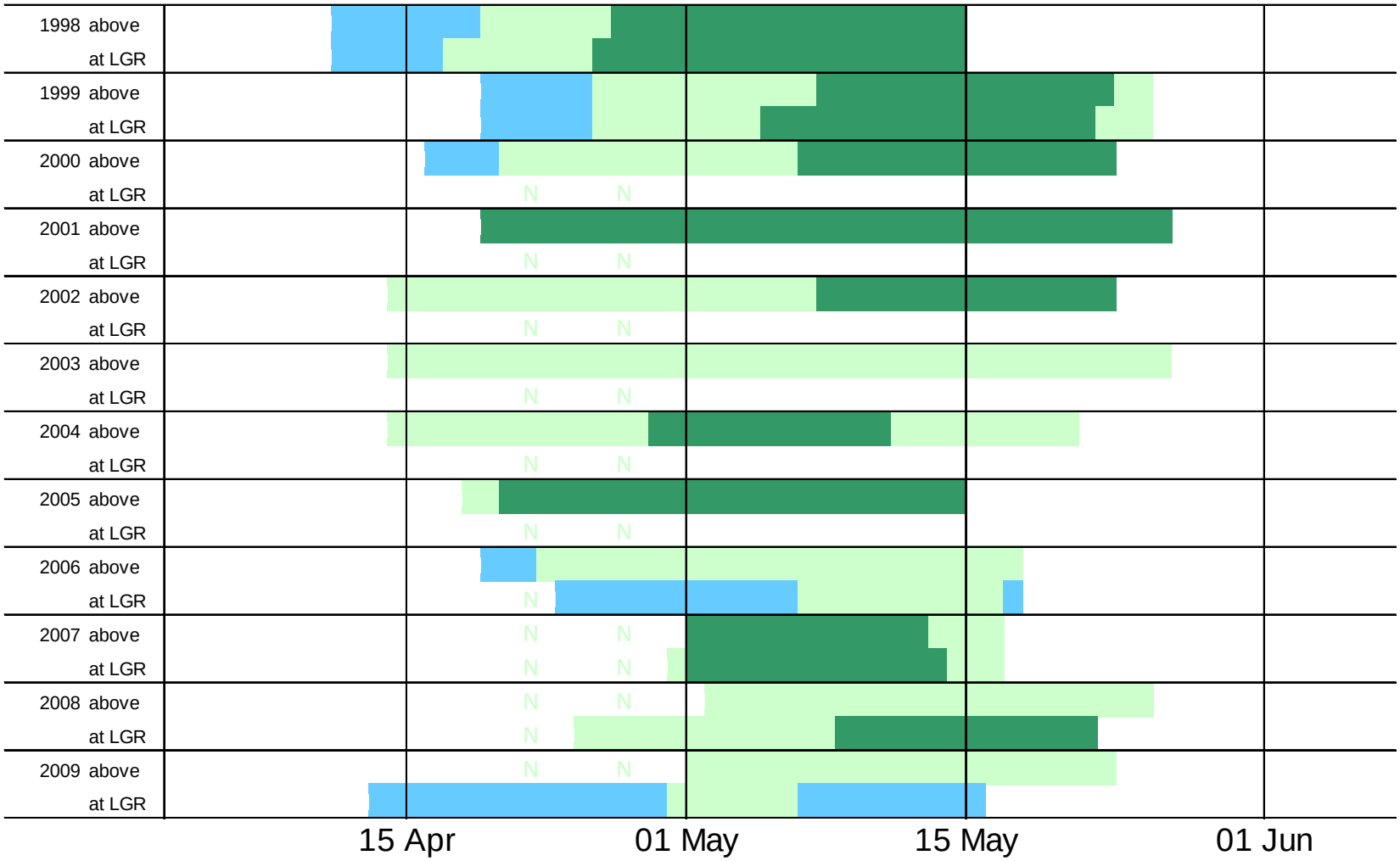

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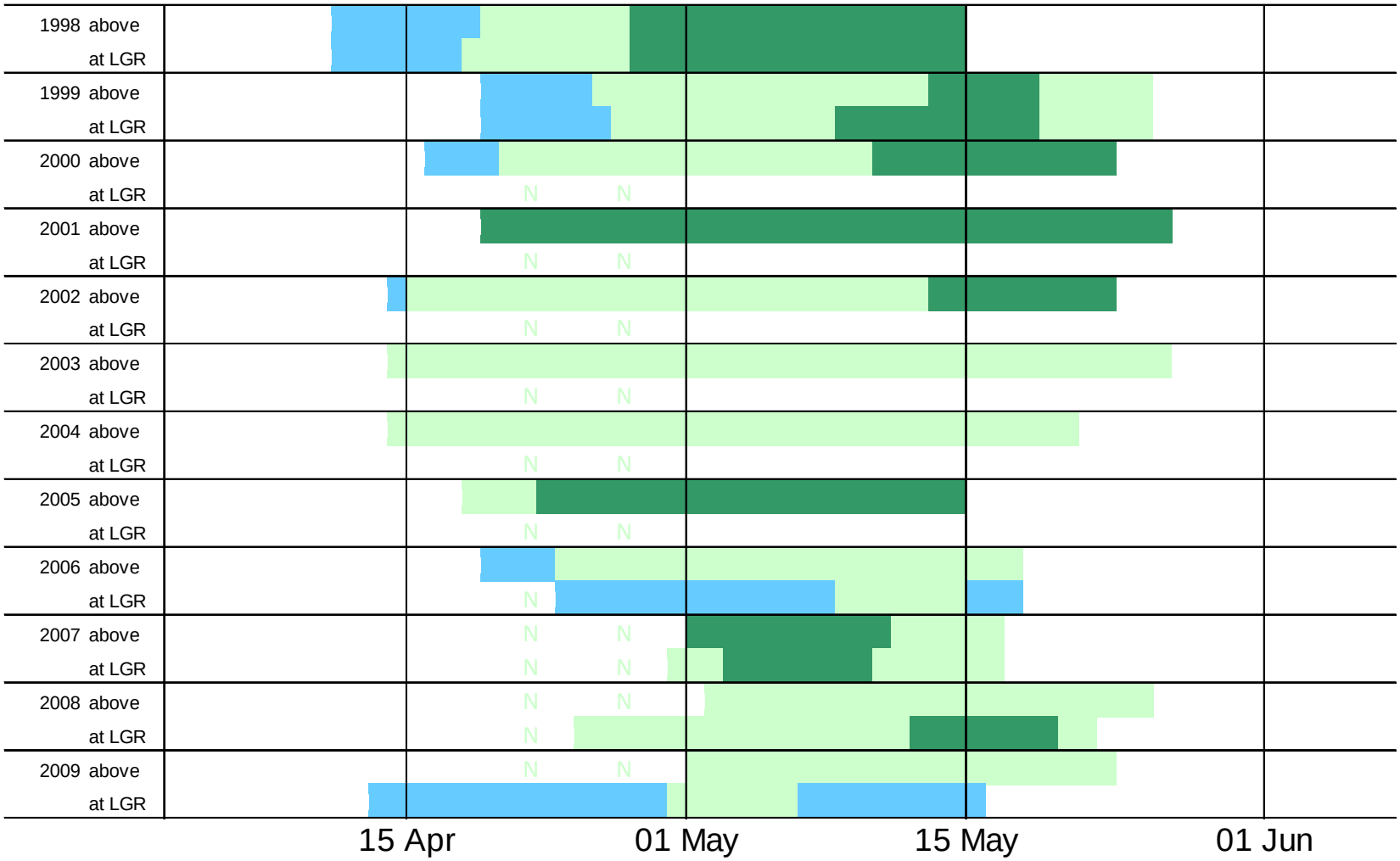

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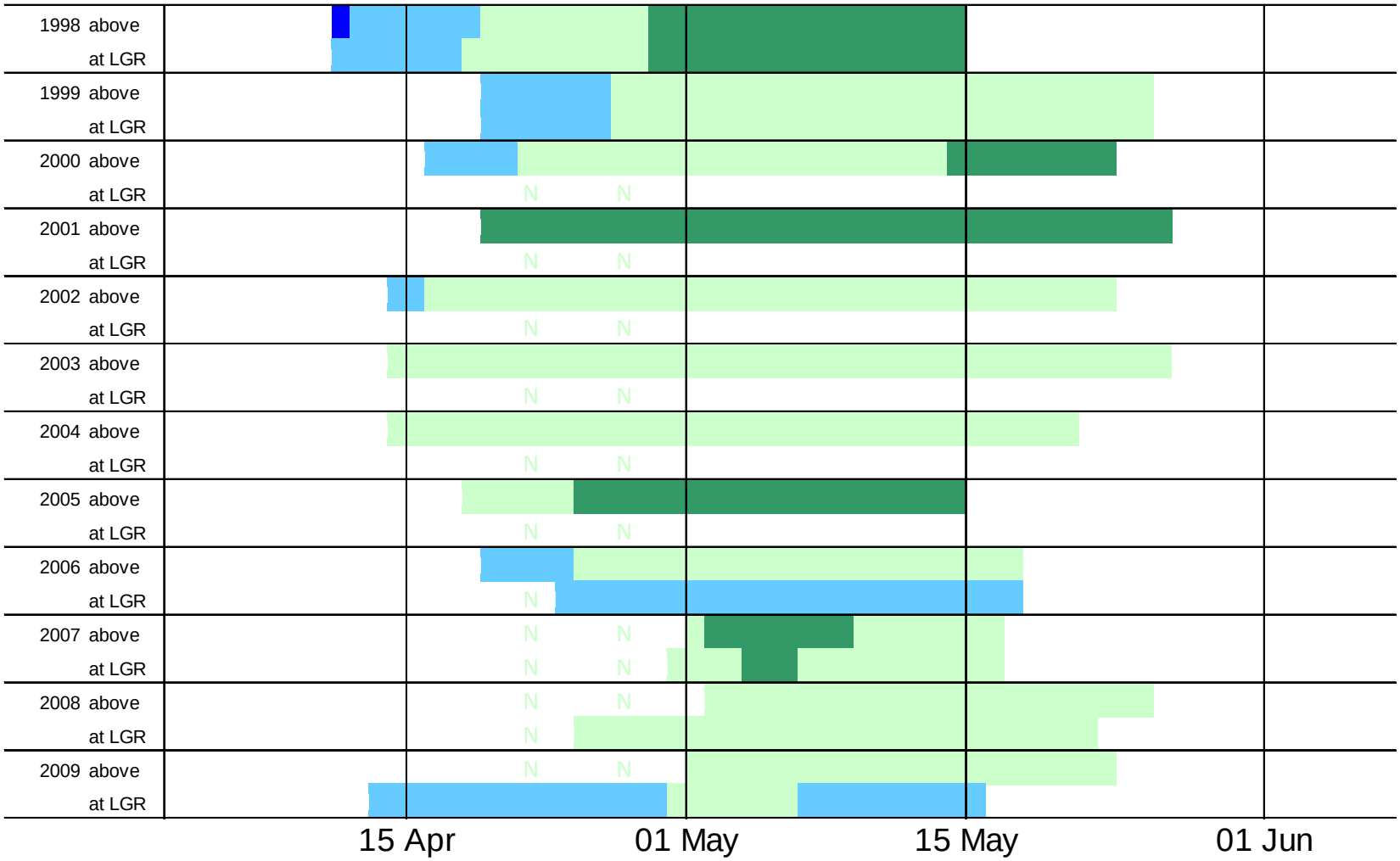

Wild Steelhead - Summary of Model-Averaged T:M Values (Descriptive)

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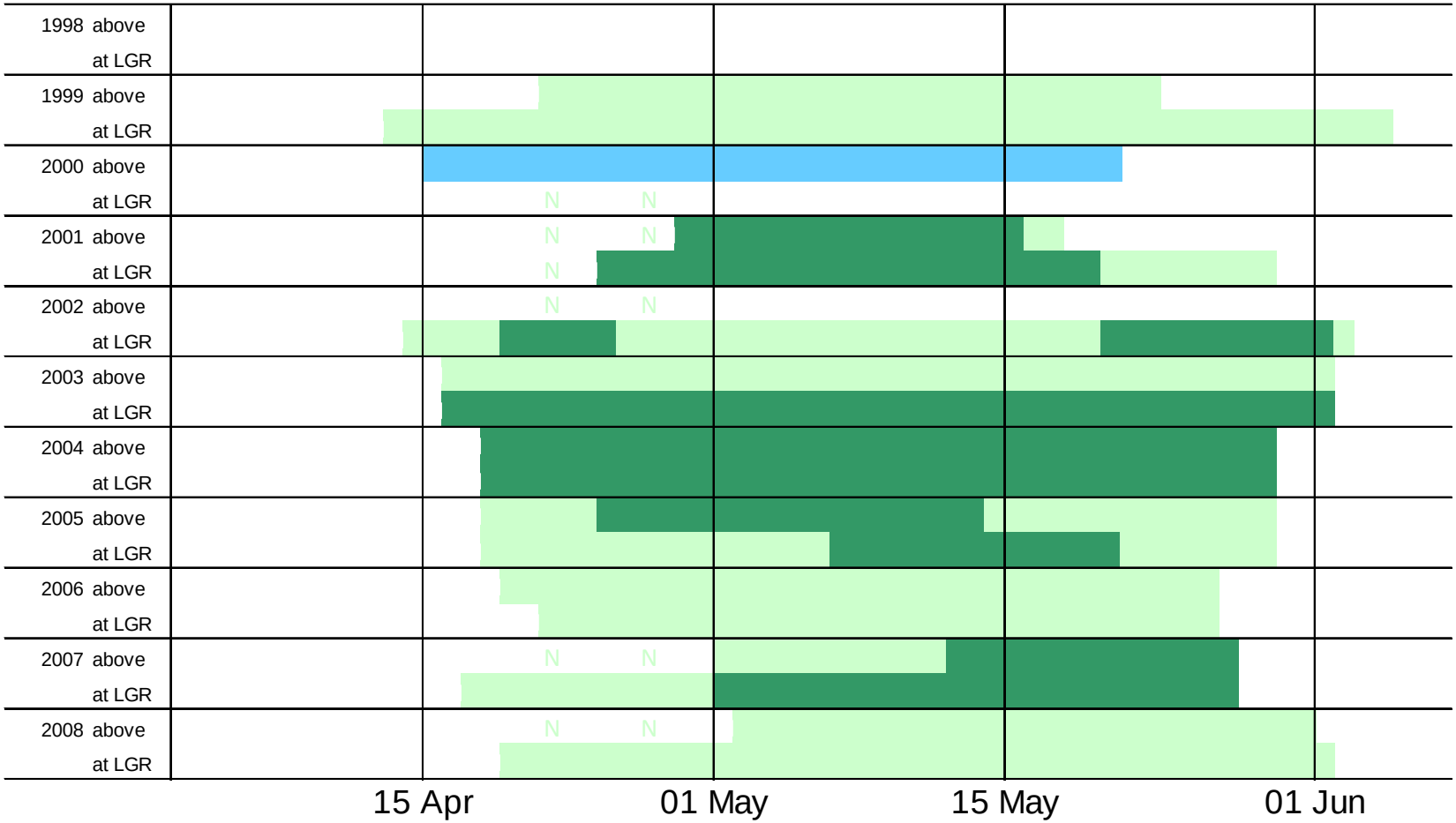

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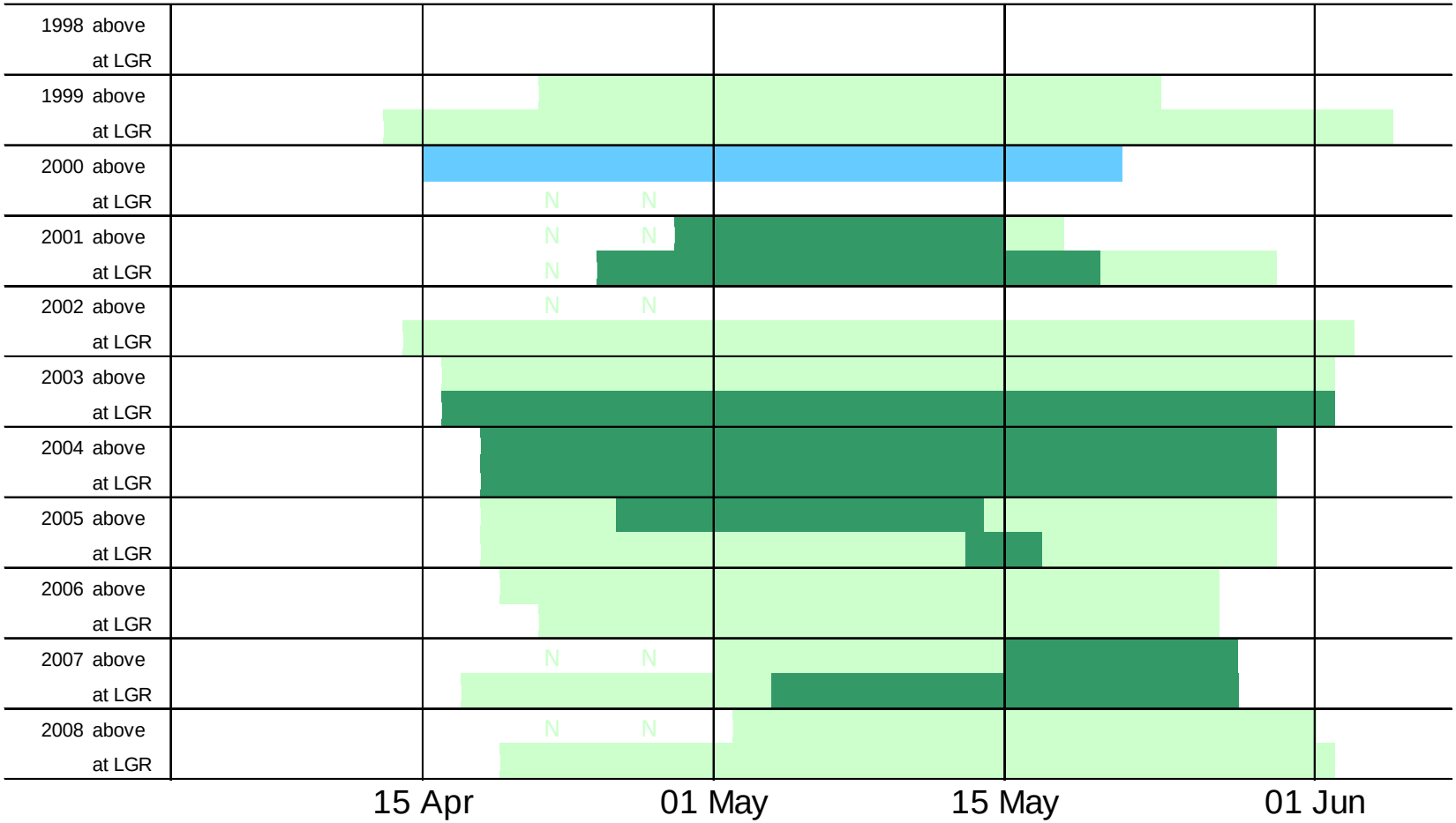

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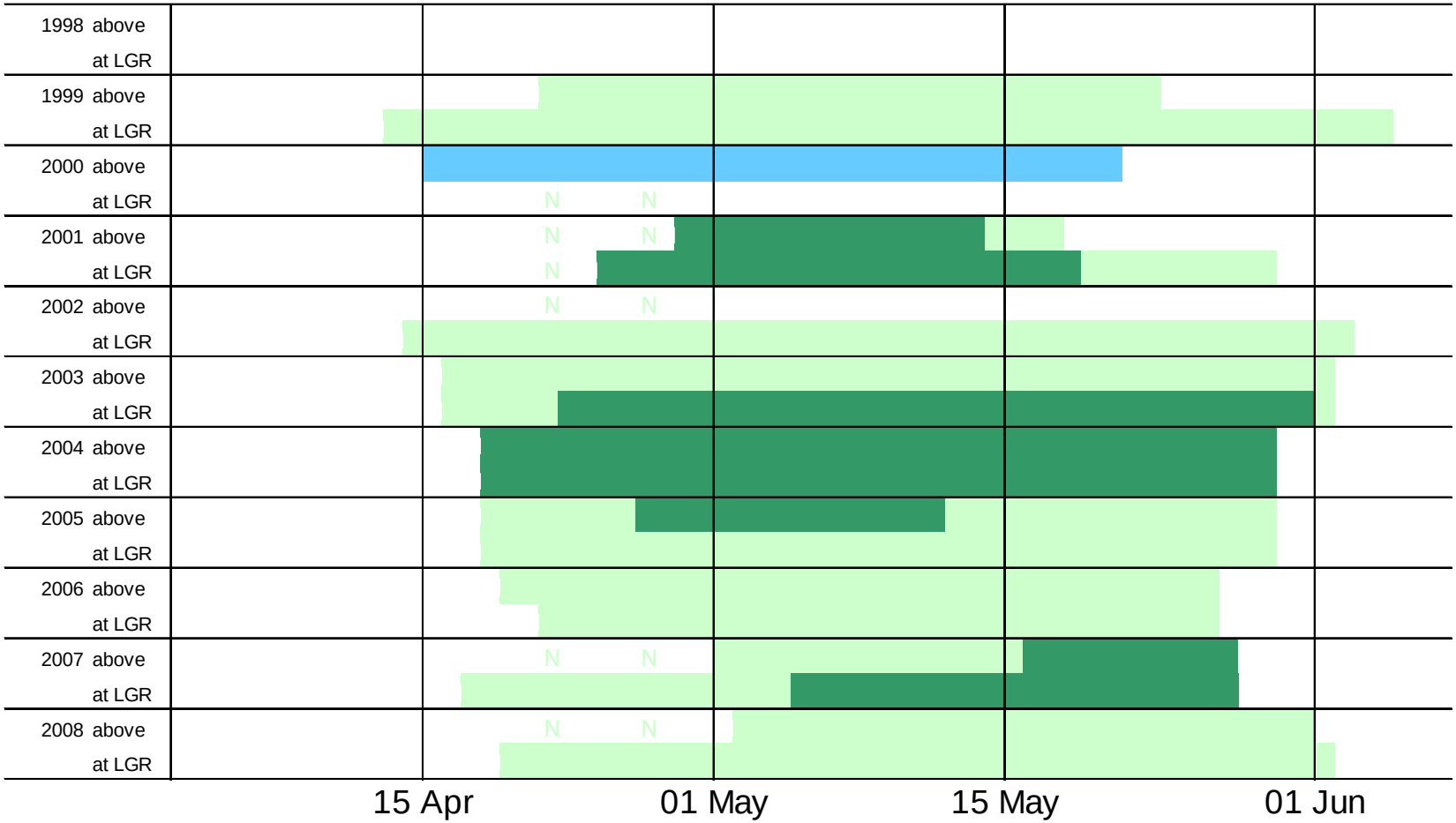
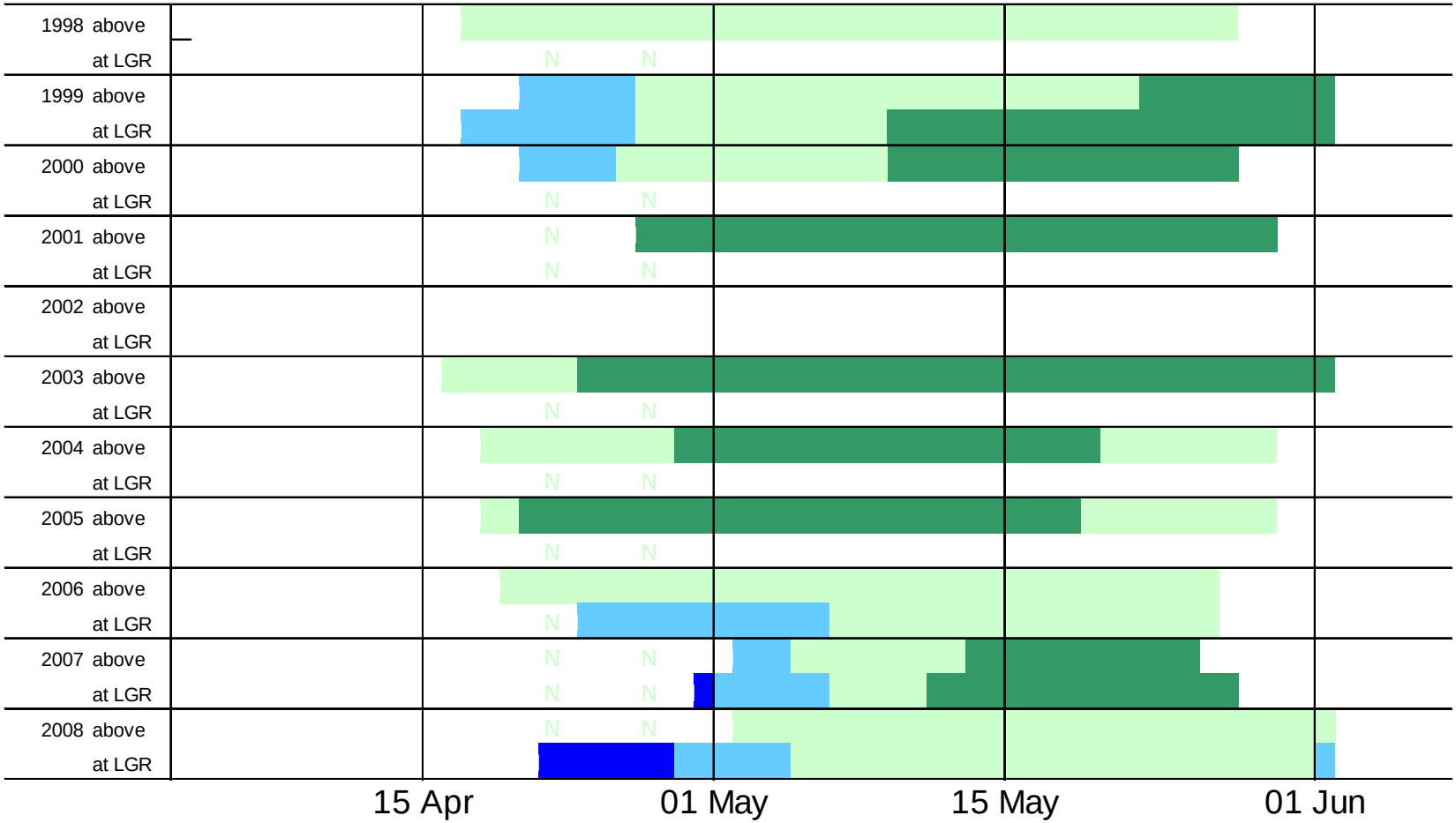


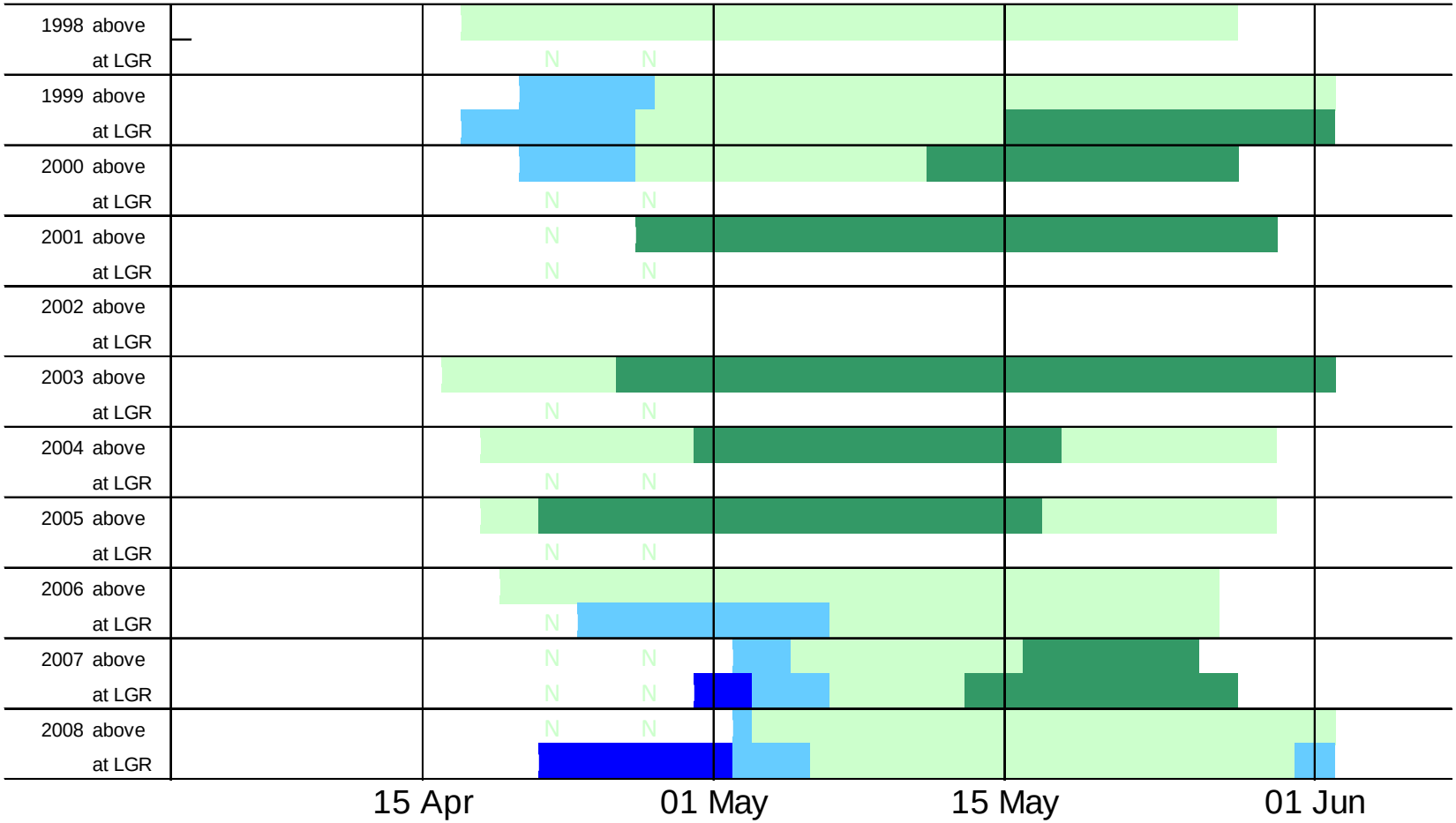
Hatchery Steelhead - Summary of Model-Averaged T:M Values (Descriptive)

Standard = 1.0



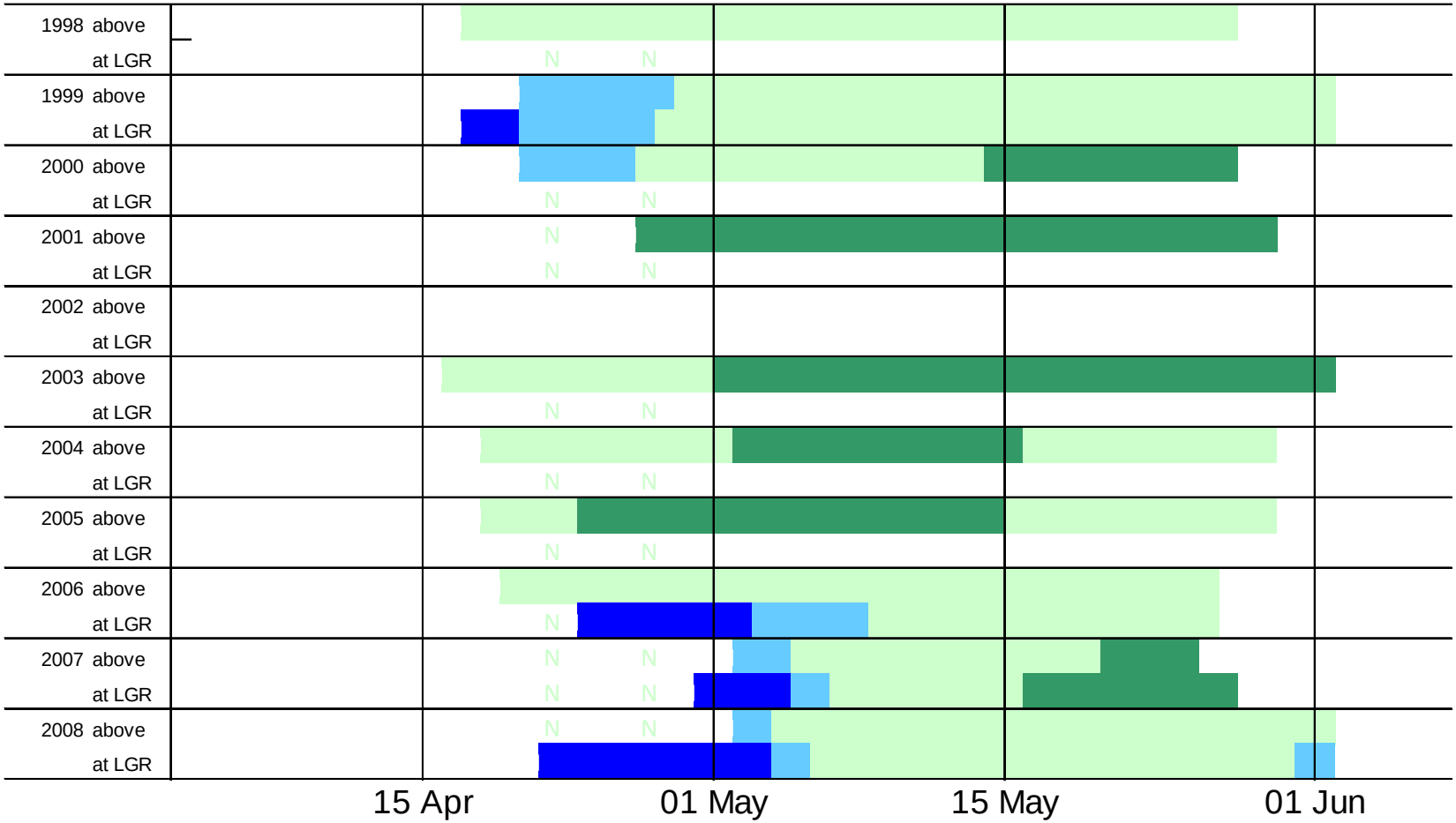
Hatchery Steelhead - Summary of Model-Averaged T:M Values (Descriptive)

Standard = All Inriver

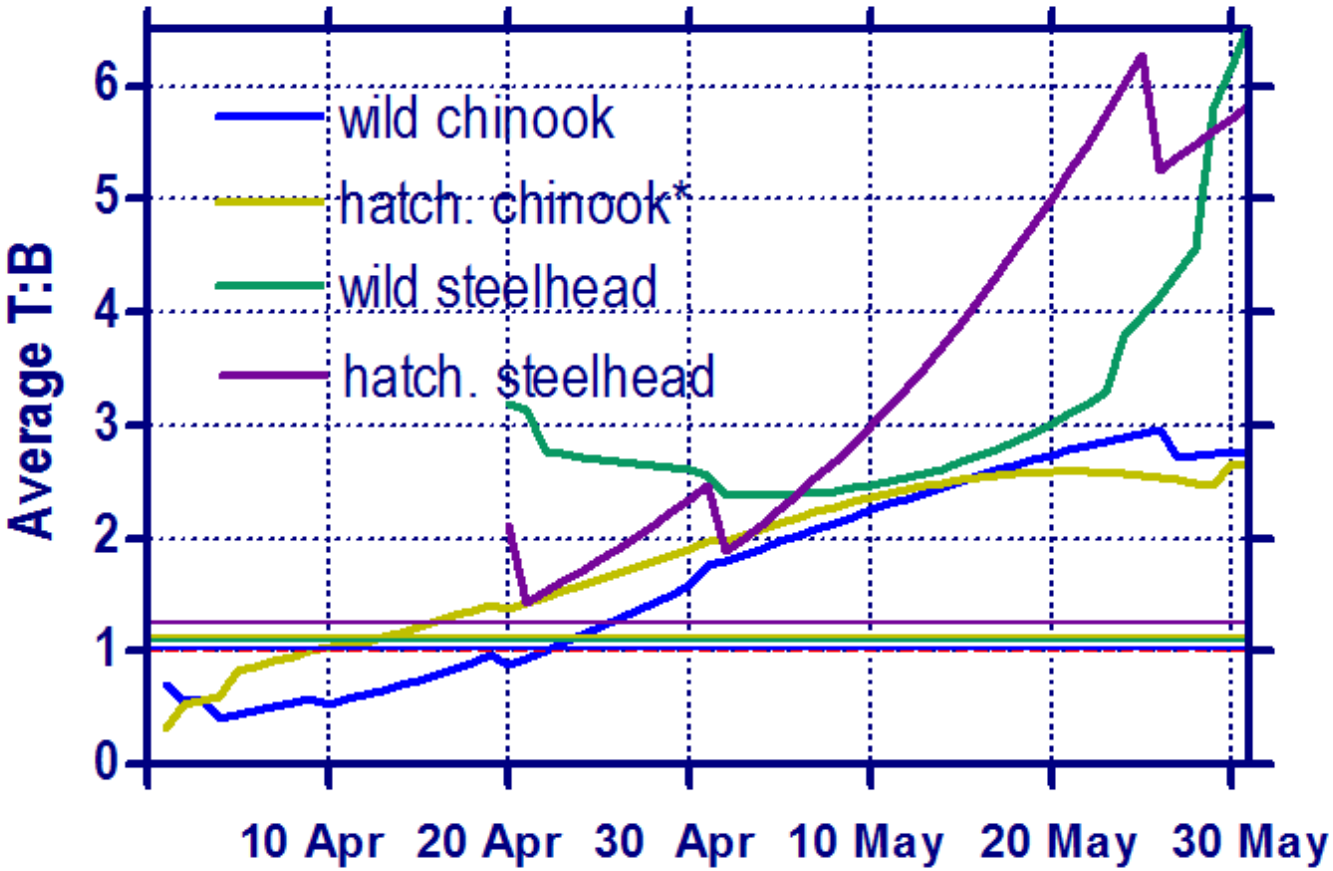


Hatchery Steelhead - Summary of Model-Averaged T:M Values (Descriptive)

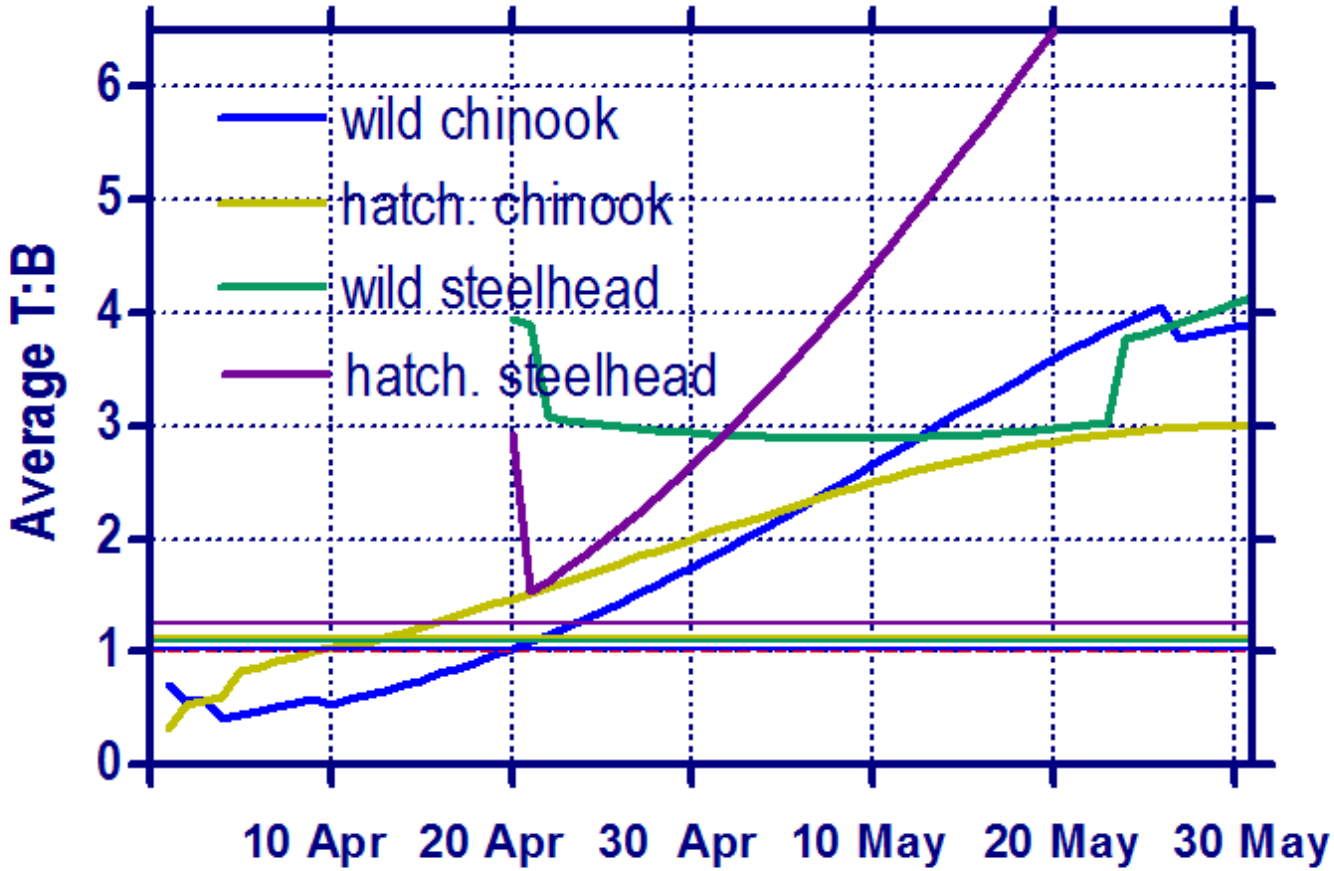
Standard = C0



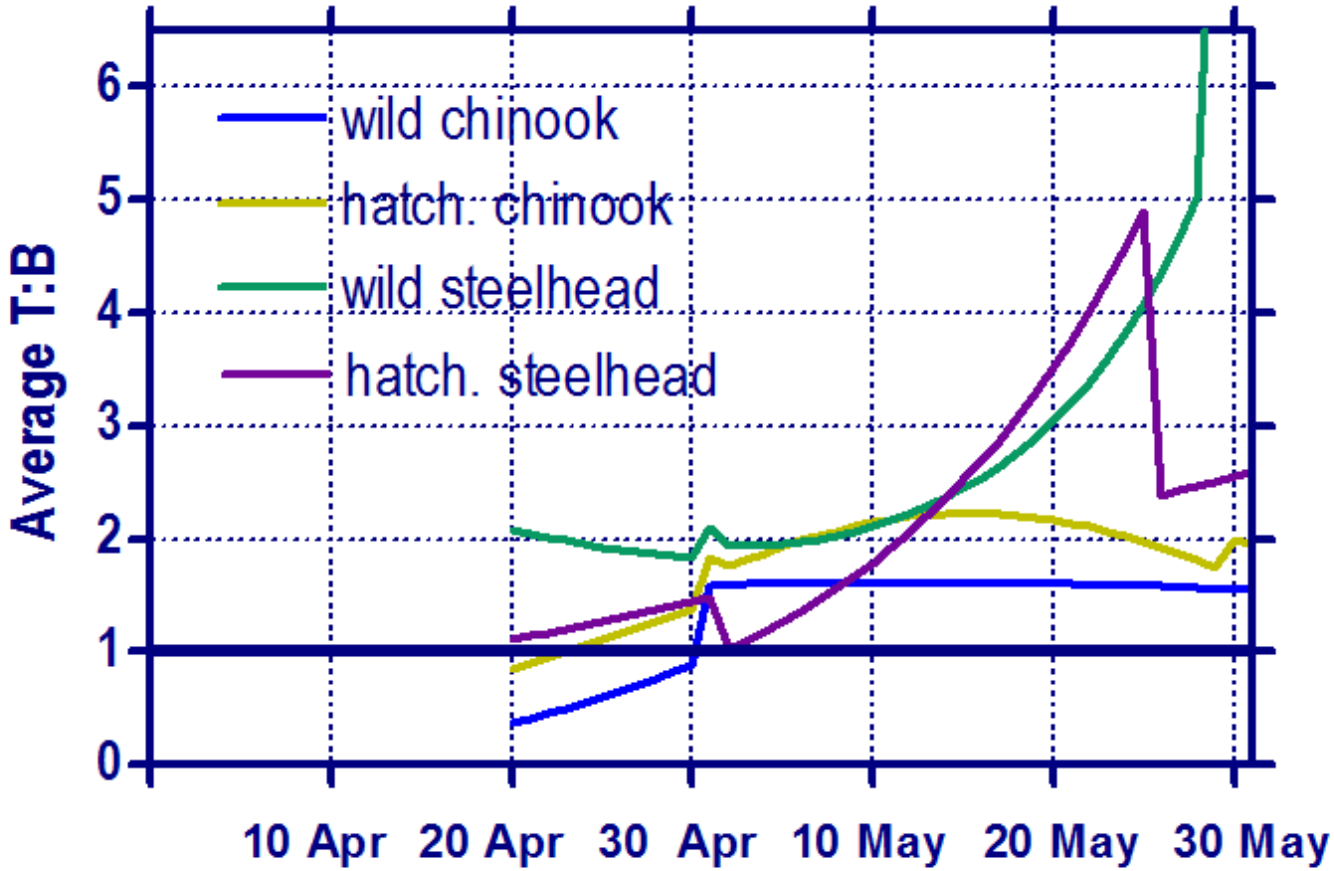
Geometric Mean
Model-Averaged T:B
1998-2008



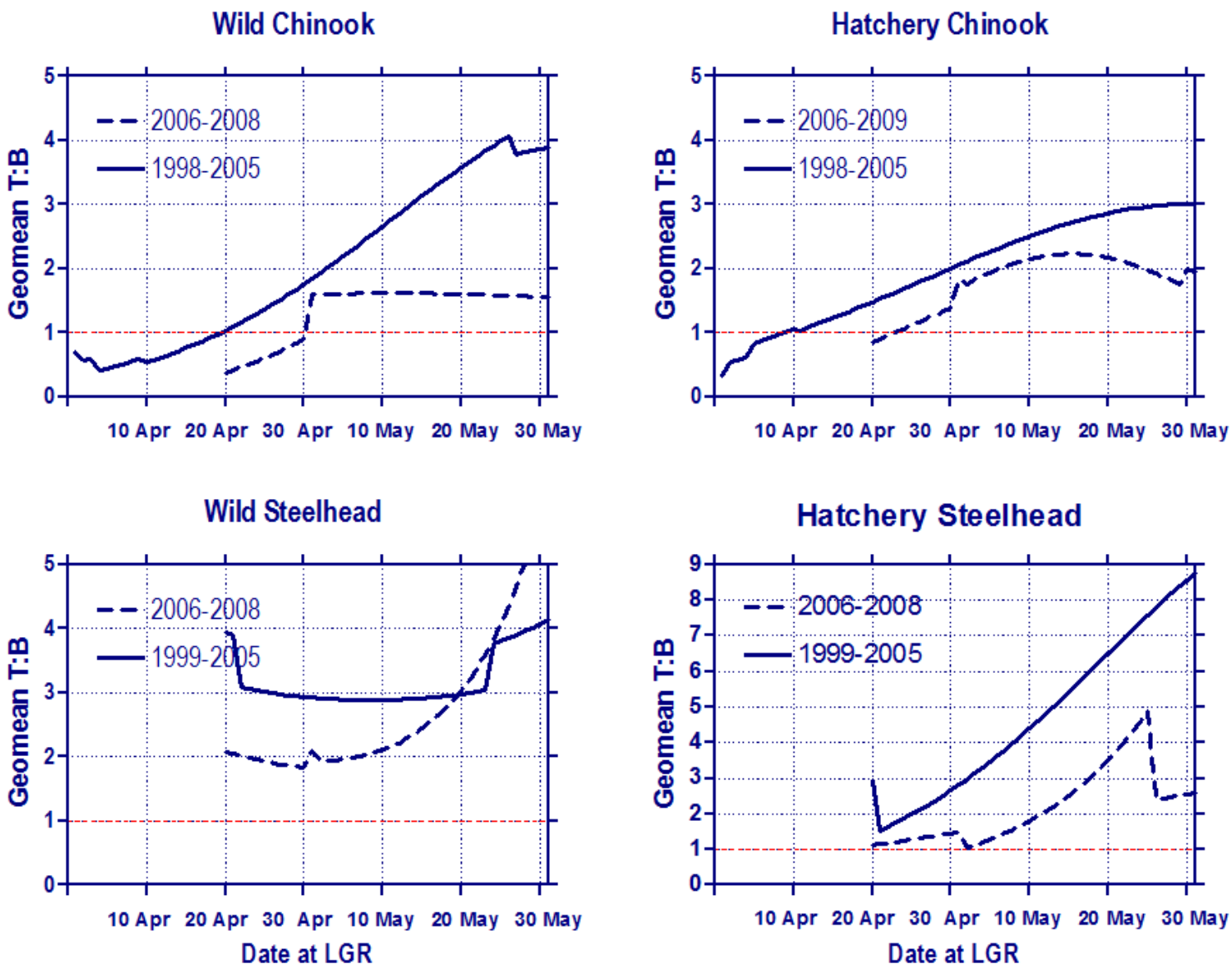
Geometric Mean
Model-Averaged T:B
1998-2005



Geometric Mean
Model-Averaged T:B
2006-2008



Recent Years vs. Previous



Next (Current) 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?