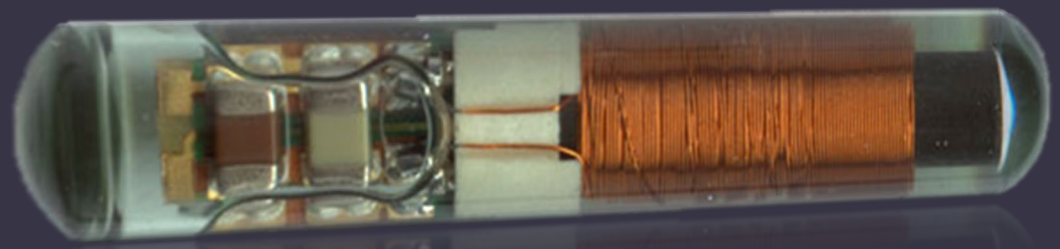
Trends in PIT-tag Data Availability for Juvenile Snake River Salmon and Steelhead



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Interrogation Sites on Migration Path for Snake River Salmon and Steelhead

Since 1998:
Towed array (TWX), pile dike (PD7) and others

Since 1988:
Detectors in juvenile bypass systems (IHR in 2005)

Estuary

LGS LMN LGR

MCN

IHR

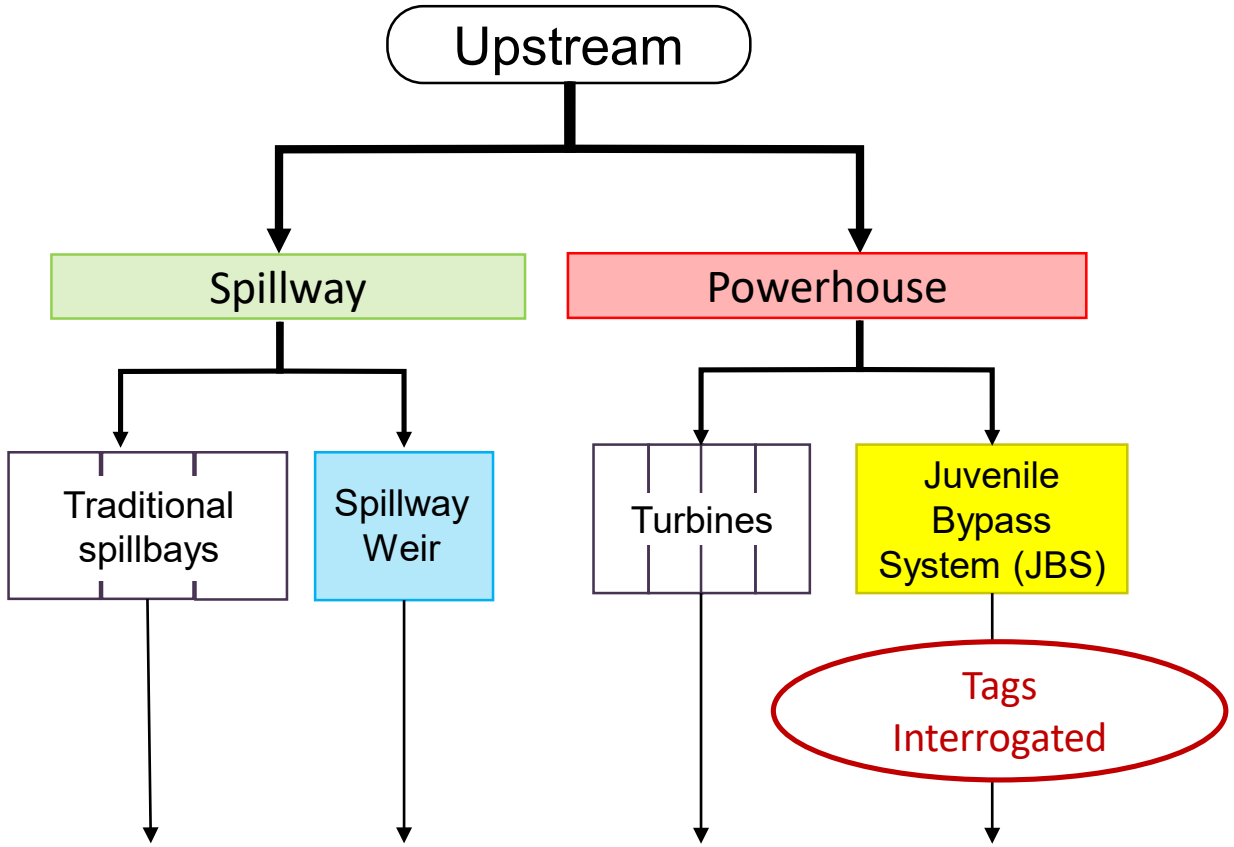
BON TDA JDA

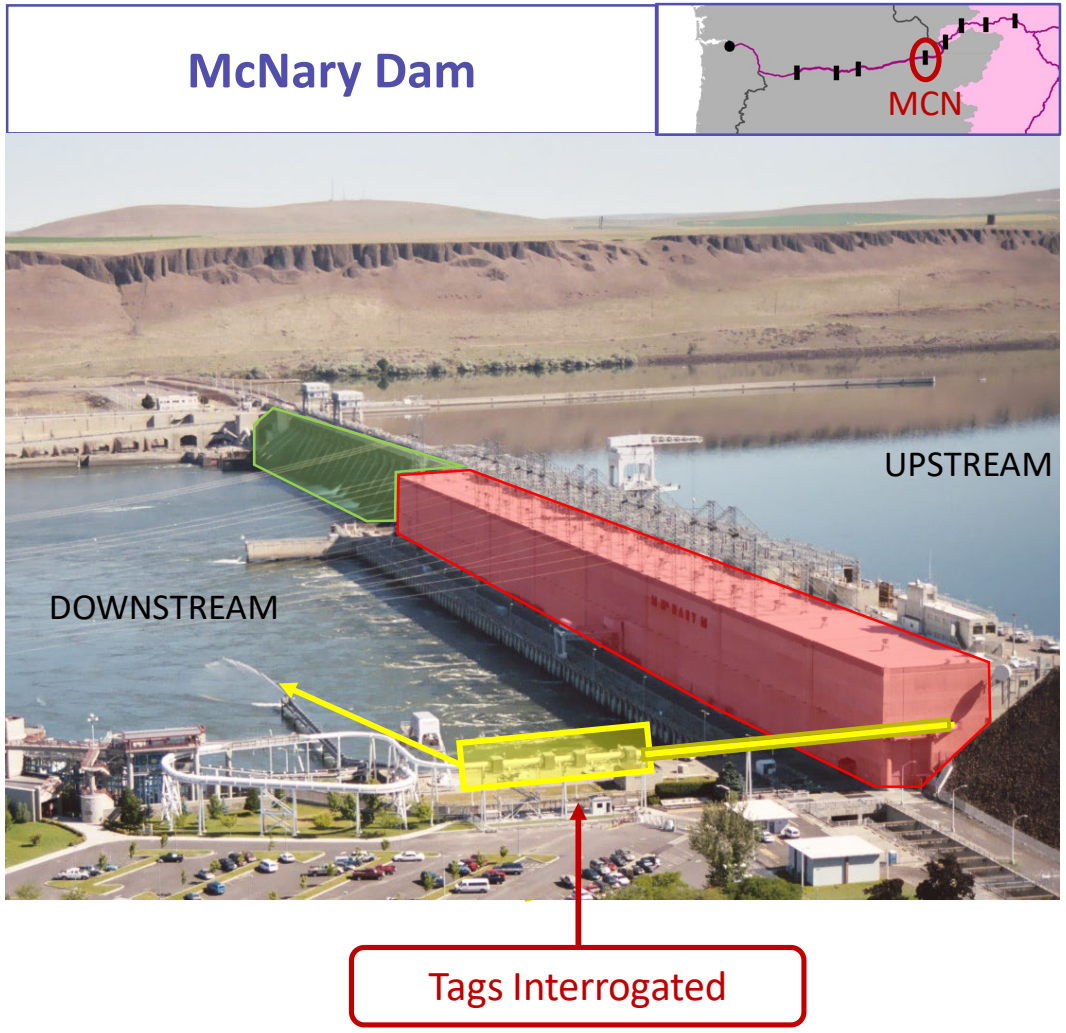
Since 2021:
- Flexible cable (towed and stationary)
- Pile dike antennas that target smolts

Since 2006:
Corner Collector (BCC)

Since 2020:
Spillway weir detector (GRS)

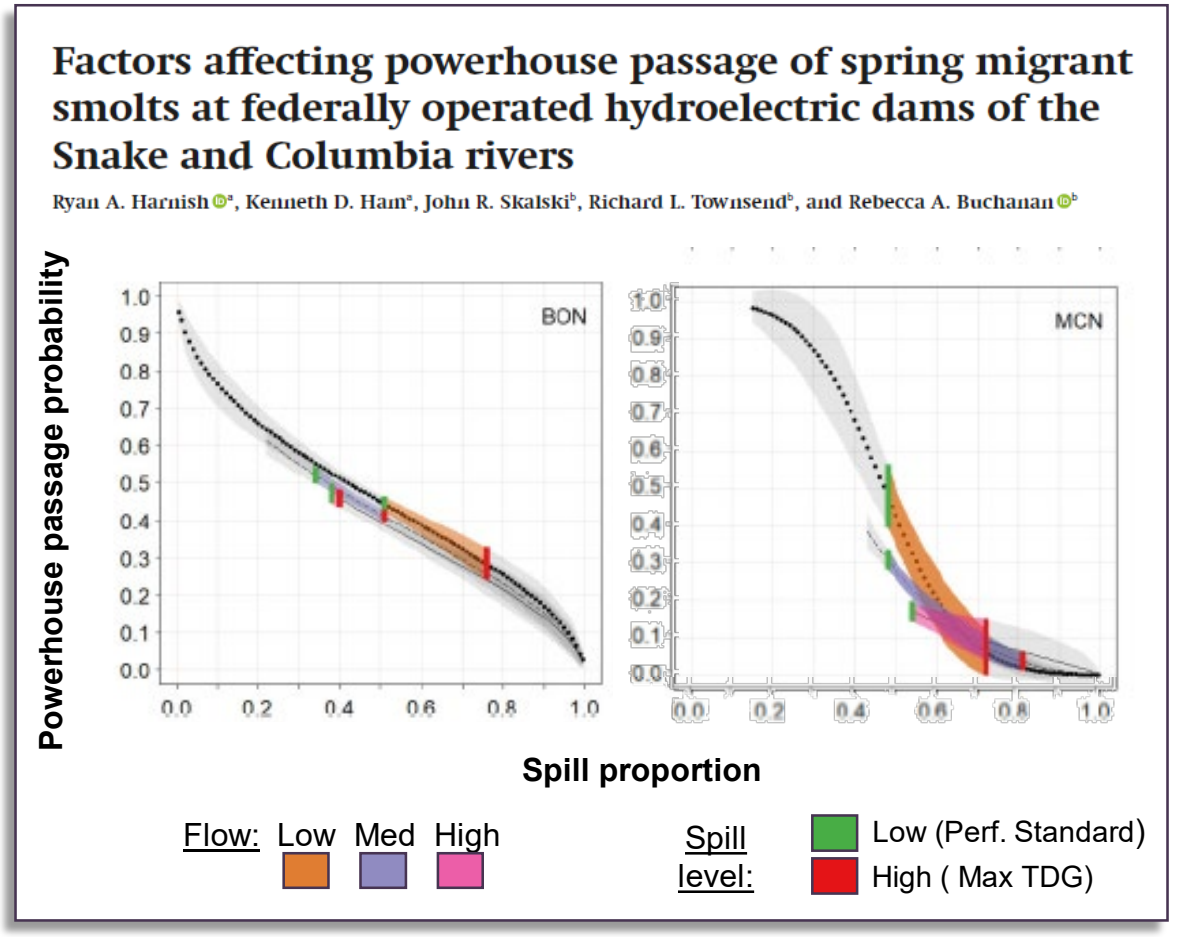
Downstream Passage Routes



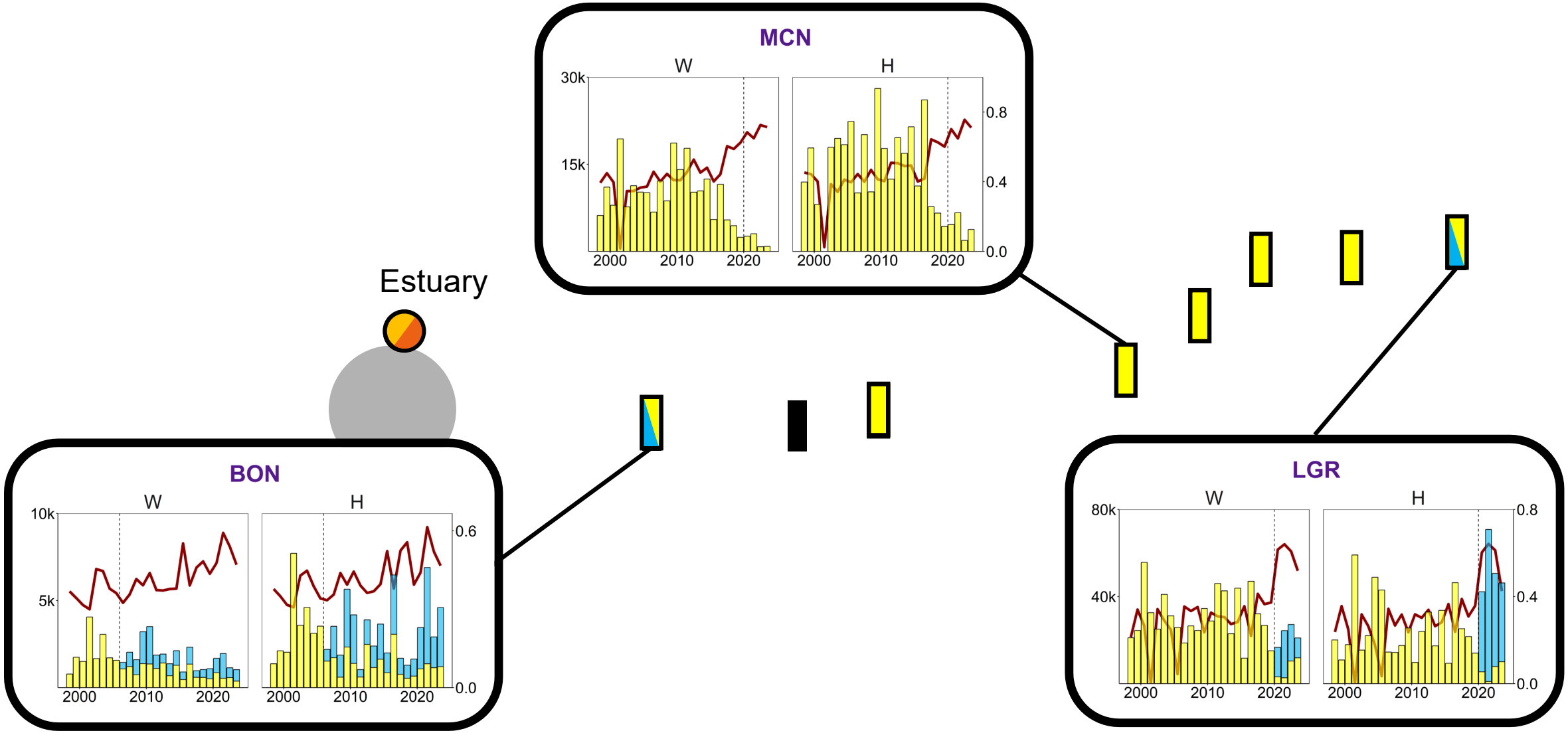


Route Usage and Spill Proportion

- Route usage is affected by many factors (Harnish et al. 2023)
  - Individual
    - Species, fork length
  - Environmental
    - Discharge, temperature, time of day
  - Operational
    - **Spill proportion**
- Current conservation strategy: Increase spill proportion to discourage powerhouse passage during outmigration

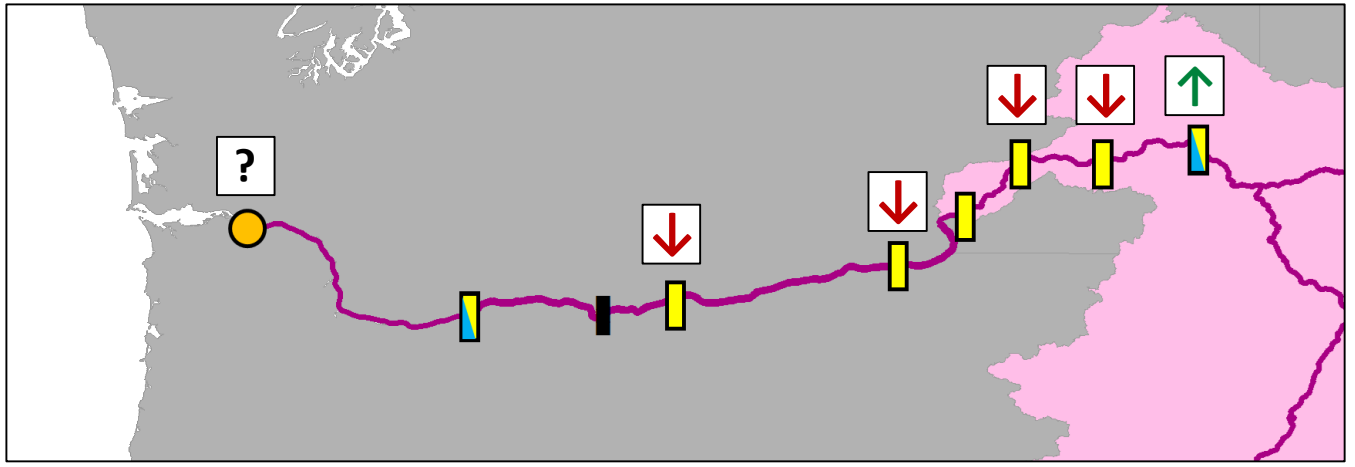


Detections of Snake River Spring/Summer Chinook Salmon vs. Spill Proportion



Research Question

How has the capacity to monitor juvenile salmon survival been affected by increased spill and new interrogation sites?



Study Objectives

1) Quantify the “capacity to monitor” juvenile survival for Snake River ESUs/DPS based on data sparseness and precision
2) Use these measures to compare monitoring capacity across time periods, species, and rear type

Quantifying the "Capacity to Monitor" Juvenile Survival

Statistical measures:

- Bias
  - Assessed with simulation or resampling
- Precision
  - Measured by computing variance
- Sparsity
  - Sufficiency of a dataset to provide estimates
  - Connected to bias and precision

Sparsity Criteria

Estimable

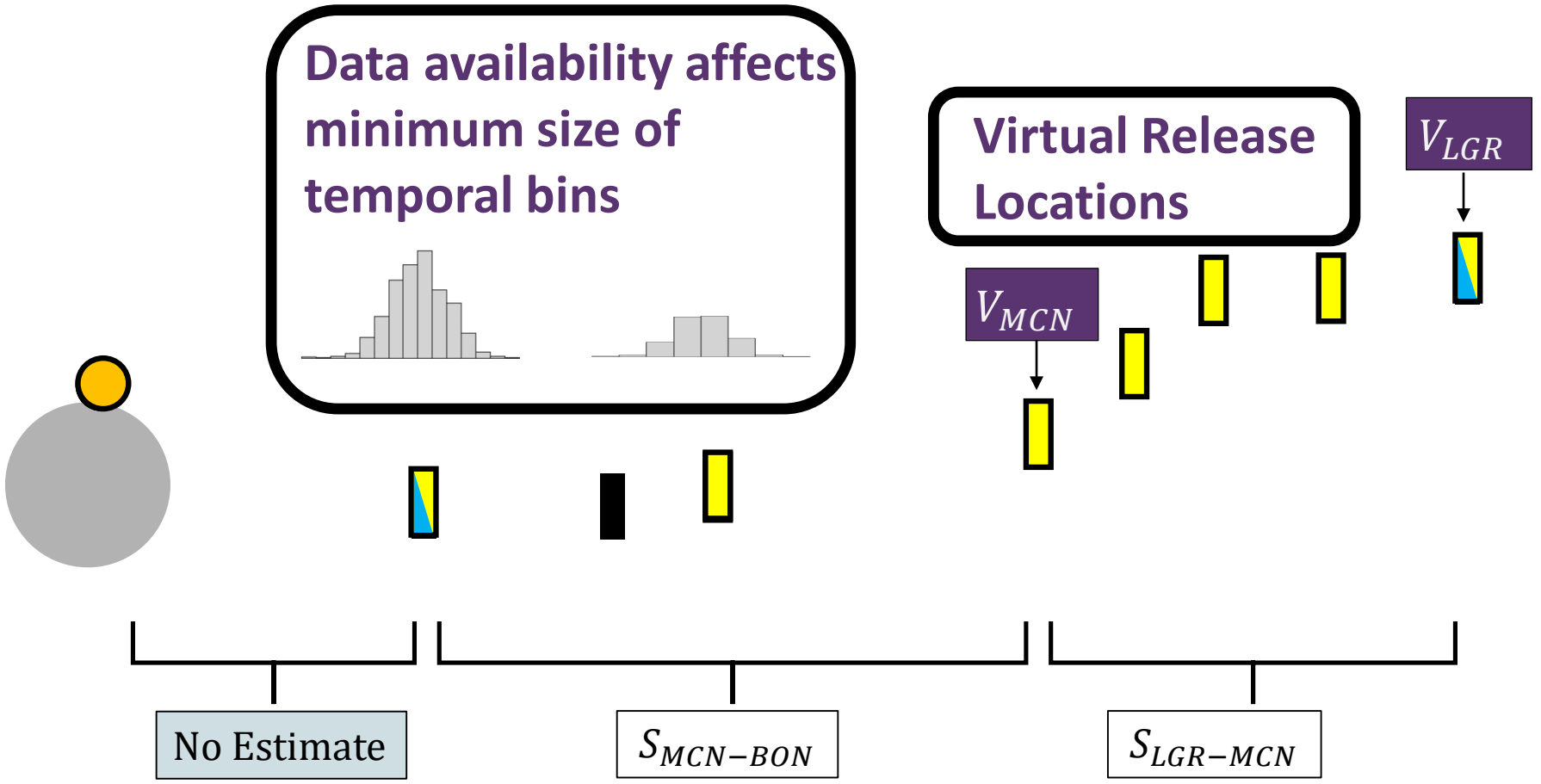
- Sufficient statistics (i.e., not missing critical detection histories)

Admissible

- $\hat{S} < 1.2$
- Coefficient of variation < 50%

$$\mathrm{CV} = \frac{\mathrm{SE}(\hat{s})}{\hat{s}} \times 100$$

Reaches Where Juvenile Survival is Estimated Annually



Focal Populations and Time Periods

- Spring migrants from Snake River ESUs/DPSs
- Detection Counts at LGR, MCN, BON, and Estuary

Species

- Chinook Salmon
- Steelhead
- Sockeye Salmon

Rear types

- Wild
- Hatchery

Temporal Bins

- Day
- Week
- Month
- Year

Spill Operation Regimes

Past (2011-2019)

- Prior to GRS and elevated spill targets

Current (2020-2023)

- Post GRS and elevated spill targets

Simple Cormack-Jolley-Seber Survival Estimation

$Reach\ Survival$	R	$Site\ 1$	$Site\ 2$
$\hat{S}_{LGR-MCN}$	LGR	MCN	$BON + Estuary$
$\hat{S}_{MCN-BON}$	MCN	BON	$Estuary$

- Condition on initial detection
- 4 possible detection histories:

$$n_{00}\ n_{10}\ n_{01}\ n_{11}$$

- Closed-form estimates of $\hat{p}$, $\hat{S}$, $\hat{\lambda}$, and $Var(\hat{S})$

$$\hat{p} = \frac{n_{11}}{n_{11} + n_{01}} \qquad \hat{S} = \frac{n_{11} + n_{10}}{\hat{p}}$$

Quantifying the "Capacity to Monitor" Juvenile Survival

Analysis Procedure

1) Identify middle 99% of detection distribution
2) Aggregate data using temporal bins
3) Try to obtain survival estimates from within each bin
4) Categorize estimate quality

Data Quality Metric

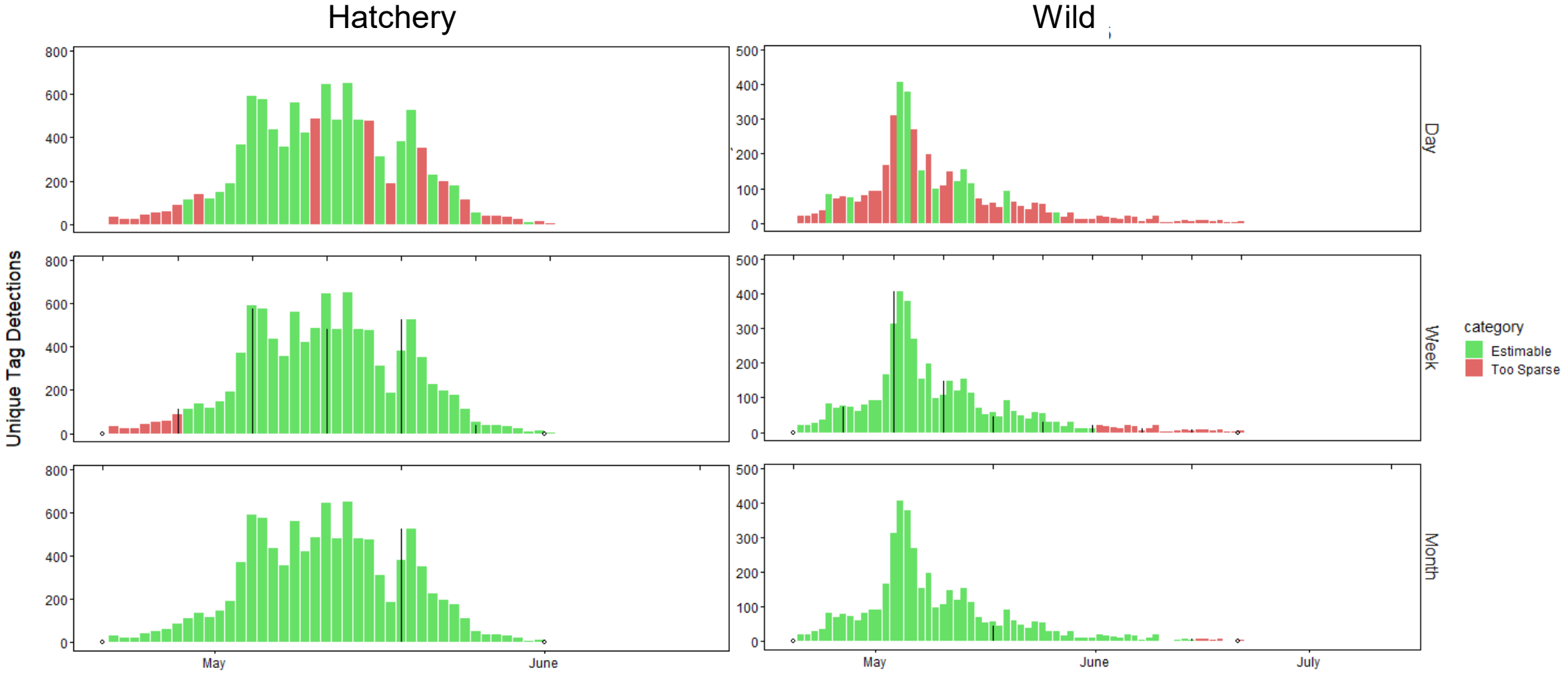
Categories:

- Estimable
- Inadmissible
- Too Sparse

Survival Monitoring Days:

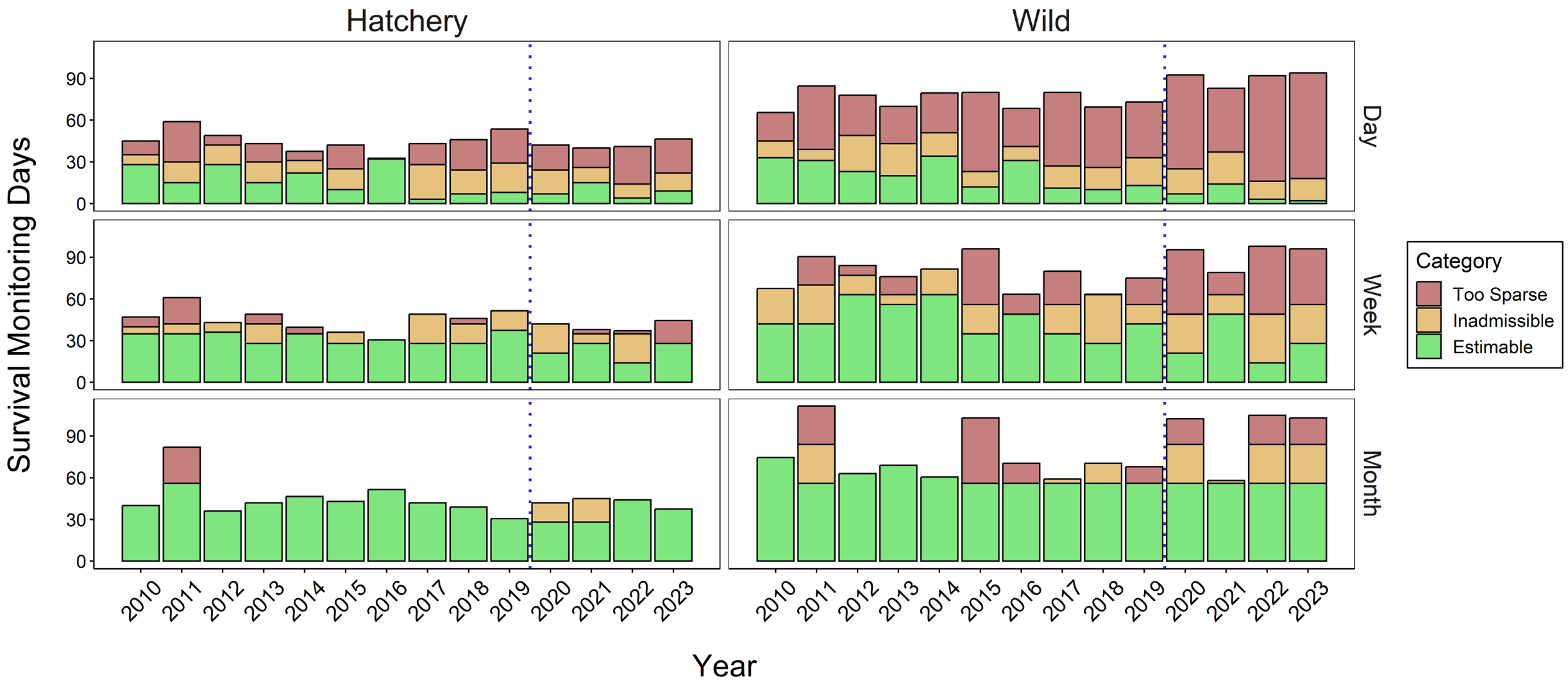
- Days in which a survival estimates were possibly attainable

2015 Daily Detections of Snake River Spring/Summer Chinook

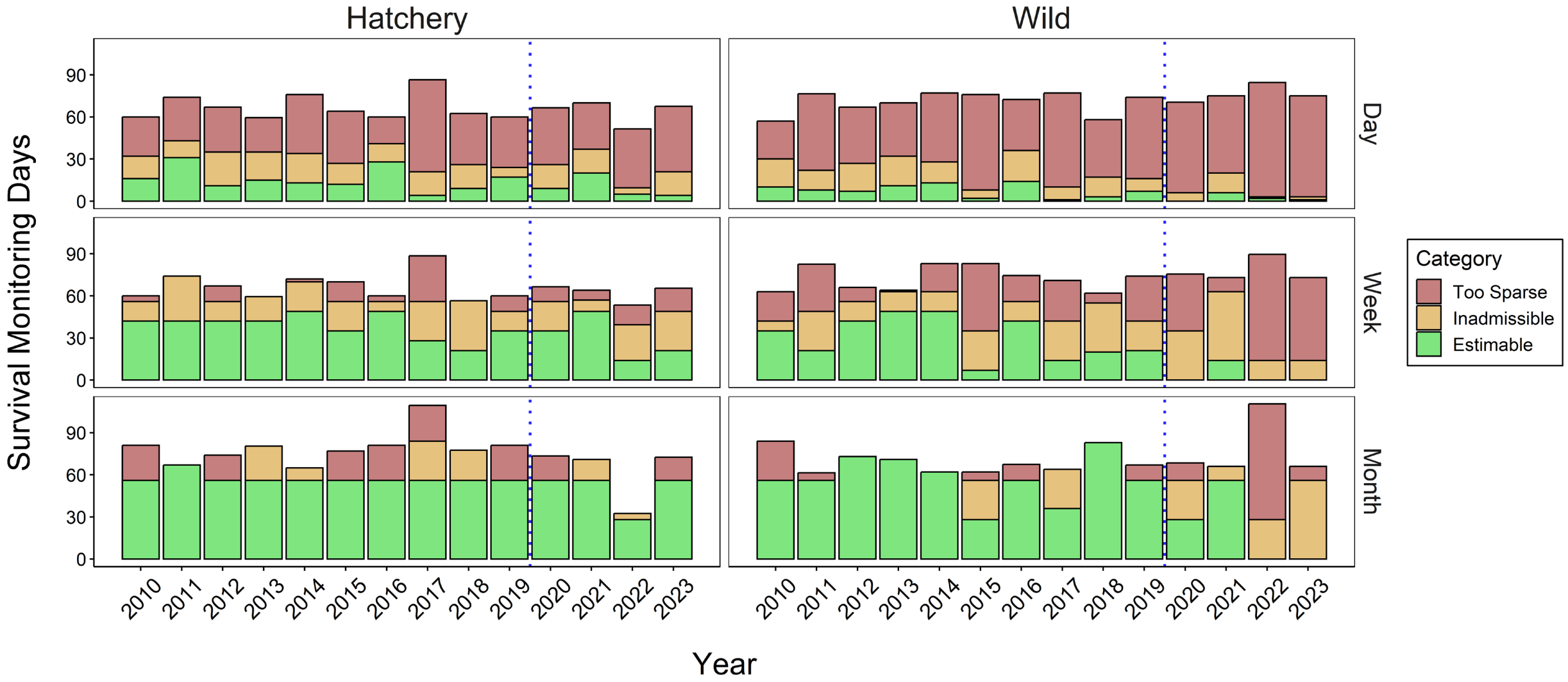


Results

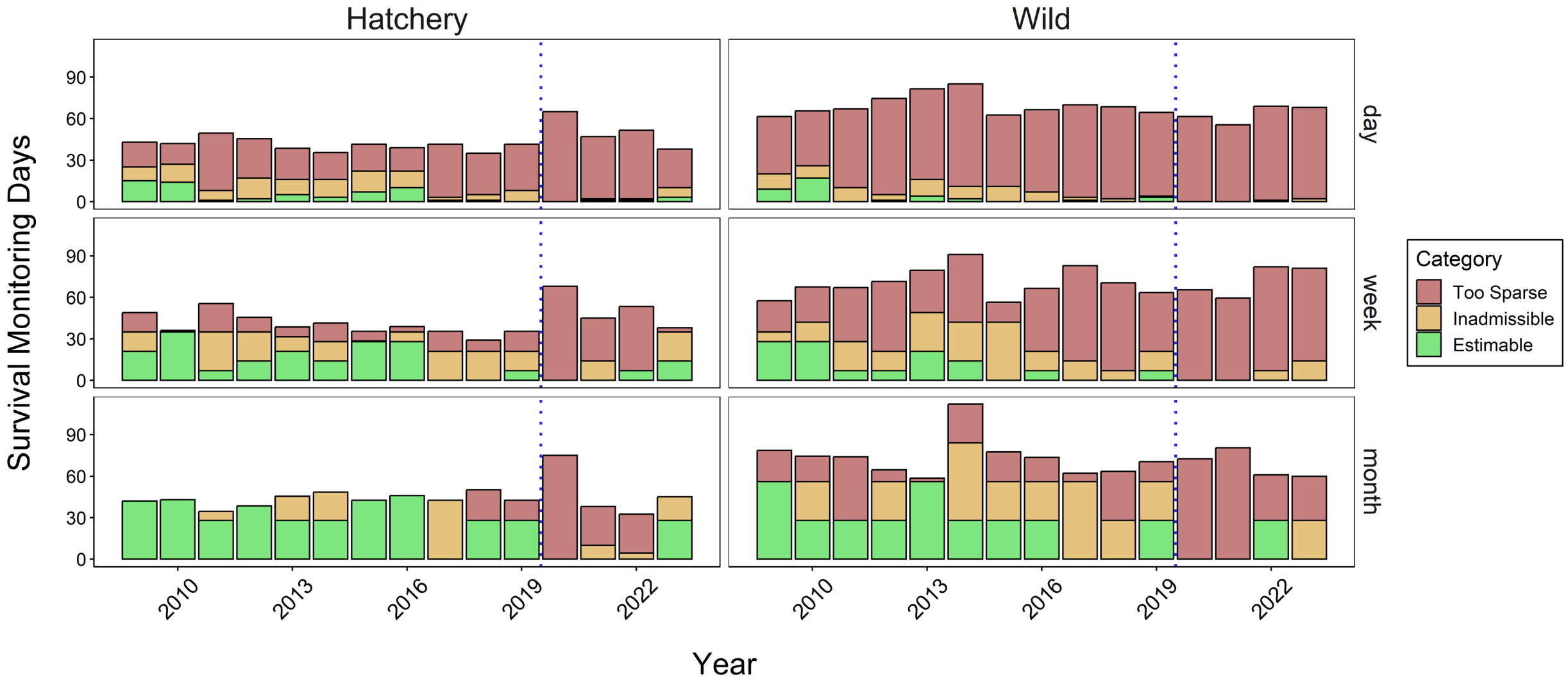
Snake River Spring/Summer Chinook Salmon Juvenile Survival (LGR-MCN)



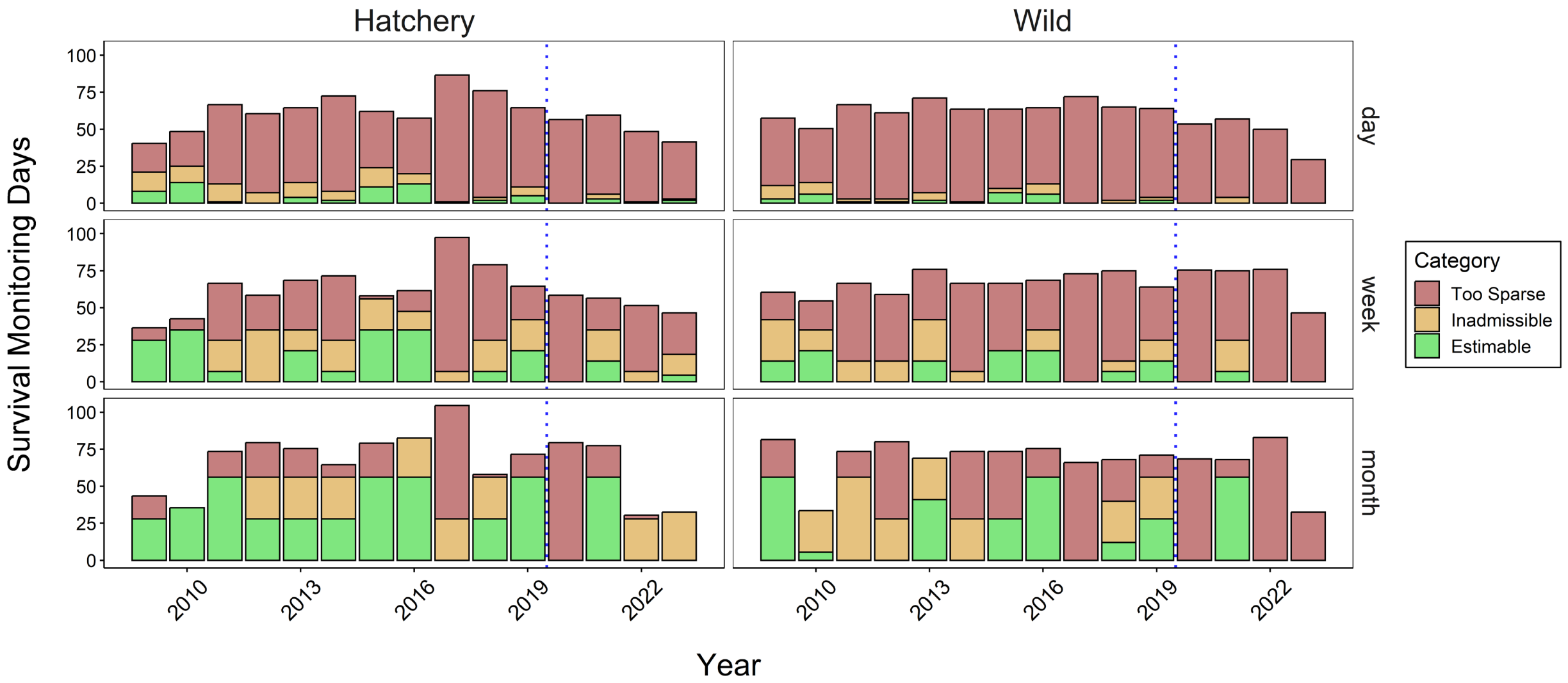
Snake River Steelhead Juvenile Survival (LGR-MCN)

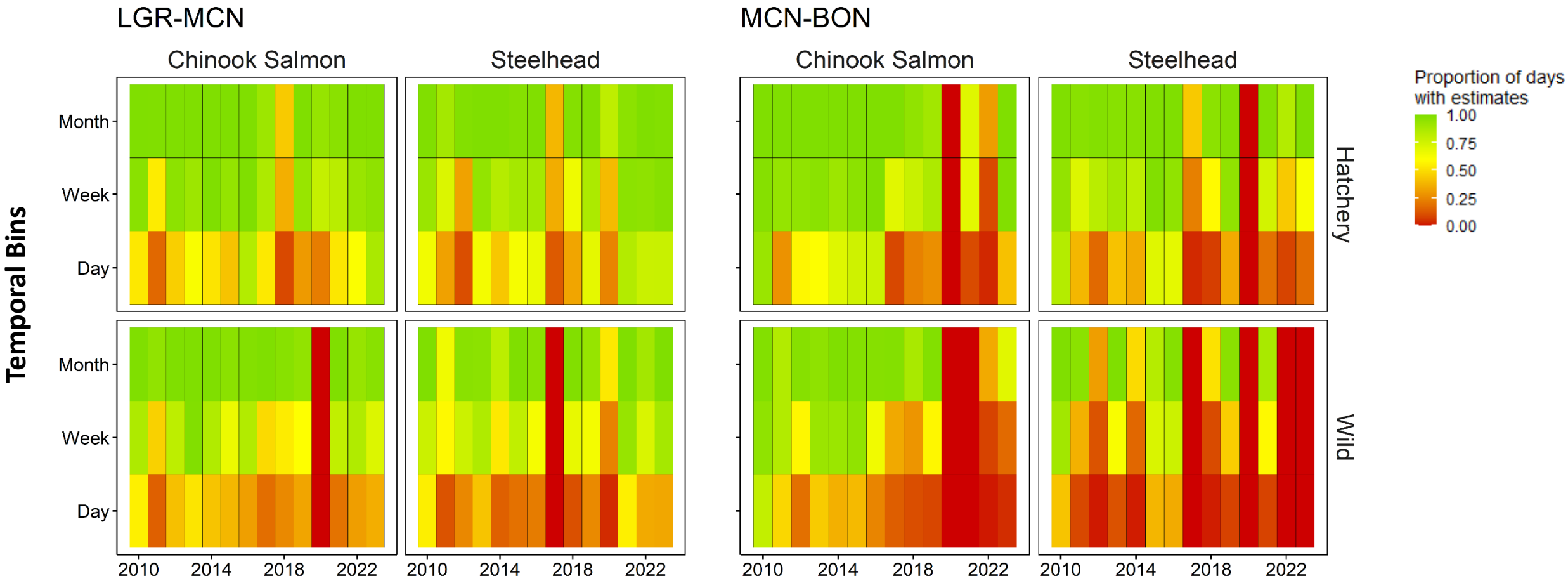


Snake River Spring/Summer Chinook Salmon Juvenile Survival (MCN-BON)



Snake River Steelhead Juvenile Survival (MCN-BON)




LGR-MCN
MCN-BON
Chinook Salmon
Steelhead
Chinook Salmon
Steelhead
Temporal Bins
Month
Week
Day
Month
Week
Day
Hatchery
Wild
2010
2014
2018
2022
2010
2014
2018
2022
2010
2014
2018
2022
2010
2014
2018
2022
Proportion of days with estimates
1.00
0.75
0.50
0.25
0.00

Conclusions

- The capacity to estimate survival from Juvenile PIT tag detection data sets has decreased in conjunction with the new spill regime
  - Especially an issue for the MCN-BON reach
- Enhancements to the PIT tag detection system do not appear to full compensate for lower frequency of detections within juvenile bypass systems

Future Work

- Simulation study to examine bias
- Focused analysis on the effects of experimental detection systems in the estuary

2023

Snake River Spring/Summer Chinook (Wild)