

# A Multistate Model to Estimate Upper Columbia River Spring Chinook Life Cycle Survival from Passive Integrated Transponder (PIT) Tagging and Detection

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# Outline

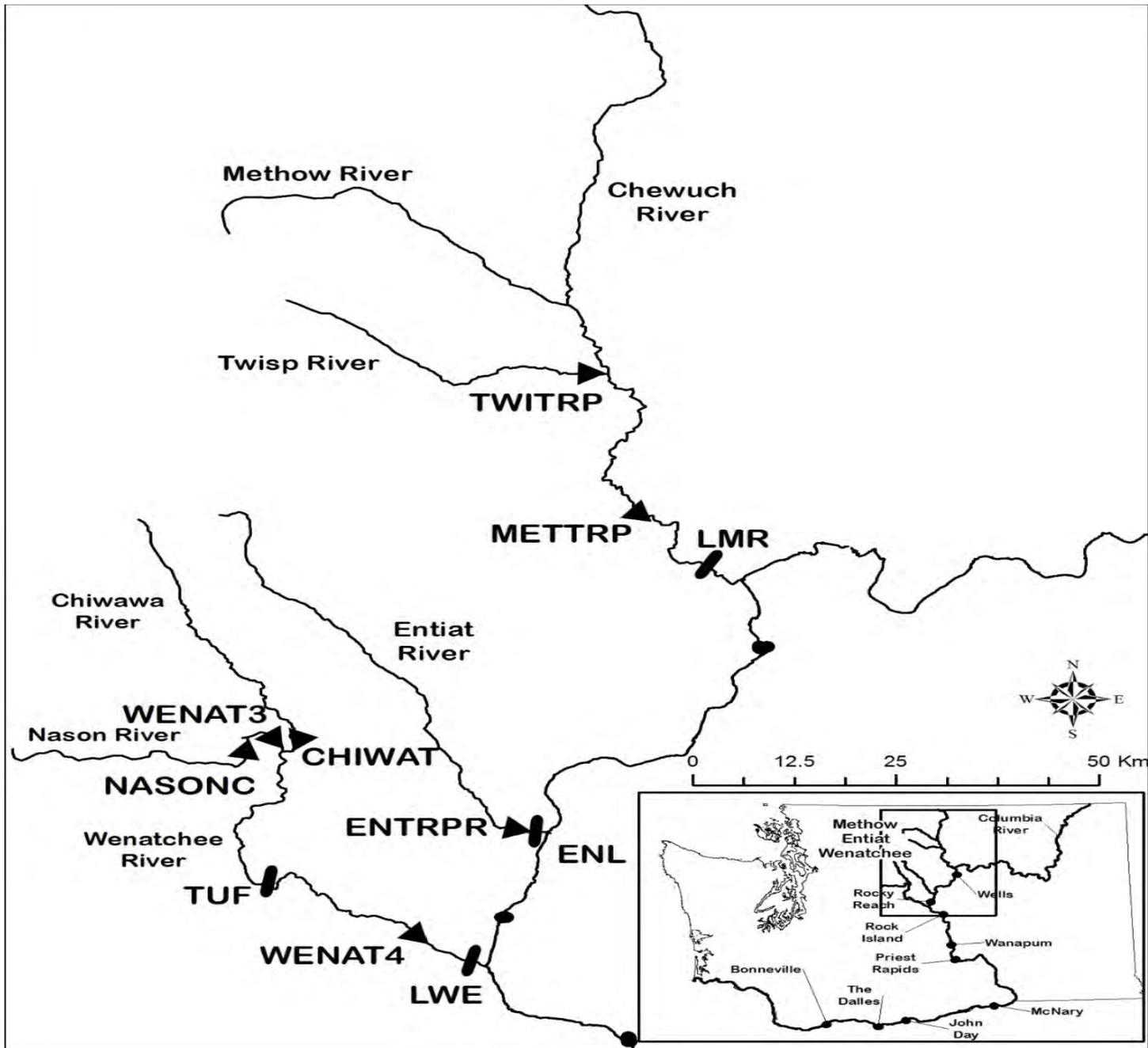
- Need
- Methods
- Results
- Summary
- Next Steps

# Existing Approaches to Estimate UC Survival

- Natural Origin Upper Columbia Spring Chinook remain listed for protection under the US Endangered Species Act
- UC Public Utility Districts (PUDs) have developed juvenile project survival studies to meet their license requirement but survival studies rely primarily on hatchery fish and their applicability to natural origin juvenile survival is unknown
- Comparative Survival Study (CSS) models focus on Smolt-Adult>Returns (SAR) from the first Dam (McNary for Wenatchee, Rock Reach for Entitit & Methow) to Bonneville Dam (BON), which lacks fine scale information, and does not account for adult mortality above BON to natal streams
- Current life cycle models (LCM) of wild UC spring Chinook include:
  - A Wenatchee spring Chinook LCM developed by NOAA and WDFW including hatchery and hydro modules
  - A Wenatchee and Methow spring Chinook LCM developed by CSS Workgroup using spawning escapement, smolt abundance to estimate marine survival and juvenile and adult hydro-system survival.
- In general, current approaches have not focused on natural origin fish and role up survival estimates to large spatial scales

# Multistate Modified Cormack-Jolly-Seber (CJS) Model

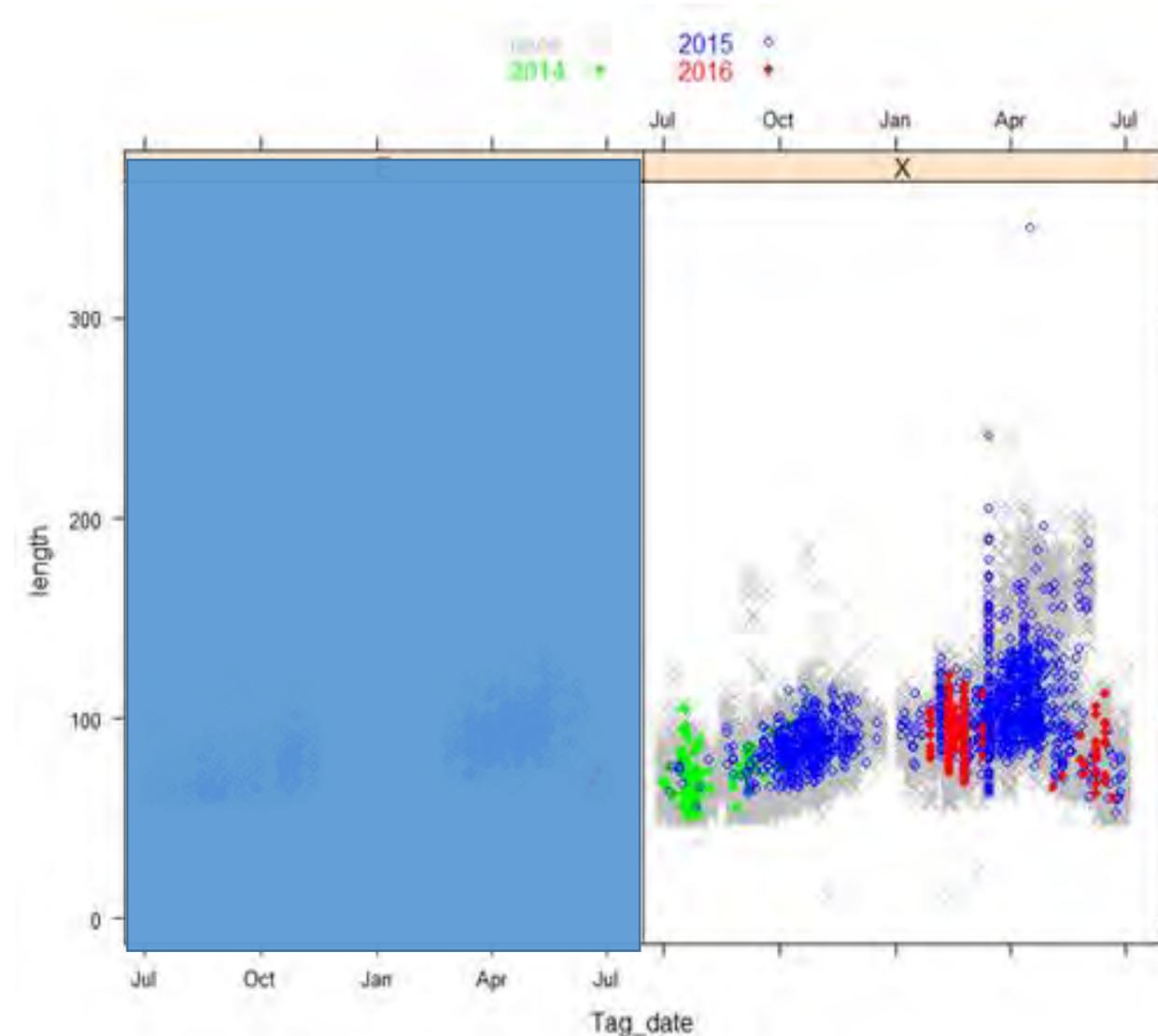
- Estimate survival of PIT tagged fall parr or spring smolts by reach from time of tagging to return as mature fish (adults/jacks) to spawning stream.
- Treats migration year as a state to account for heterogeneity in survival between different age groups (e.g. juvenile – parr vs. smolts) or ocean survival of mature fish (e.g. age 3 vs. age 5).
- May include covariates (flow, spill, etc.) to improve detection and survival estimates
- Scales across the life cycle (parr survival from tagging to spring outmigration) or (parr to estuary) or parr to adult subbasin returns



Upper Columbia  
spring Chinook  
salmon  
-tagging sites &  
detection sites

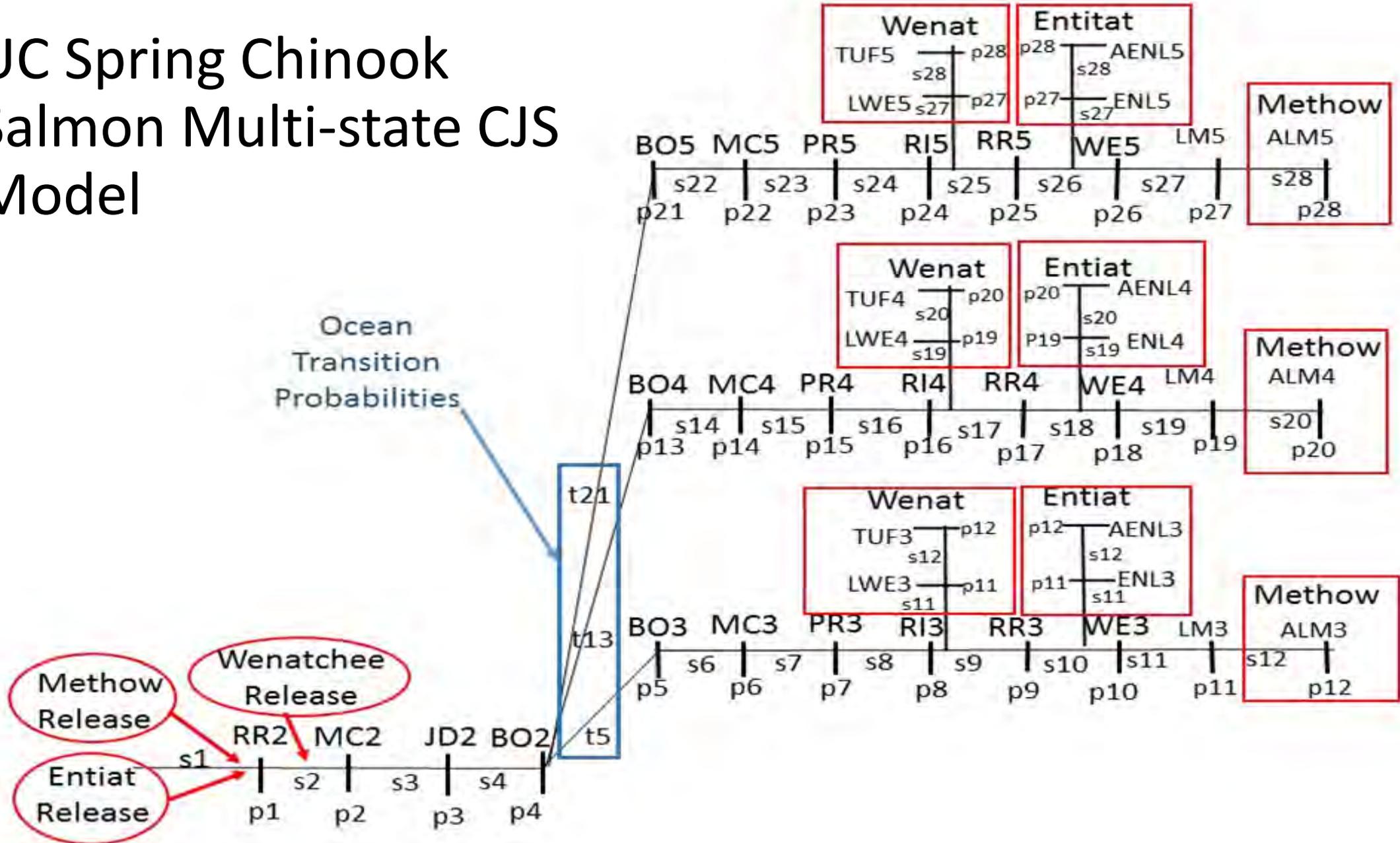


# Data QA/QC

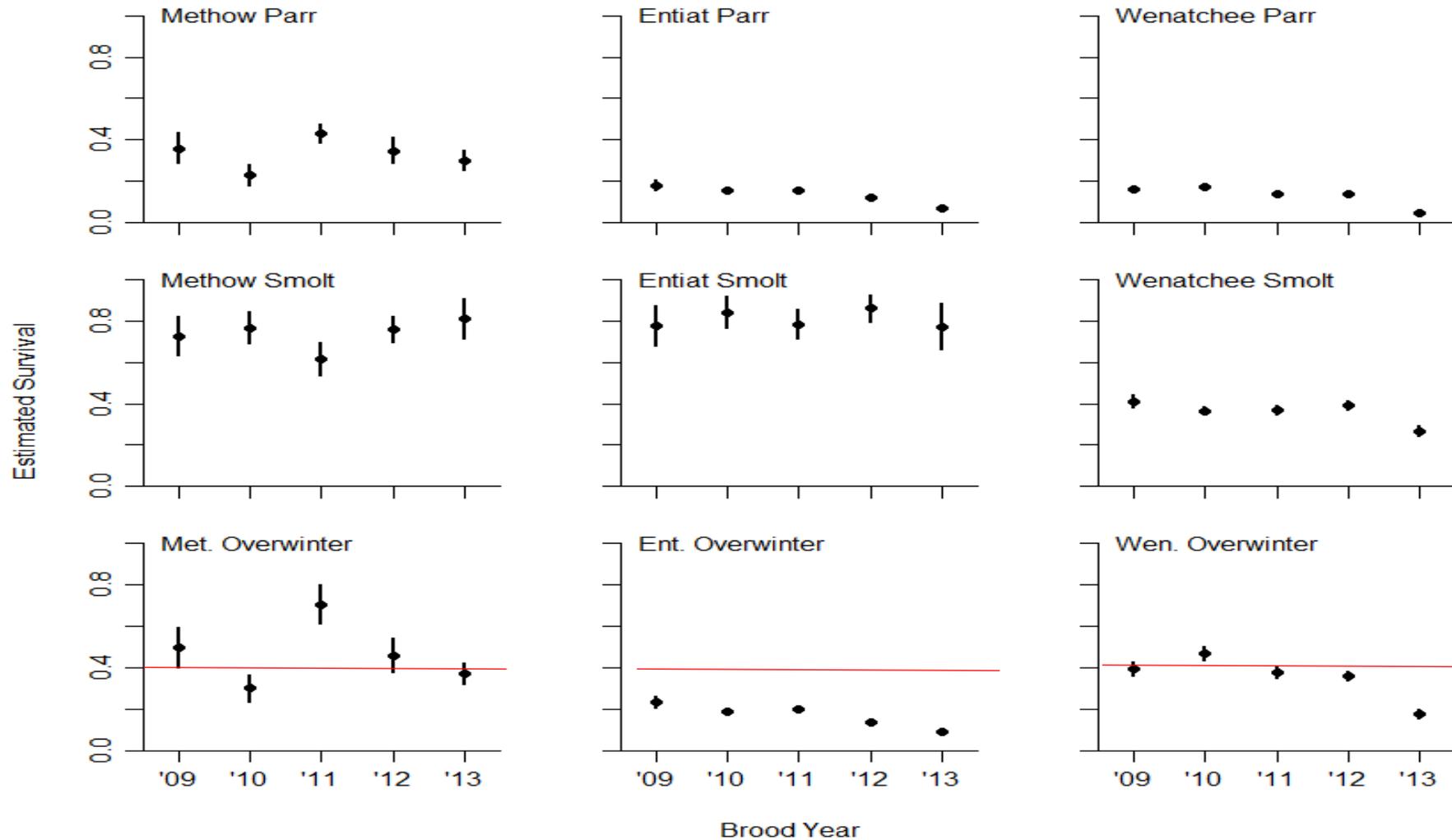


- Due to mix of Spring and Summer Chinook must develop rule set based on location/timing/length/life history to determine spring Chinook for analysis
- Green are summer Chinook migrants in 2014, red are likely spring parr that migrate following year.
- Dataset for analysis

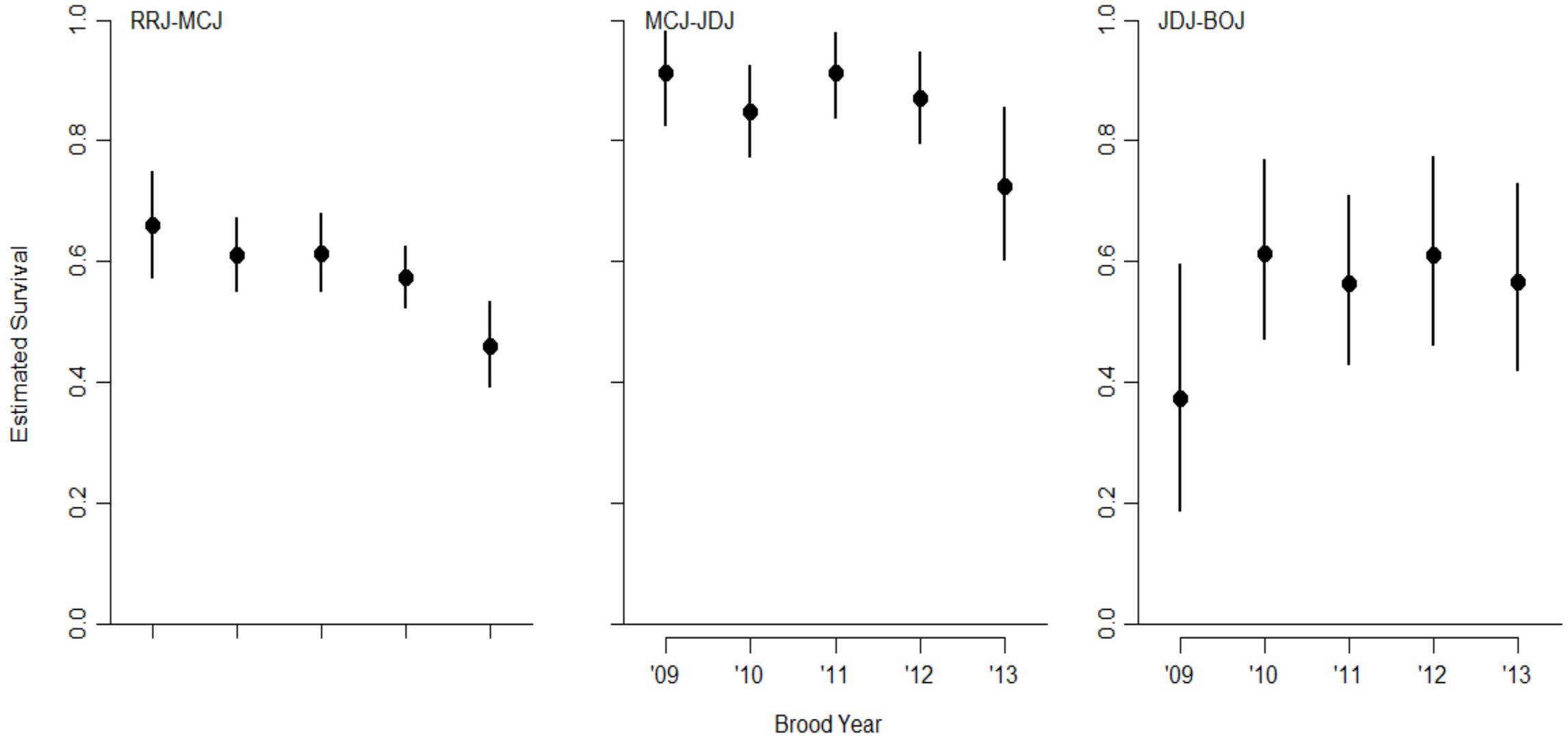
# UC Spring Chinook Salmon Multi-state CJS Model



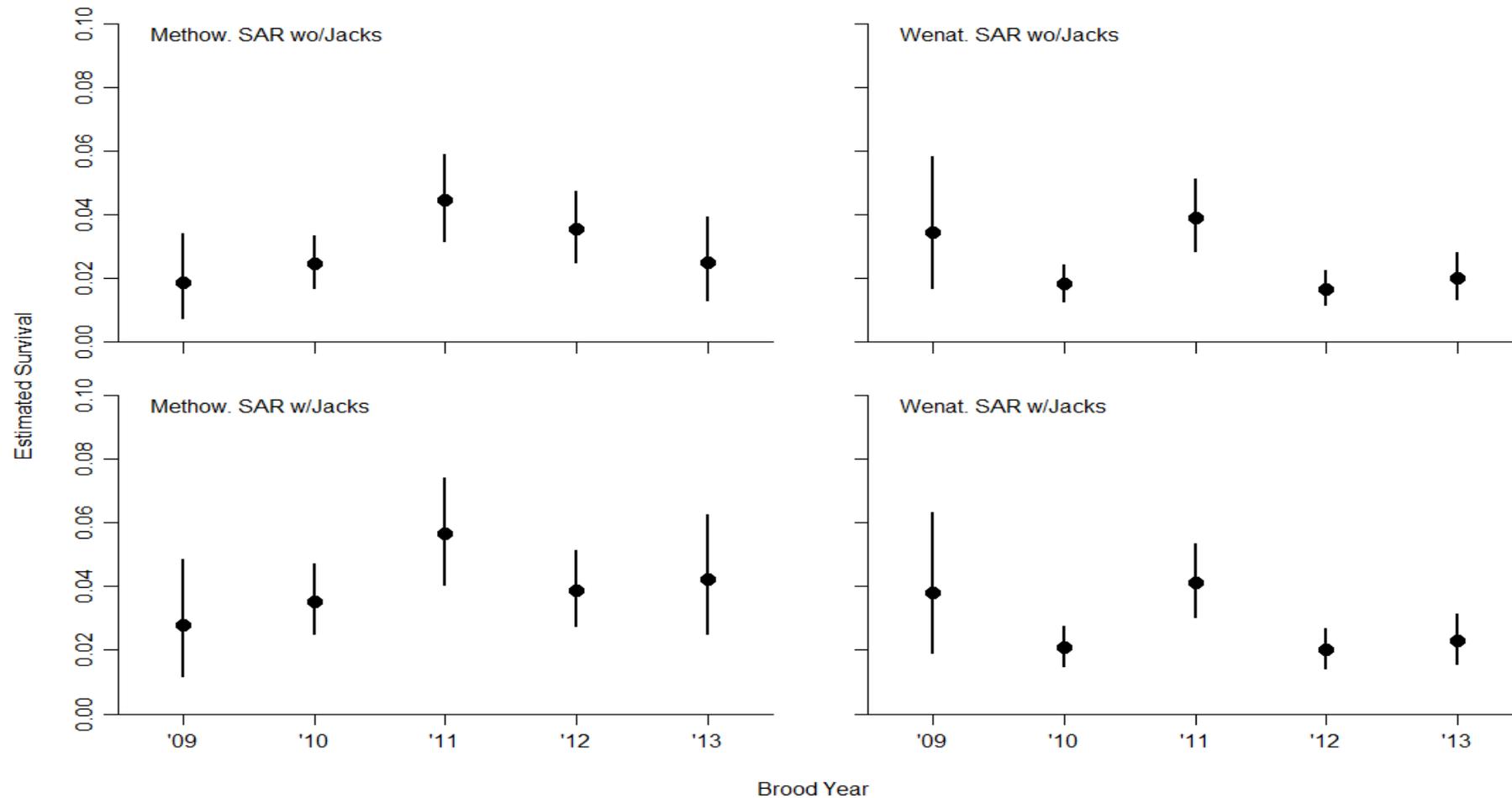
# Upper Columbia spring Chinook parr and smolt survival to the first dam and parr overwinter survival



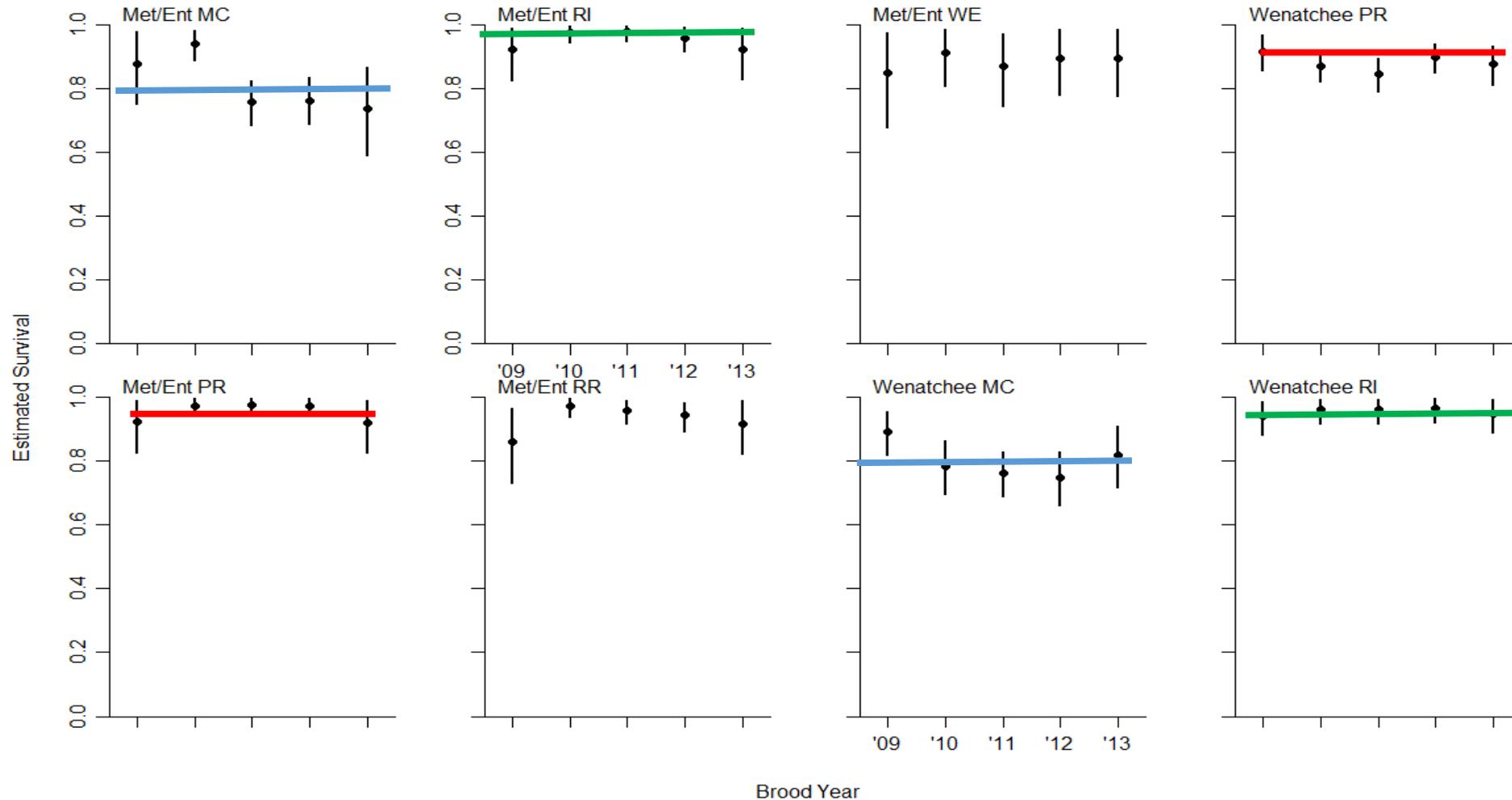
# Upper Columbia spring Chinook smolt reach survival



# Upper Columbia spring Chinook smolt to adult return (SAR) from BON to BON



# Upper Columbia spring Chinook adult survival from BON to upper most dam



# Summary

- Significant juvenile and adult mortality from man-made and natural causes in the Columbia River hydro-system remain
- Enitiat Spring Chinook parr that overwinter in the Columbia have low survival rates <10% compared to Wenatchee or Methow spring Chinook parr
- Juvenile survival of natural origin spring Chinook from Rocky Reach to Bonneville Dam ~ 35%
- Ocean survival (BON-BON) ~ 2-3%
- Adult survival of natural origin spring Chinook from Bonneville to Wells Dam is ~ 65%

# Next Steps

- Current model uses Brood Years 2009-2013 but can add additional brood years
- Due to overlap in juvenile outmigration between spring and summer Chinook, these PIT tags have not been used in the analysis. However, they can be incorporated into the analysis as adults detected at BON.
- Can expand the model to include PIT tag parr captured in tributaries to evaluate survival strategies. For example, survival of PIT tag fish that overwinter in the Twisp River (Methow tributary) compared to PIT tag fish that overwinter in the Methow.
- Other Species (e.g. steelhead)