Using genetics and scales to estimate Snake River Basin steelhead emigration for VSP metrics at Lower Granite Dam

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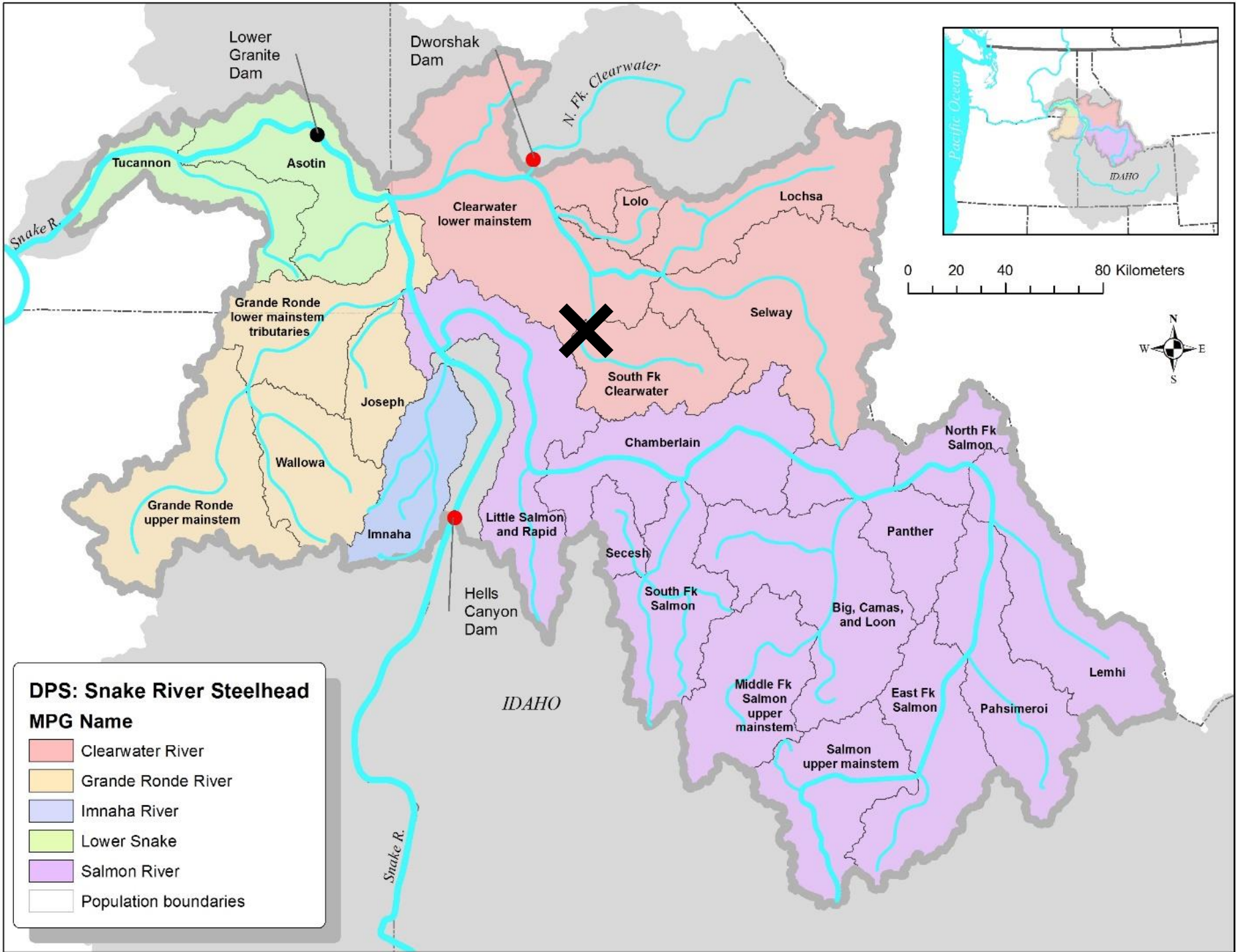
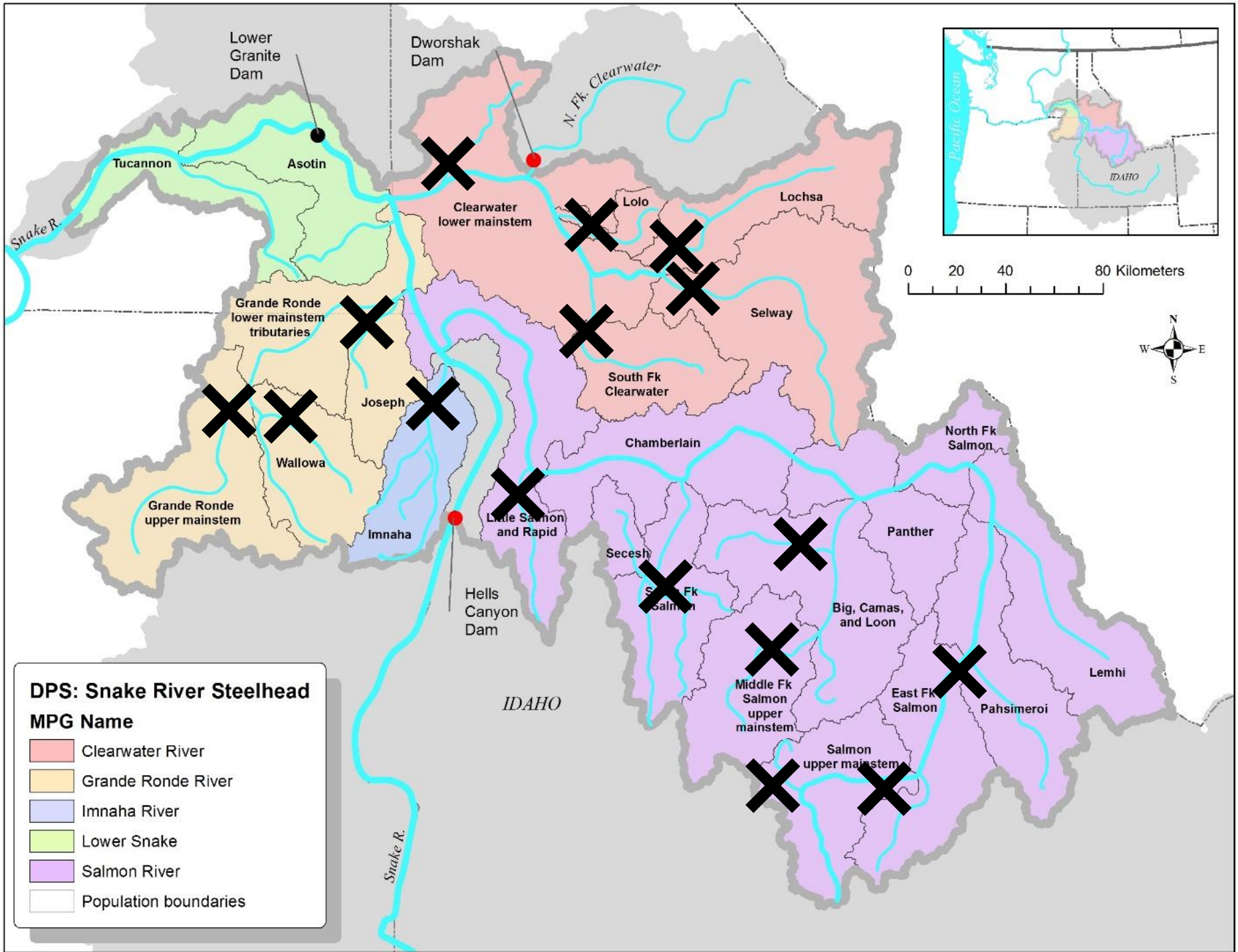
[1]Idaho Fish and Game
[2]Pacific States Marine Fisheries Commission

Challenges for Snake River steelhead


Lower Granite Dam
Dworshak Dam
N. Fk. Clearwater
Tucannon
Asotin
Snake R.
Clearwater lower mainstem
Lolo
Lochsa
Selway
Grande Ronde lower mainstem tributaries
South Fk Clearwater
Joseph
Chamberlain
North Fk Salmon
Wallowa
Grande Ronde upper mainstem
Imnaha
Little Salmon and Rapid
Panther
Secesh
South Fk Salmon
Big, Camas, and Loon
Hells Canyon Dam
Lemhi
Middle Fk Salmon upper mainstem
East Fk Salmon
Pahsimeroi
Salmon upper mainstem
IDAHO
Snake R.
Pacific Ocean
IDAHO
0 20 40 80 Kilometers
N
W
E
S
DPS: Snake River Steelhead
MPG Name
Clearwater River
Grande Ronde River
Imnaha River
Lower Snake
Salmon River
Population boundaries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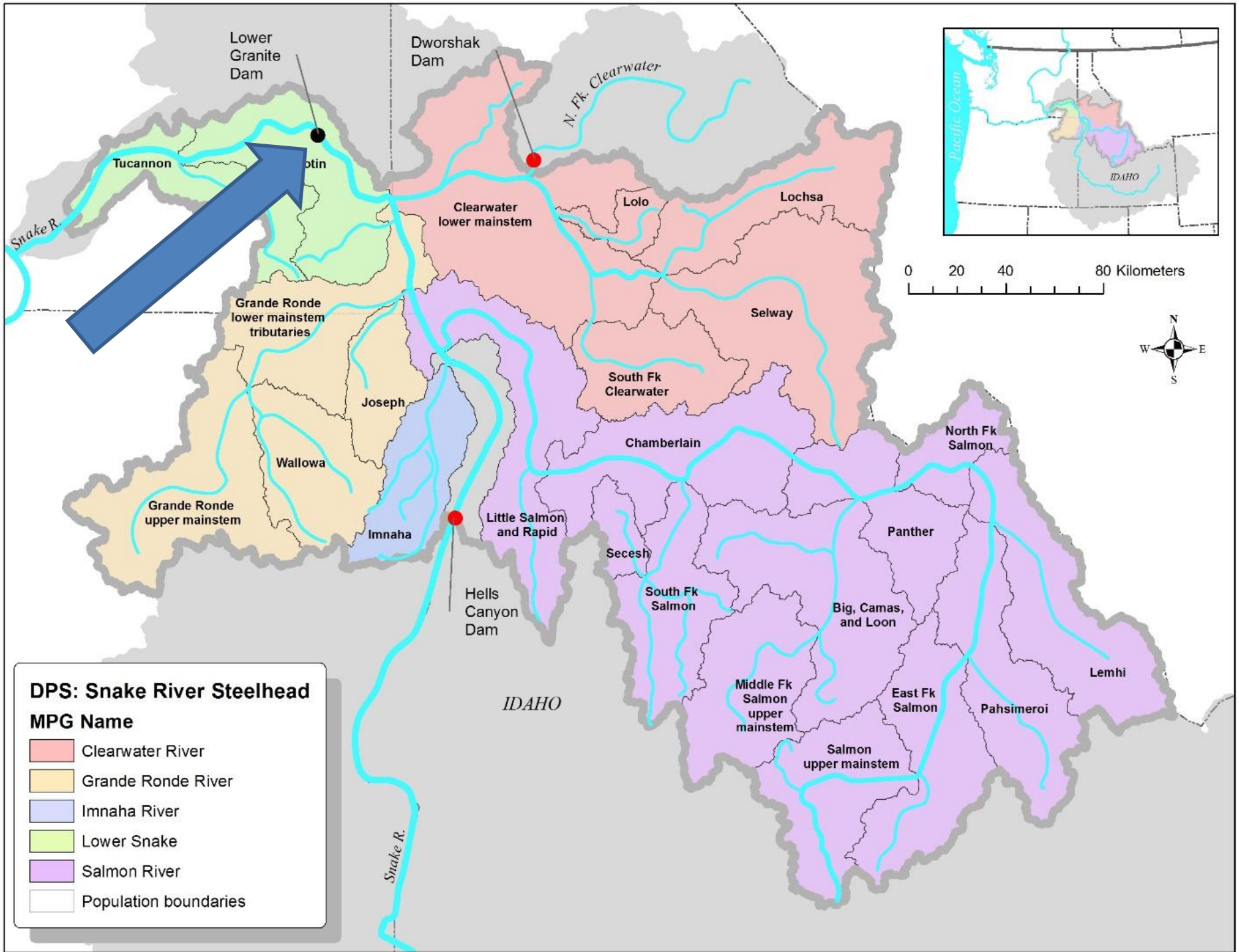
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Population boundaries

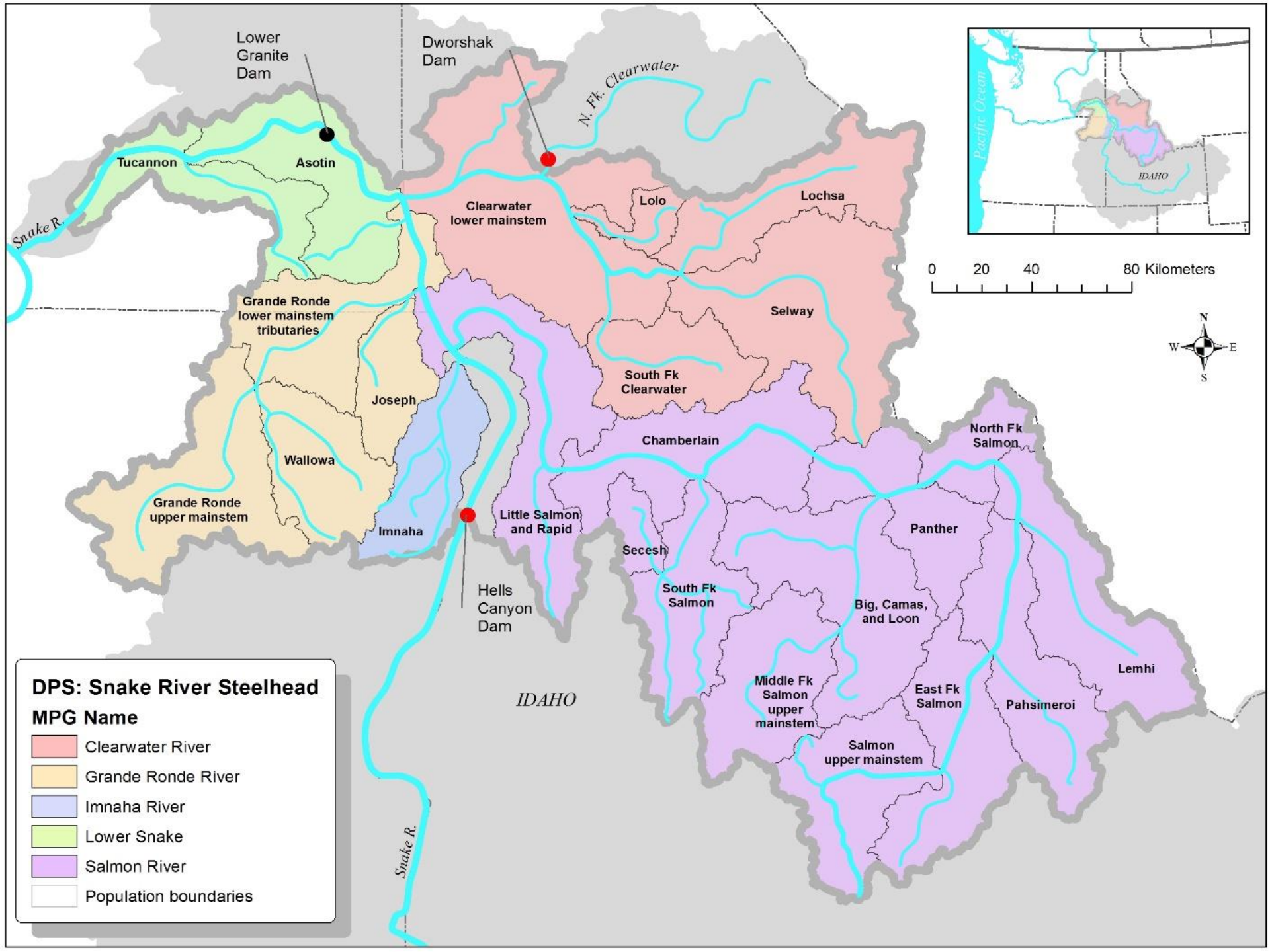
Lower Granite Dam

Objective

Estimate abundance and productivity of juvenile Snake River summer steelhead at Lower Granite Dam

- How many of them are there?

- How well do they reproduce & survive?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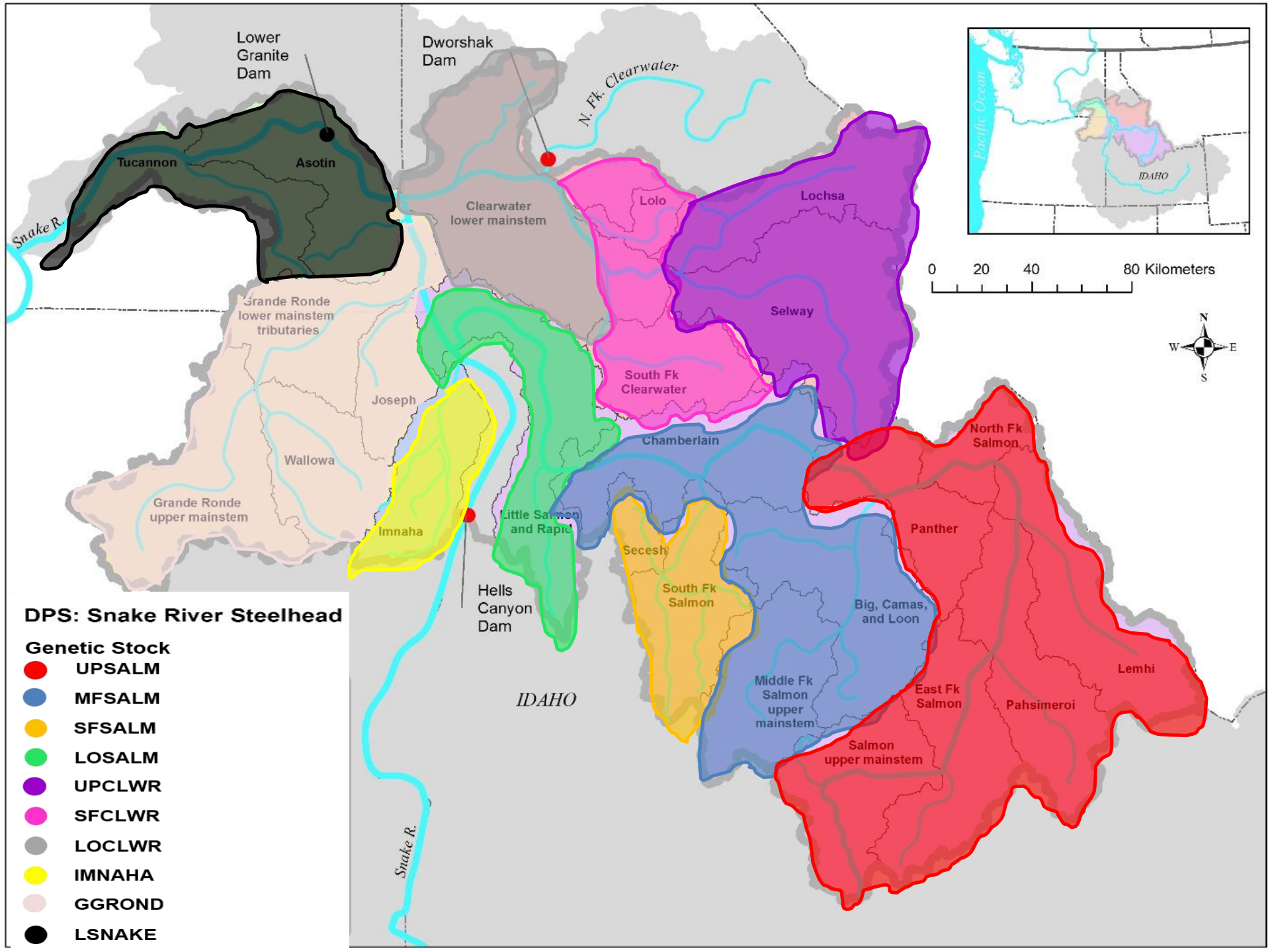
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N
W
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DPS: Snake River Steelhead
Genetic Stock
UPSALM
MFSALM
SFSALM
LOSALM
UPCLWR
SFCLWR
LOCLWR
IMNAHA
GGROND
LSNAKE

Juvenile Fish Facility
(i.e. Mega Screw Trap)

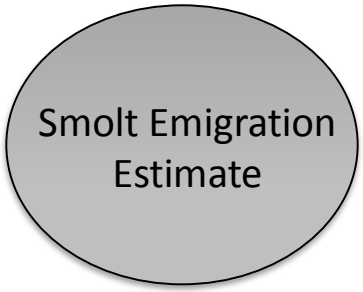
Collected

Counted

Sampled

SCRAPI

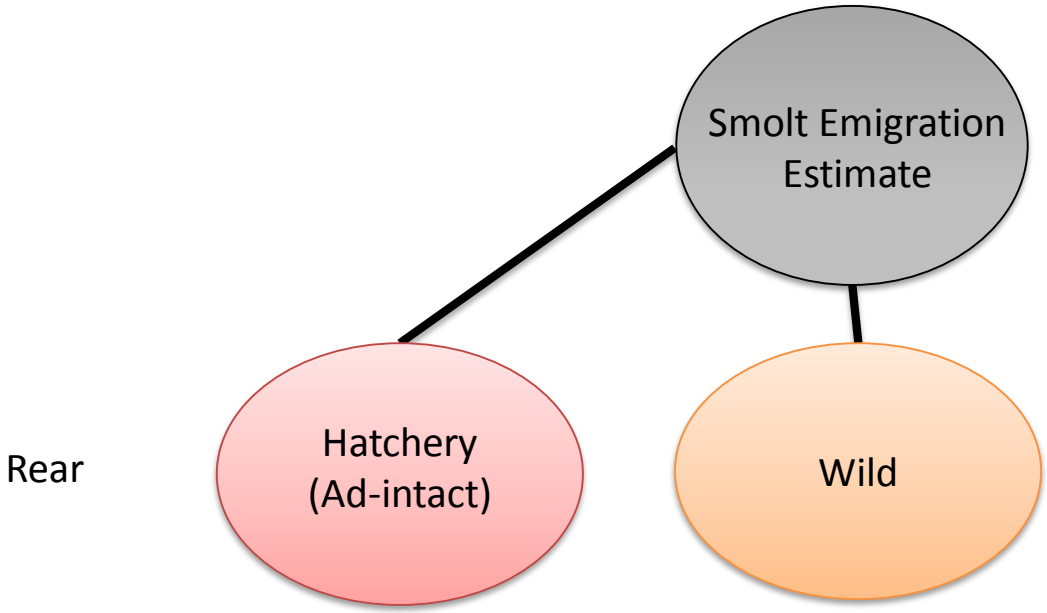
(Juvenile Salmonid Compositional Bootstrap Intervals)



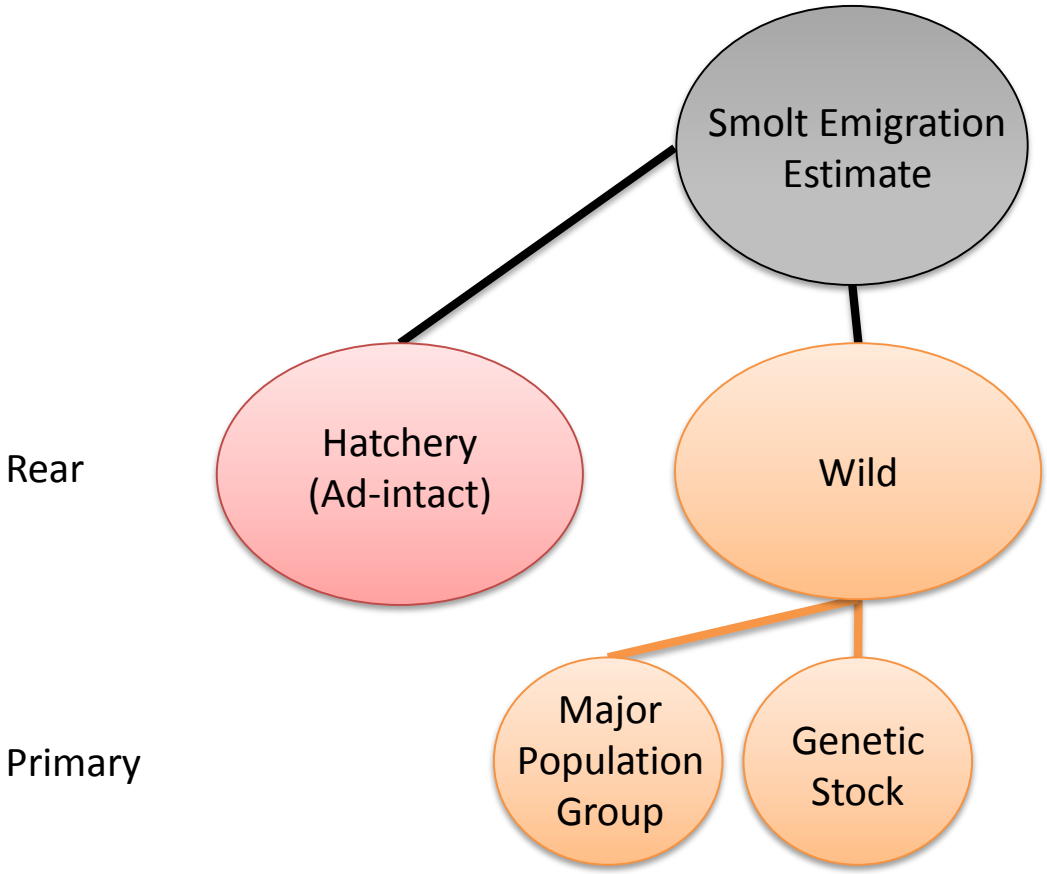
Smolt Emigration Estimate = $\sum$ Daily Estimates

$$\text{Daily Estimate} = \frac{Daily\ Smolt\ Count}{Daily\ Sample\ Rate * Daily\ Detection\ Efficiency}$$

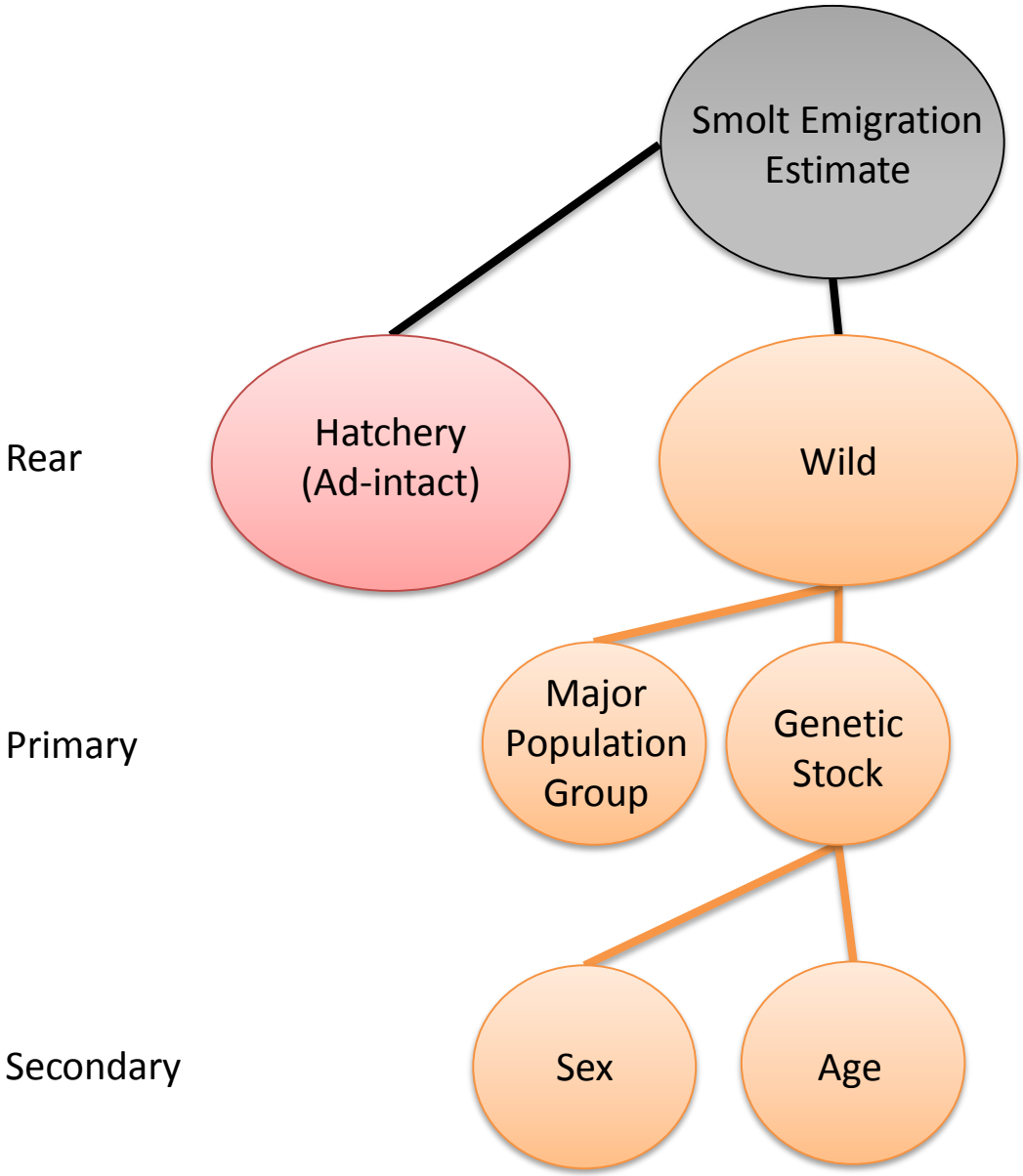
SCRAPI

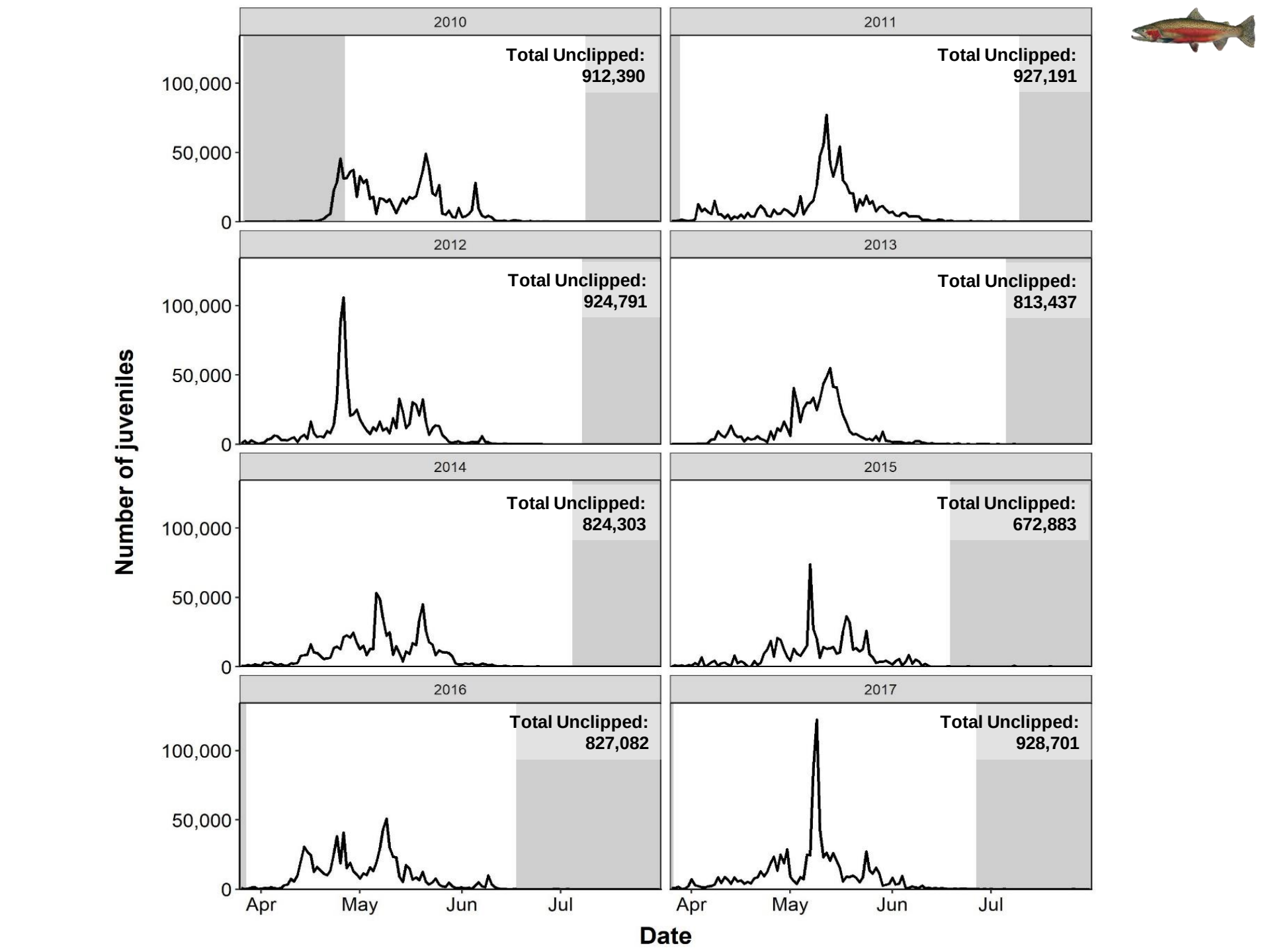


SCRAPI

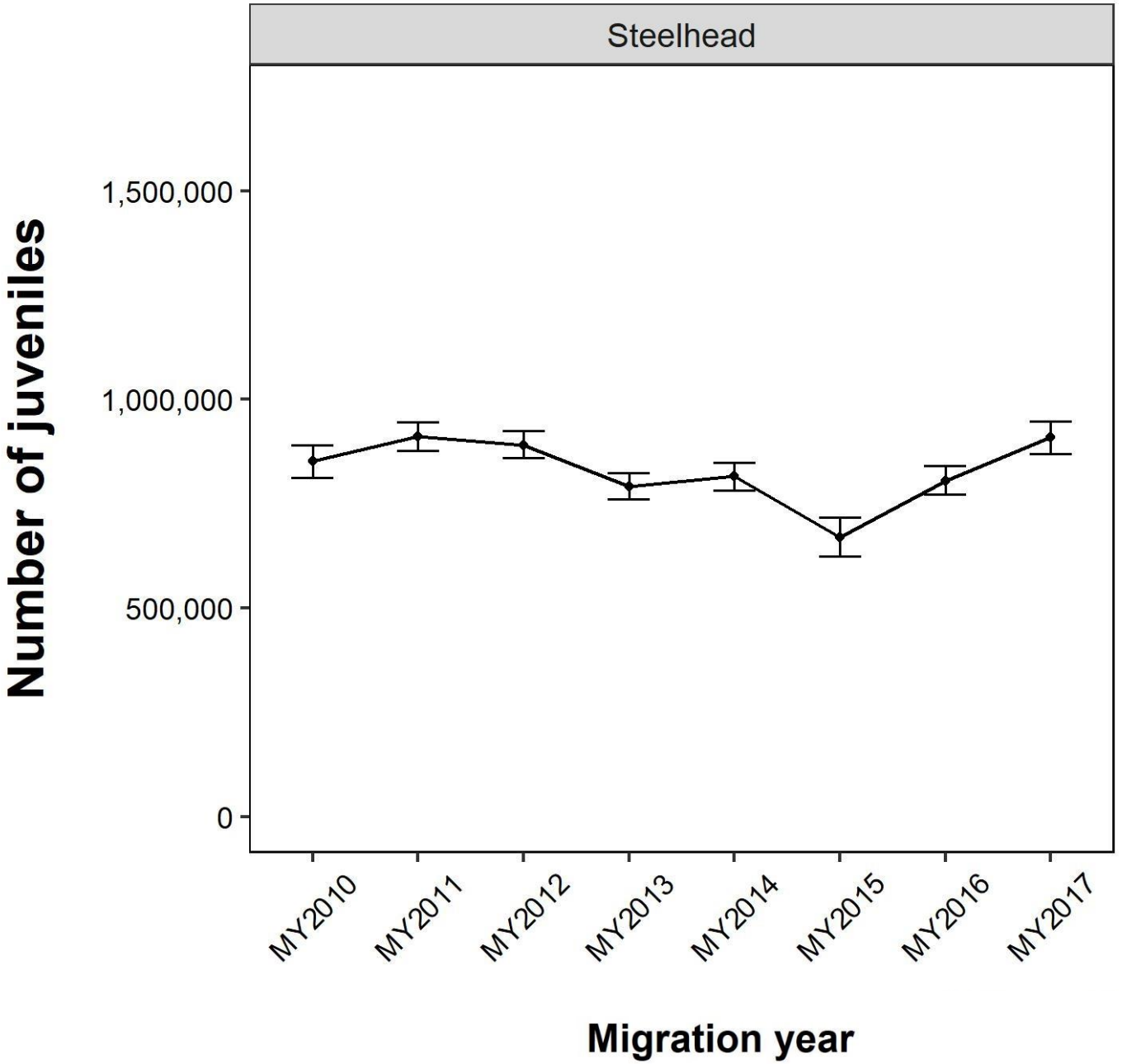

Smolt Emigration Estimate
Rear
Hatchery (Ad-intact)
Wild
Primary
Major Population Group
Genetic Stock

SCRAPI

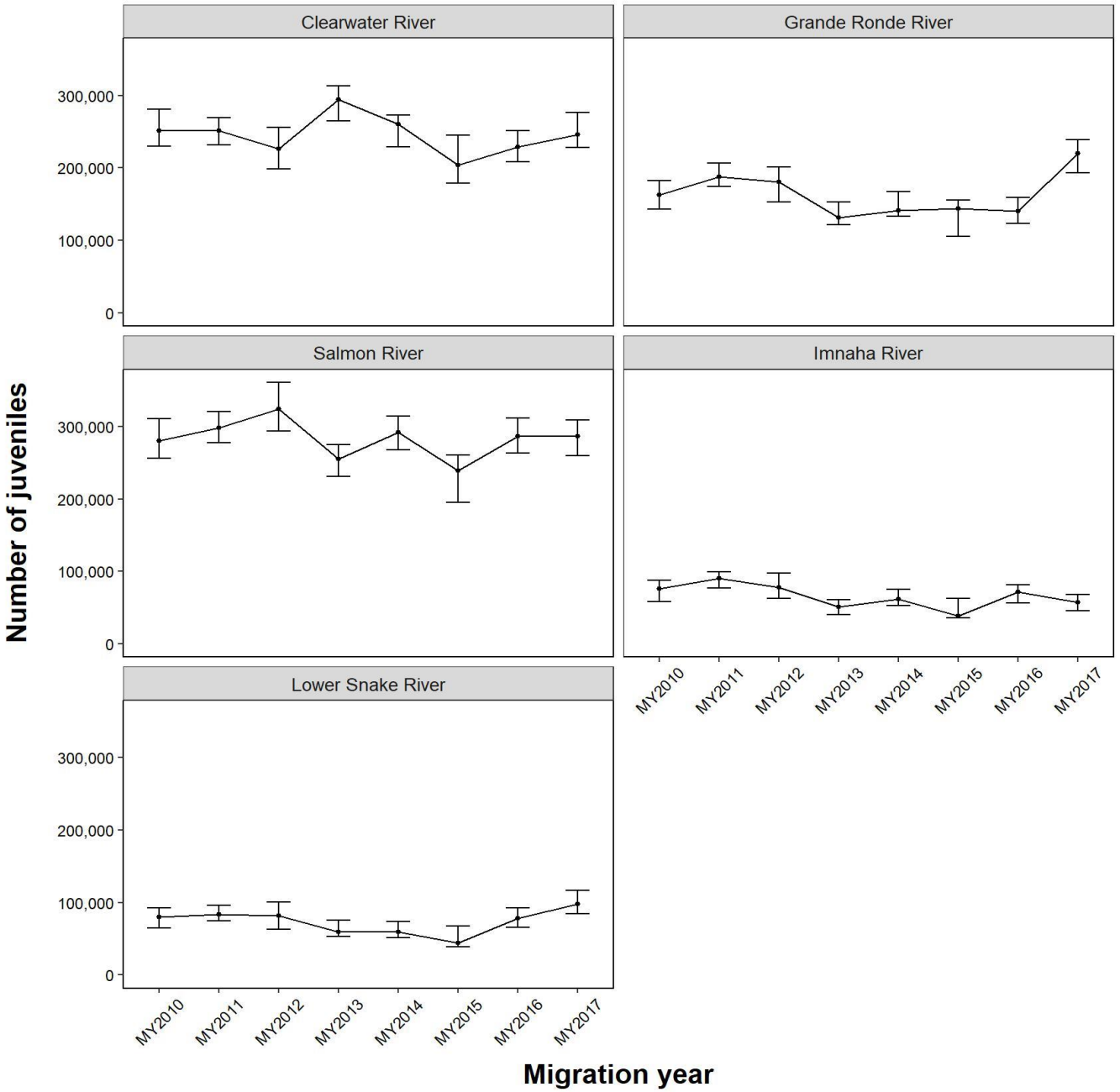

Smolt Emigration Estimate
Rear
Hatchery (Ad-intact)
Wild
Primary
Major Population Group
Genetic Stock
Secondary
Sex
Age


2010
Total Unclipped:
912,390
2011
Total Unclipped:
927,191
2012
Total Unclipped:
924,791
2013
Total Unclipped:
813,437
2014
Total Unclipped:
824,303
2015
Total Unclipped:
672,883
2016
Total Unclipped:
827,082
2017
Total Unclipped:
928,701
100,000
50,000
0
Apr
May
Jun
Jul
Number of juveniles
Date

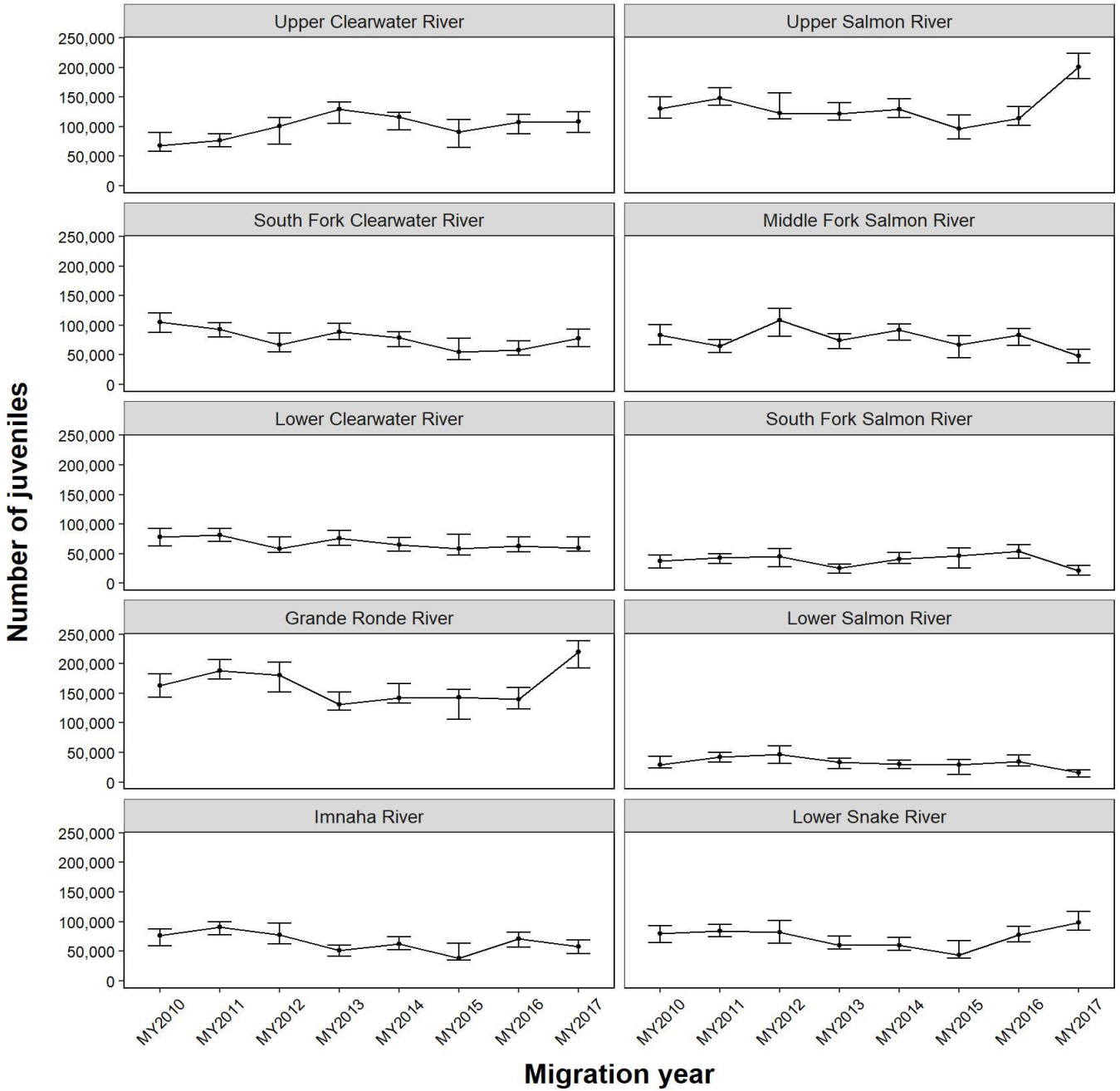
Wild Juvenile Emigration



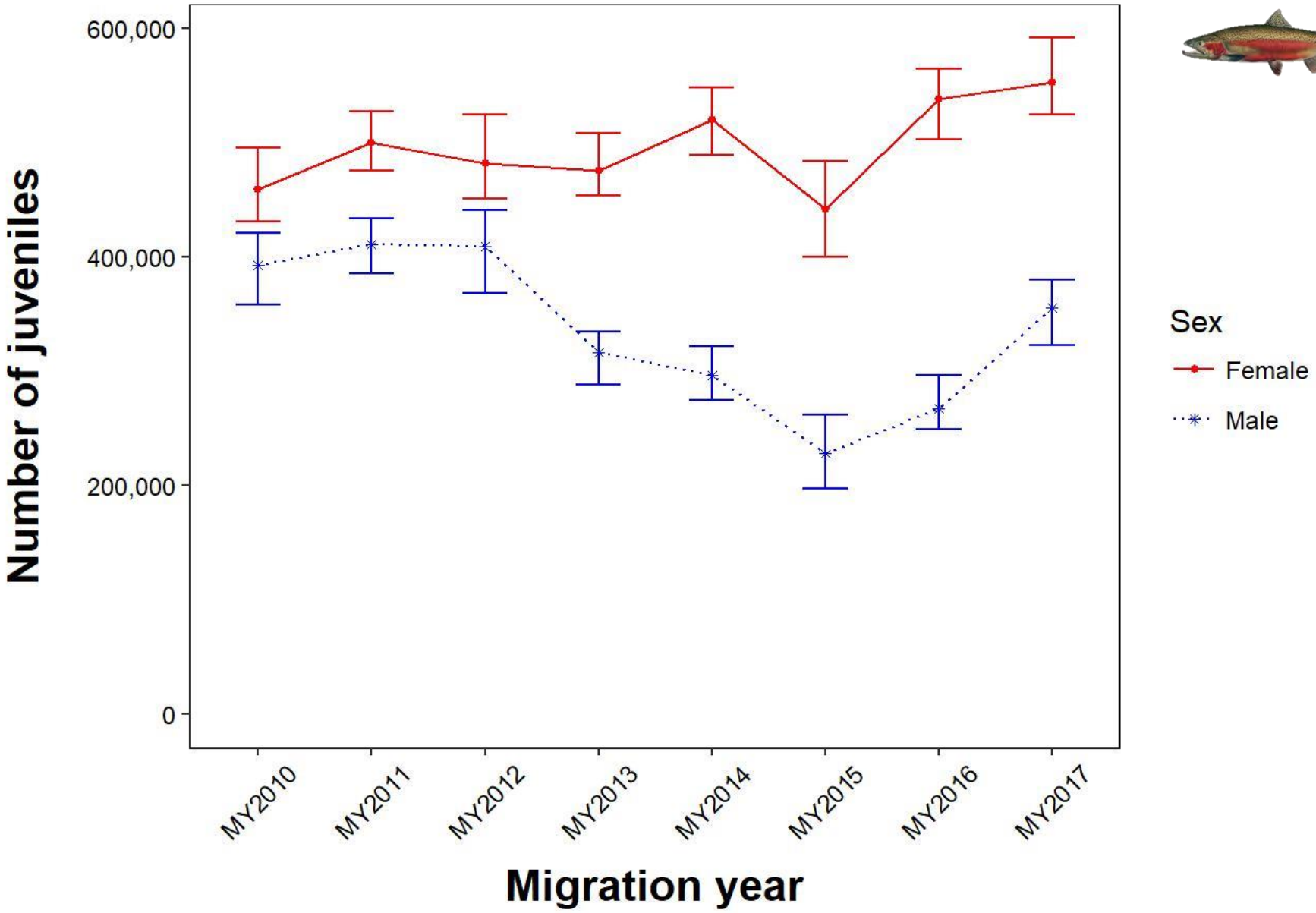
Wild Juvenile Emigration - MPG



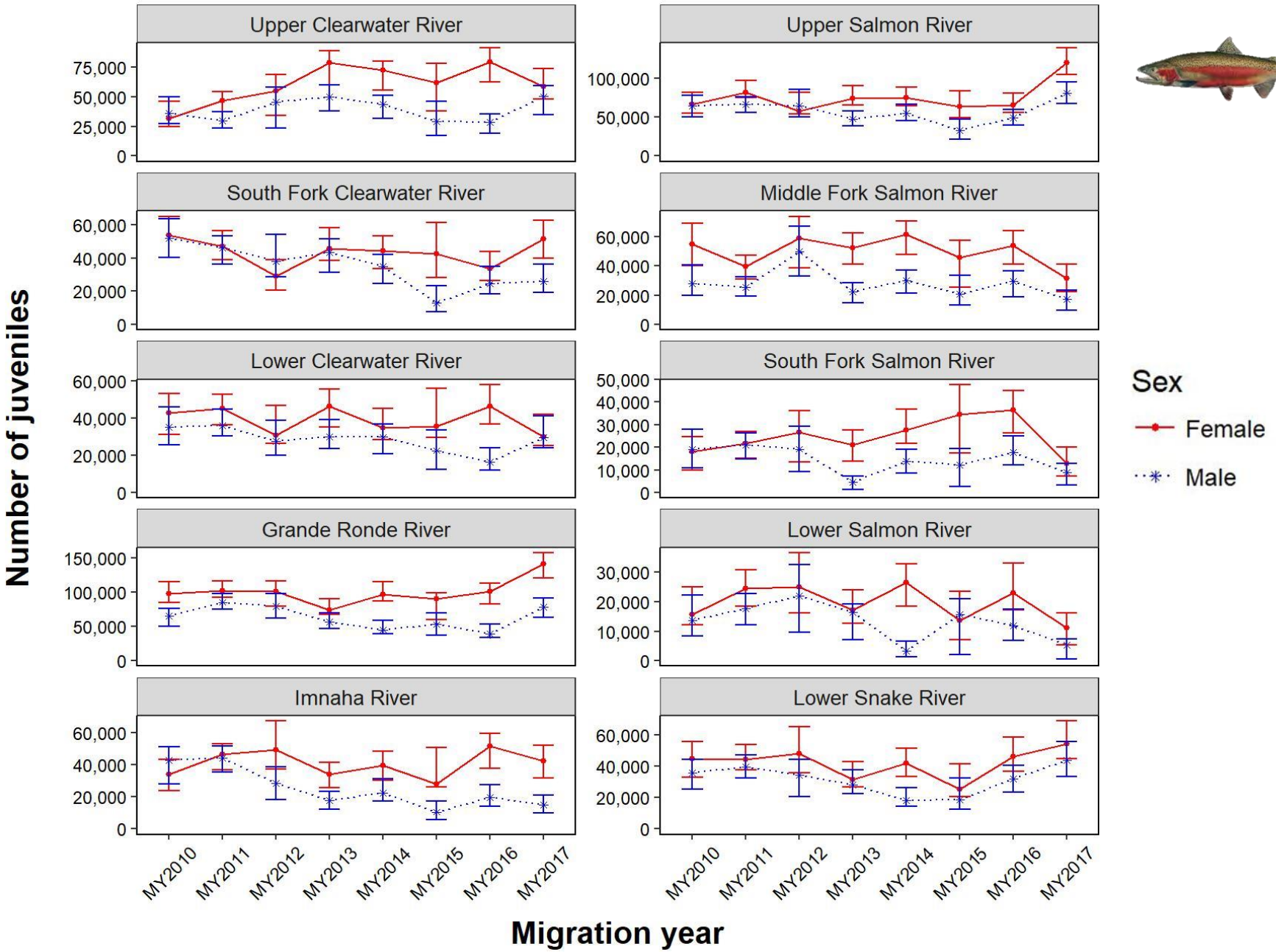
Wild Juvenile Emigration – Genetic Stock



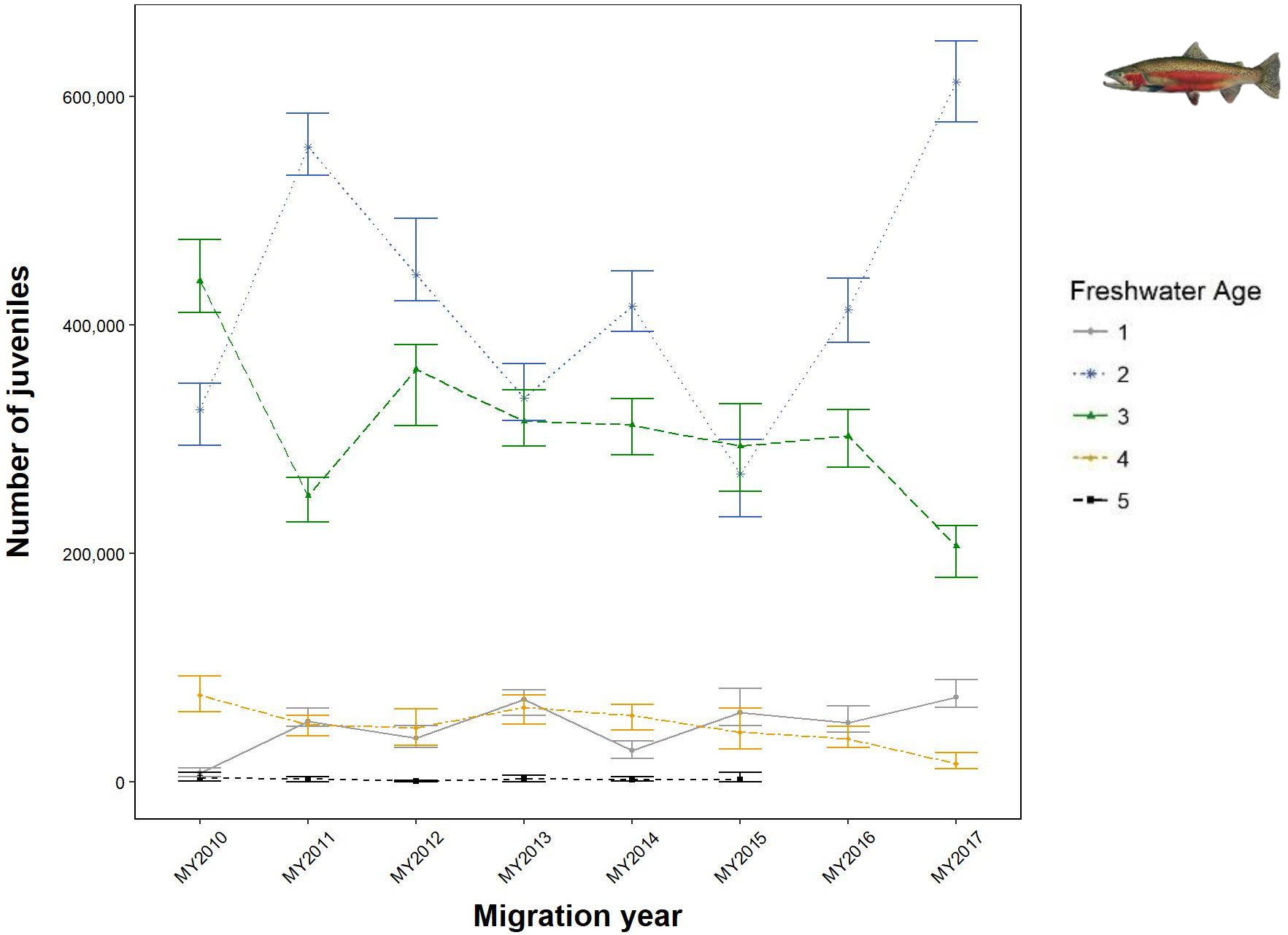
Wild Juvenile Emigration - Sex



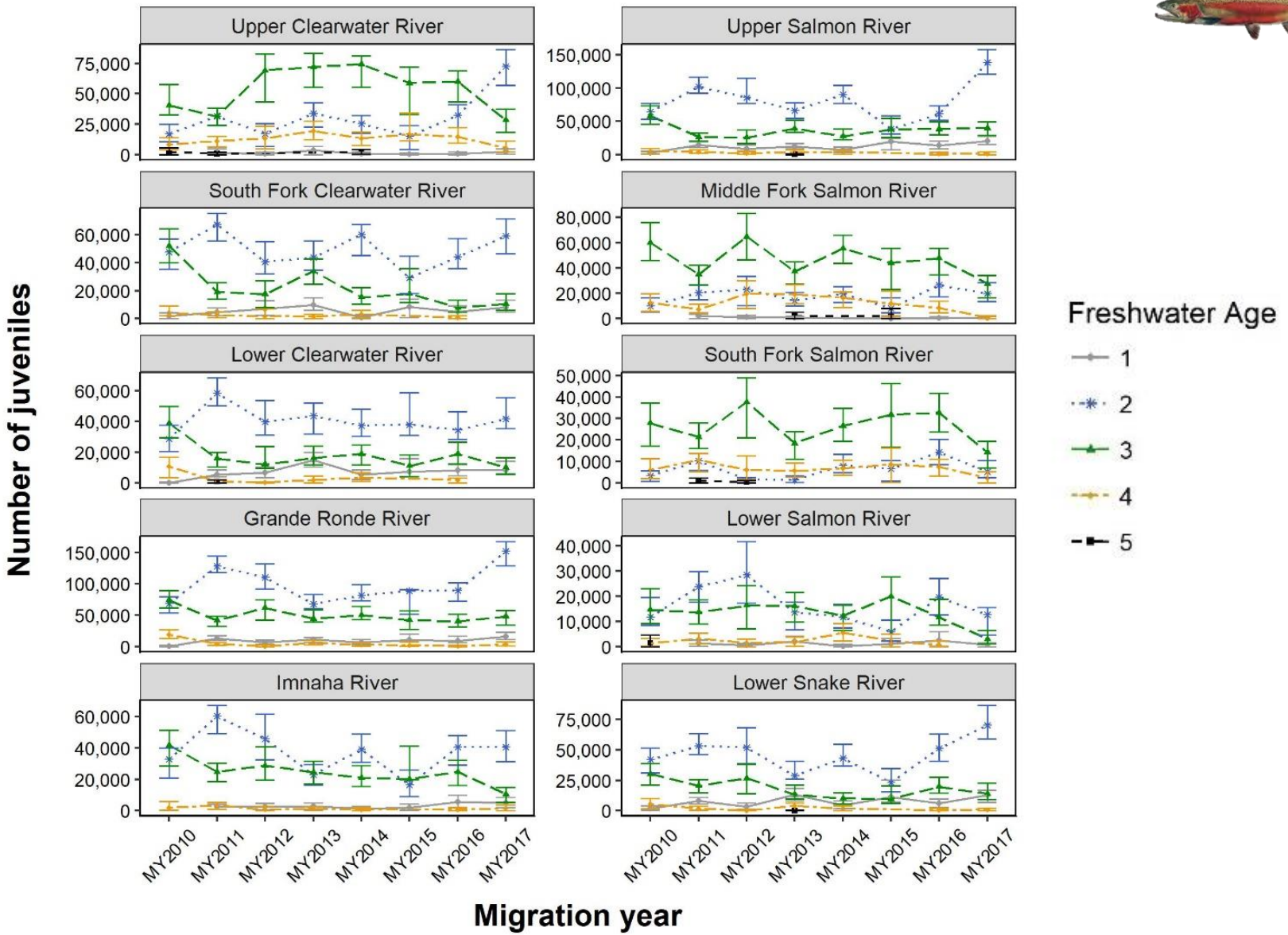
Wild Juvenile Emigration – Genetic Stock by Sex



Wild Juvenile Emigration - Freshwater Age



Wild Juvenile Emigration – Genetic Stock by Freshwater Age



Brood (cohort) Table

Brood Year	Number of Juvenile Recruits					
	Age-1	Age-2	Age-3	Age-4	Age-5	Total
2005	-	-	-	-	3,373	3,373
2006	-	-	-	76,191	2,320	78,511
2007	-	-	438,408	49,996	433	488,837
2008	-	325,957	250,416	47,058	2,807	626,238
2009	7,552	555,648	361,135	65,325	1,896	991,556
2010	53,222	443,850	315,579	58,298	2,103	873,052
2011	38,189	336,186	312,250	43,312	0	729,937
2012	72,140	416,646	293,866	37,961	0	820,613
2013	27,129	269,544	302,436	15,704	-	614,813
2014	60,617	413,454	206,331	-	-	680,402
2015	51,582	612,391	-	-	-	663,973
2016	74,130	-	-	-	-	74,130

Lower Granite Dam

Lower Granite Dam

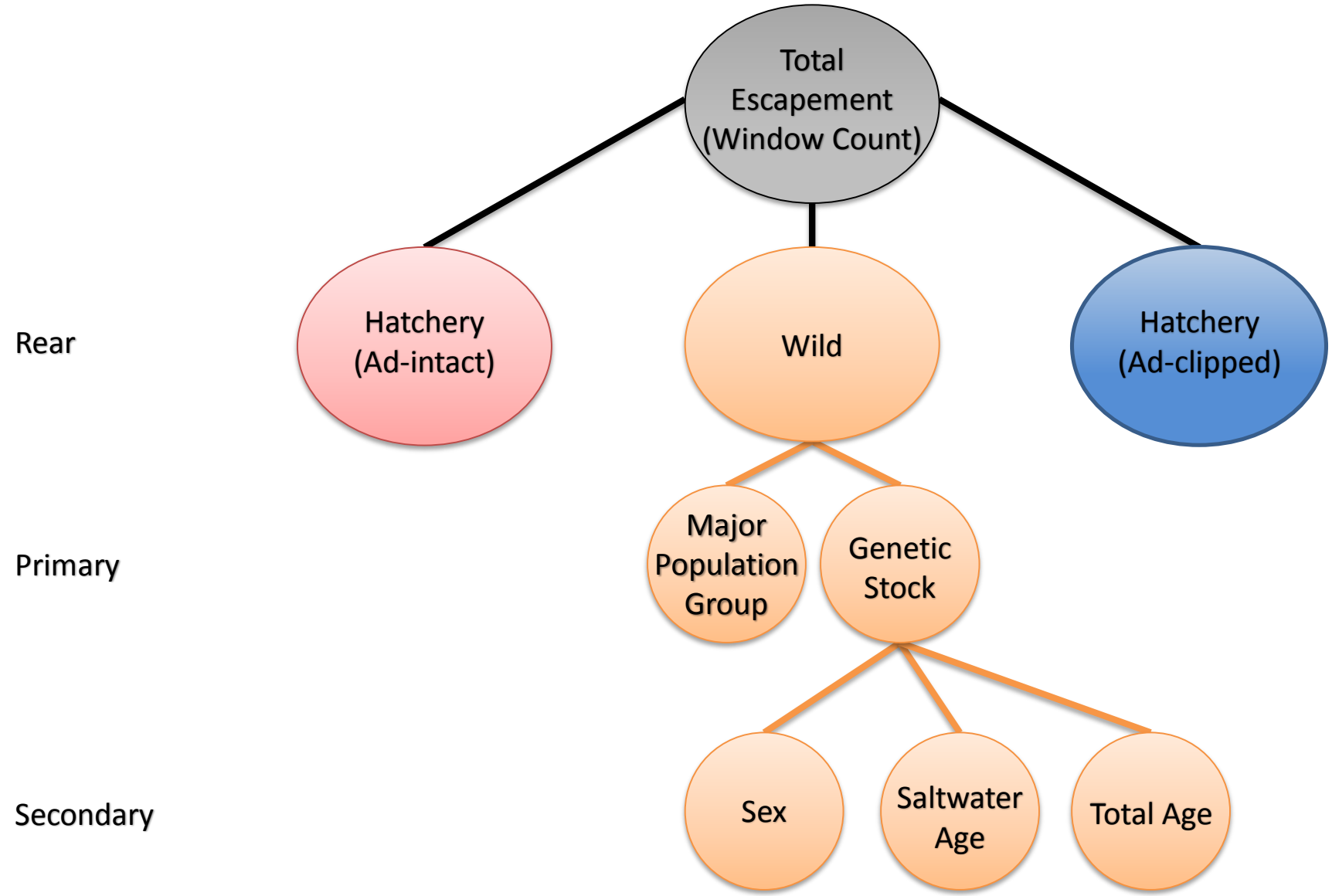
Window Count
(i.e. Almost a census)

Adult Fish Ladder
(i.e. XXL Weir)

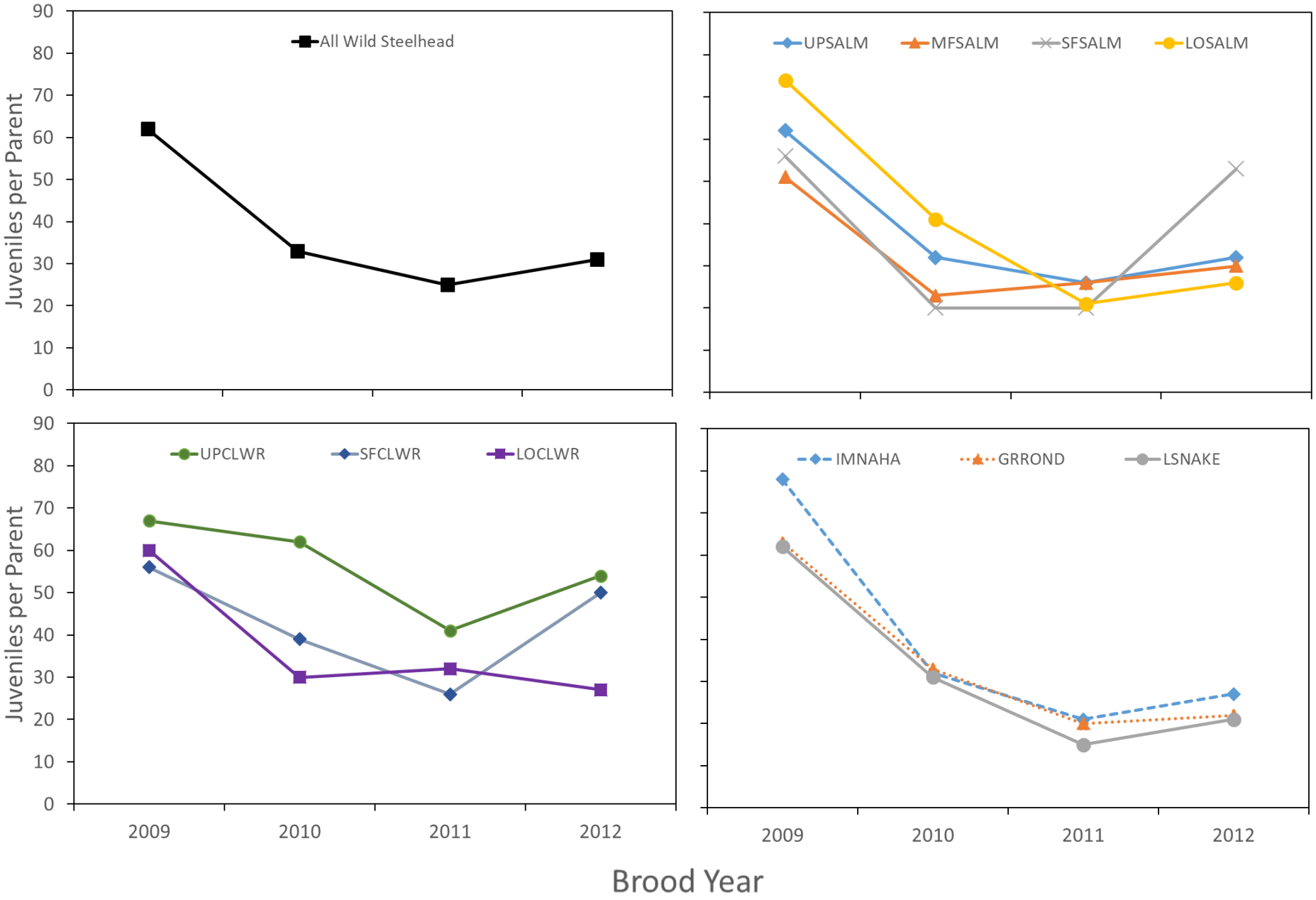
Juvenile Fish Facility
(i.e. Mega Screw Trap)

SCOBI

(**S**almonid **CO**mpositional **B**ootstrap **I**ntervals)

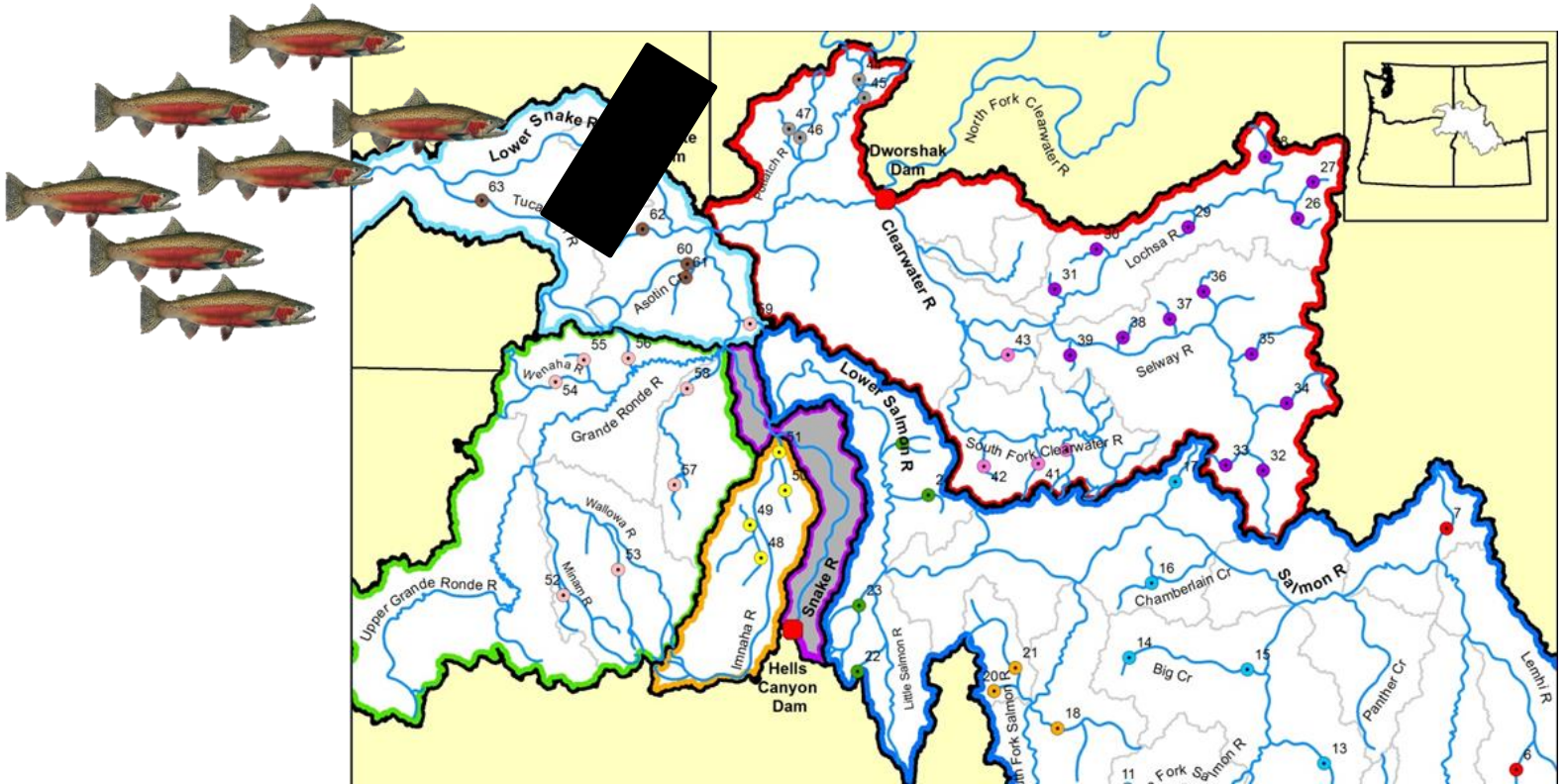


Juveniles per Parent



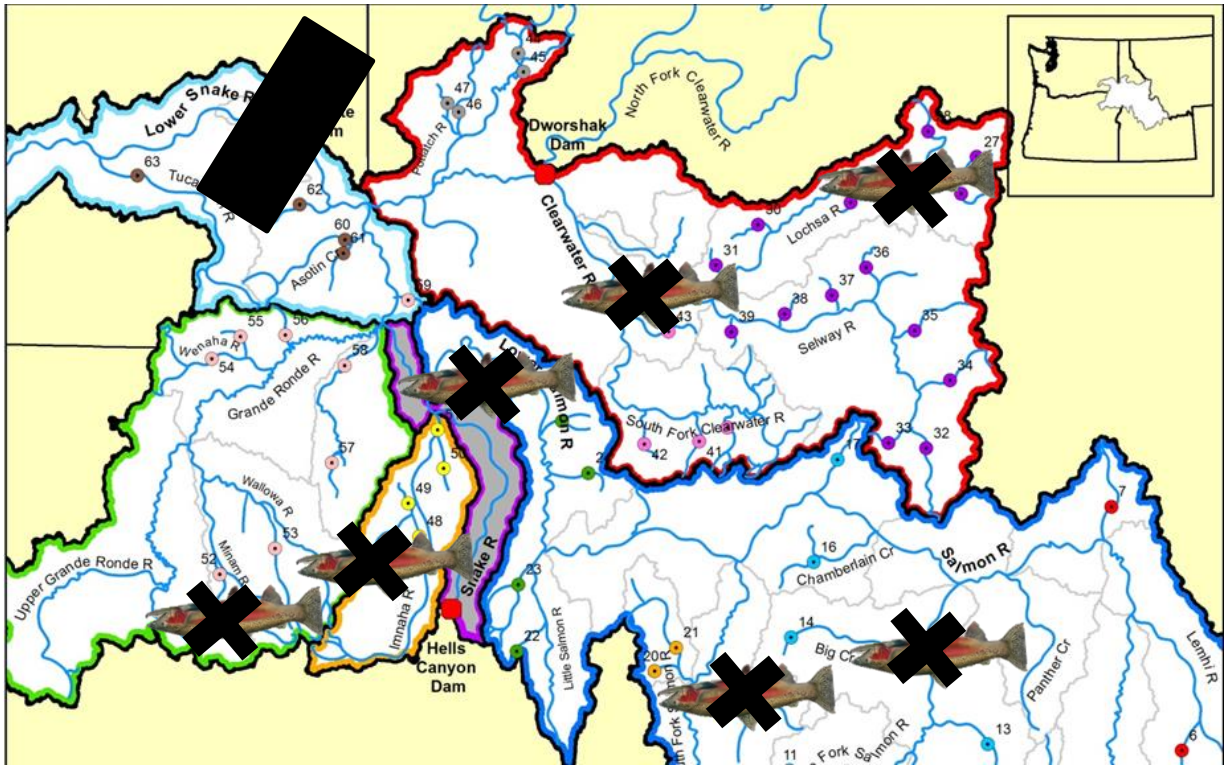
Follow Cohorts Though Life Cycle

Brood Year
2009



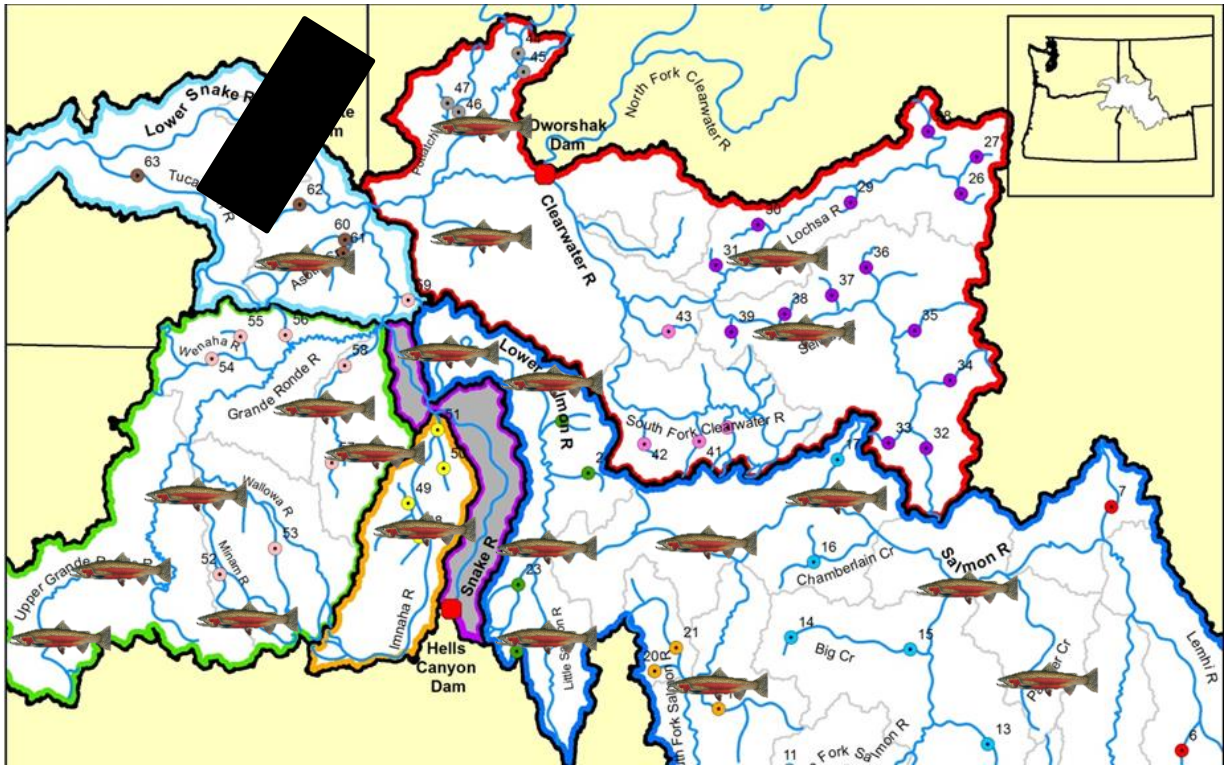
Follow Cohorts Though Life Cycle

Brood Year	Parents
2009	23,875



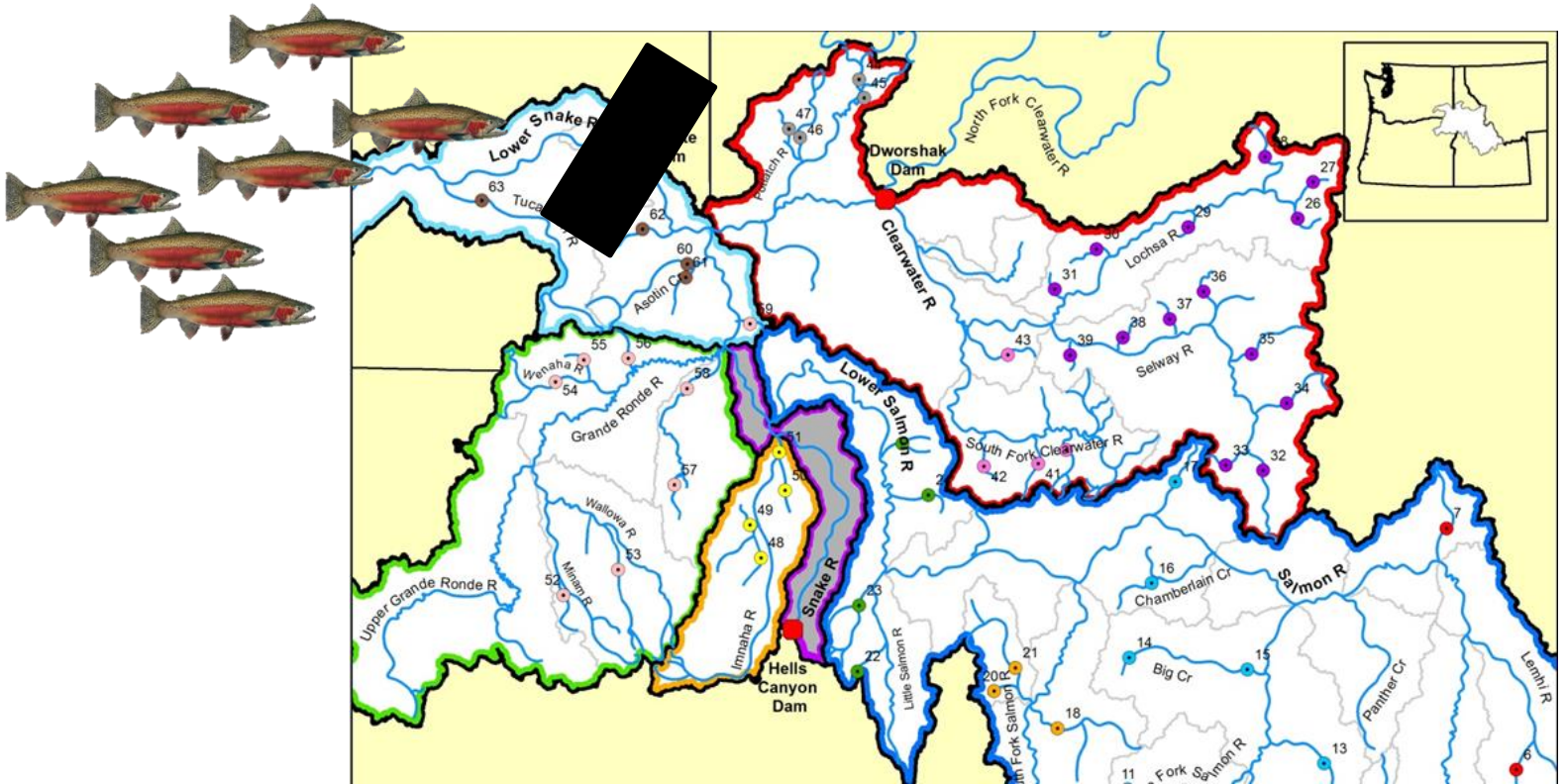
Follow Cohorts Though Life Cycle

Brood Year	Parents
2009	23,875



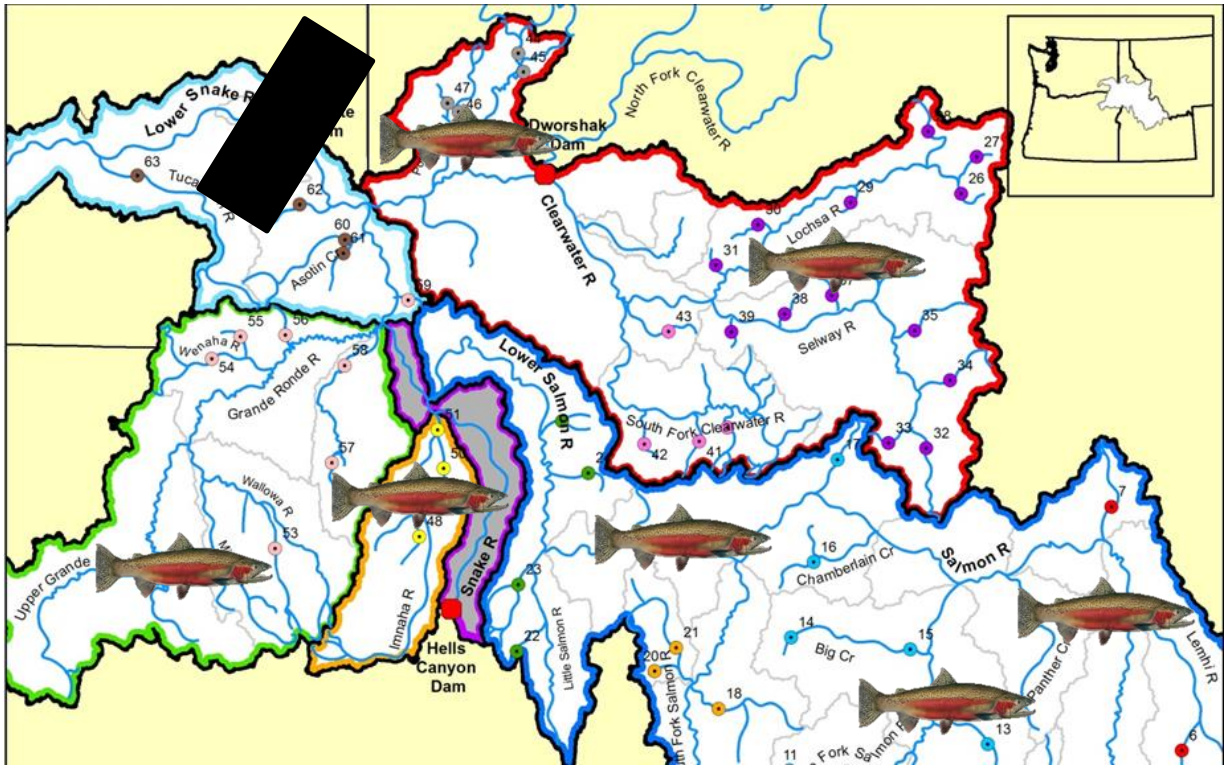
Follow Cohorts Though Life Cycle

Brood Year	Parents	Juvenile Emigration	Juveniles per Parent
2009	23,875	991,556	42



Follow Cohorts Though Life Cycle

Brood Year	Parents	Juvenile Emigration	Juveniles per Parent	Returning Adults	Smolt to Adult	Adult to Parent
2009	23,875	991,556	42	22,964	2.32%	0.96
2010	42,739	873,052	20	43,704	5.01%	1.02
2011	44,133	729,937	17	35,619	4.88%	0.81
2012	39,438	820,613	21	21,126	2.57%	0.55



Summary

Abundance

- Aggregate:
  - Ave = 830,679; Range = 669,442 – 911,602
- MPG:
  - SALMON 32-36%
- Genetic Stock:
  - GRROND 17-24%

- Genetic stocks within a MPG not always synchronous
  - Habitat differences
  - Response to climate variation
  - Differences in life history characteristics

Productivity

- Juvenile per parent (BY2009-2012)
  - Aggregate:
    - Range = 17 - 42
  - Genetic Stock
    - followed aggregate trend except UPCLWR & SFSALM

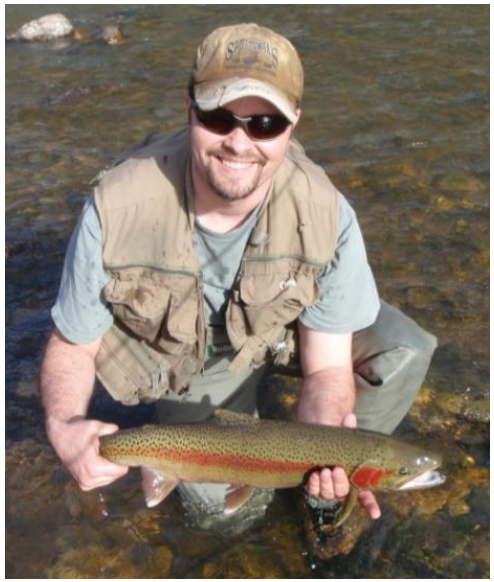
- Smolt to Adult
  - BY2009: 1.21 – 3.02

Summary

Life History Diversity

- Female biased at the aggregate but not always within each genetic stock
    - Residual males
        - Female to female productivity
            - Iteroparous females

- Freshwater age: 4 to 5 classes
    - Age-2 and age-3 dominate
    - More age-3 in traditionally larger fish (≥78 cm) populations



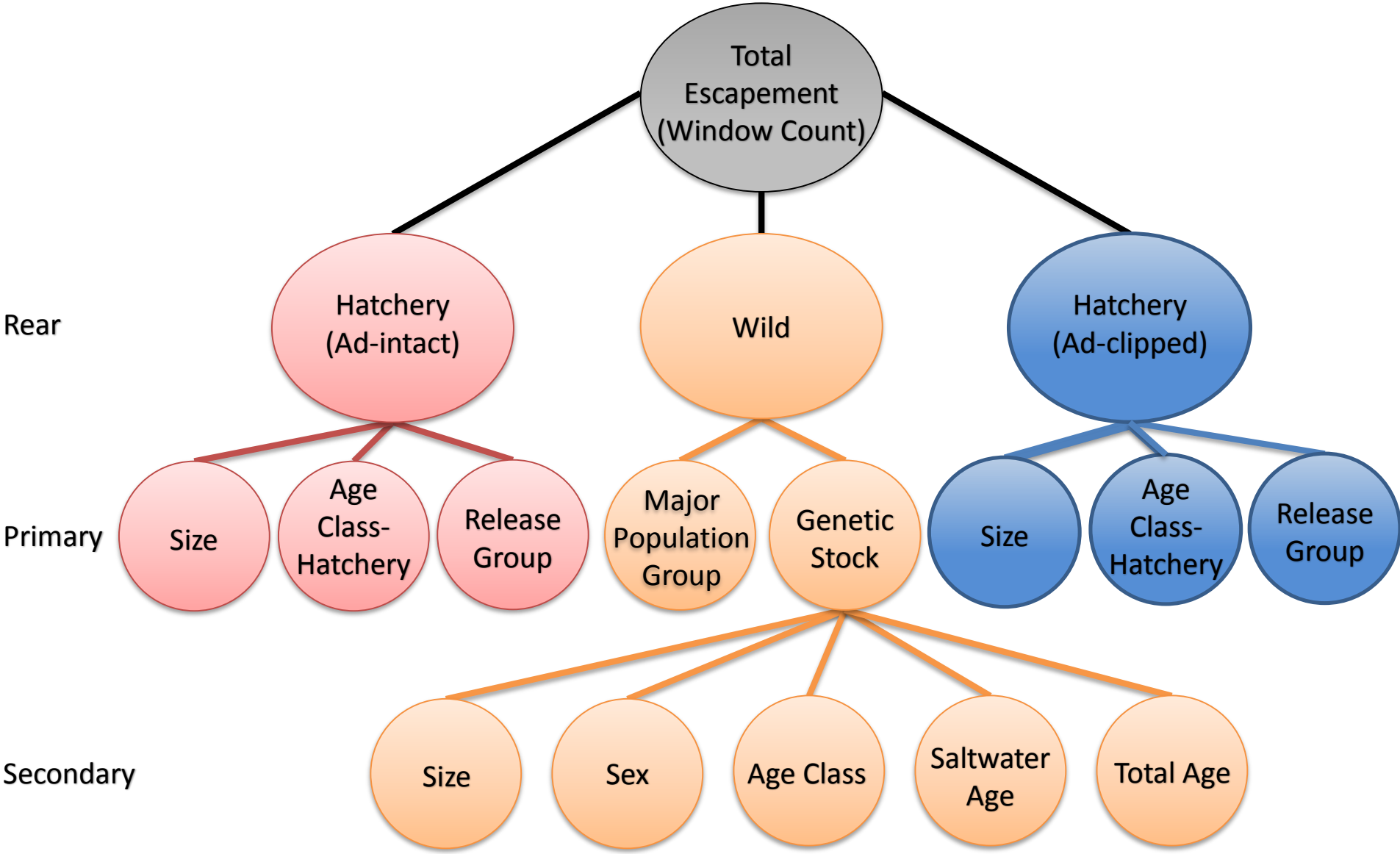
Summary

- Just the start….
- Removal of hatchery = true wild smolt abundance
- Running dataset for Wild Snake River steelhead
  - Size/Abundance
  - Growth Rates/Productivity
  - Diversity
  - Spatial Structure
- Useful for exploring relationships and mechanisms
  - forecast run sizes (aggregate or stock)
    - preliminary Columbia River Basin fisheries management plans

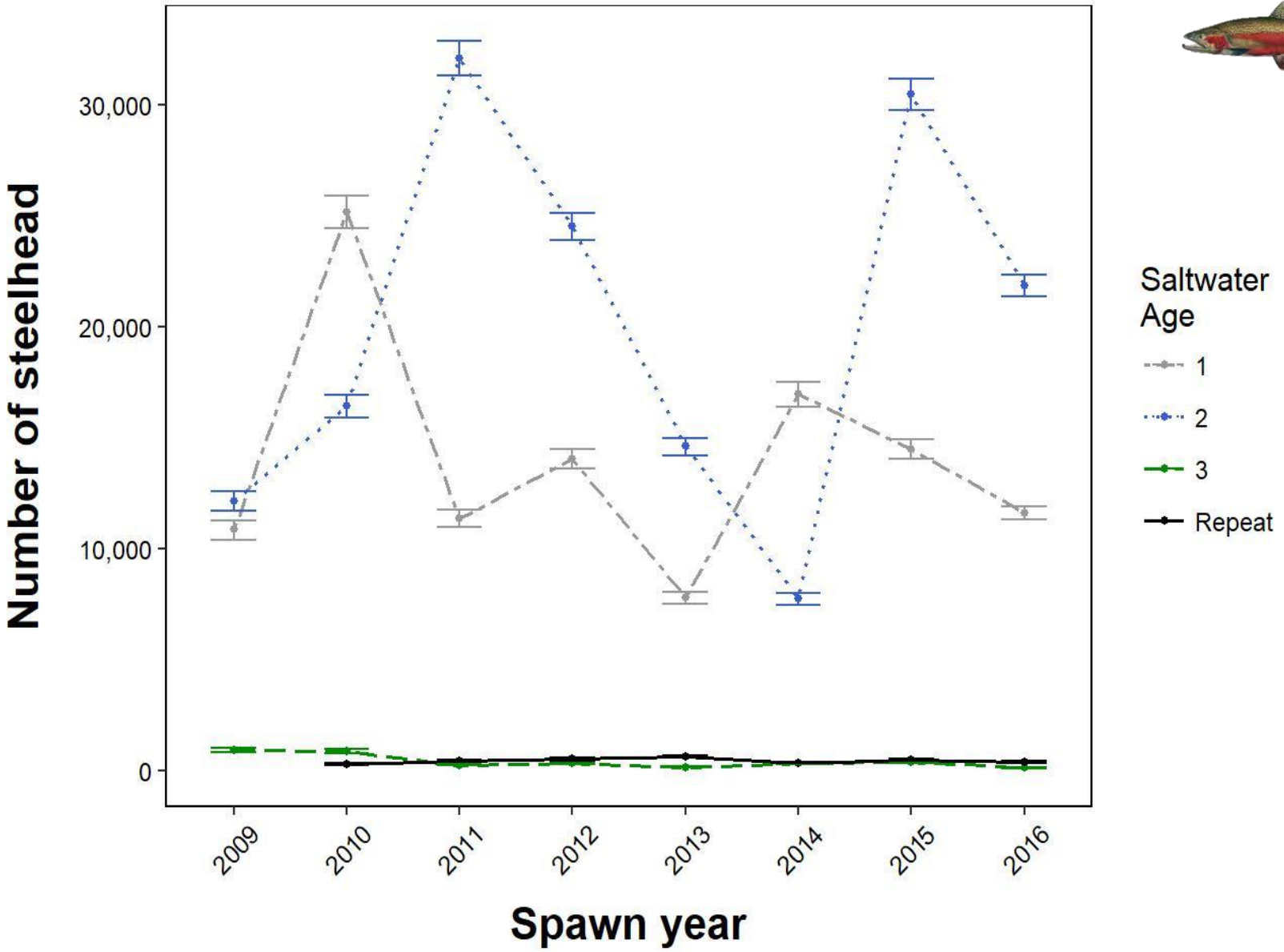
Acknowledgments

Questions

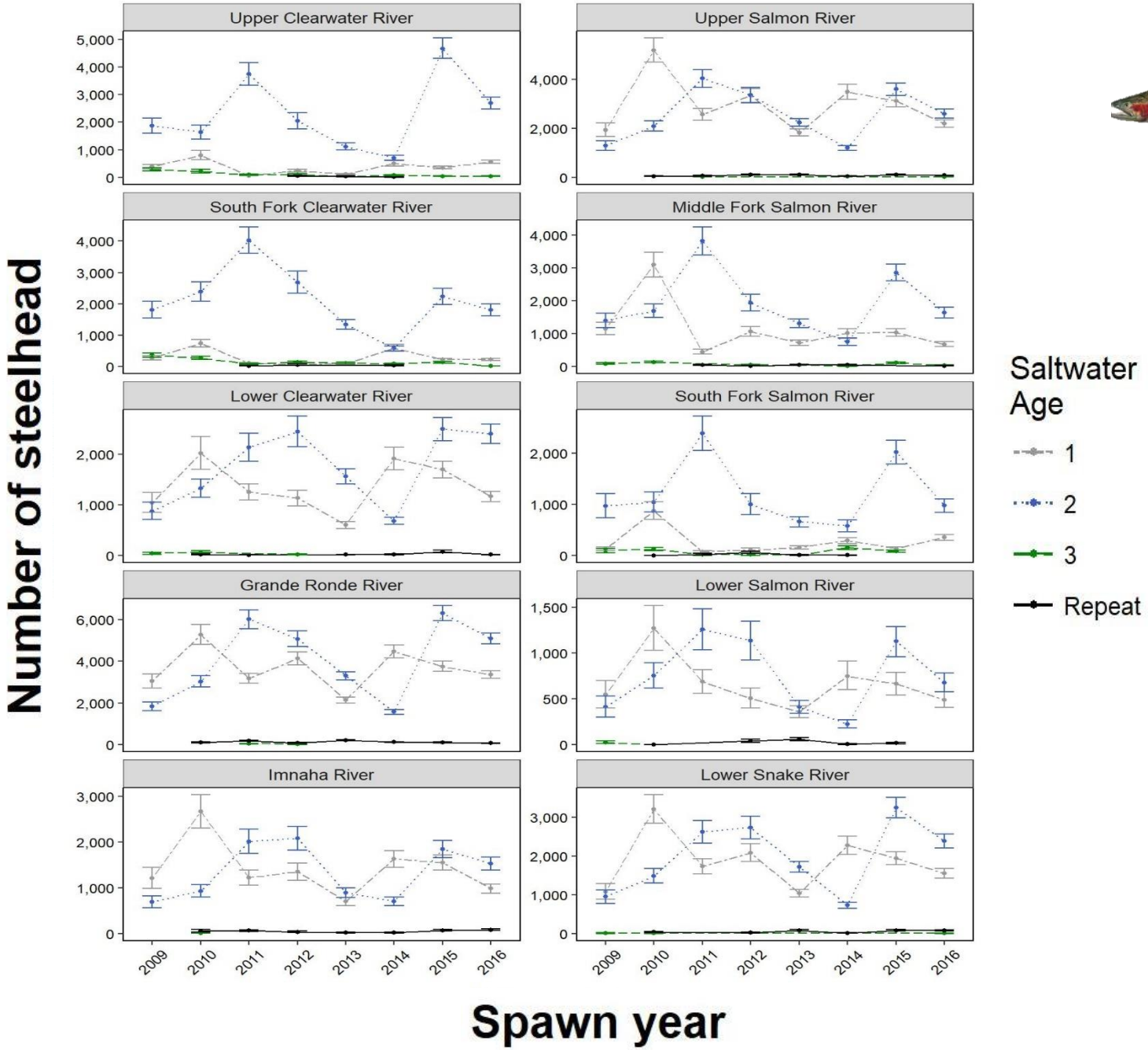
Salmonid **CO**mpositional **B**ootstrap **I**ntervals (**SCOBI**)



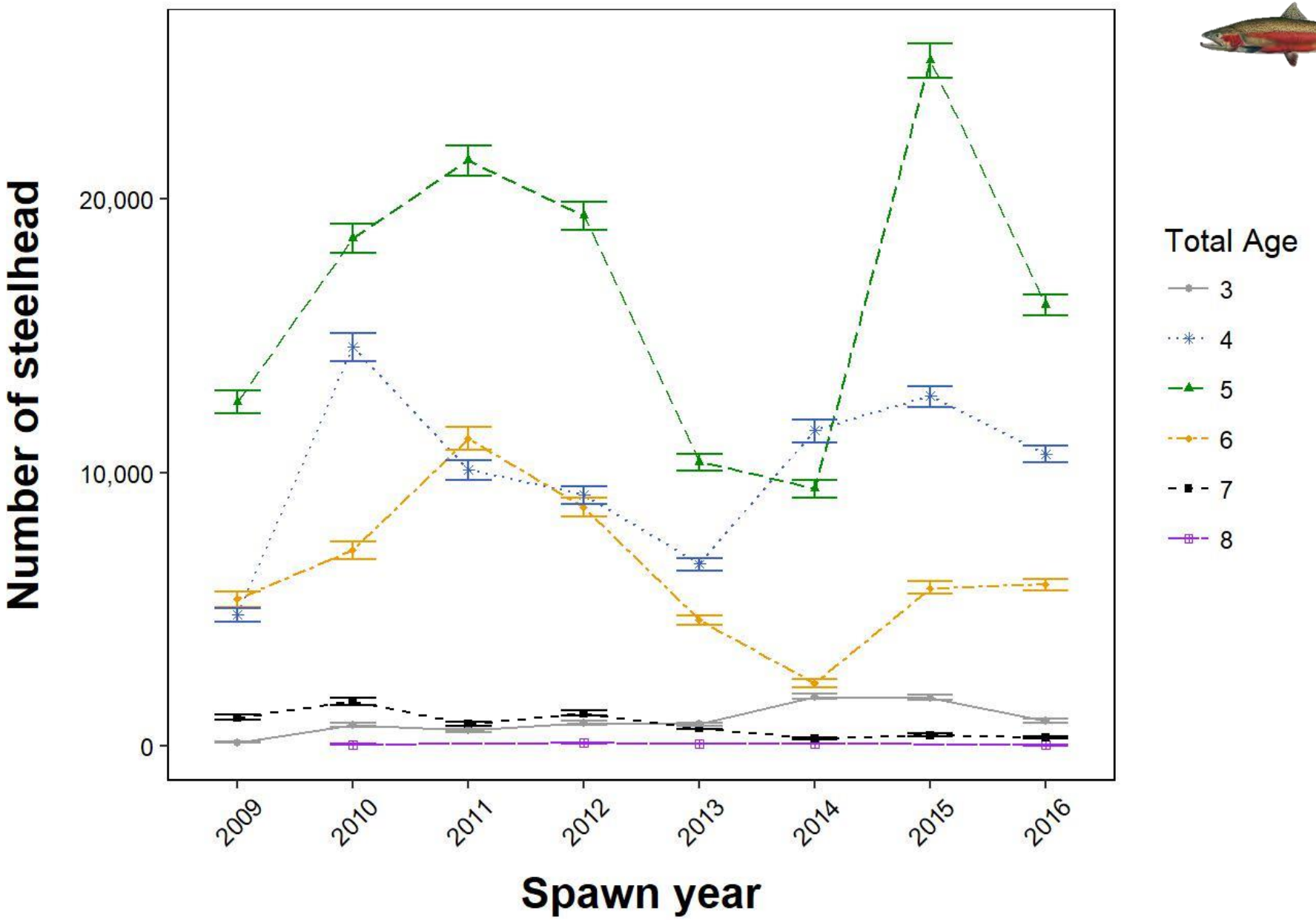
Wild Escapement - Saltwater Age



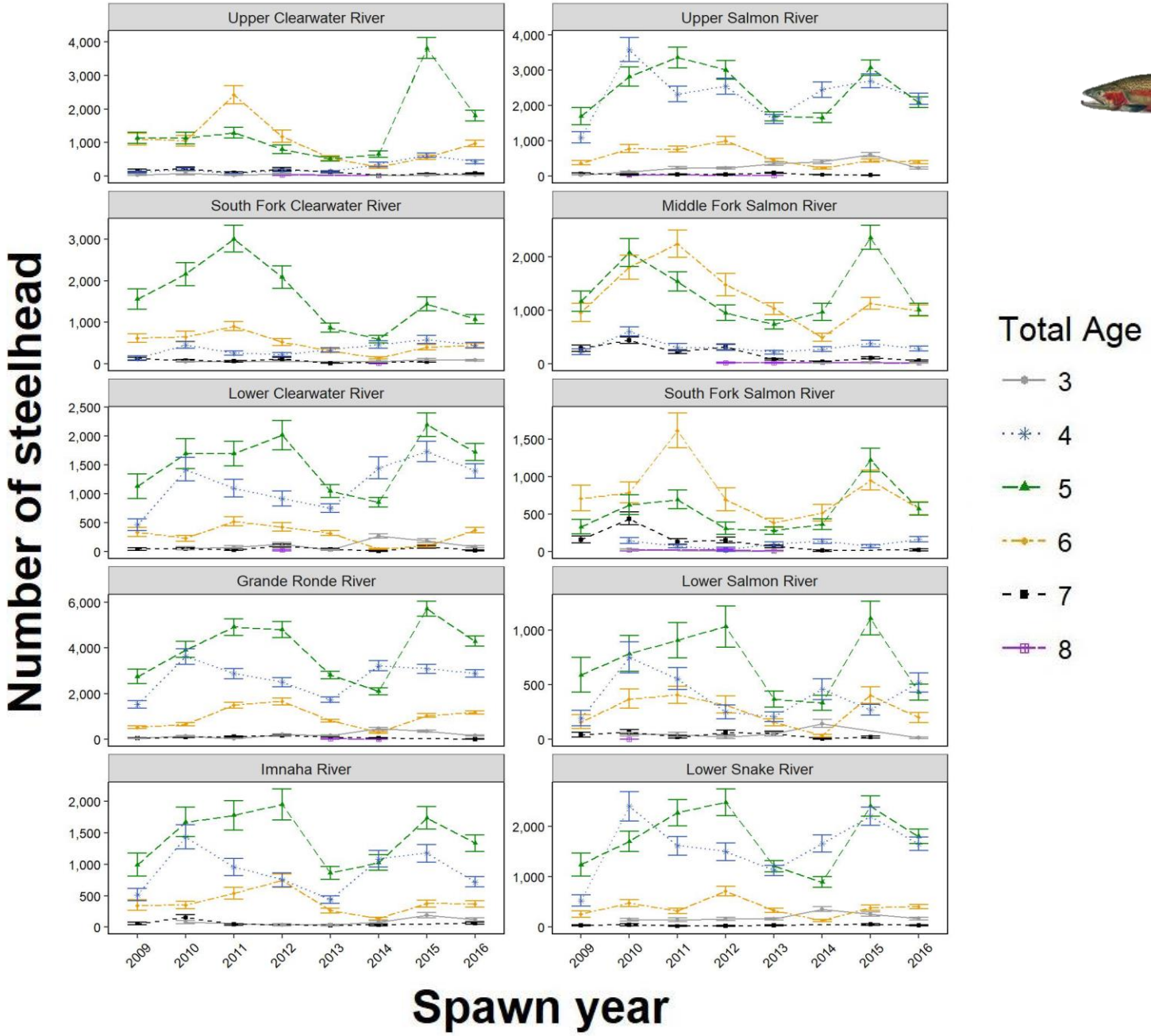
Wild Escapement – Genetic Stock by Saltwater Age



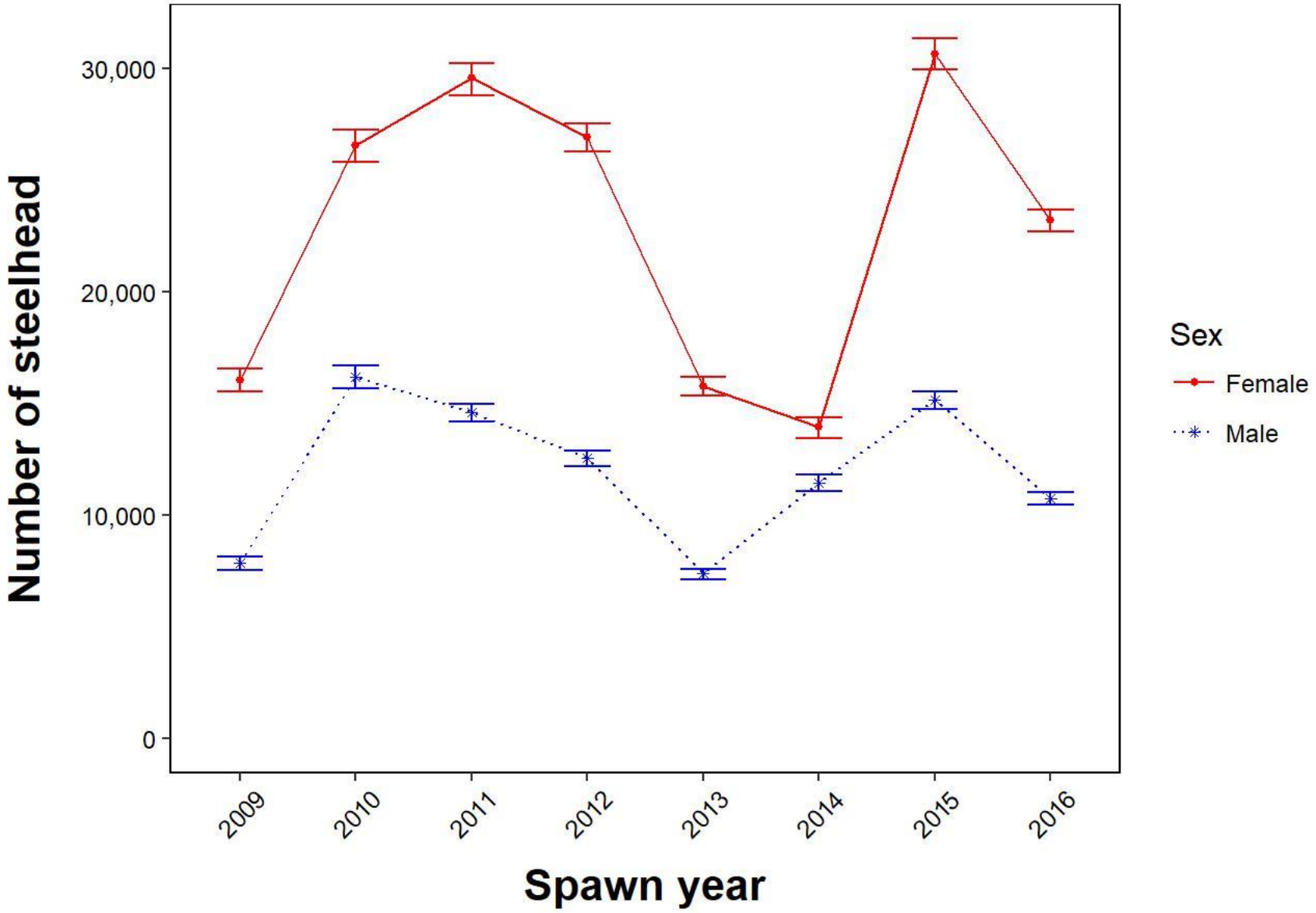
Wild Escapement - Total Age



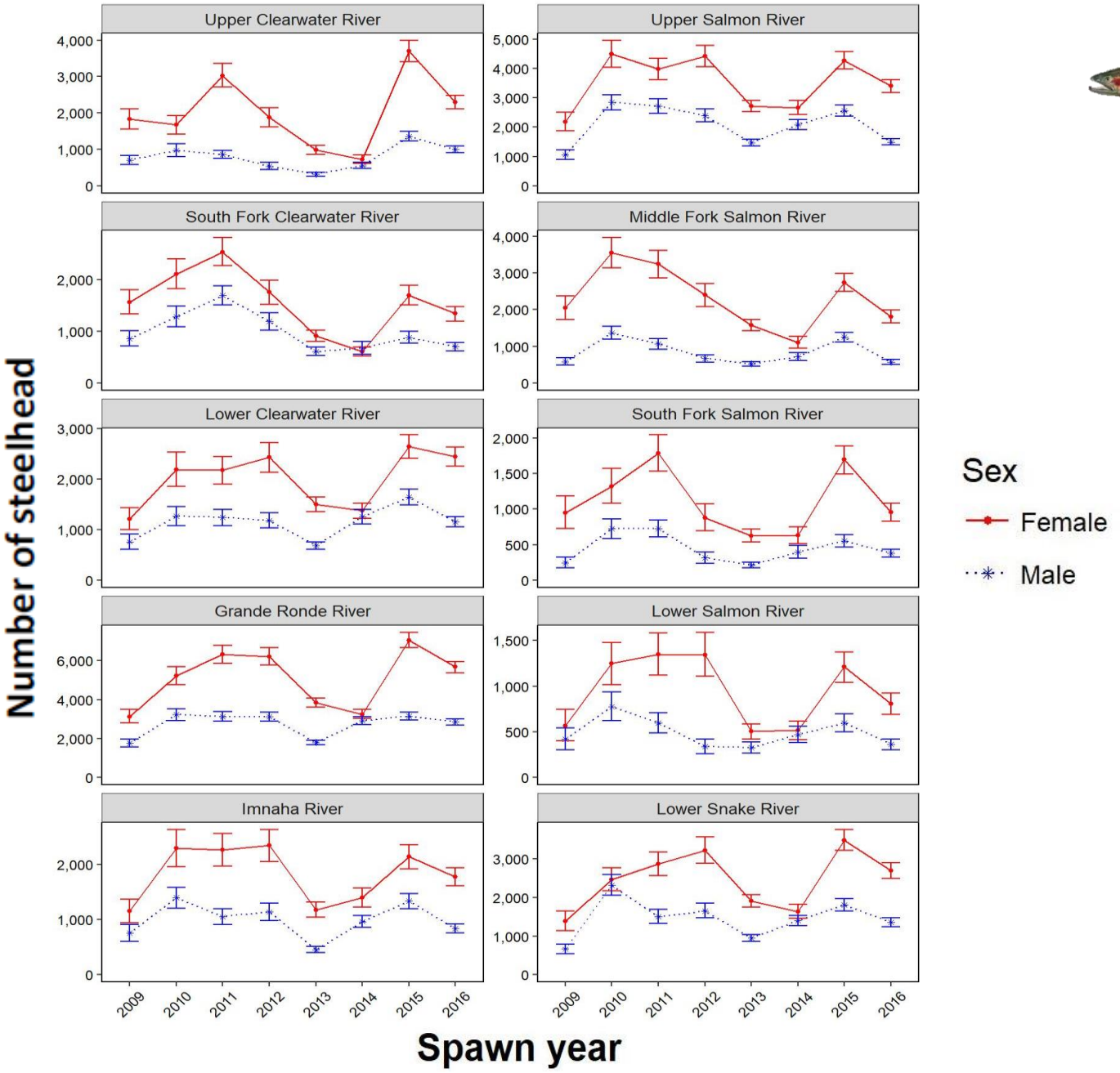
Wild Escapement – Genetic Stock by Total Age



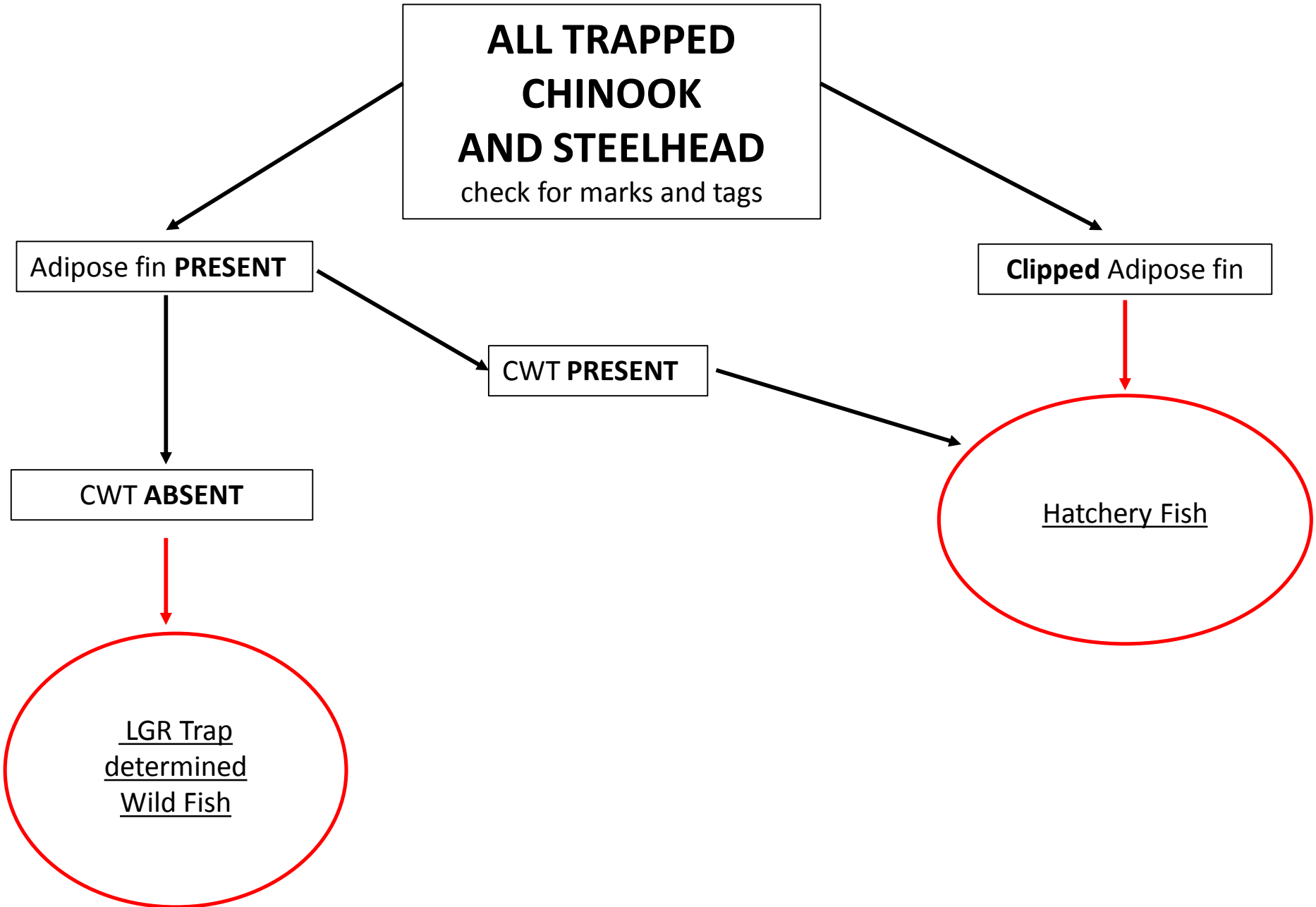
Wild Escapement - Sex



Wild Escapement - Genetic Stock by Sex



Rear Determination



Rear Determination - Post Hoc