Reproductive Success of Artificially Reconditioned Kelt Steelhead in the Yakima River

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- CRITFC Genetics Crew
- Prosser Hatchery Crew

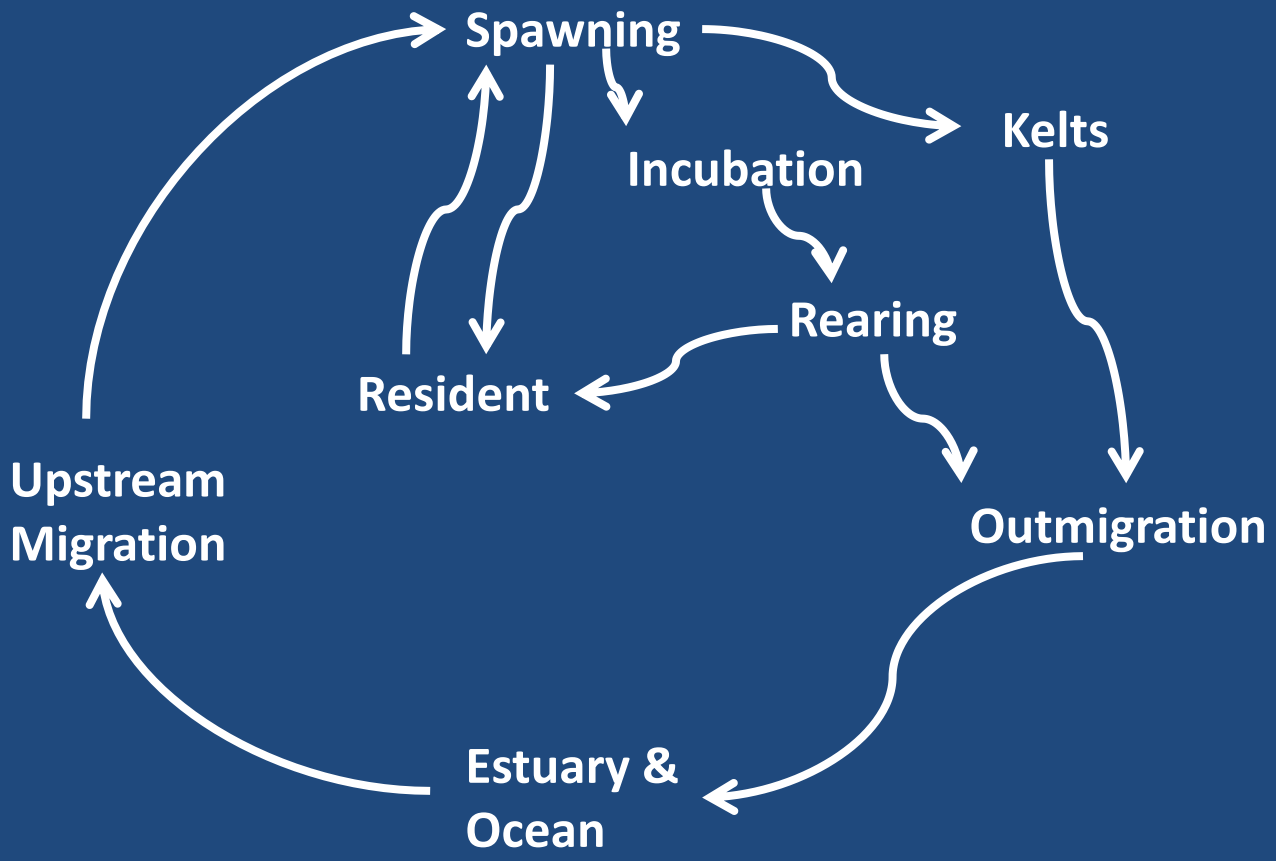
Outline

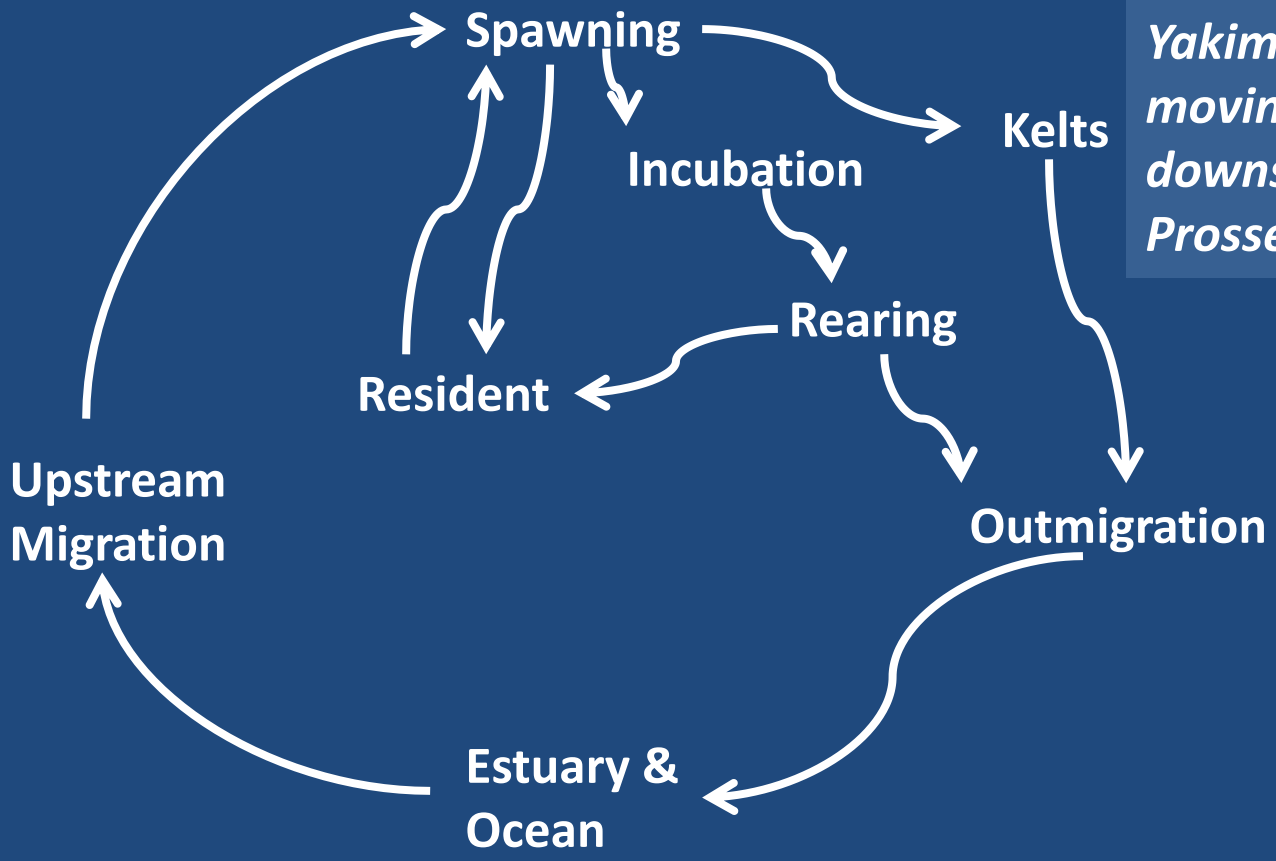
- Provide some background on the kelt reconditioning program
- Present research questions for this study
- Preliminary results and some interpretation of parentage analysis

Natural Reproductive Success

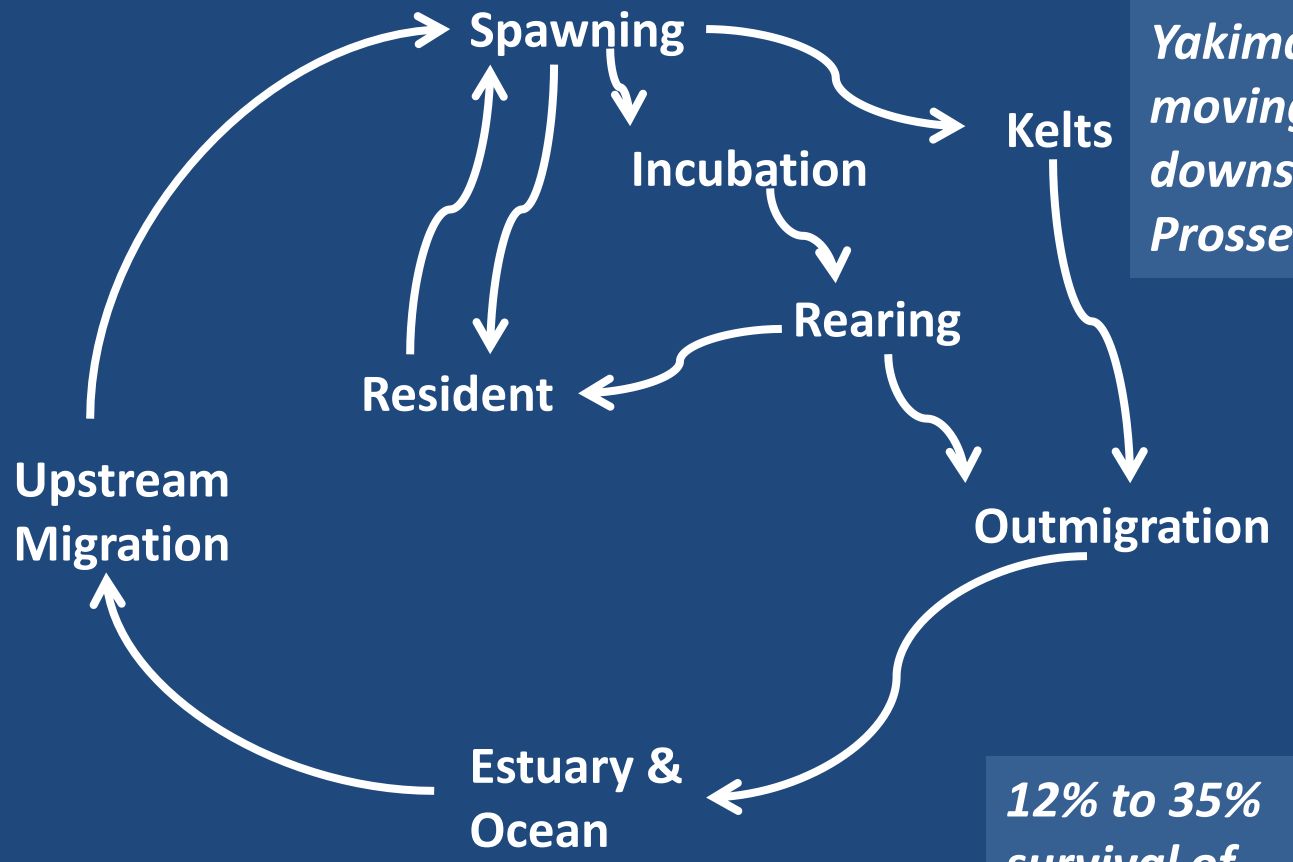
- Seamons & Quinn 2010 studied 19 Brood years of a wild population of steelhead
  - Theorized that: “lifetime reproductive success (LRS)….. should scale with the number of breeding seasons”
  - Found that: female repeat spawners had “nearly twice” the success of one time spawners

Life history of natural kelts in Yakima





~70% of the Yakima run is moving downstream of Prosser



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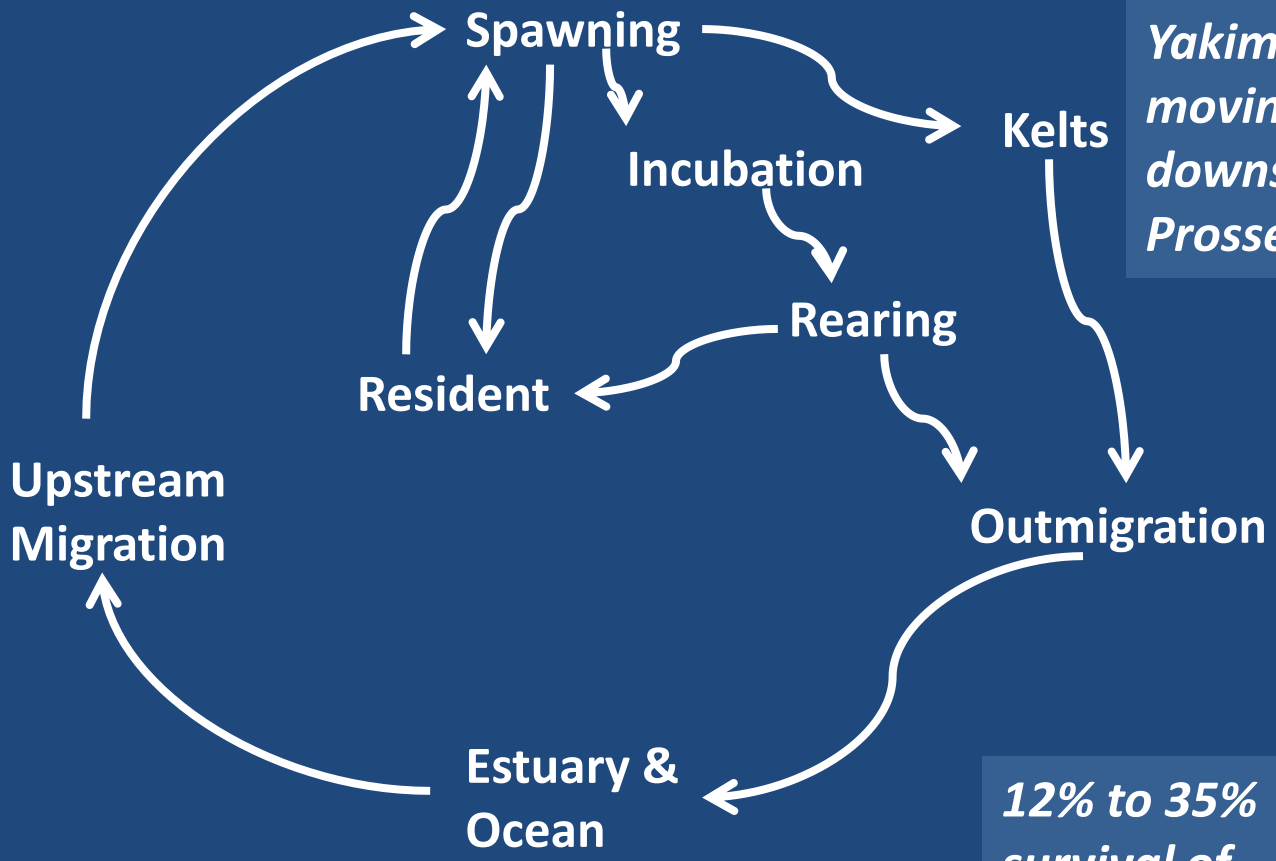
12% to 35% survival of Yakima kelts to the ocean



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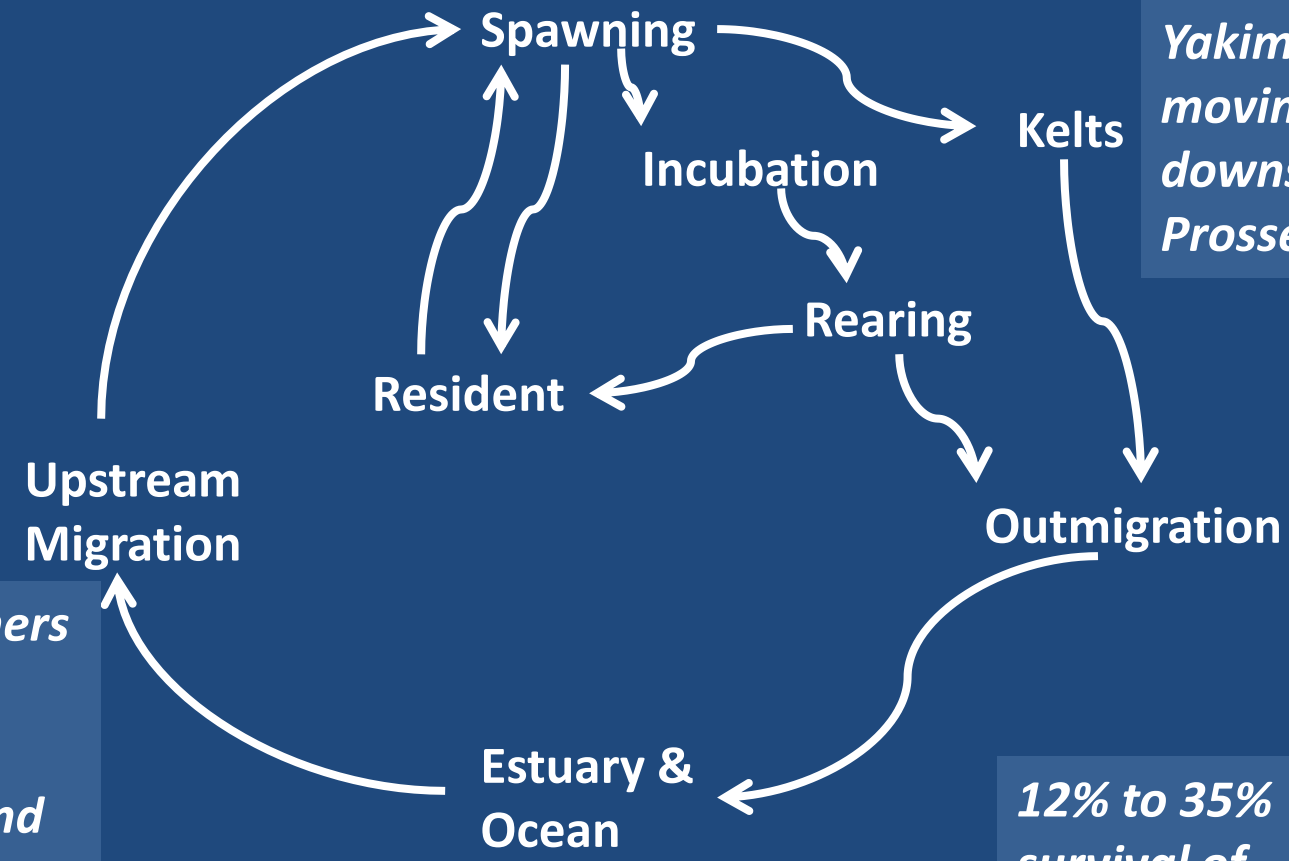
high seas samples contain 7.2% previous spawners



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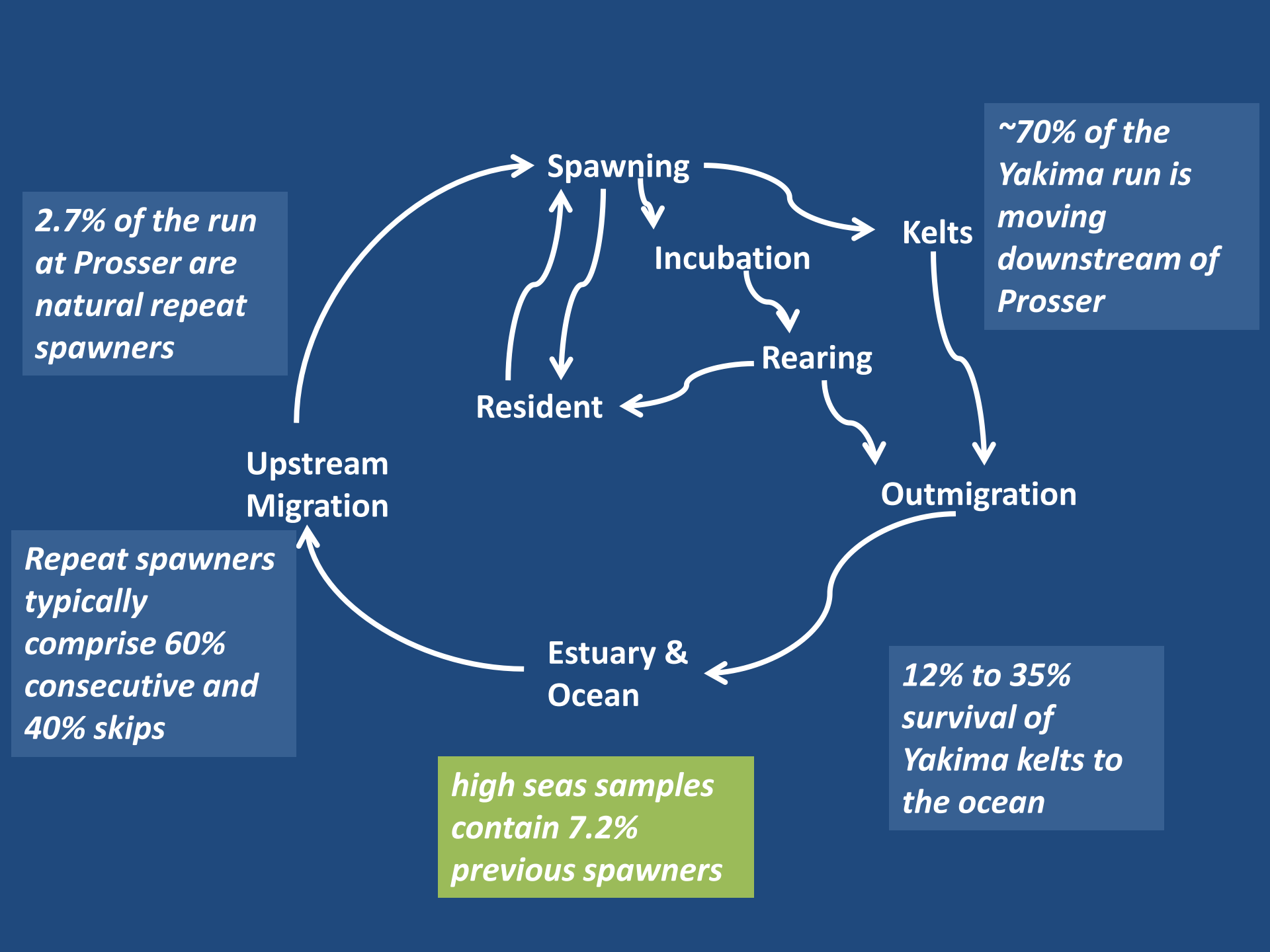

Spawning
Incubation
Rearing
Resident
Kelts
Outmigration
Estuary & Ocean
Upstream Migration
2.7% of the run at Prosser are natural repeat spawners
~70% of the Yakima run is moving downstream of Prosser
Repeat spawners typically comprise 60% consecutive and 40% skips
12% to 35% survival of Yakima kelts to the ocean
high seas samples contain 7.2% previous spawners

Artificial Reconditioning In the Yakima River to date

- Capture and feed for 6 to 9 Months
- Collected 8,110 kelt steelhead
- Reconditioned and released 3,305
- Survival to release ~ 40%
- Individual survival correlated with fish condition
- *Hatch et al. 2013. NAJFM 33(3)*

Research Questions

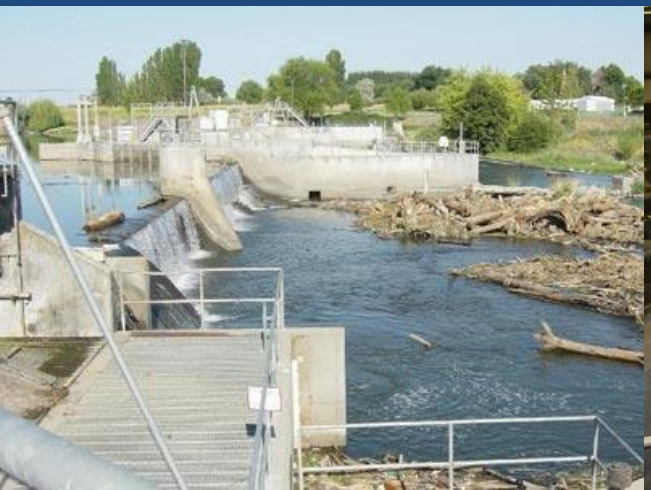
1. Do artificially reconditioned kelt steelhead reproduce in the wild?
2. What is the relative reproductive success (RRS) of artificially reconditioned kelt steelhead?
3. What is the lifetime reproductive success (LRS) of artificially reconditioned kelt steelhead?

Logistical Issues

- Limited power due to sampling a small proportion of the population
- Incidental sampling of resident offspring
- Need to know juvenile age
- No data for skip spawners
- No data for naturally reconditioned kelts
- Currently have only two years of data

Parent Collections-Female Only

- Pre-spawn maidens. Upstream at Prosser
- Post-spawn maidens. Downstream at Chandler
- Reconditioned Kelts. Upstream at Prosser
  - Includes known non-rematuring fish

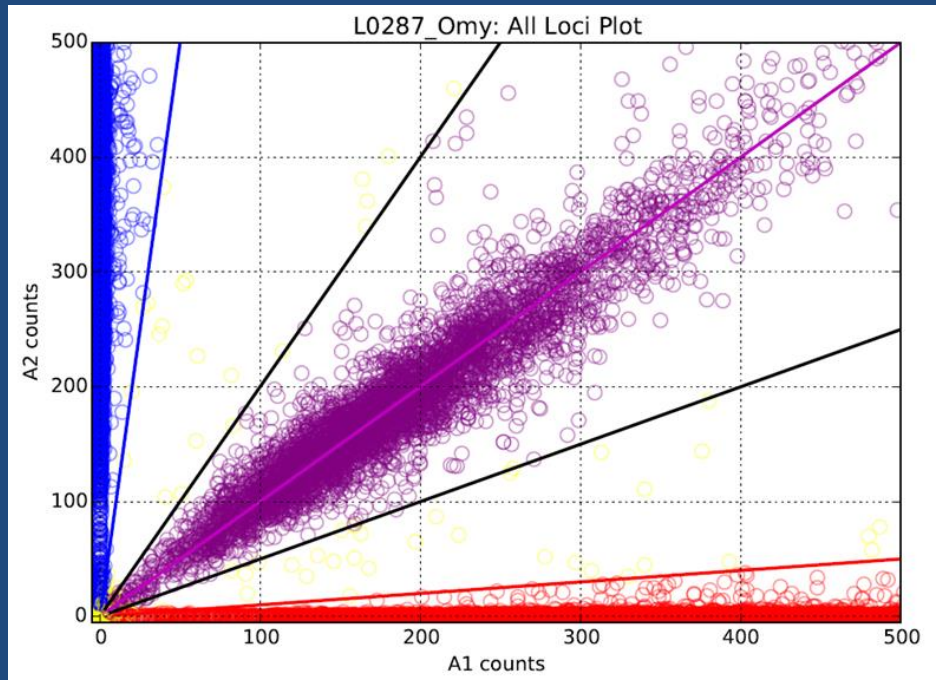


Offspring collections

- Electrofished in August and September
- Targeted areas with known steelhead spawning
- Targeted age-0 young of the year

Genotyping Methods

- Genotyped 192 SNP markers using targeted amplicon sequencing on Illumina Hiseq 1500
- Dropped 40 markers
  - 35 with low diversity (MAF < 0.05)
  - 3 cutthroat diagnostic
  - 1 poor genotypes
  - 1 sex marker



Sample with Genotypes

- 1,440 Genotyped Parents

	2013	2014
Pre-spawn maidens	306	287
Post-spawn maidens	307	239
Reconditioned kelts	209	92

- 1,161 Genotyped Offspring

	2013	2014
Satus Creek	248	234
Toppenish Creek	300	257
Naches River		89
Big Creek		19
Ahtanum Creek		14

Parentage Method

- Used the Program CERVUS
- Simulations ran to determine a 99% confidence interval for LOD scores (natural log of overall likelihood ratio).
- Progeny assignments were used if
  - Met 99% confidence interval
  - Had one or less mismatching loci. Allows for minor genotyping error

Parentage Results

- Juveniles assignment rates
  - 2013: 19% (105 of 548) to at least 1 parent
  - 2014: 30% (148 of 491) to at least 1 parent

- Parent assignment rates
  - 2013: 5.6% (46 of 822) had at least 1 progeny
  - 2014: 7.9% (49 of 618) had at least 1 progeny

- Low detection rates are the result of the low proportions of parents and progeny sampled throughout the Yakima Basin

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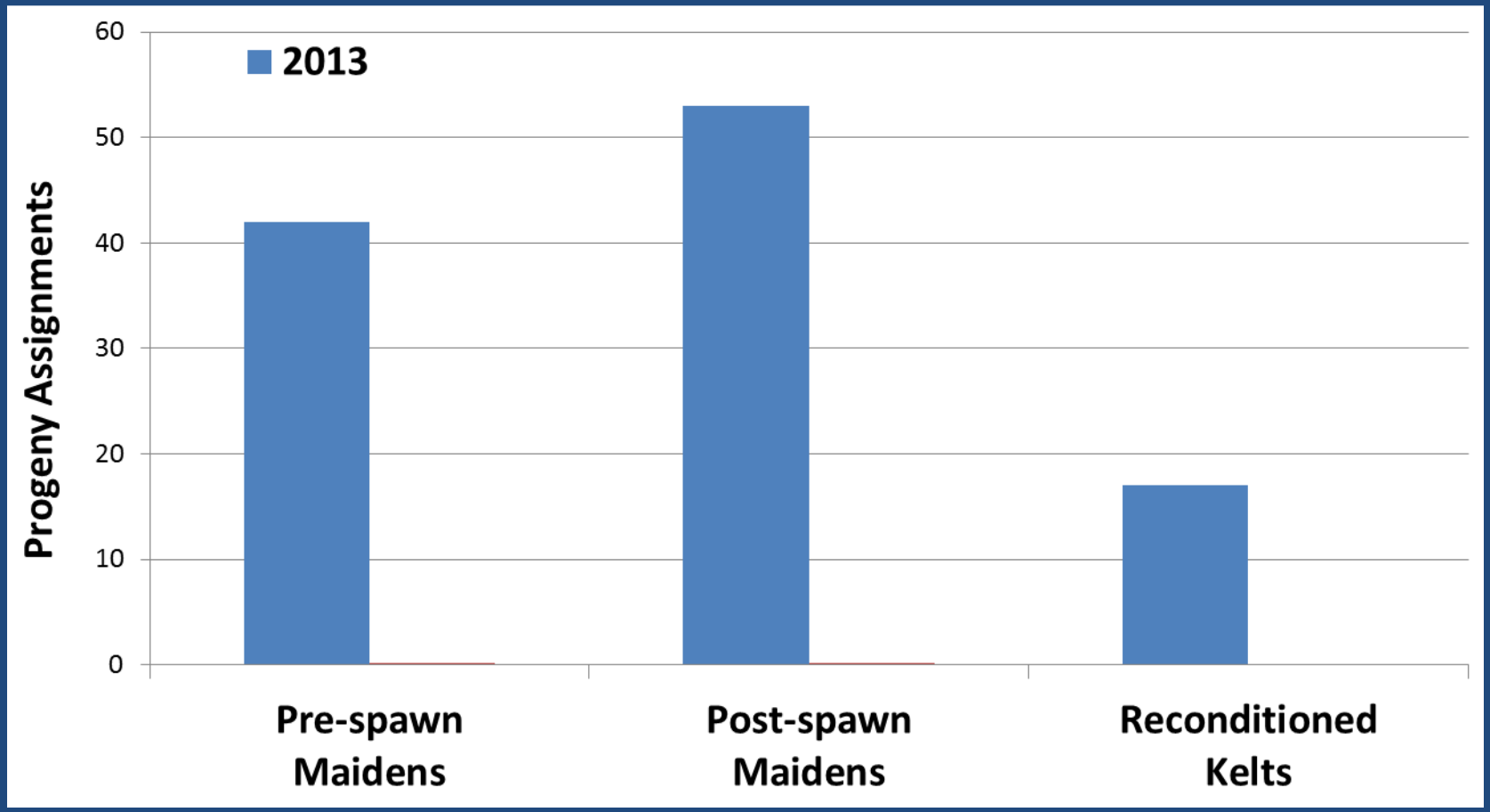

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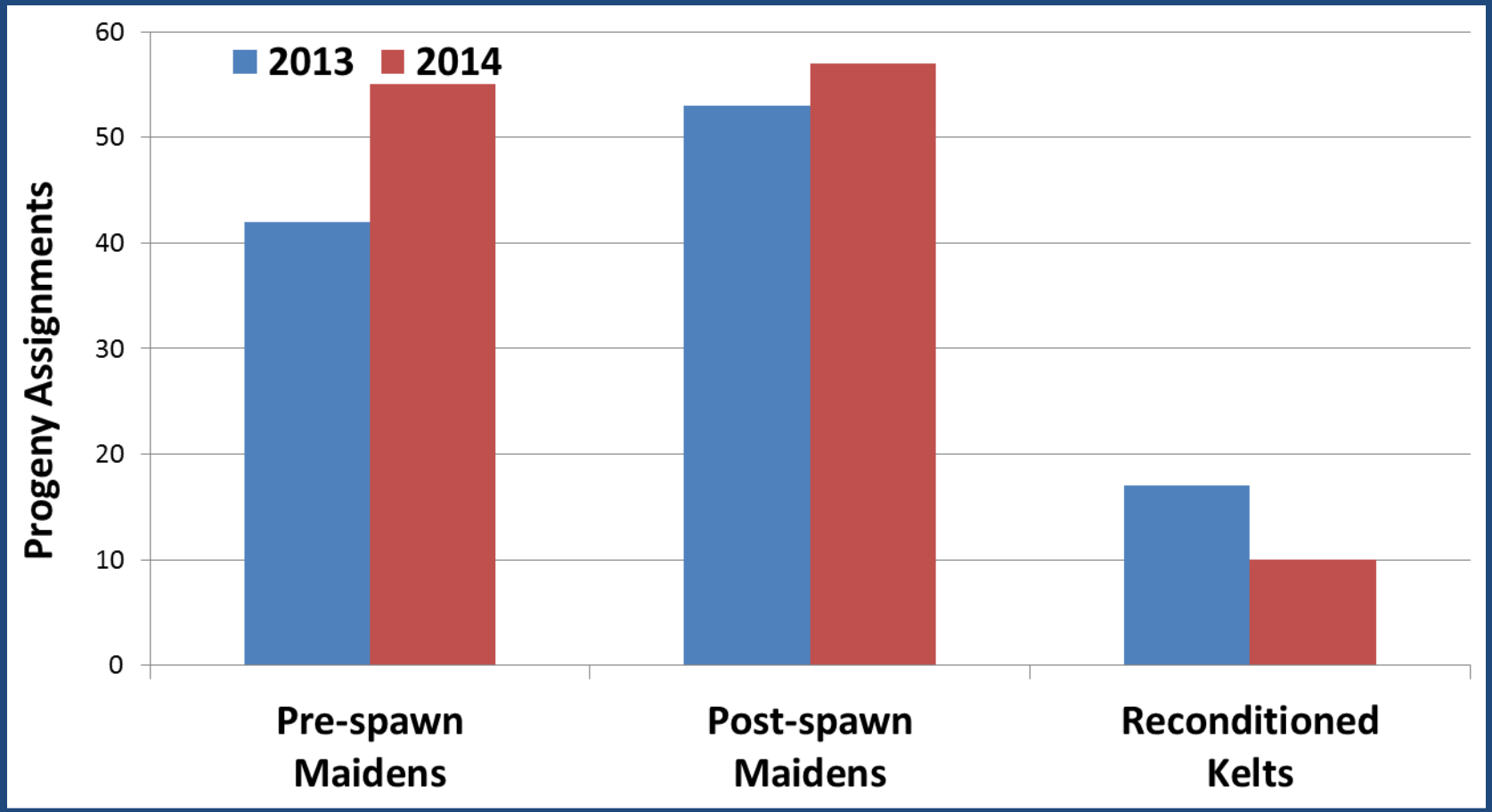

2. What is the relative reproductive success of artificially reconditioned kelt steelhead?

Standardized to pre-spawn maidens

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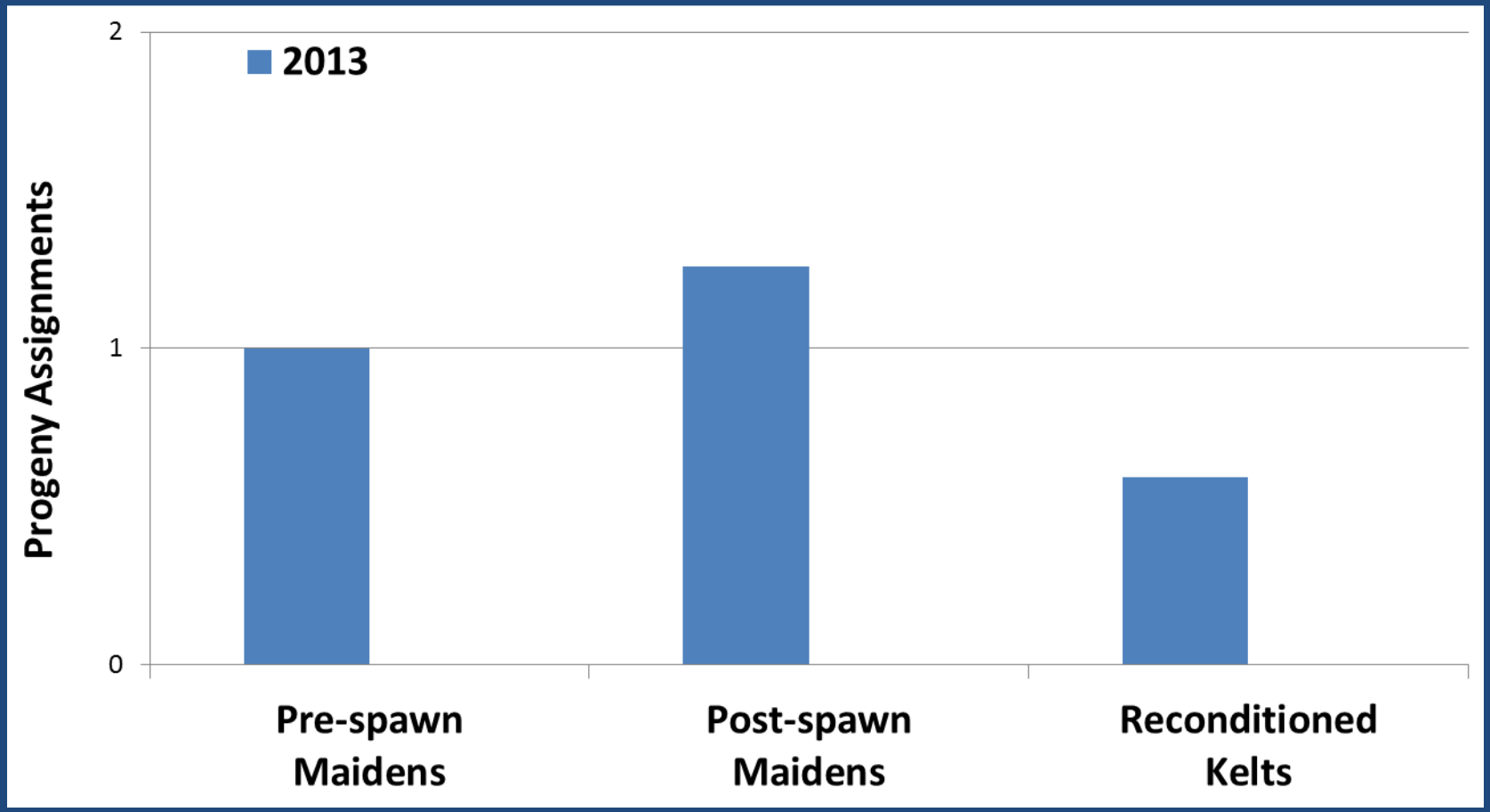

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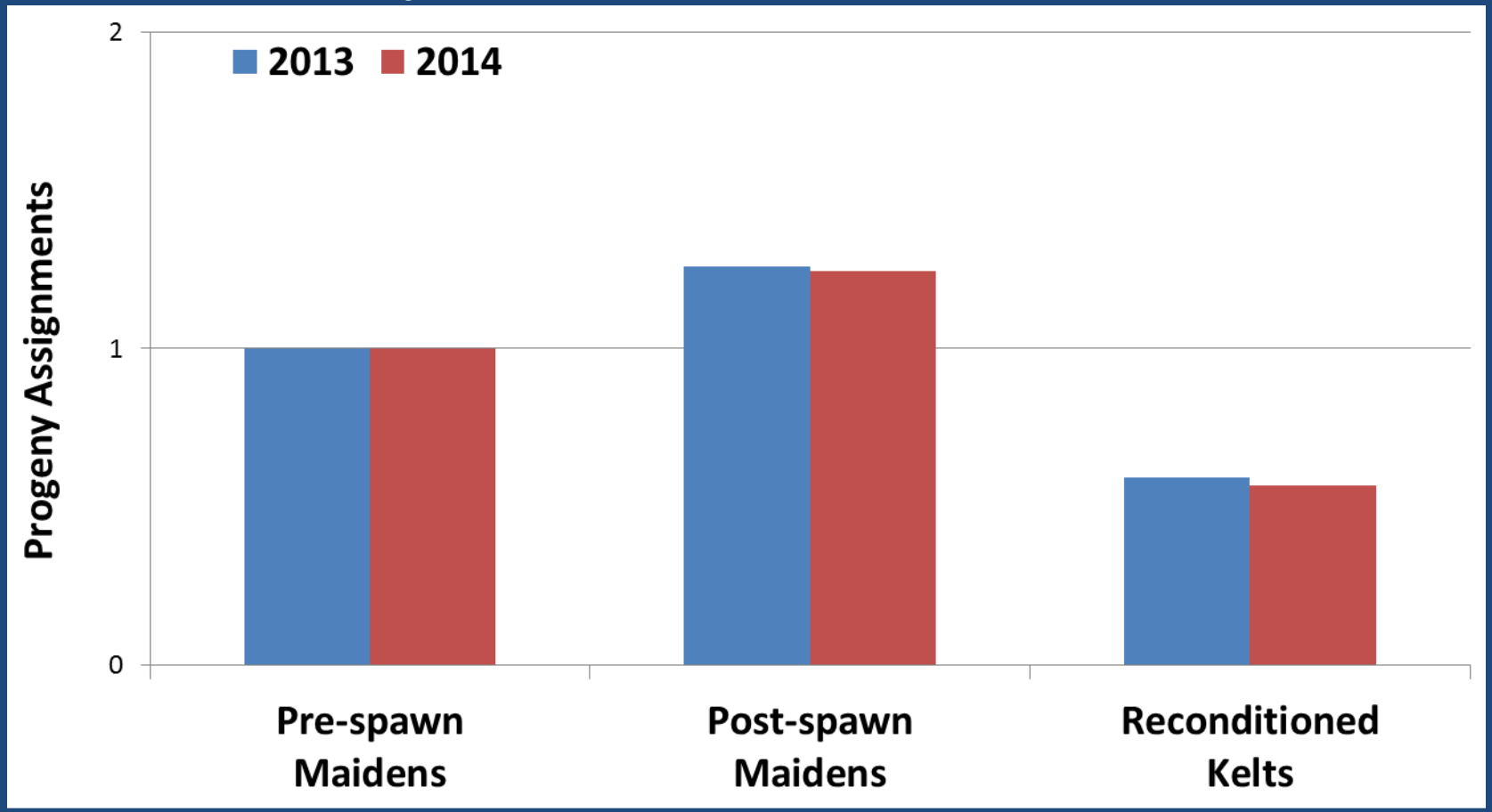

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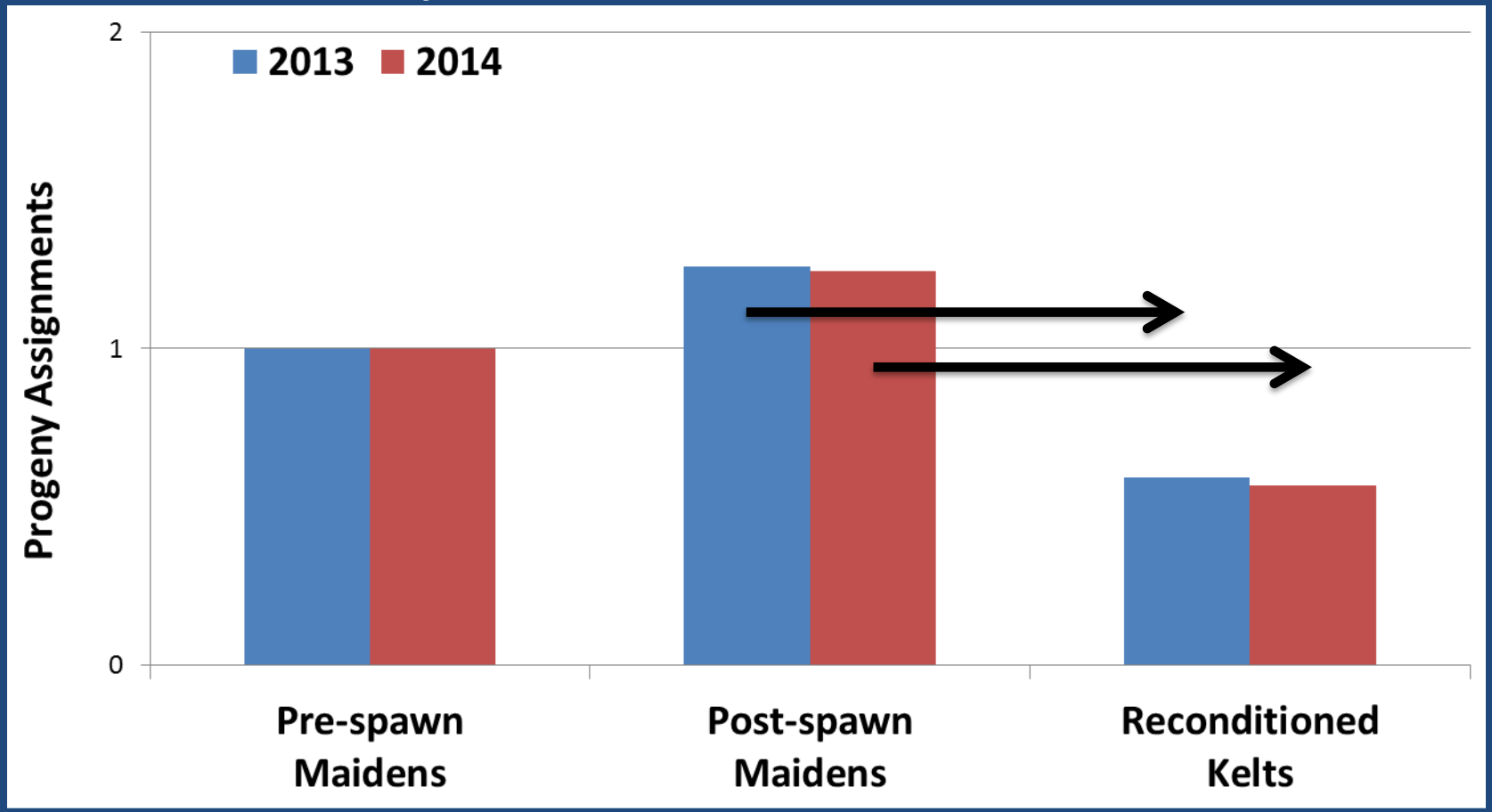
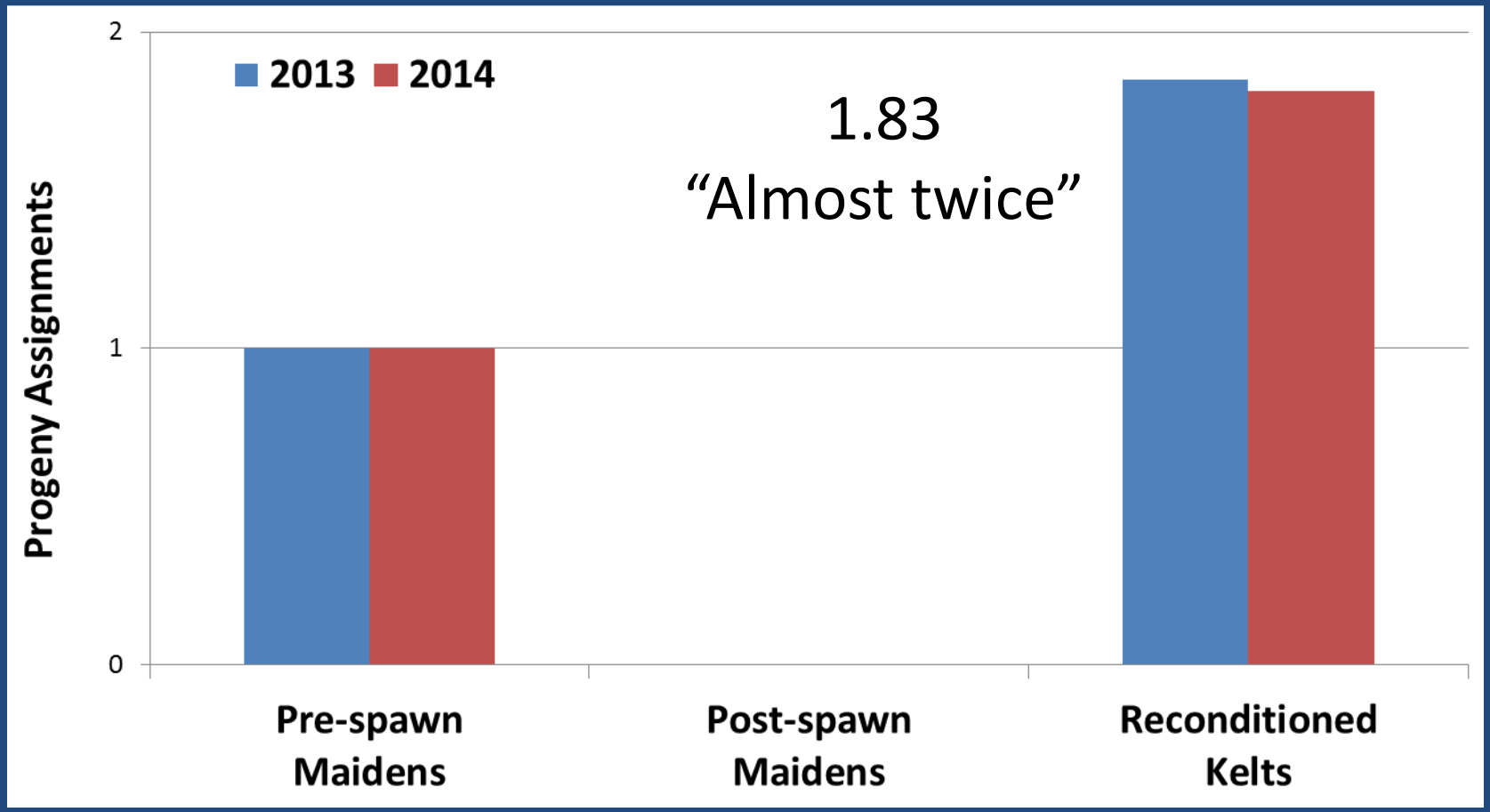


3. What is the LRS of artificially reconditioned kelt steelhead relative to first-time spawners?



Preliminary Conclusions

- Kelts represent an important life history for steelhead
- Reconditioned kelts reproduce in the wild
- Reconditioned kelts had a LRS level similar to natural kelts (Seamons & Quinn 2010)
- Reconditioned kelts have the potential to increase productivity of natural populations