Estimating the proportion of steelhead and rainbow trout using sex ratios

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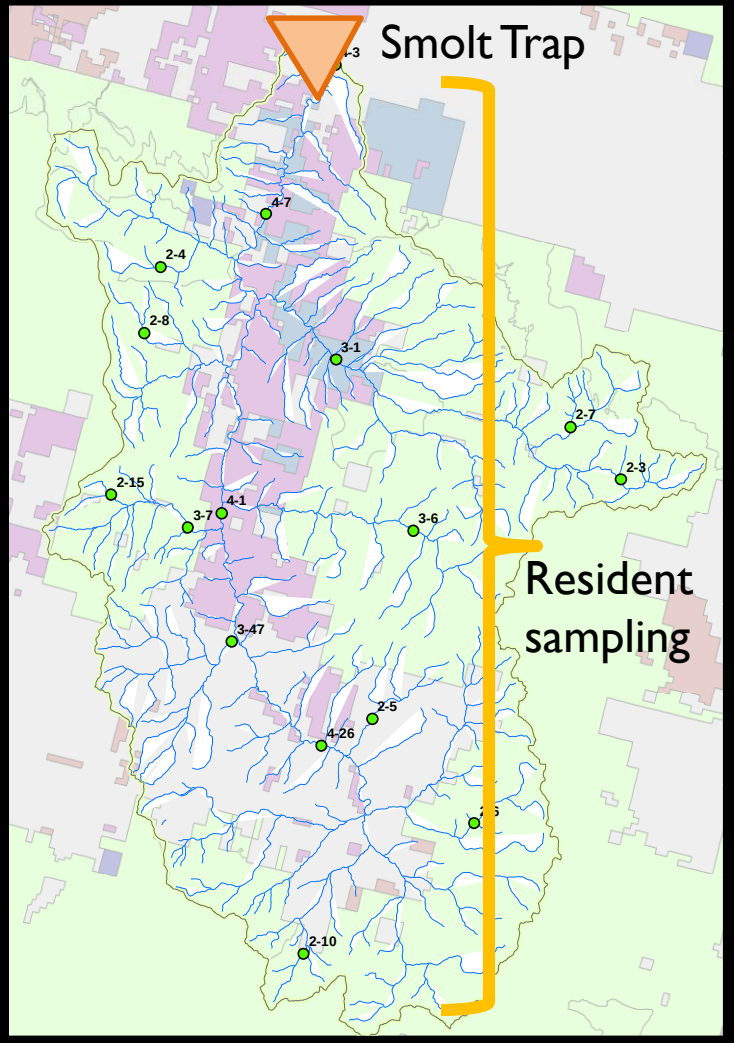
Measuring Proportion of Steelhead and Residents is Challenging

- Need to know **both**
- Juveniles identical
- Smolts captured in one place, residents not

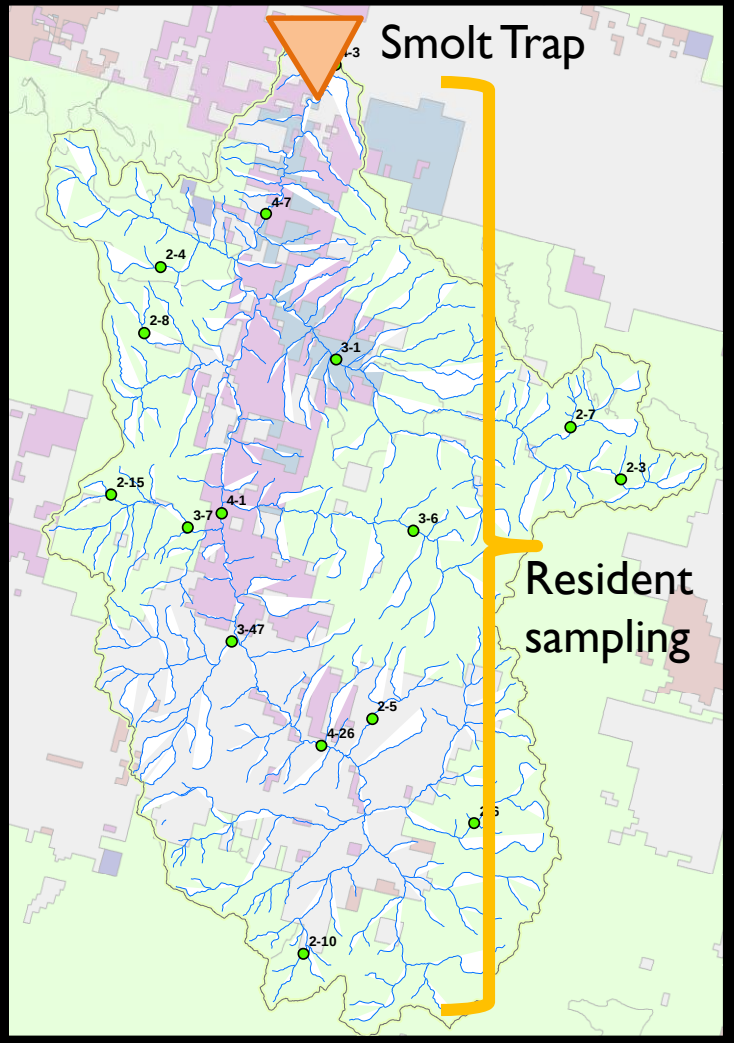


Sex Ratios

- Still need to sample watershed

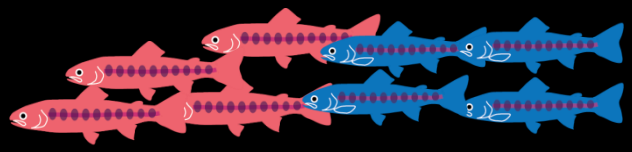
But,

- Requires fewer individuals
- Population numbers not scaled twice
- Less effort each site

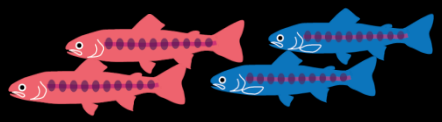


Conceptual Model

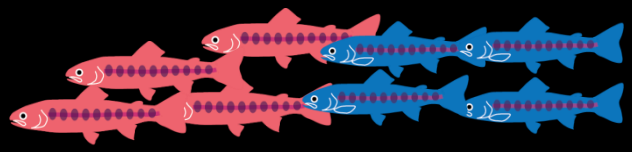
Steelhead offspring



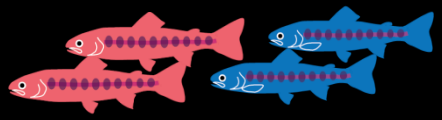
Resident offspring

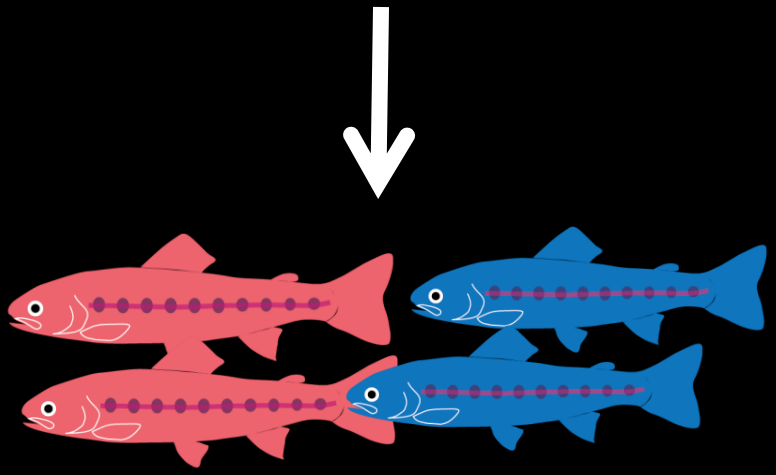


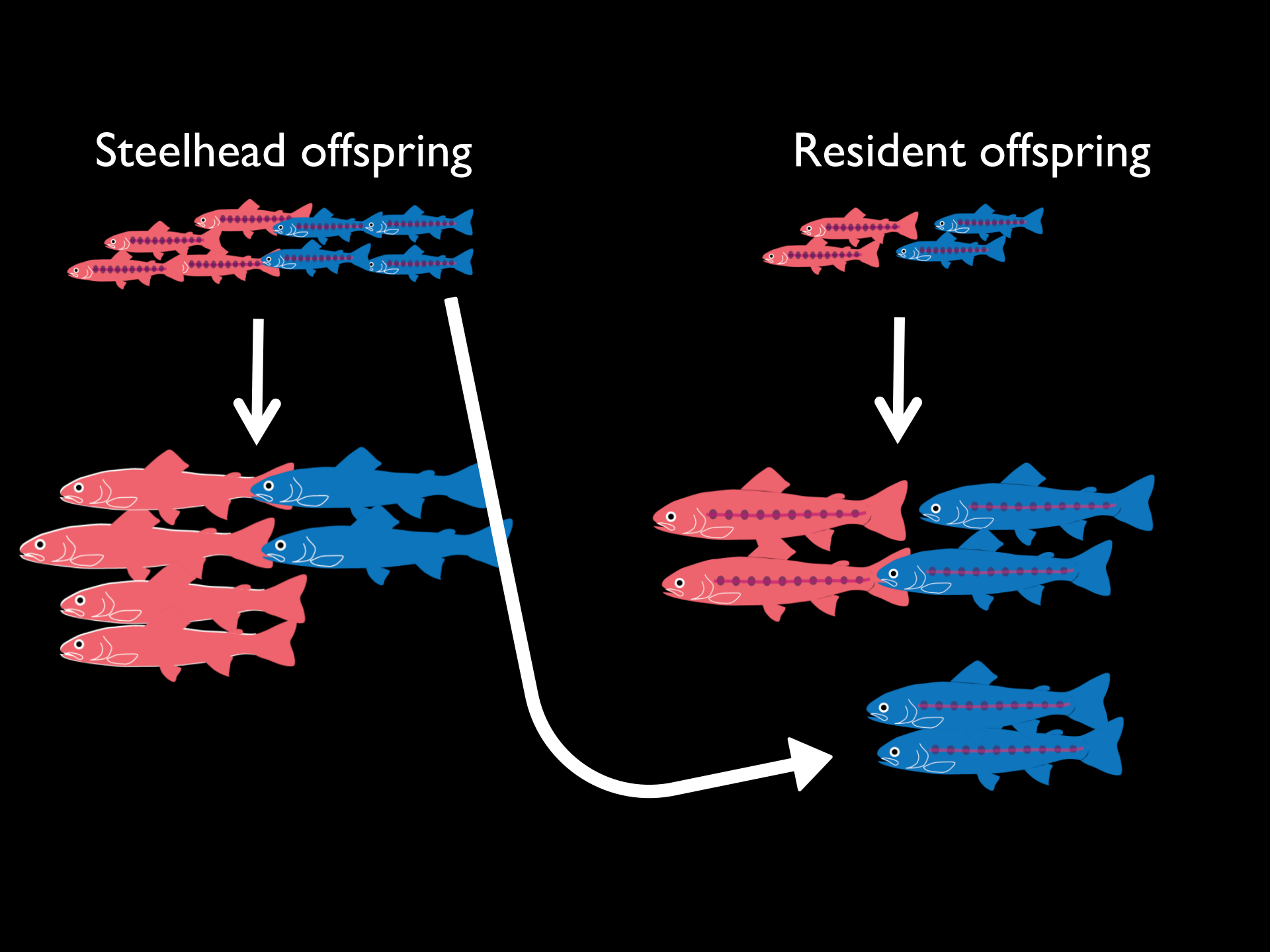
Steelhead offspring

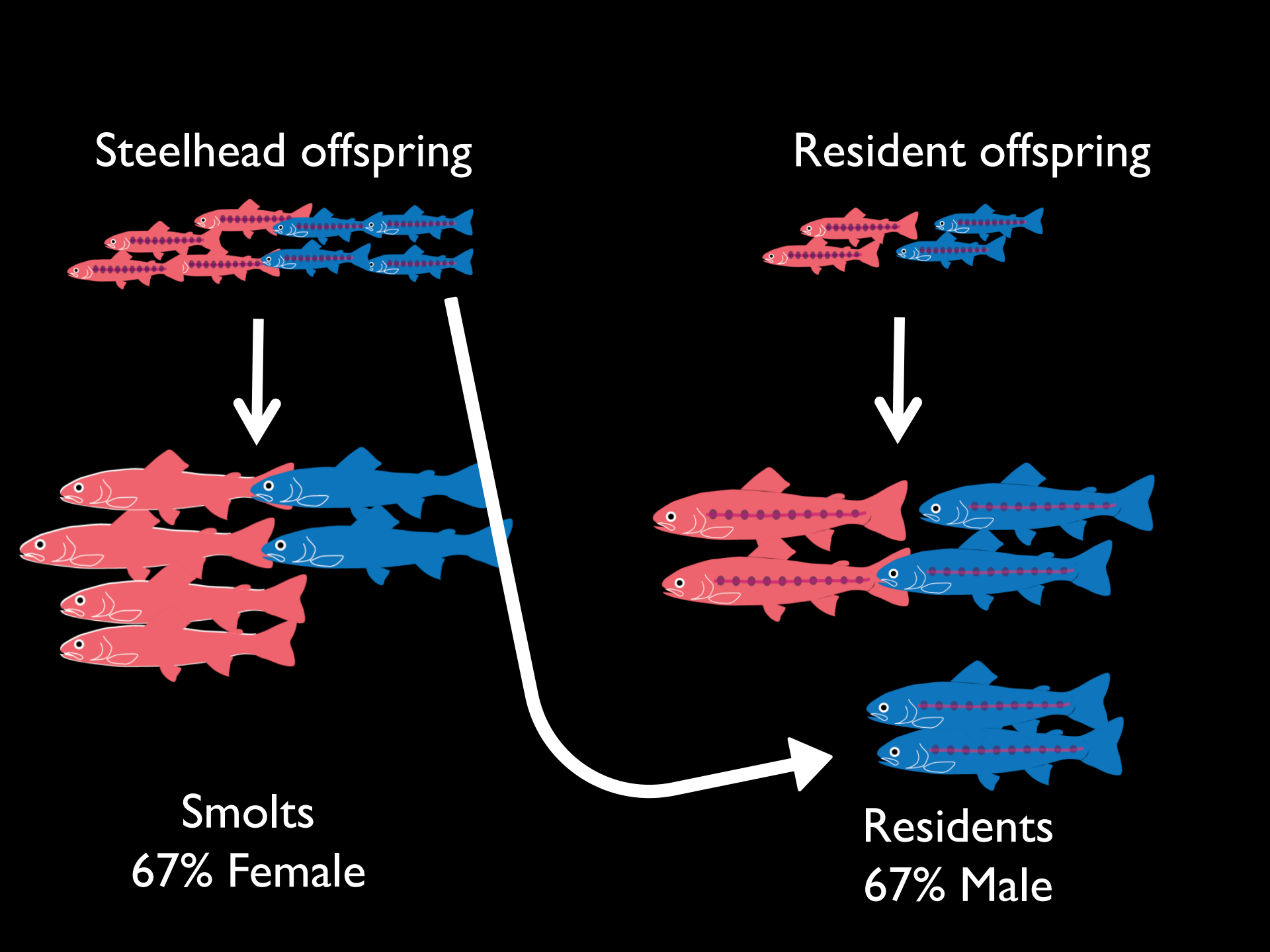


Resident offspring

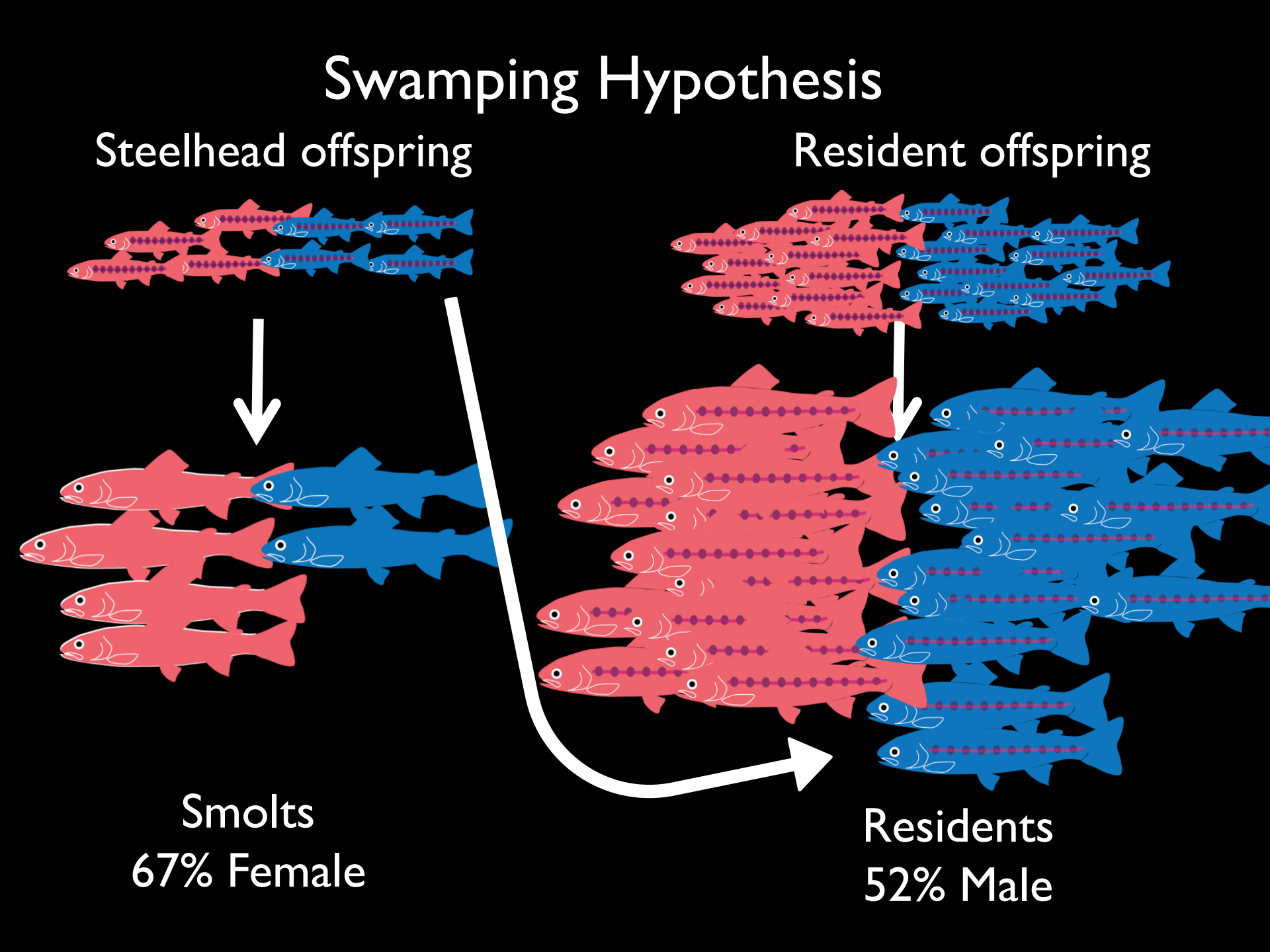


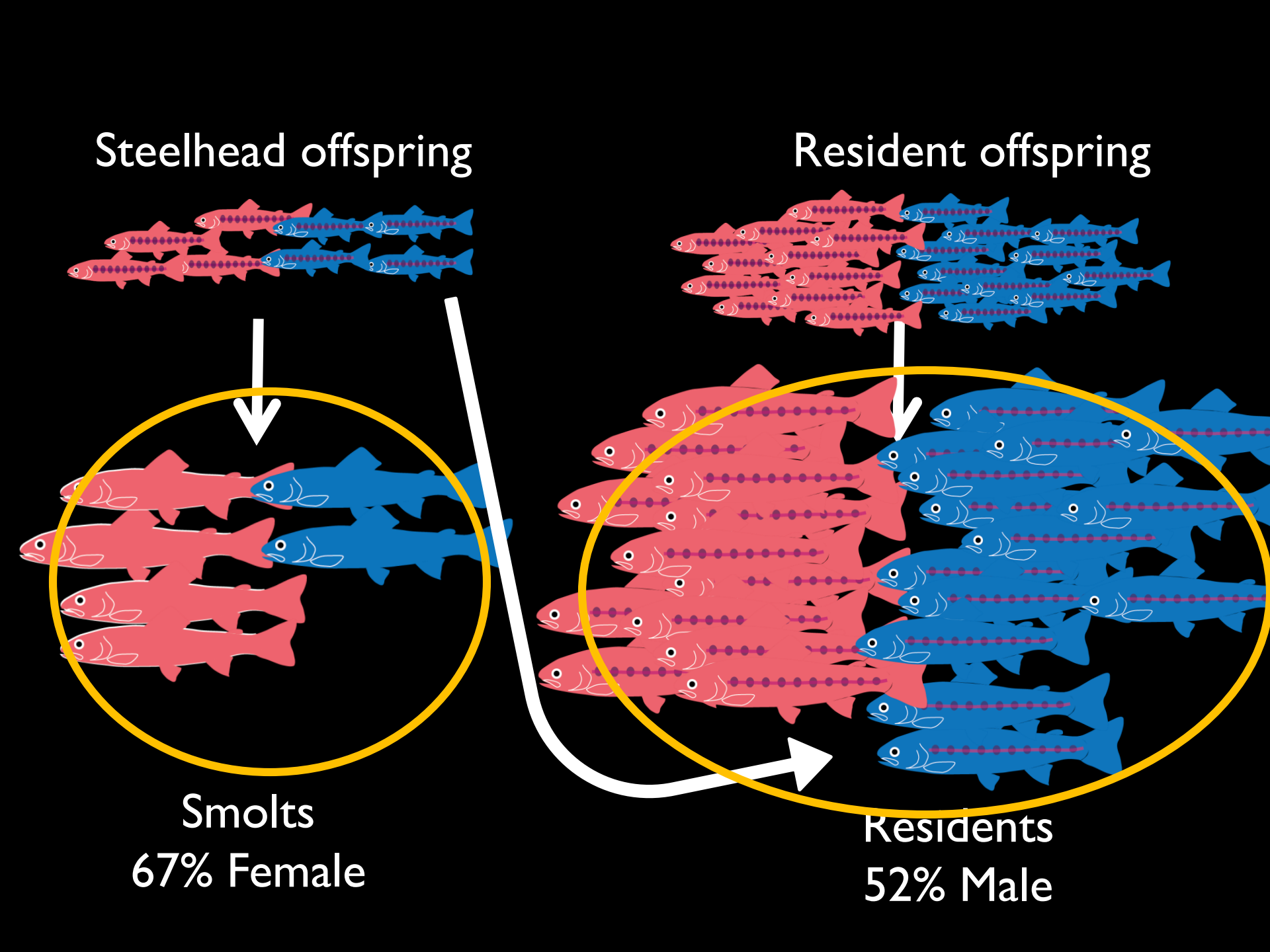


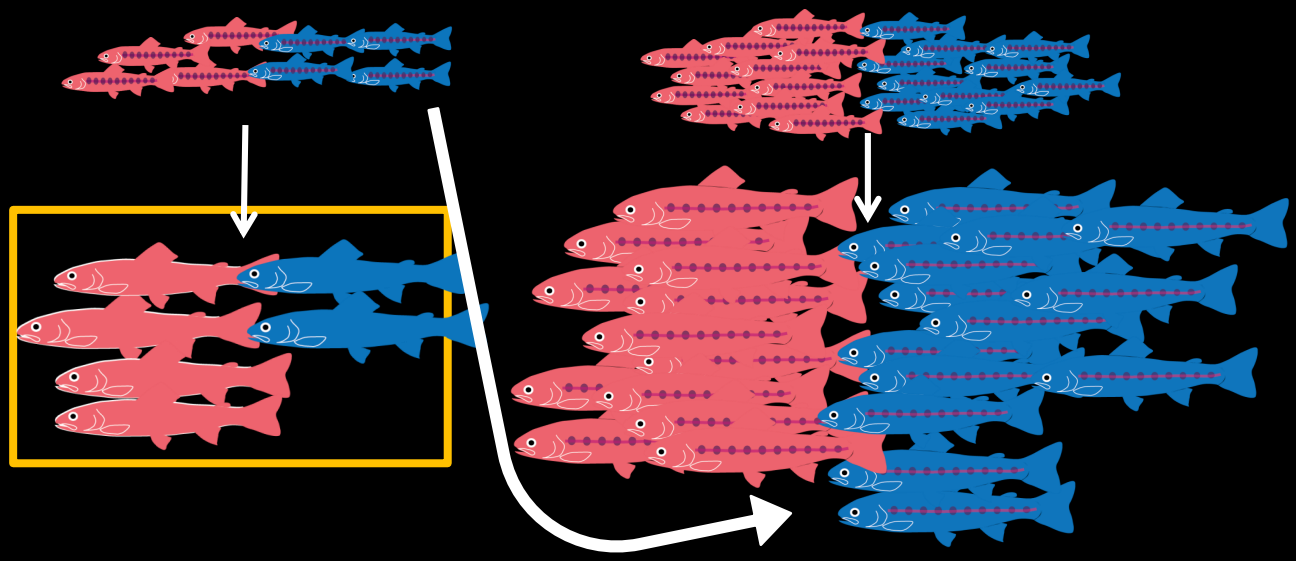

Steelhead offspring
Resident offspring


Steelhead offspring
Resident offspring
Smolts
67% Female
Residents
67% Male

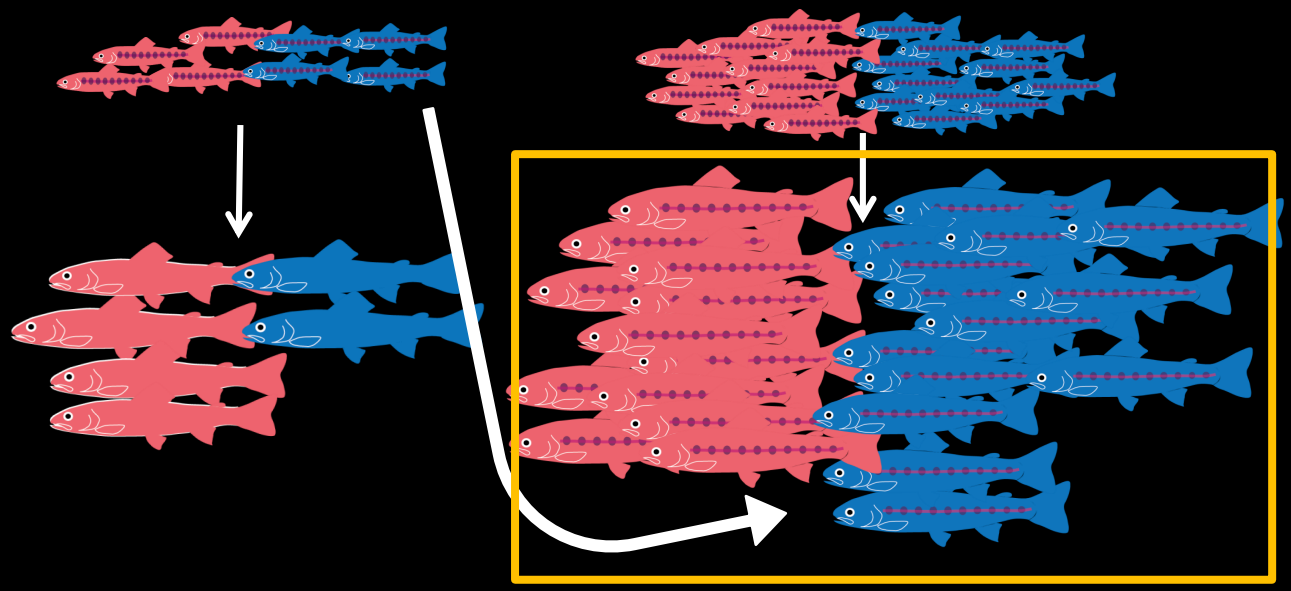
Swamping Hypothesis



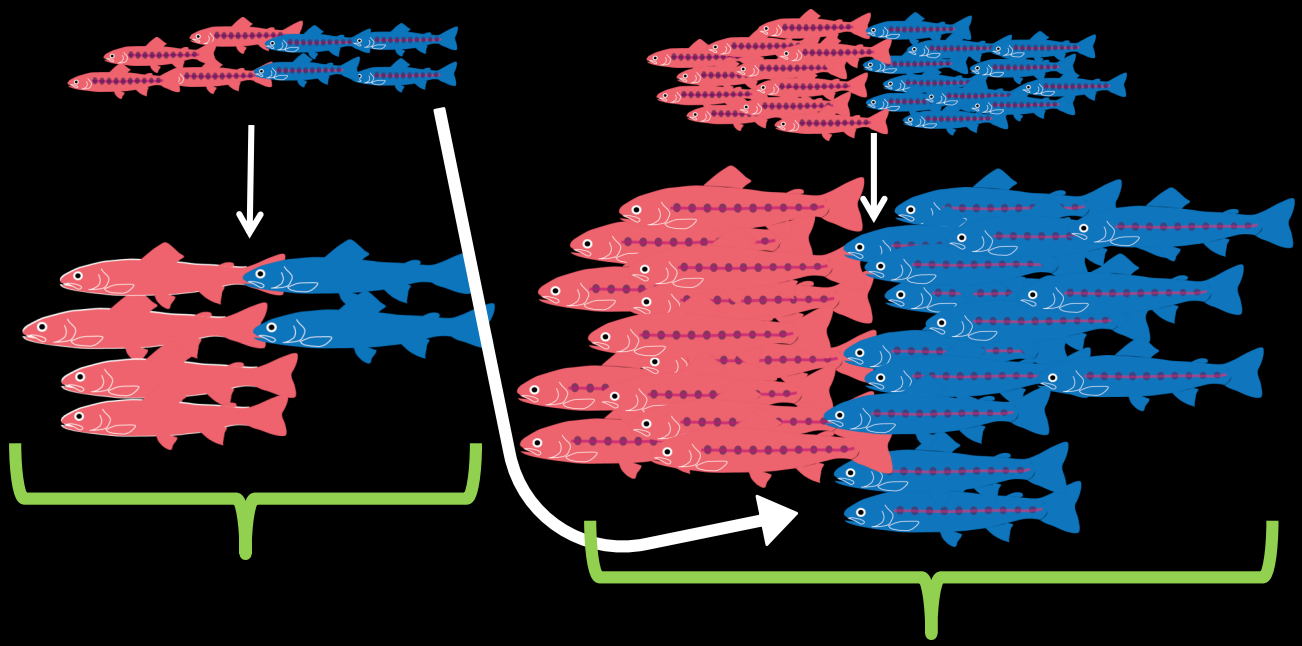

Steelhead offspring
Resident offspring
Smolts
67% Female
Residents
52% Male



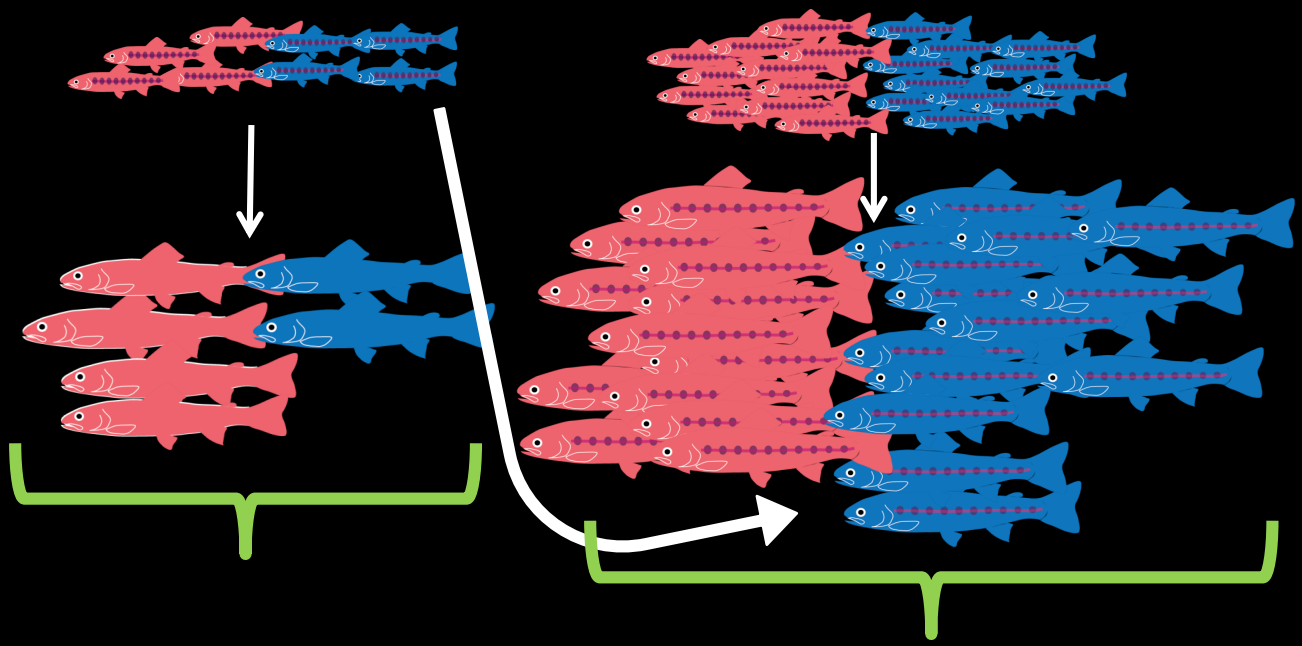
1. Sex ratio of smolts (S_S)



1. Sex ratio of smolts (S_S)
2. **Sex ratio of residents (S_R)**



1. Sex ratio of smolts (S_S)
2. Sex ratio of residents (S_R)
3. **Proportion of steelhead (P_S)**



1. Sex ratio of smolts (S_S)
2. Sex ratio of residents (S_R)
3. Proportion of steelhead (P_S)
4. **Assume *starting* sex ratio 1:1, equal mortality**

The equation

Steelhead ♂ + Res. ♂ = Steelhead ♀ + Res. ♀

The equation

Steelhead ♂ + Res. ♂ = Steelhead ♀ + Res. ♀

$(1- S_S)P_S + S_R(1- P_S)$

The equation

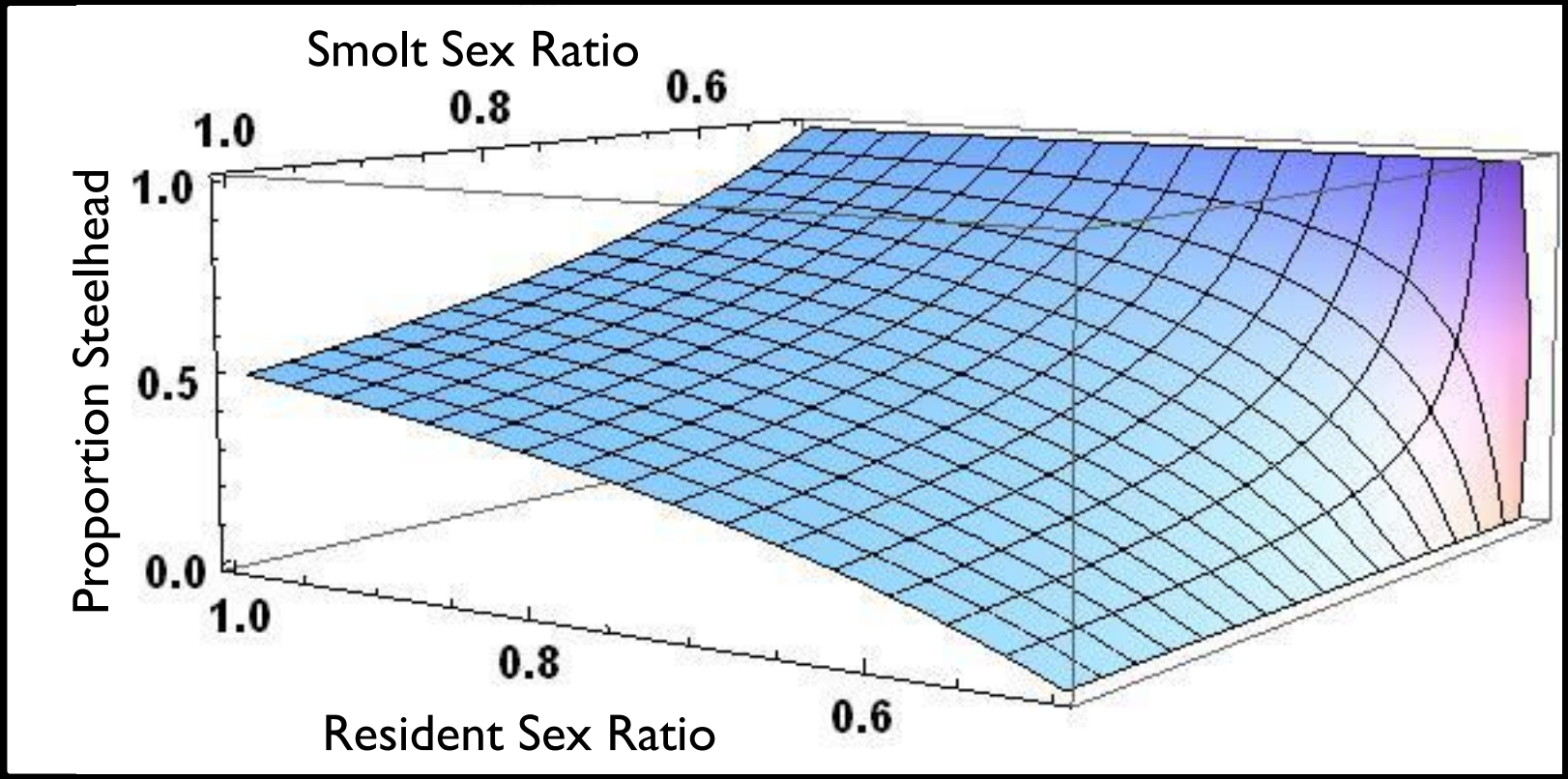
Steelhead ♂ + Res. ♂ = Steelhead ♀ + Res. ♀

$$(1- S_S)P_S + S_R(1- P_S) = S_S * P_S + (1- S_R)*(1-P_S)$$

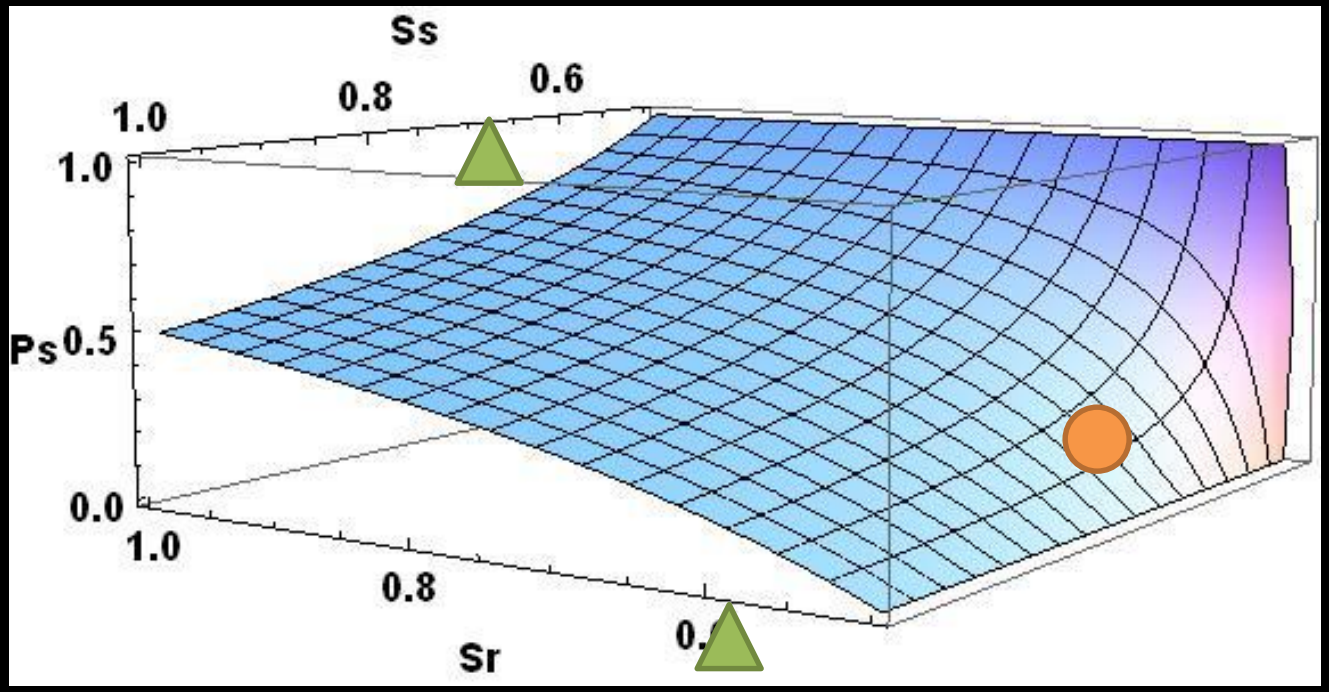
Solve for Proportion Steelhead (P_S)

$$P_S = (S_R - 0.5) / (S_R + S_S - 1)$$

Proportion Steelhead

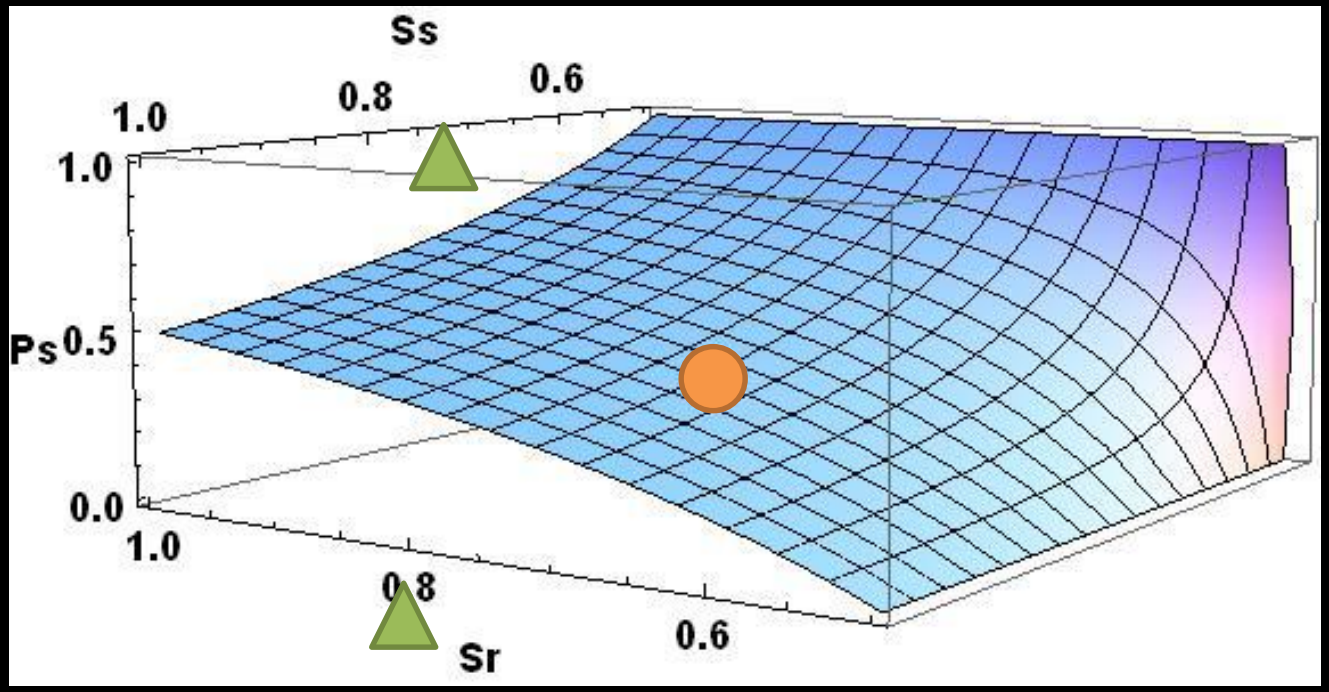


SF John Day Example



- Smolt Sex Ratio (S_S) = 0.76
- Resident Sex Ratio (S_R) = 0.58
- Proportion Steelhead (P_S) = 0.235

Mann Creek

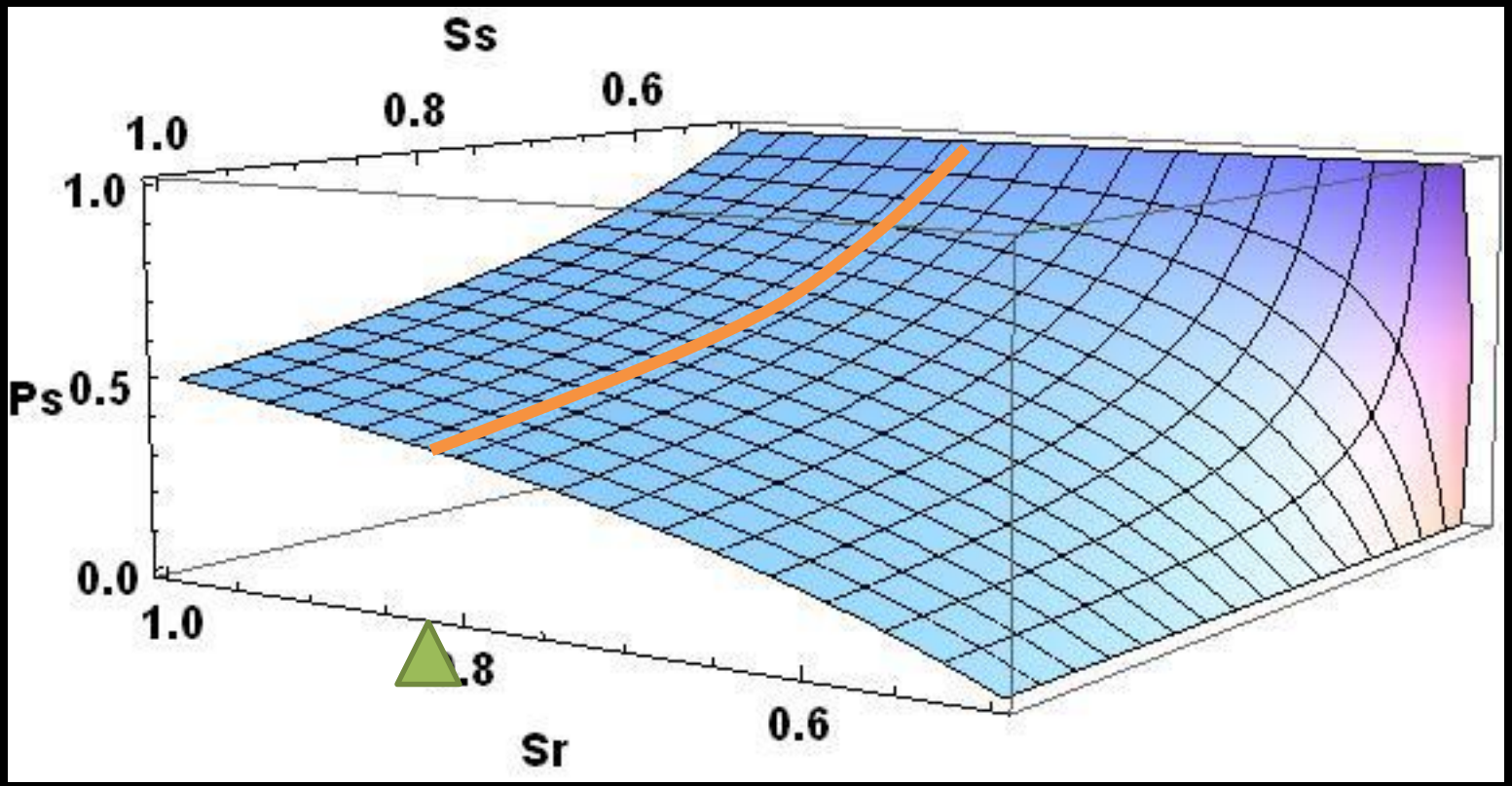


Holecek and Scarnecchia (2013)

- Adfluvial Sex Ratio (S_S) = 0.74
- Resident Sex Ratio (S_R) = 0.81
- Proportion Adfluvial (P_S) = 0.44

Big Creek

- Rundio et al 2012
- 83% Residents male, no smolt sex ratio



Assumptions and Challenges

- Equal mortality
- One cohort, transitions happen in same year
- Still have to measure sex ratio in residents

Still to do

- Confidence bounds
- How big of a sample do you need?
- How sensitive to proportions near 0.5
- We need more data!

Conclusions

- Sex ratios can be used together to estimate proportion of steelhead
- Sex ratios of residents can **not** be inferred from sex ratio of steelhead without knowing proportion of steelhead
- Could be a very useful tool

Thanks

- Chris Jordan (NOAA)
- Dave Lytle (OSU)
- Gordie Reeves (USFS)

- Ohms et al. 2013. CJFAS
- haley.ohms <at> oregonstate.edu

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