



Precision and bias of snorkel survey counts of coastal cutthroat trout (*O. clarkii*).

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**Coastal Cutthroat Trout Symposium
Newport, OR**

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Snorkel Surveys

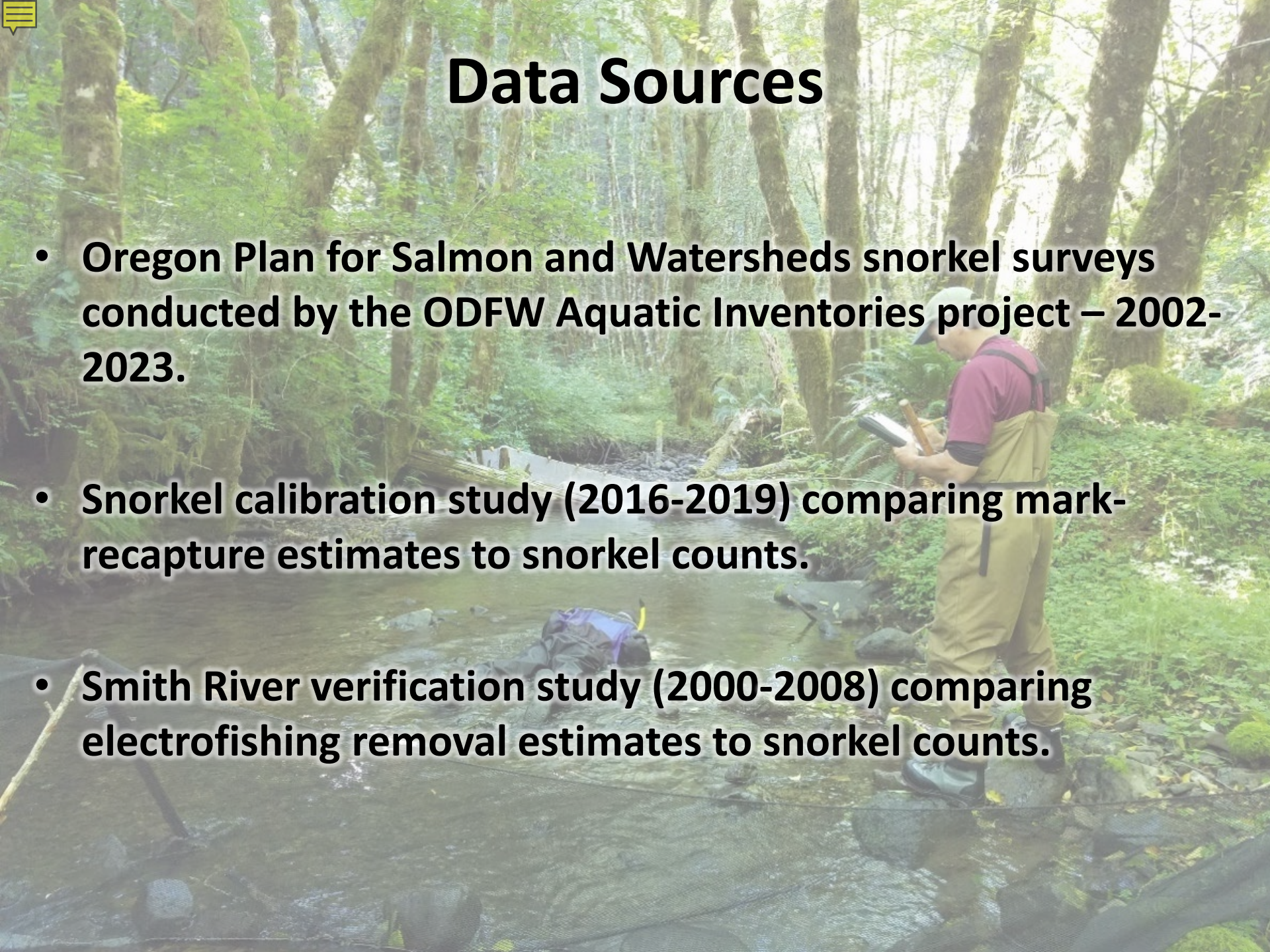
Cheaper, safer, can access remote areas, but...



- 1. Can snorkelers distinguish cutthroat from other trout?**
- 2. What is the precision of snorkel survey counts of cutthroat?**
- 3. What is the bias of these counts? How variable is this bias?**
- 4. How can snorkel surveys be used to monitor cutthroat?**

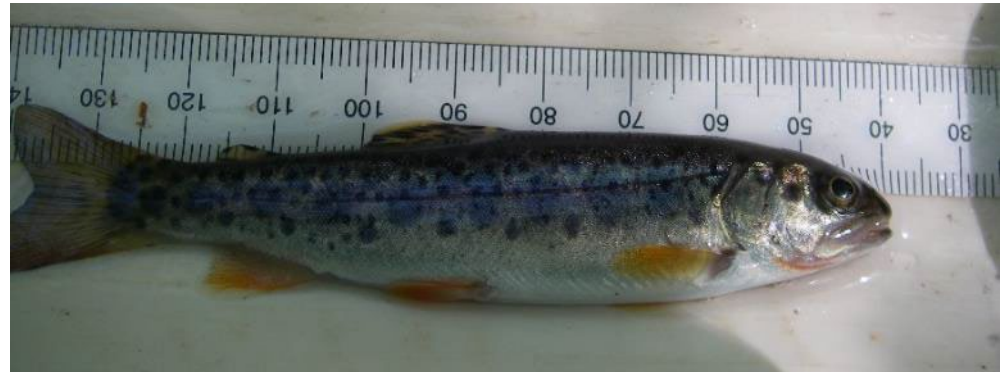


Data Sources

- **Oregon Plan for Salmon and Watersheds snorkel surveys conducted by the ODFW Aquatic Inventories project – 2002-2023.**
 - **Snorkel calibration study (2016-2019) comparing mark-recapture estimates to snorkel counts.**
 - **Smith River verification study (2000-2008) comparing electrofishing removal estimates to snorkel counts.**
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Can snorkelers distinguish cutthroat from O. mykiss?

- Can be challenging in hand.
- Hybridization occurs but seems limited in coastal Oregon.
- Some protocols lump and count trout in aggregate or do not count YOY trout.



Underwater ID



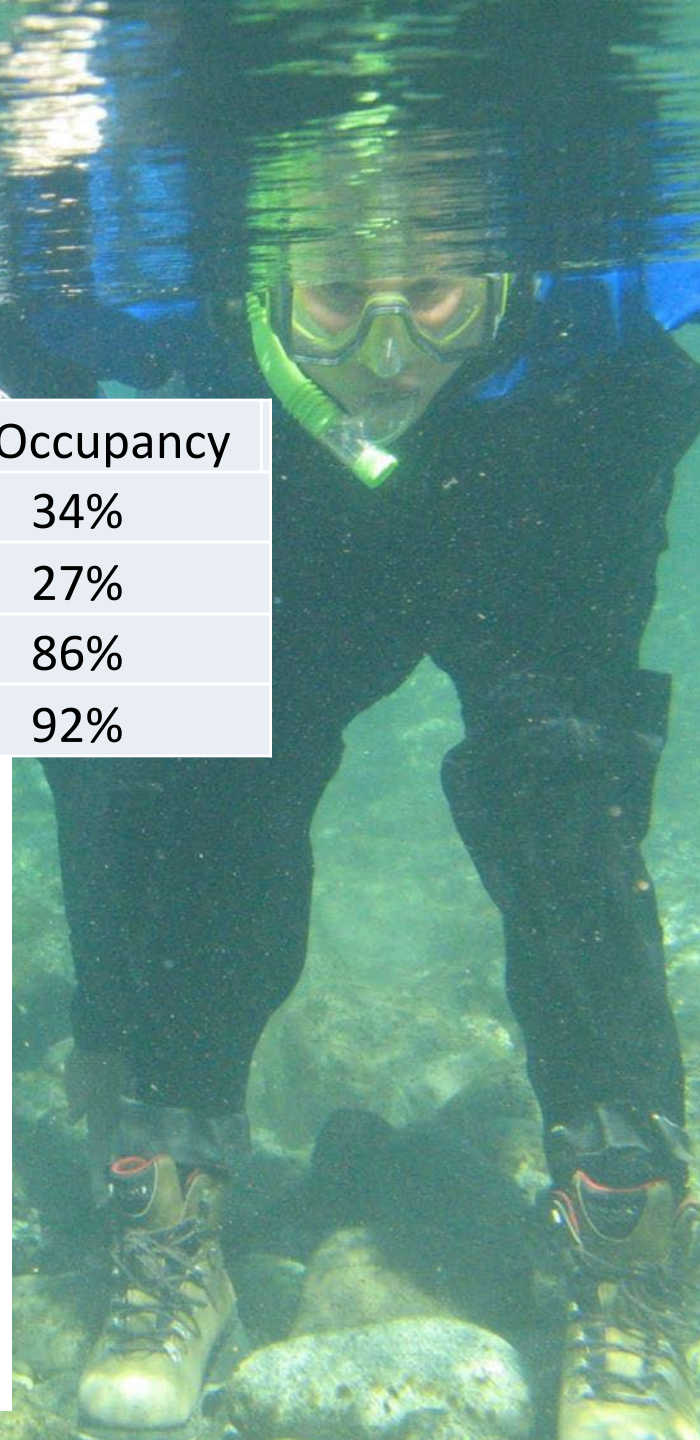
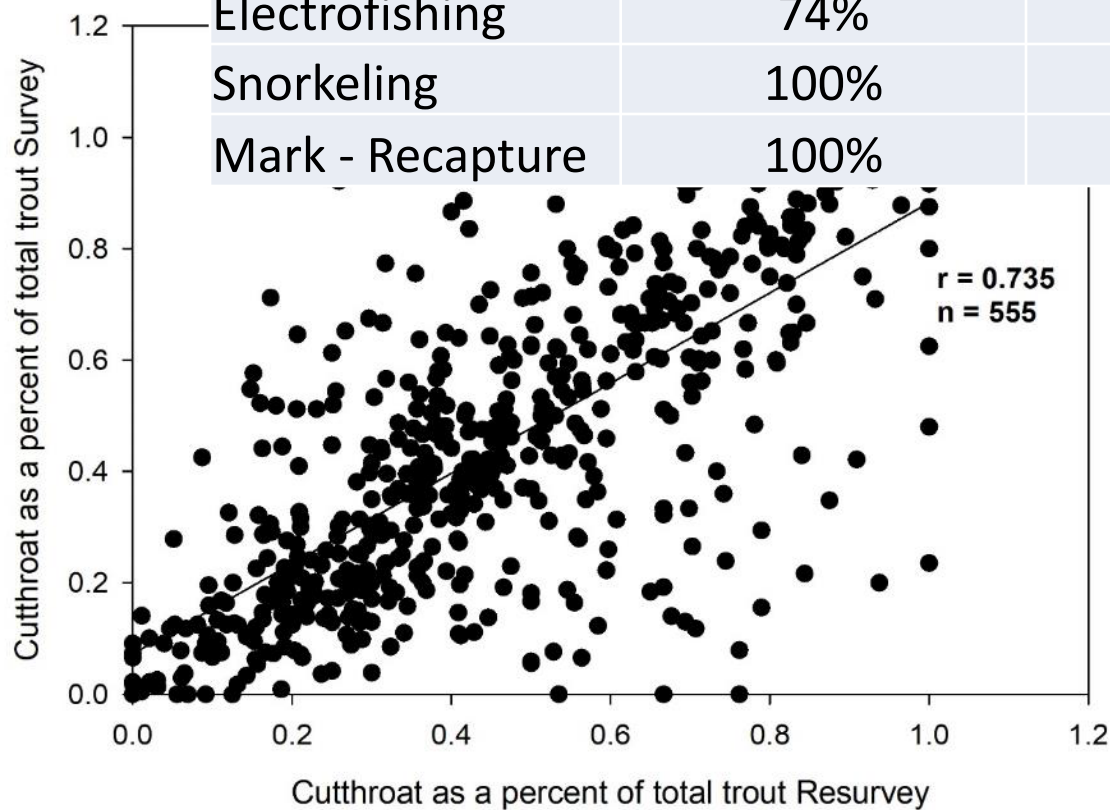
- **Never:**
 - slash marks
- **With Luck:**
 - Snout shape
 - Eye – jaw hinge
- **With Less Luck:**
 - Medial dorsal parr marks
 - Spots v. parr marks
 - Behavior

Underwater ID

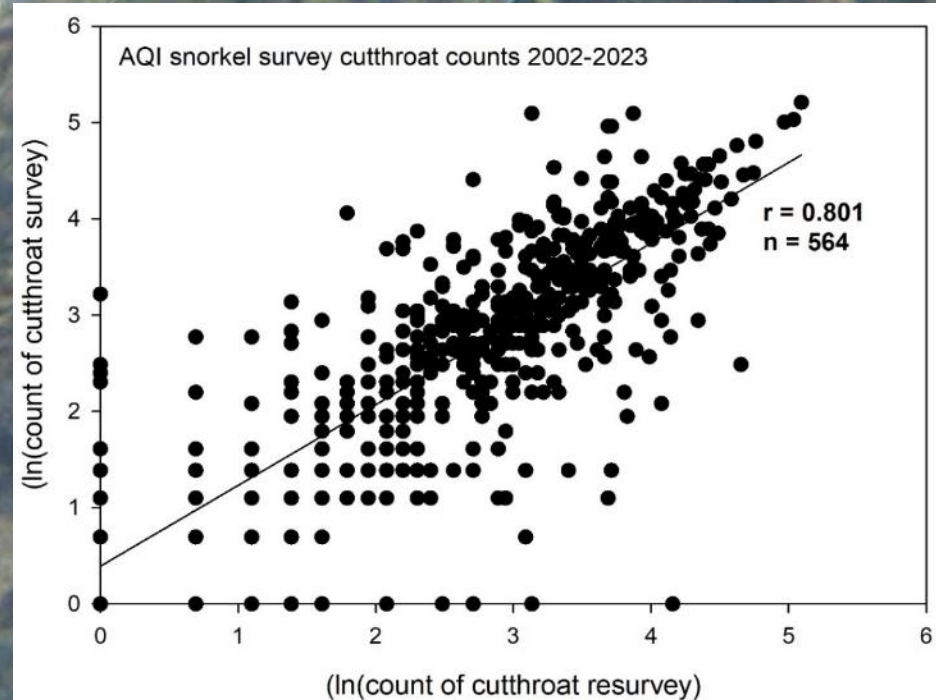
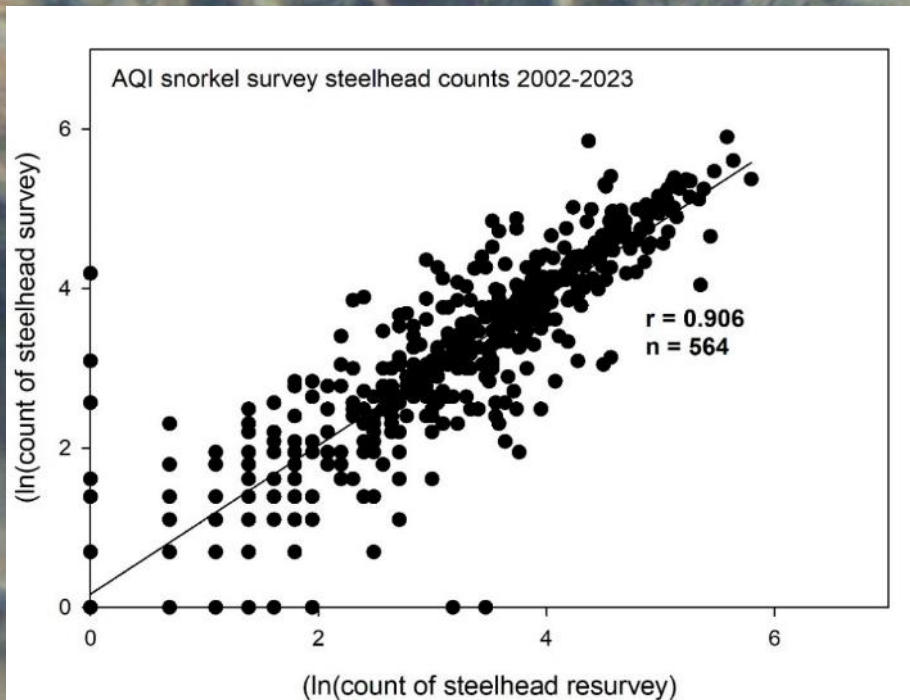


Underwater ID

Method	Site Occupancy	Pool Occupancy
Snorkeling	79%	34%
Electrofishing	74%	27%
Snorkeling	100%	86%
Mark - Recapture	100%	92%

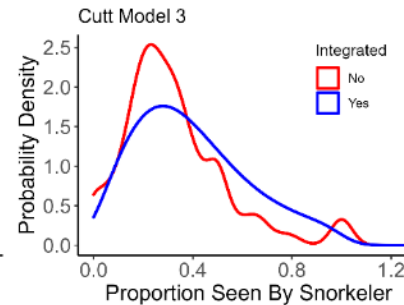
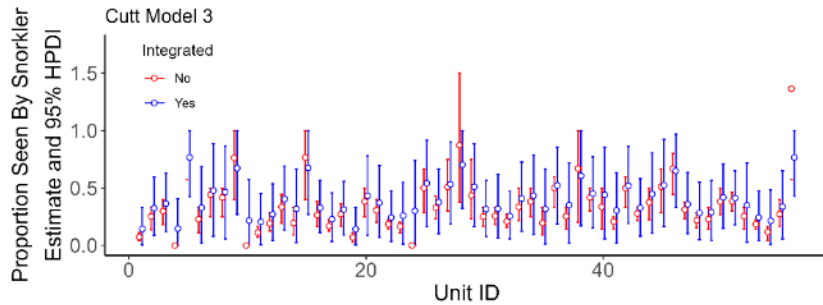
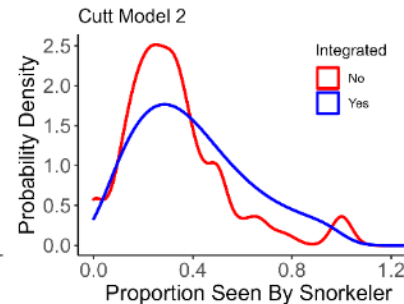
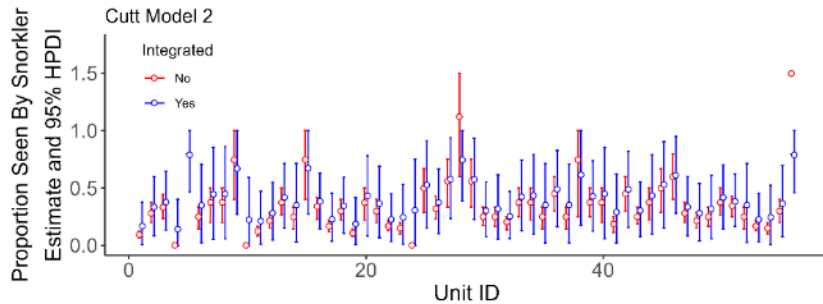
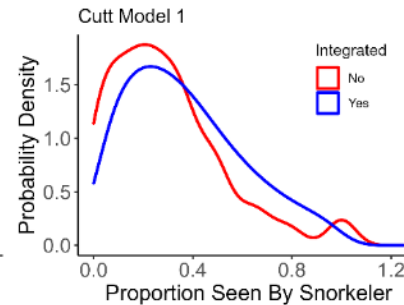
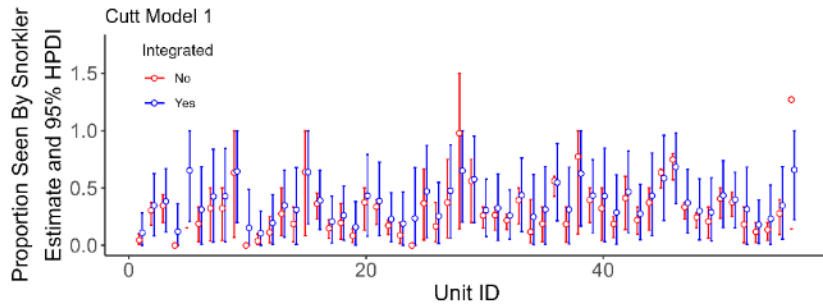


Precision



Bias

Portion of M-R observed by snorkeling

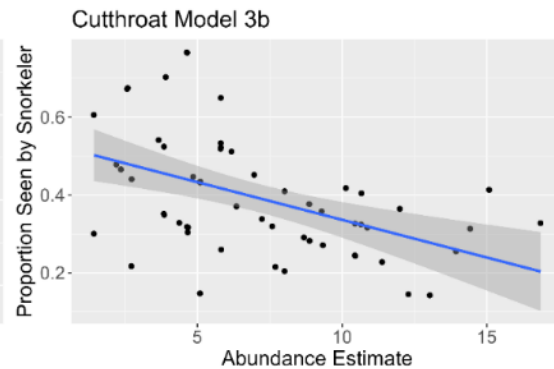
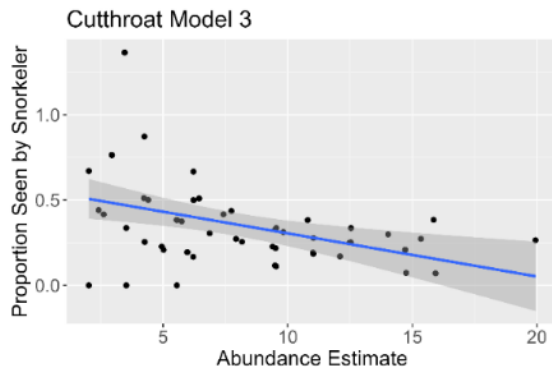
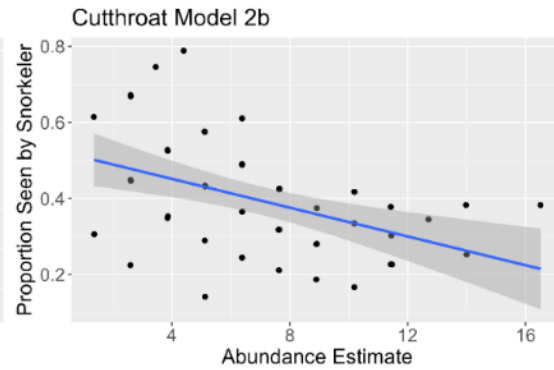
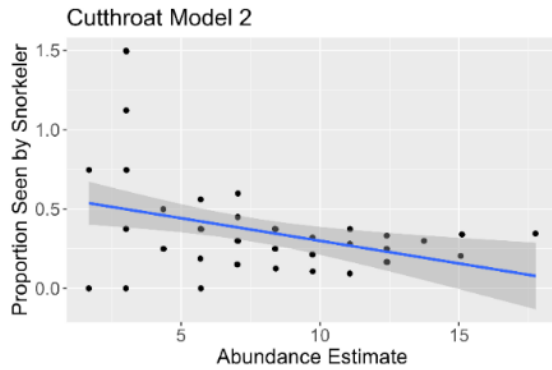
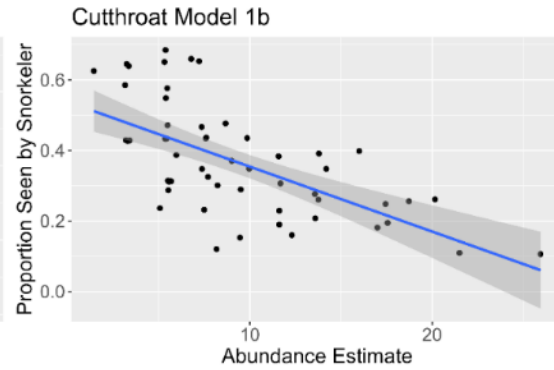
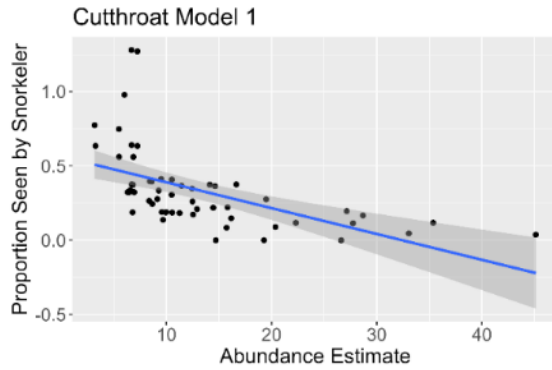


Species	Percent of M-R estimate detected by snorkeling
Cutthroat	39%
Steelhead	47%
Coho	63%



Bias

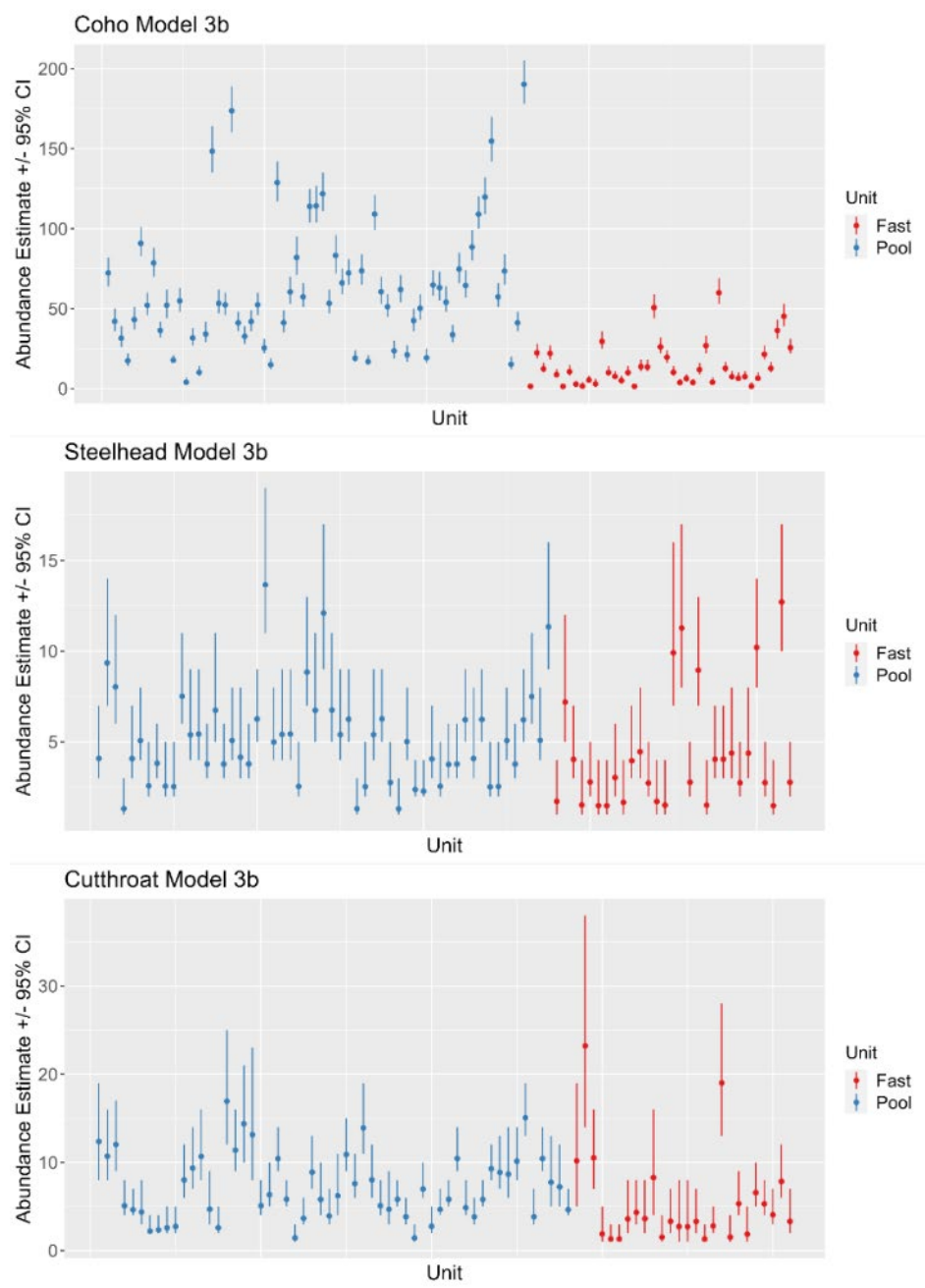
Variable and changes as abundance increases





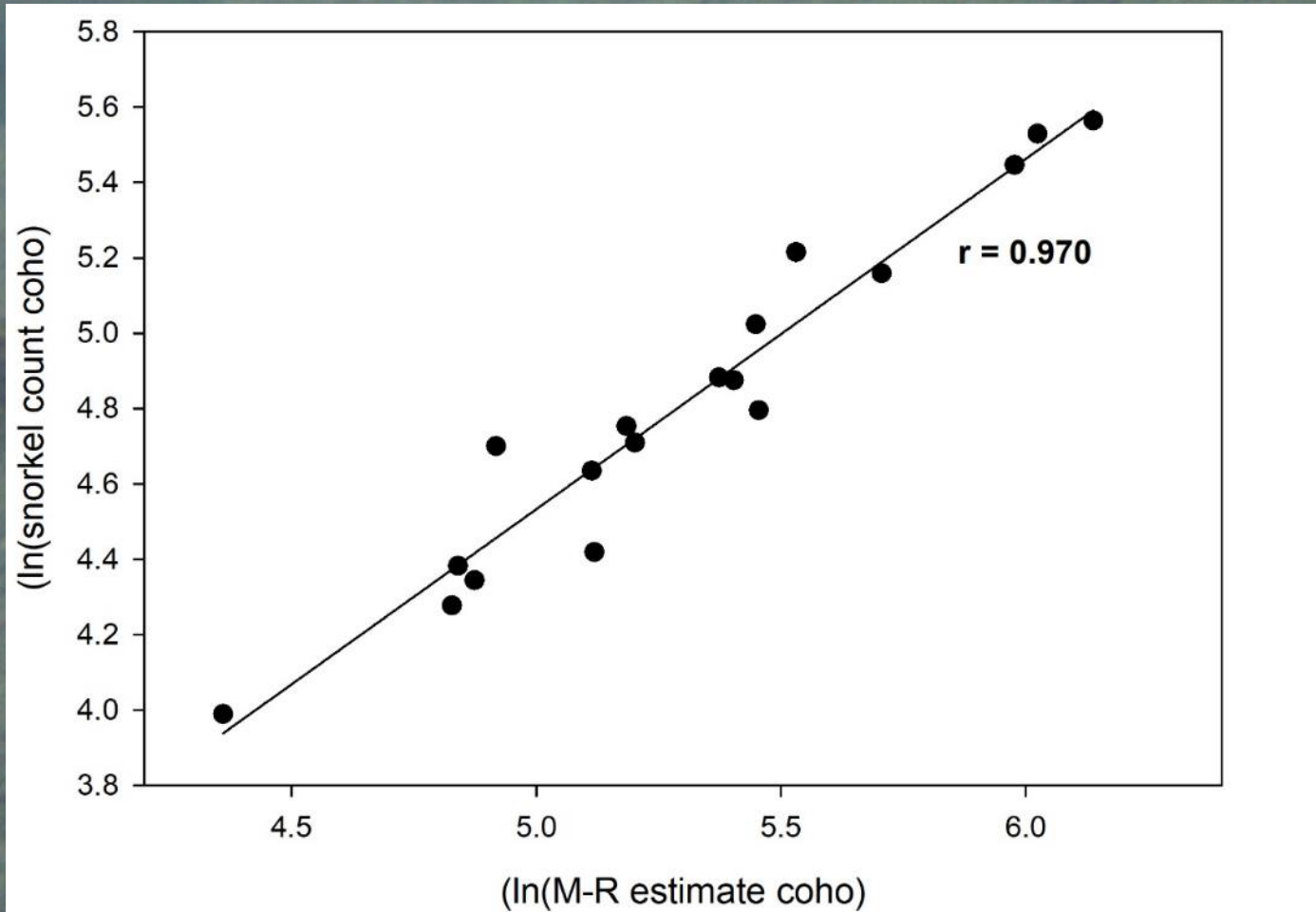
Bias

inter-annual variation in
fast:pool



Bias

Simple linear regression



So, how can snorkel surveys be used to monitor cutthroat?



Occupancy



- **Less effort = longer snorkeling sites.**
- **Electrofishing and snorkeling produce similar pool and site occupancy rates.**
- **M-R and Snorkeling produce the same site occupancy rates and similar pool occupancy rates.**

Abundance

- **Poor correlation with M-R.**
- **Variable bias.**
- **Variable portions in fastwater.**
- **Pair snorkel surveys with other methods to determine bias.**

Questions

