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# Life-history diversity and productivity of Puget Sound Chinook salmon

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Speaker
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Science Division, Fish Program

Washington Department of Fish and Wildlife

Salish Sea Ecosystem Conference
May 2, 2014

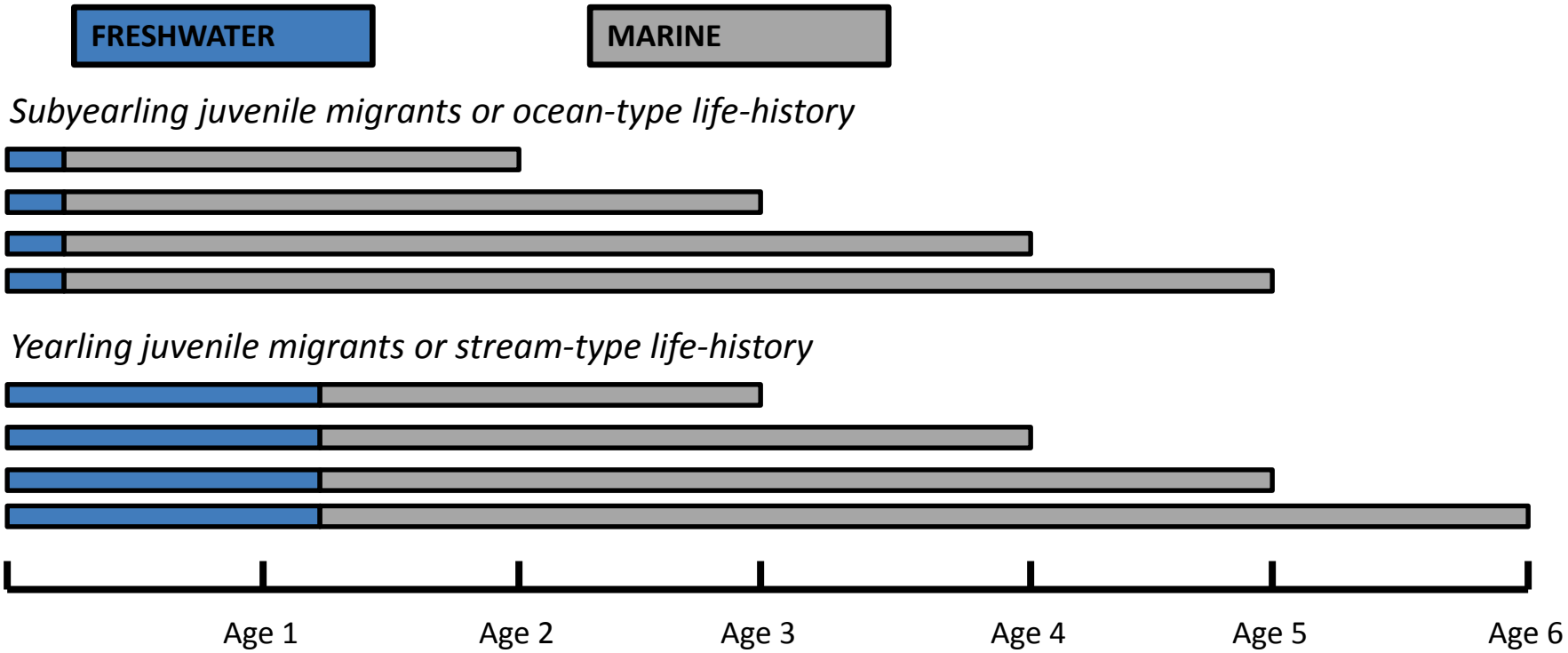
# Life-history diversity

**Why is diversity important?**

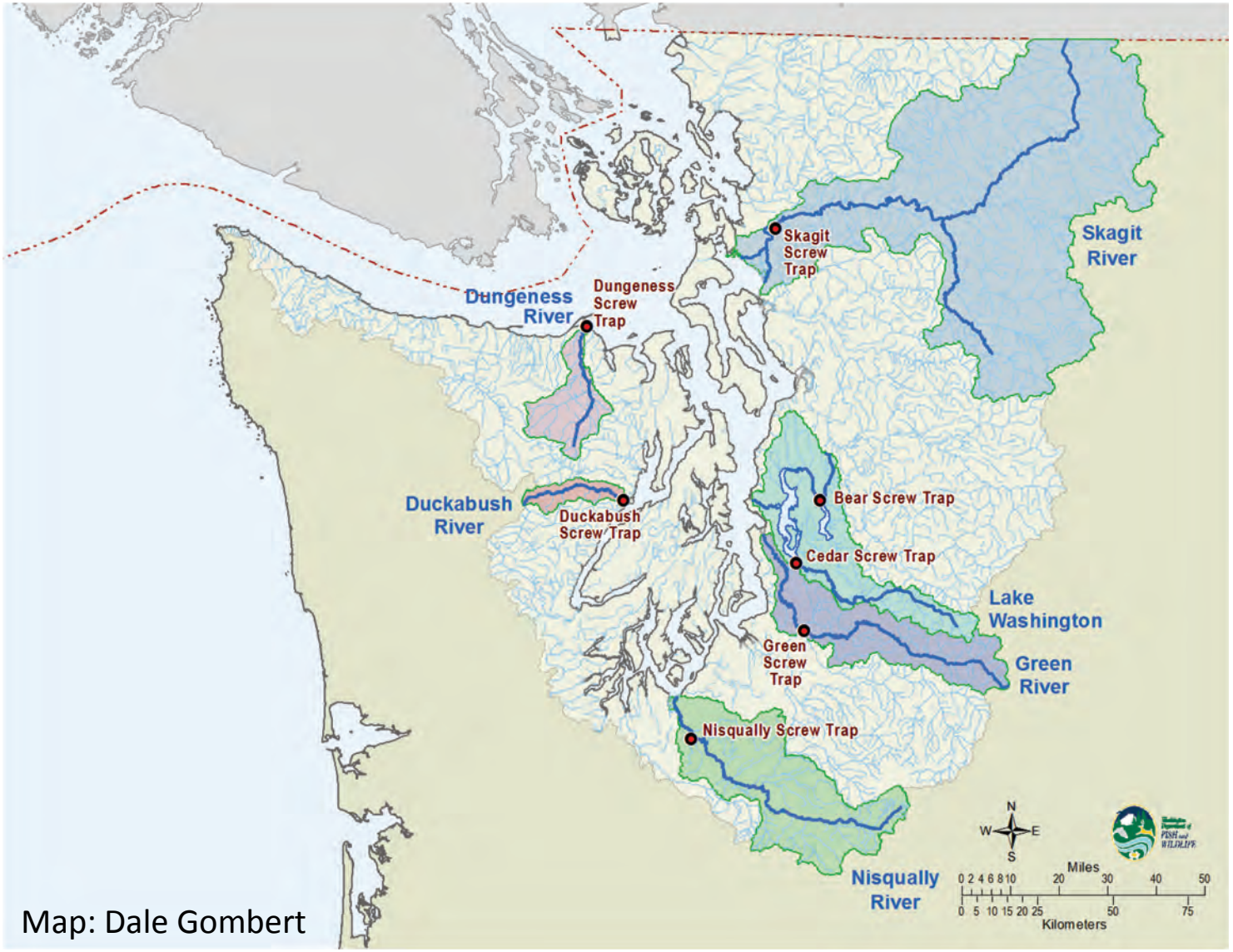
Similar to a diverse portfolio of financial assets, life-history diversity confers stability to salmon and steelhead populations given uncertain future environmental conditions

Schindler et al. 2010 *Nature*, Green et al. 2010 *Biol Letters*, Moore et al. 2010 *Cons Letters*, Moore et al. 2014 *J Anim Ecol*

**General patterns of Chinook salmon life-history diversity**



# WDFW smolt trap sites




Map: Dale Gombert

# WDFW smolt trap sites

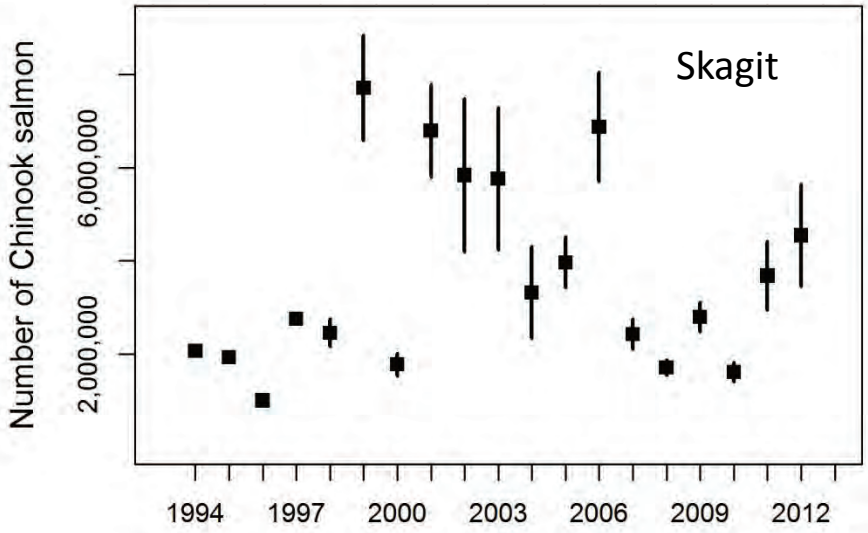
## Skagit River

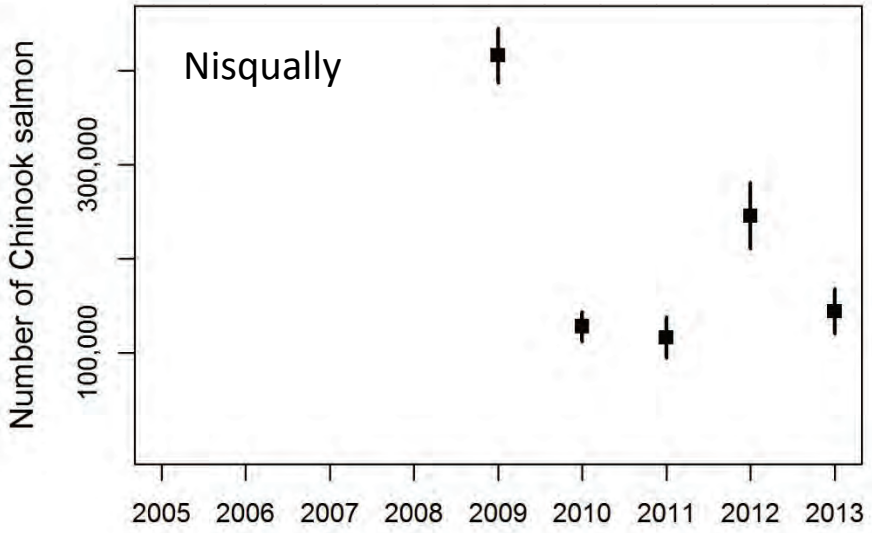
## Nisqually River

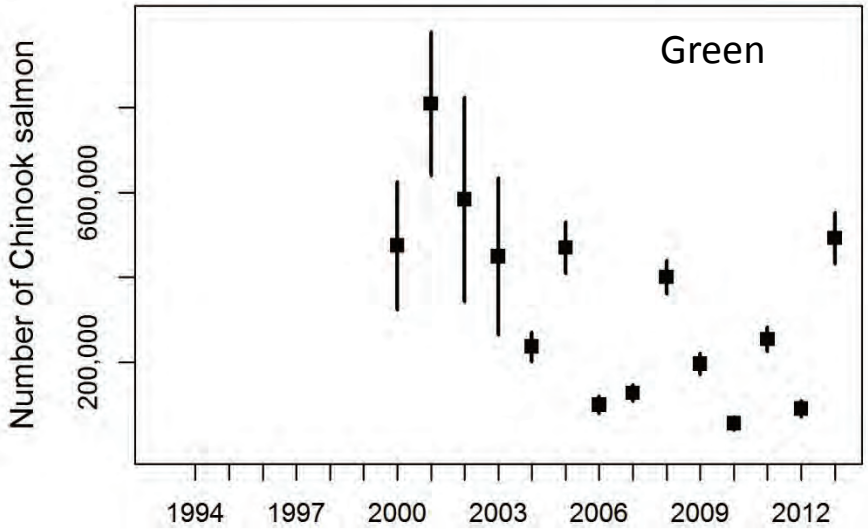
## Green River

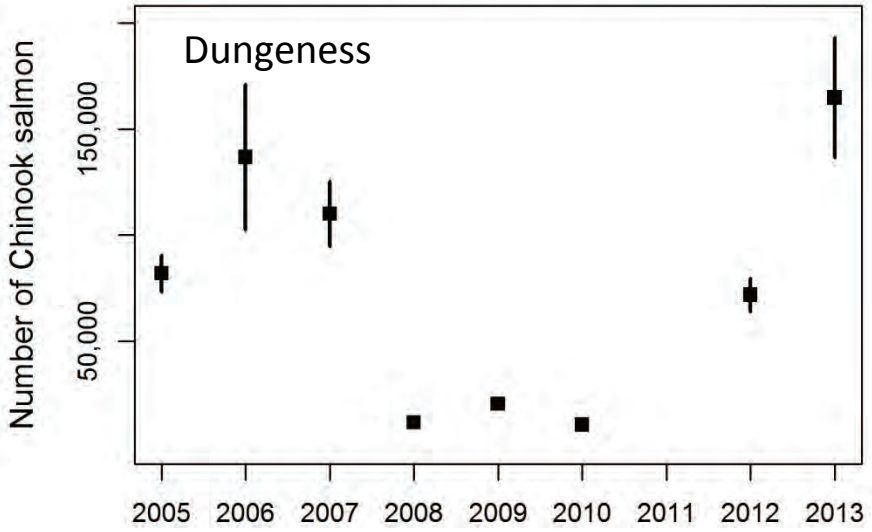
## Dungeness River

# Subyearling Chinook abundance

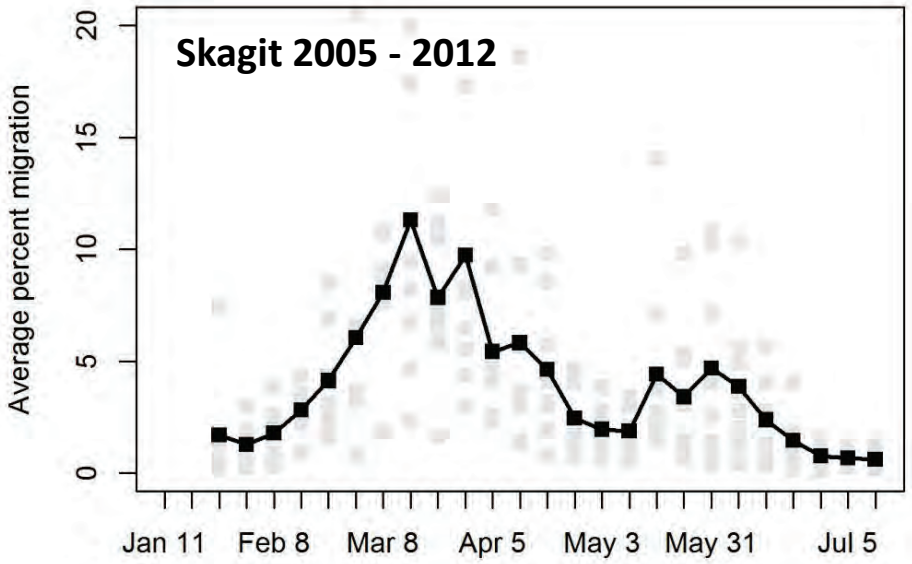


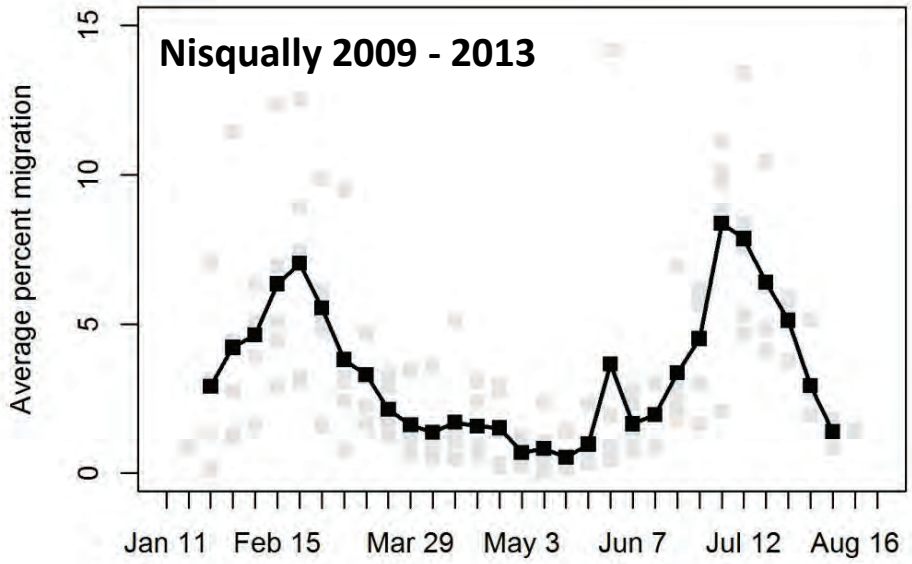



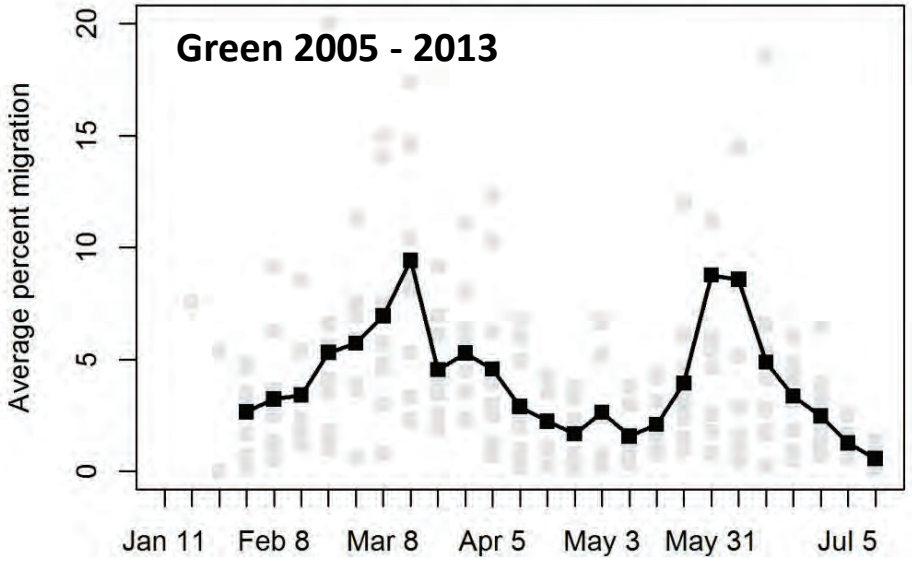



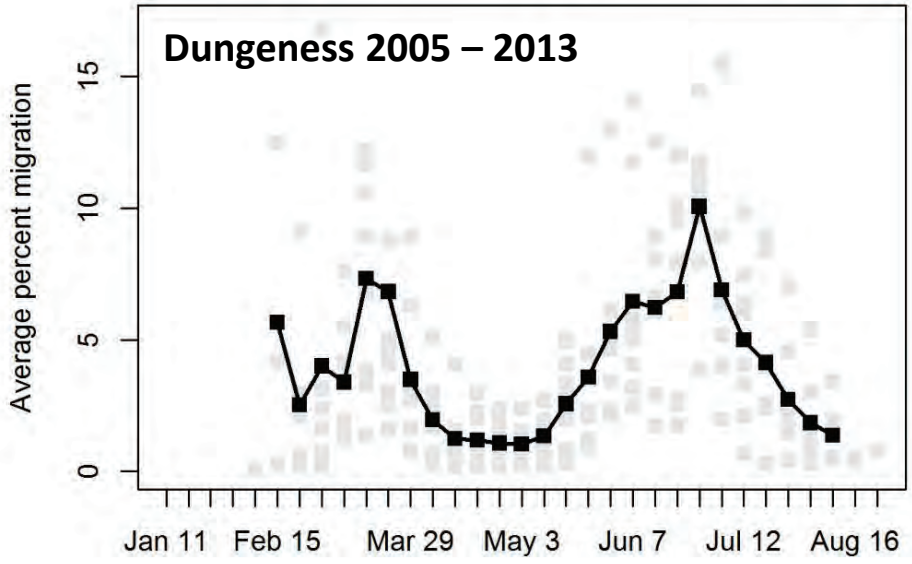



# Chinook salmon migration timing

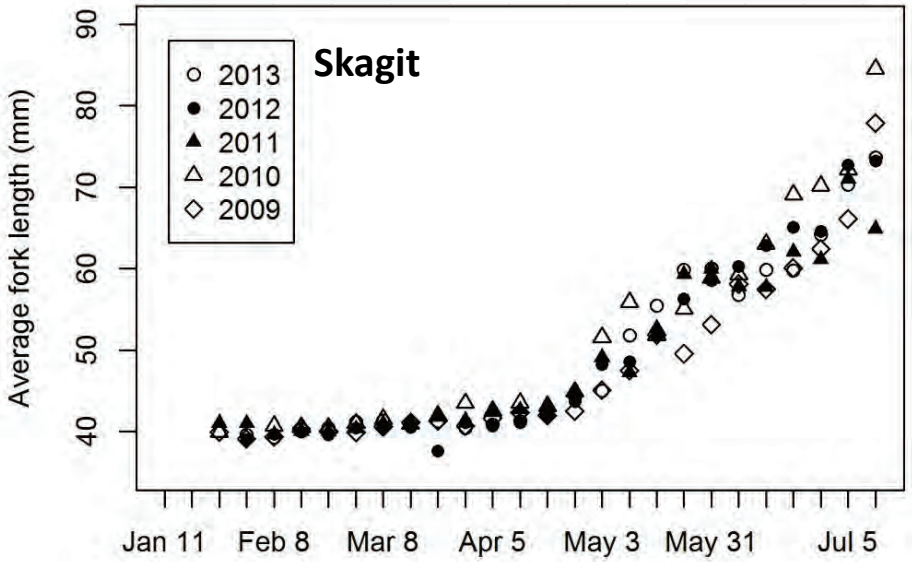


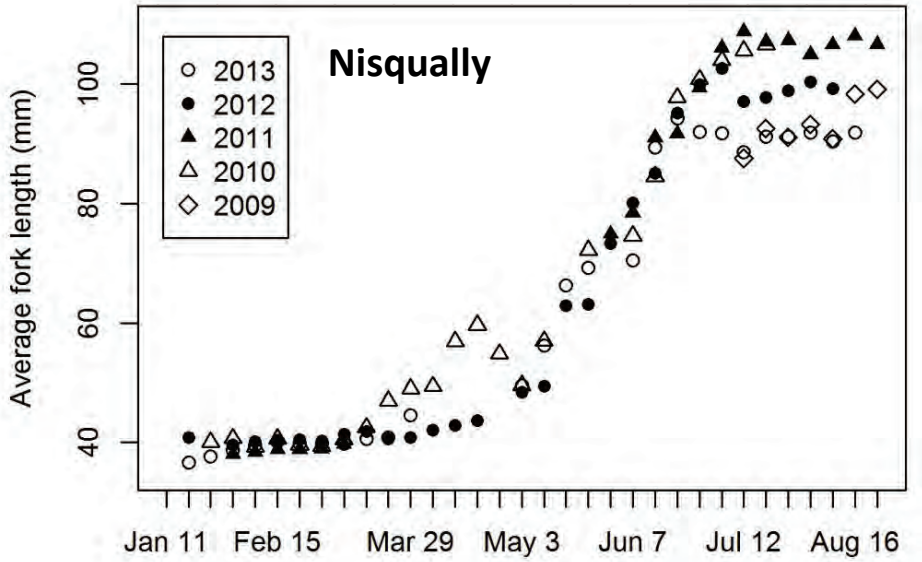



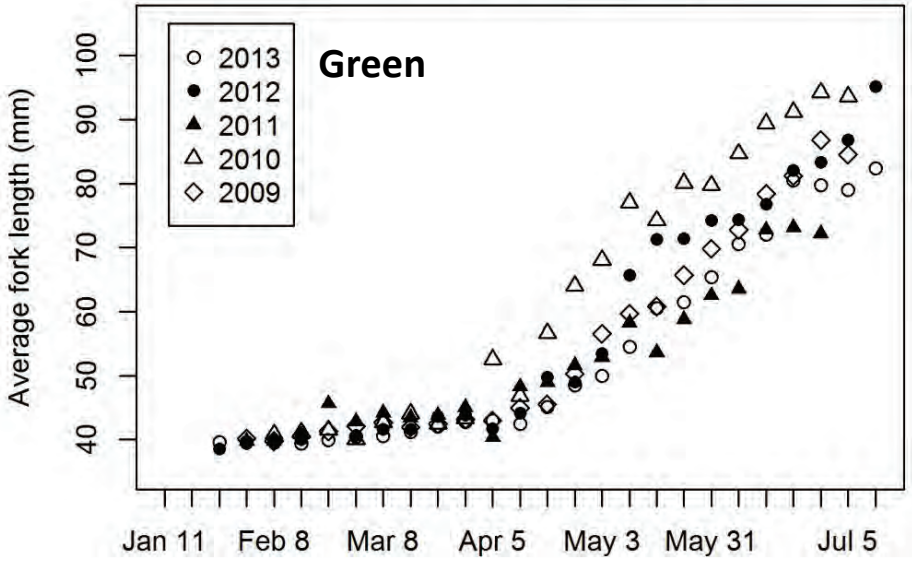



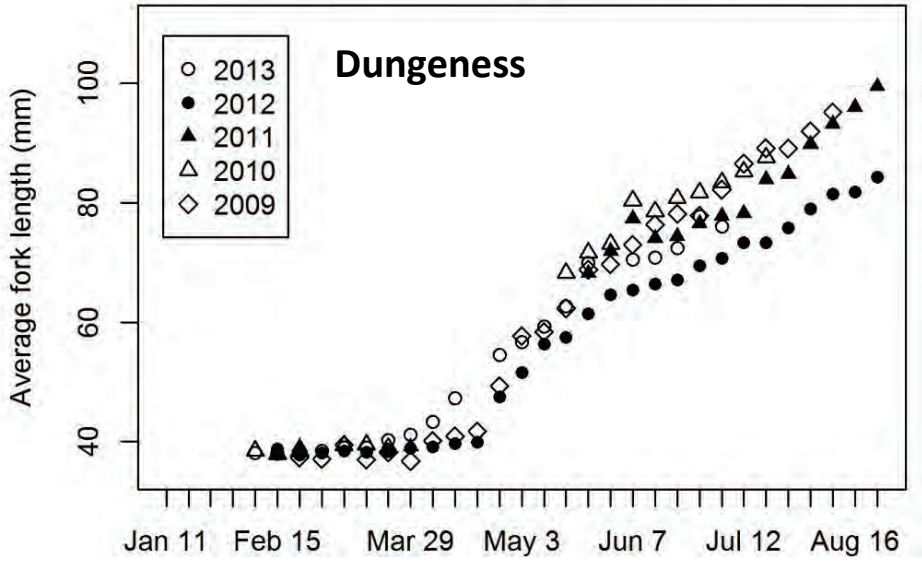



# Subyearling Chinook salmon body size



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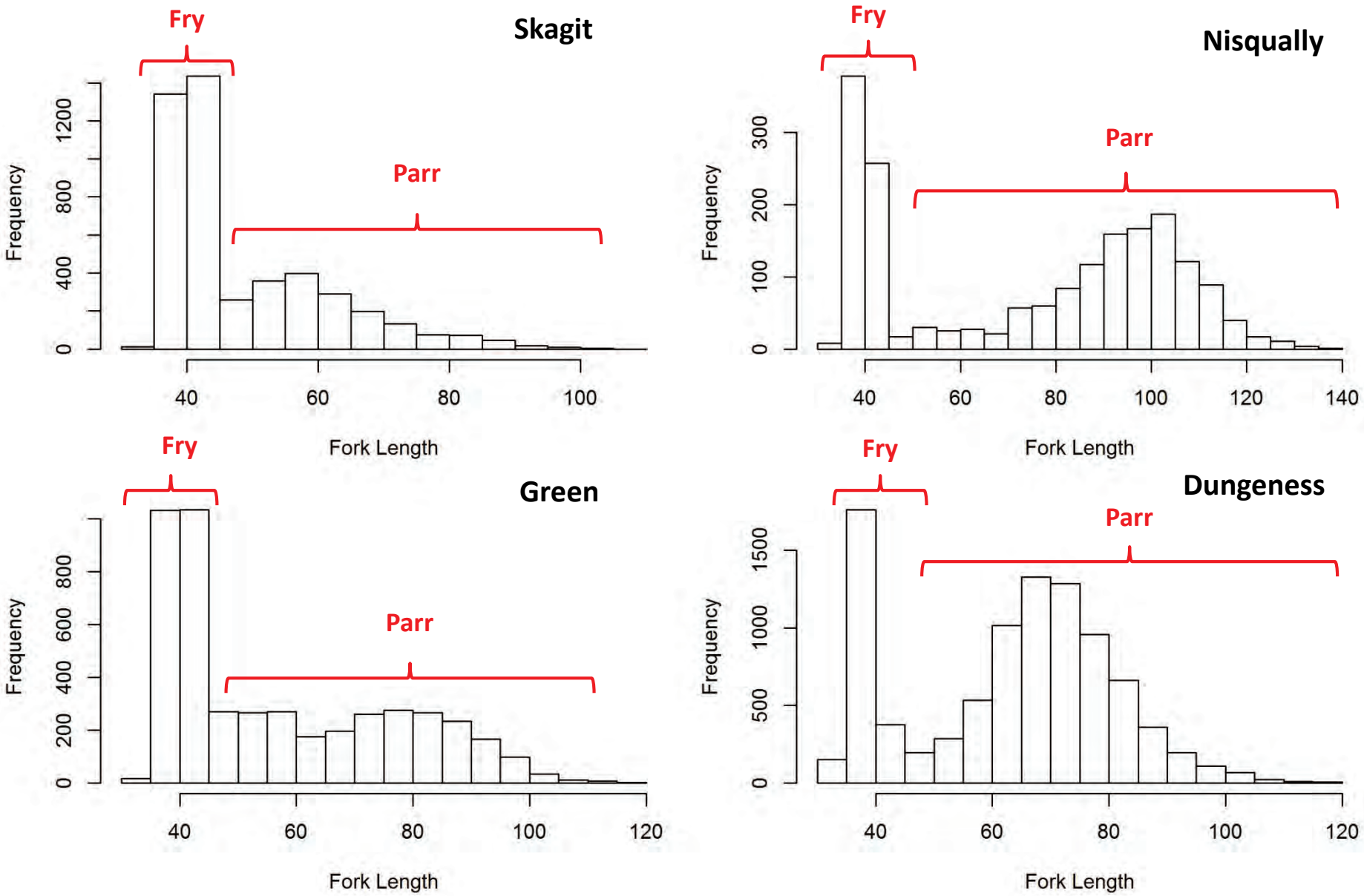
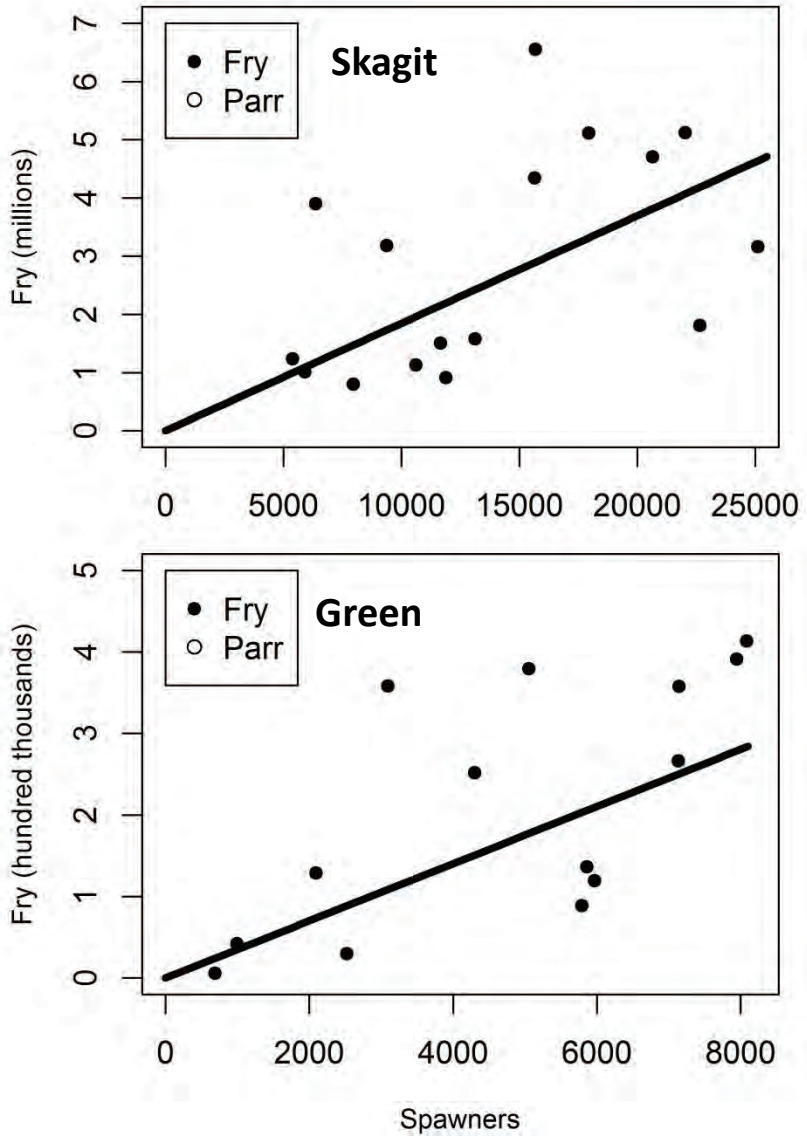


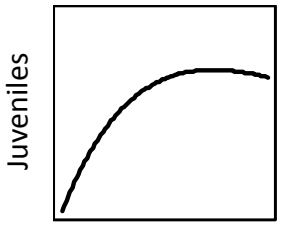
# Chinook productivity




Which model best describes patterns of productivity for each migrant life-history?

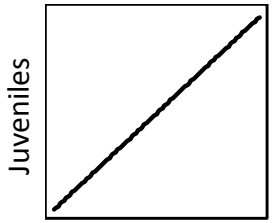
Ricker density dependent

$$log\left(\frac{J}{S}\right) = a - \frac{a}{b}S$$



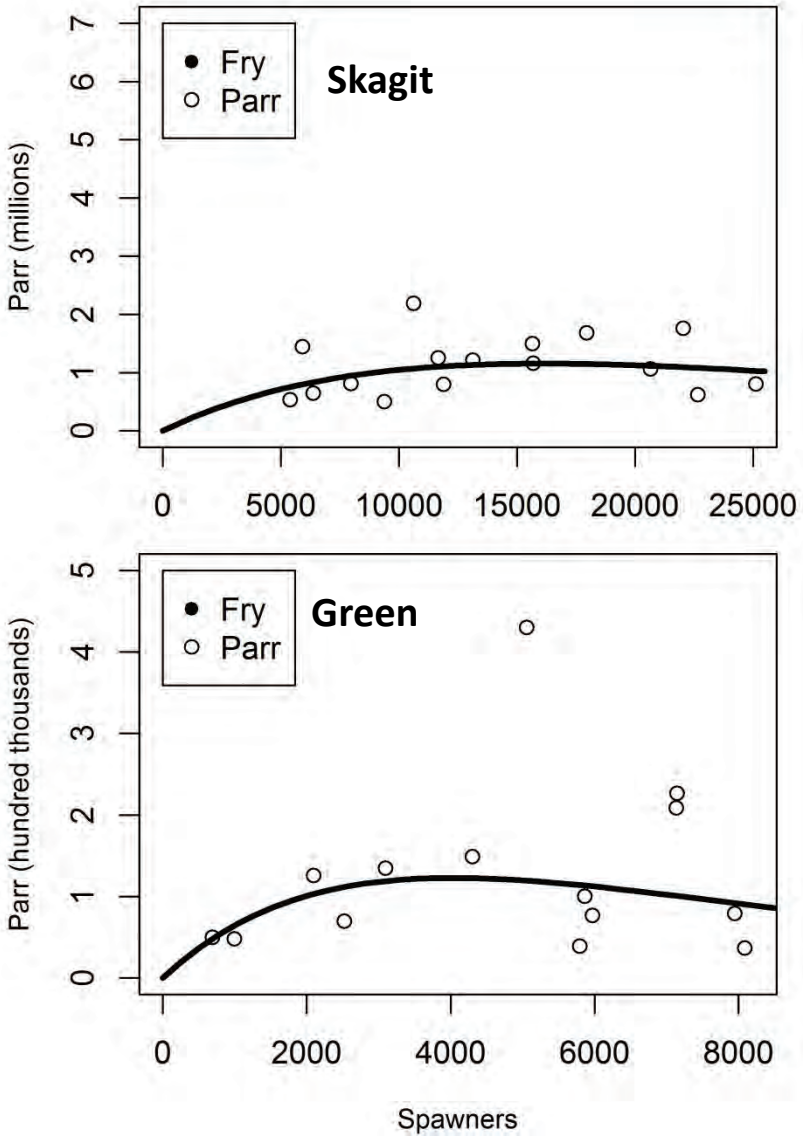

Density independent

$$log\left(\frac{J}{S}\right) = a$$




| Population | Migrant life-history | Best model | ΔAICc |
|---|---|---|---|
| Skagit | Fry | Density independent | 2.7 |
| Green | Fry | Density independent | 2.6 |

# Chinook productivity

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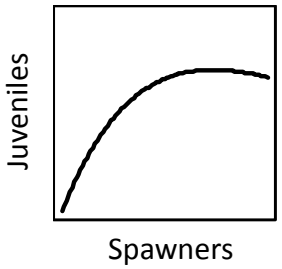
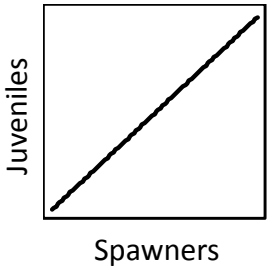



Density independent

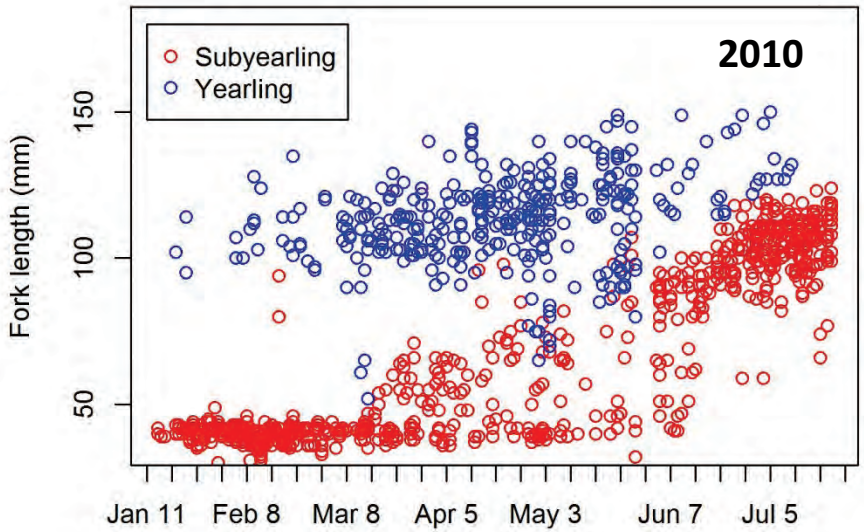
$$log\left(\frac{J}{S}\right) = a$$

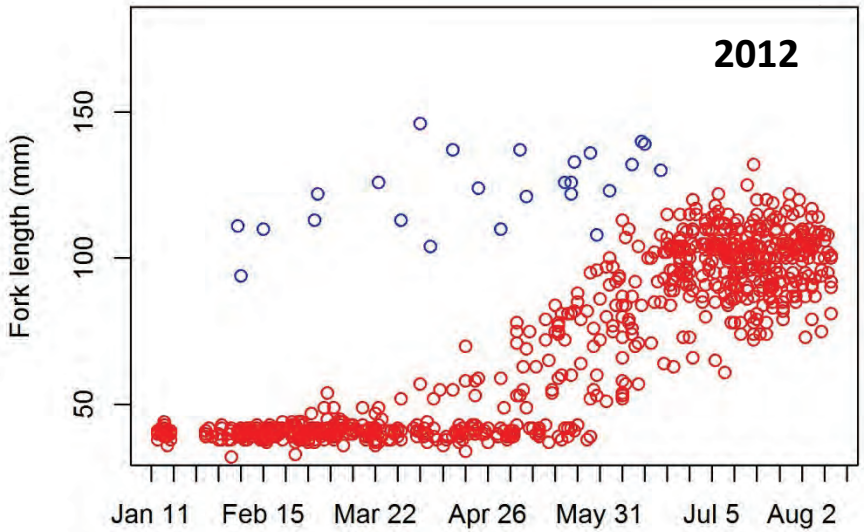


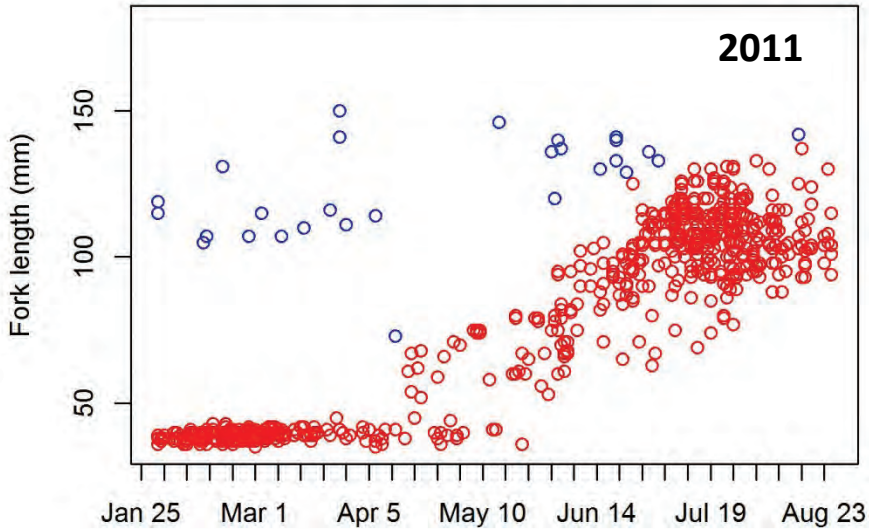

| Population | Migrant life-history | Best model | ΔAICc |
|---|---|---|---|
| Skagit | Fry | Density independent | 2.7 |
| Green | Fry | Density independent | 2.6 |
| Skagit | Parr | Ricker density dependent | 7.4 |
| Green | Parr | Ricker density dependent | 6.0 |

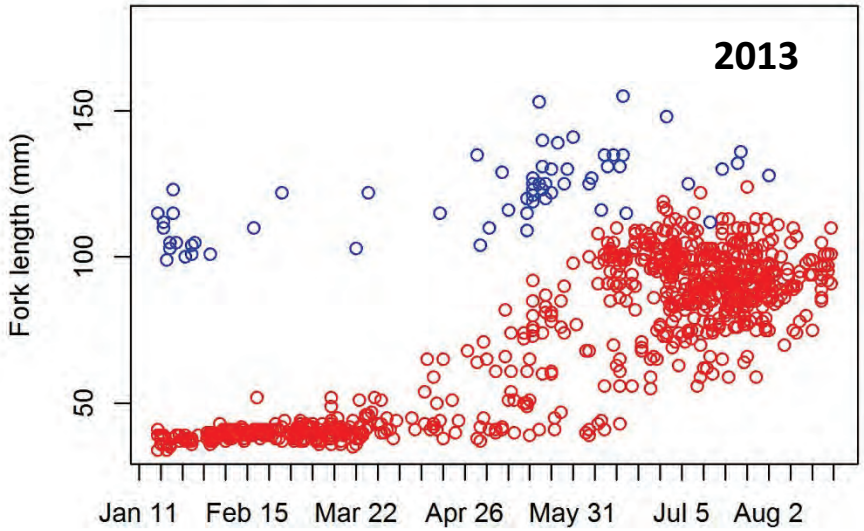
# Yearling Chinook

## Nisqually

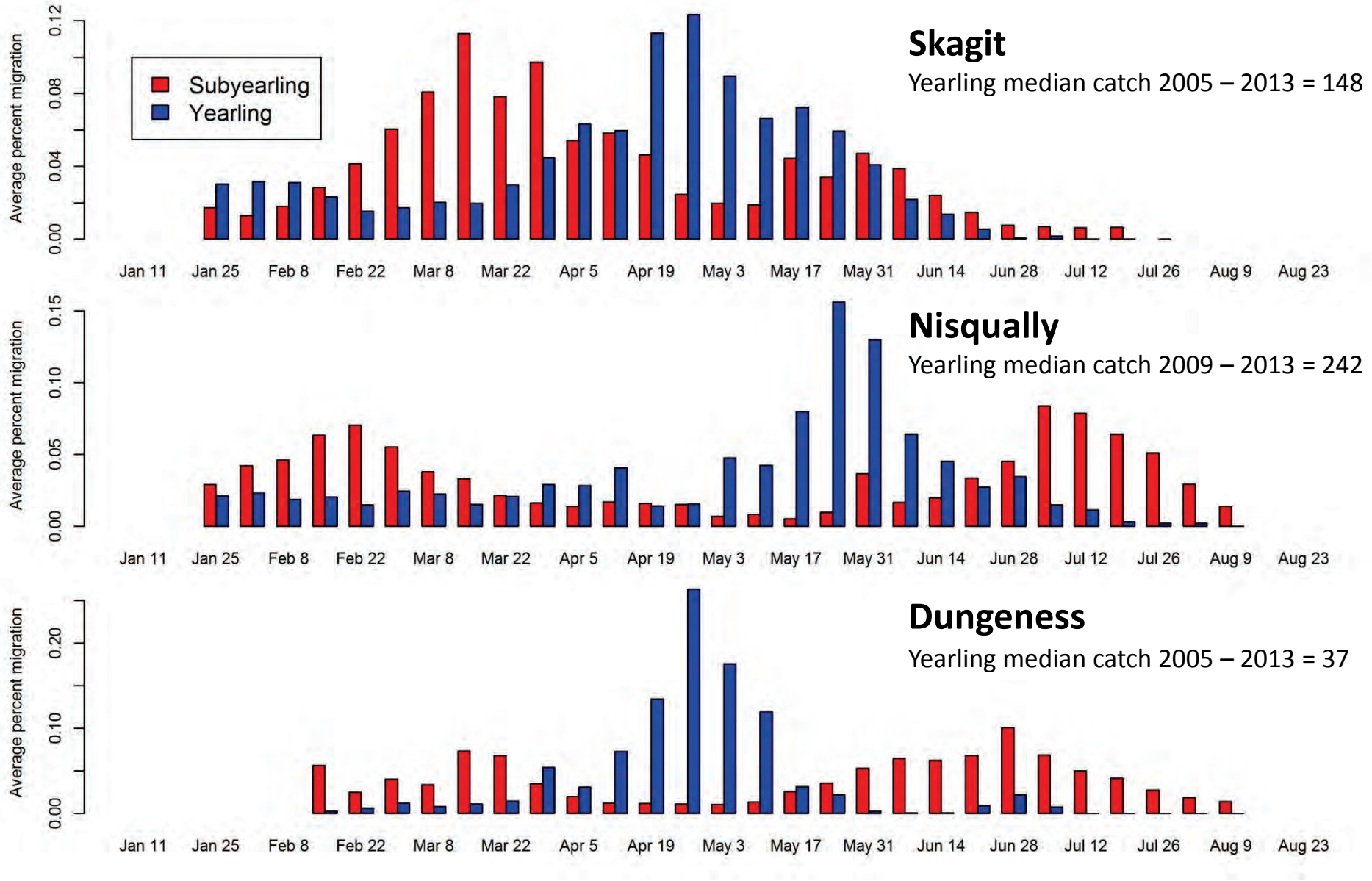


# Yearling Chinook migration timing



# Conclusions

**Life history diversity**

- Distinct bimodal subyearling Chinook migration: early small fry followed by later larger parr
- Yearling Chinook observed in Skagit, Nisqually and Dungeness, likely related to colder temperatures from snowmelt/glacial influence

**Productivity**

- In Skagit and Green, fry production increases consistently with spawners, but parr production shows evidence for density dependent capacity limits
- By inference, freshwater productivity limited by rearing not spawning habitat

**Restoration implications**

- Efforts to create and maintain juvenile rearing habitat will provide the greatest benefit to Chinook freshwater productivity
- Diverse habitats promote diverse life-histories

**Unanswered question**

- What is the relative marine survival of fry vs parr subyearling migrants?

# Acknowledgements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