



May 2nd, 8:30 AM - 10:00 AM

Life-history diversity and productivity of Puget Sound Chinook salmon

Joseph H. Anderson

Washington (State). Department of Fish and Wildlife, joseph.anderson@dfw.wa.gov

Peter Topping

Washington (State). Department of Fish and Wildlife

Clayton Kinsel

Washington (State). Department of Fish and Wildlife

Matthew Klungle

Washington (State). Department of Fish and Wildlife

Kelly Kiyohara

Washington (State). Department of Fish and Wildlife

See next page for additional authors

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Speaker

Joseph H. Anderson, Peter Topping, Clayton Kinsel, Matthew Klungle, Kelly Kiyohara, and Joshua Weinheimer

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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

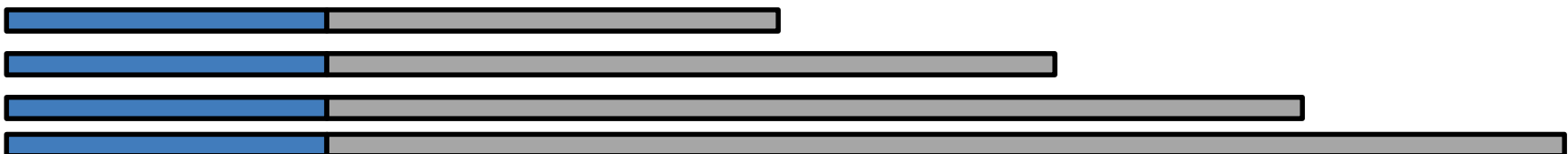
FRESHWATER

MARINE

Subyearling juvenile migrants or ocean-type life-history



Yearling juvenile migrants or stream-type life-history



Age 1

Age 2

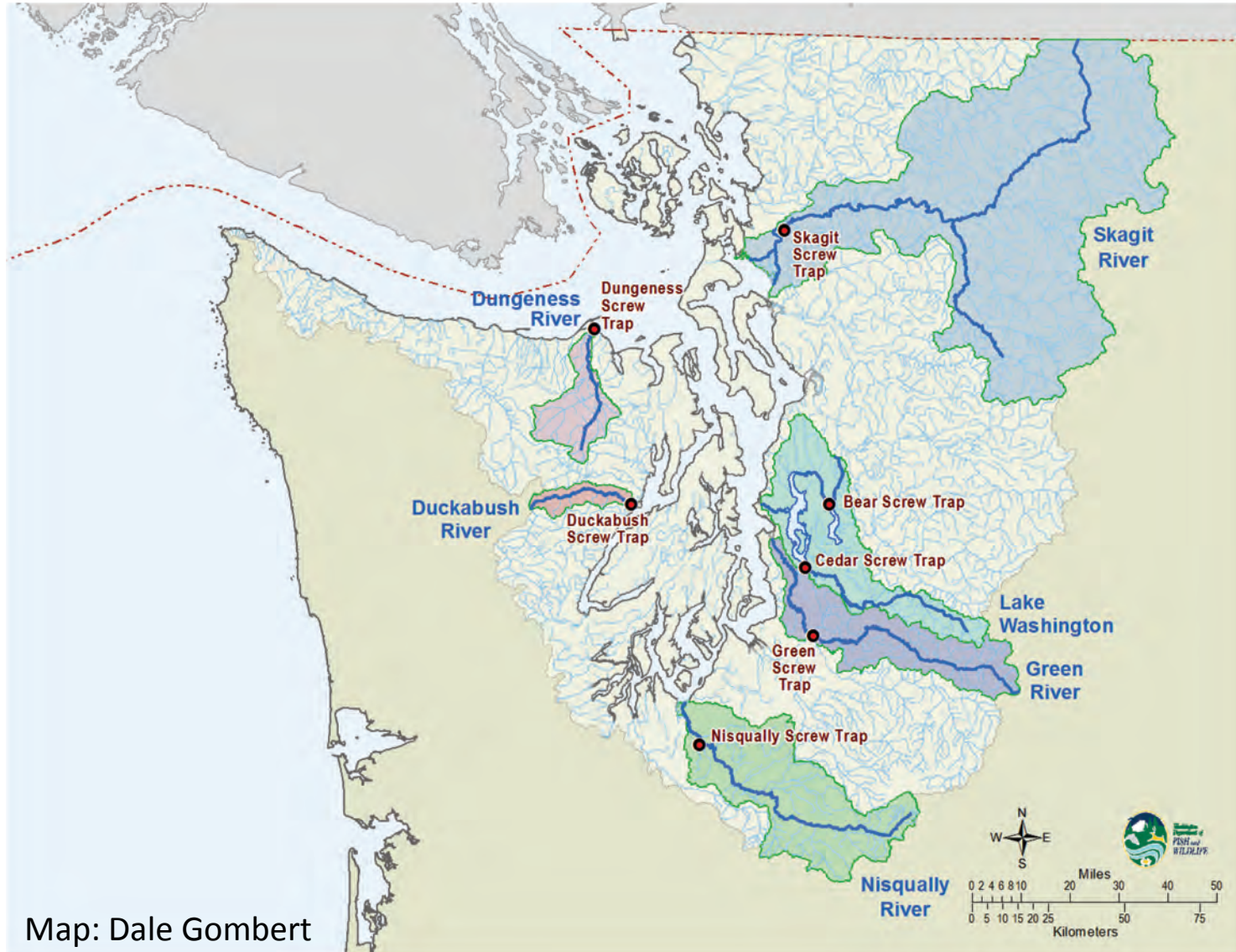
Age 3

Age 4

Age 5

Age 6

WDFW smolt trap sites



Map: Dale Gombert

WDFW smolt trap sites

Skagit River



Nisqually River



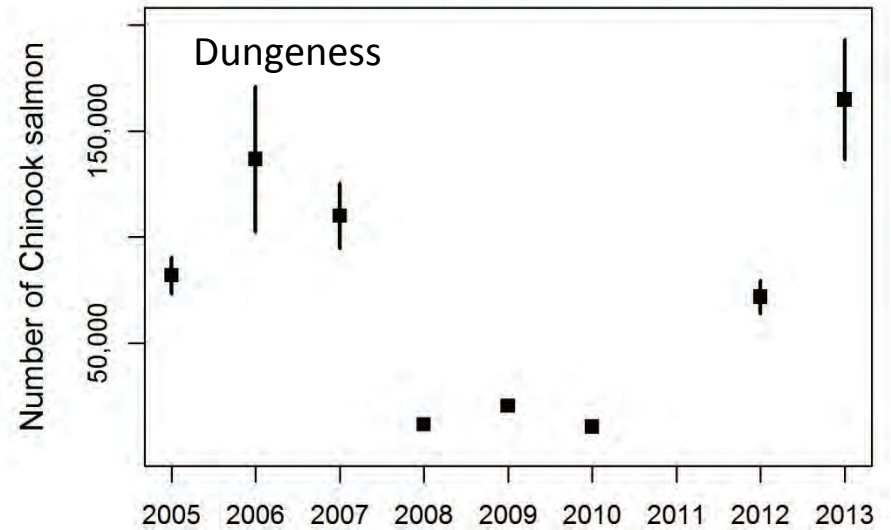
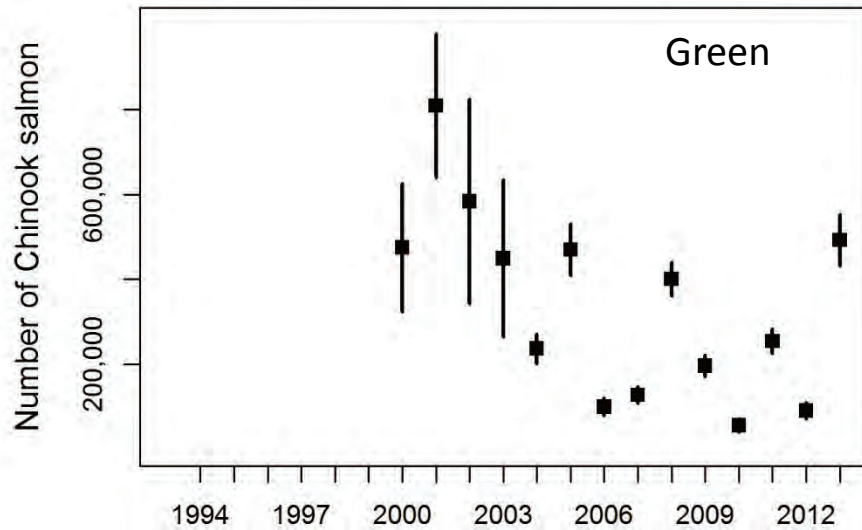
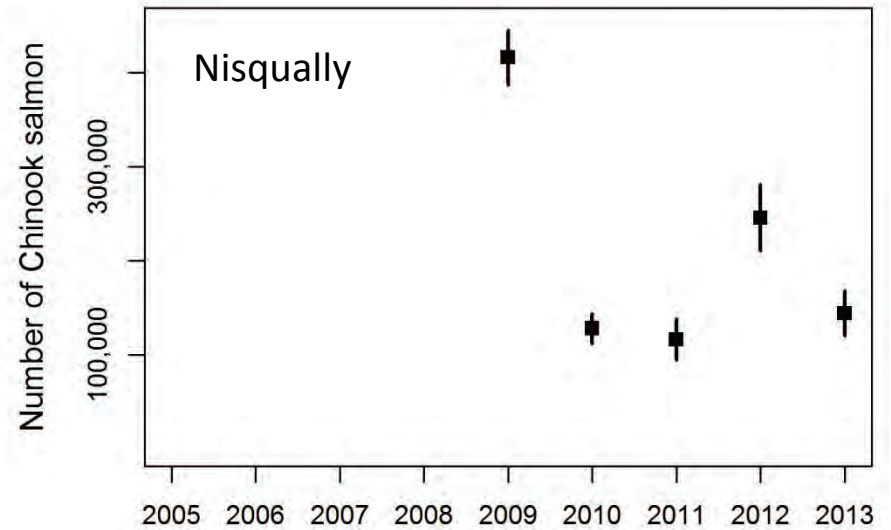
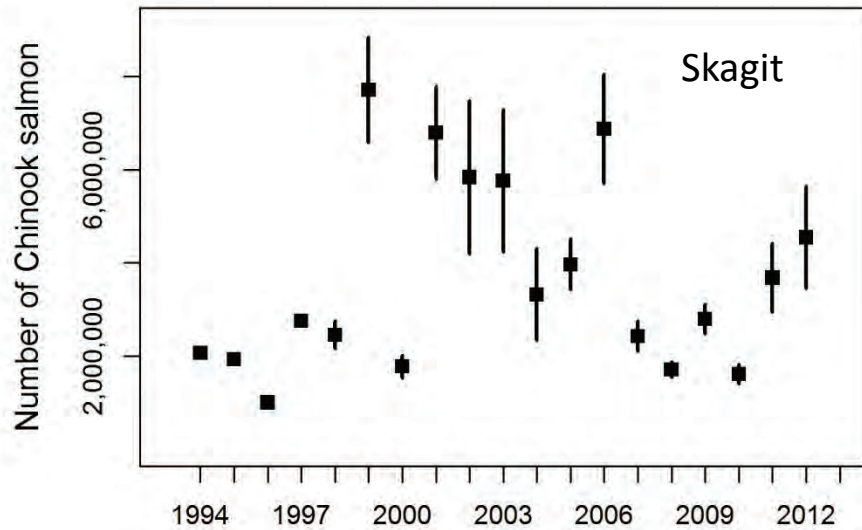
Green River



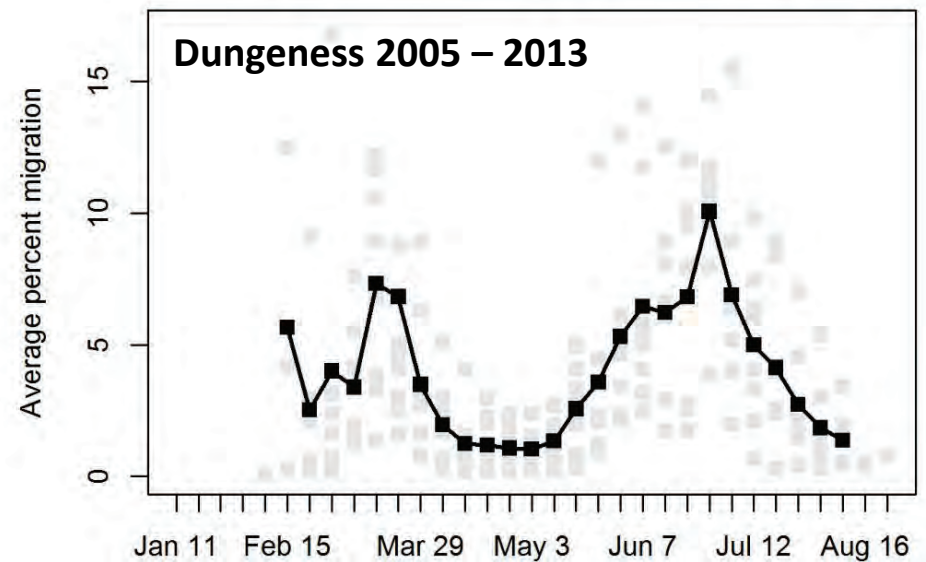
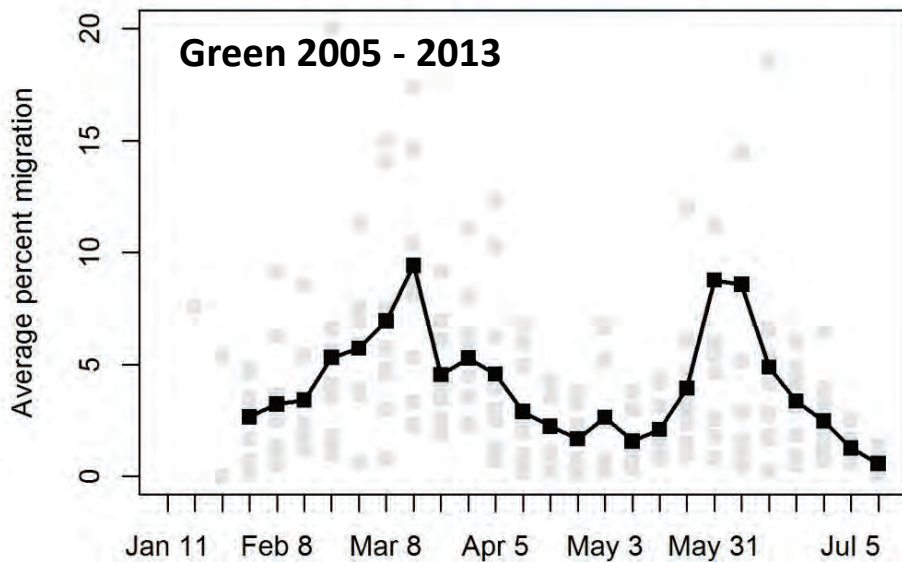
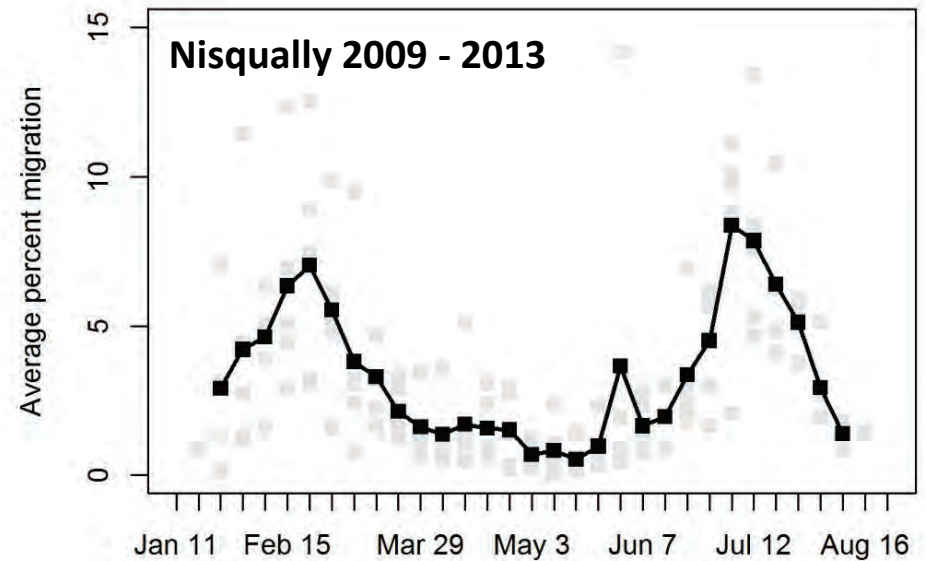
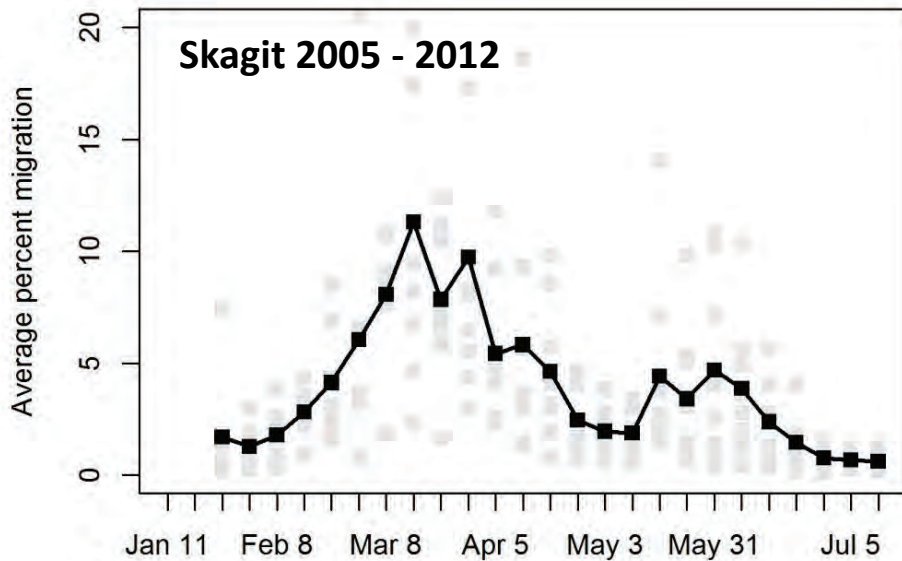
Dungeness River



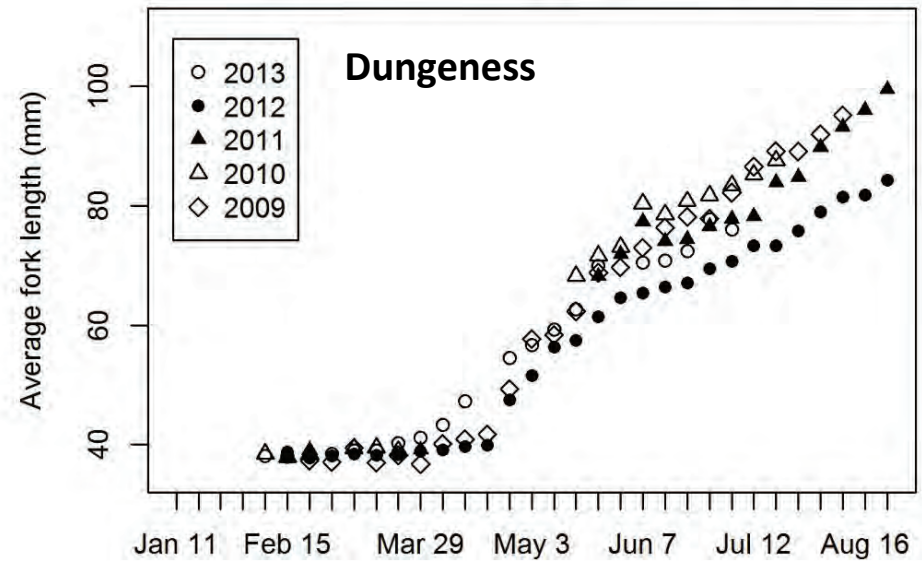
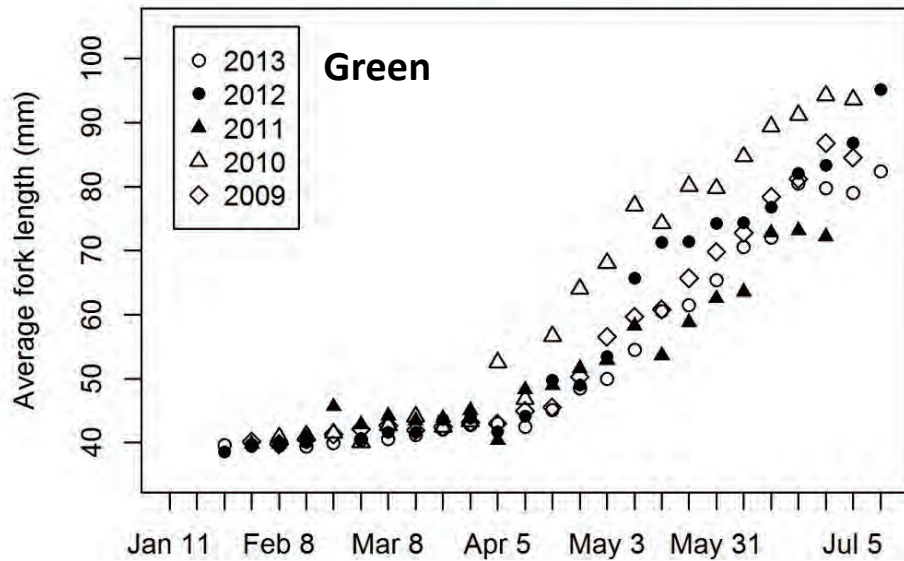
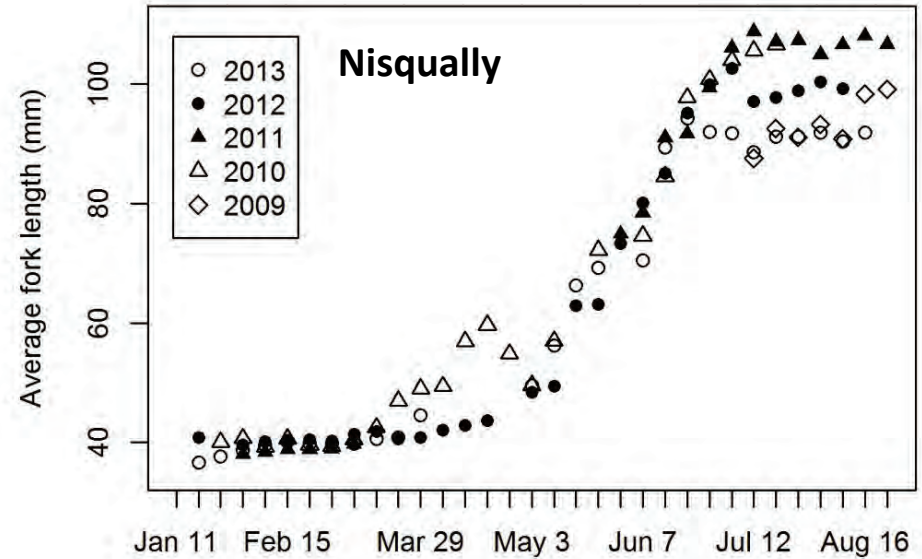
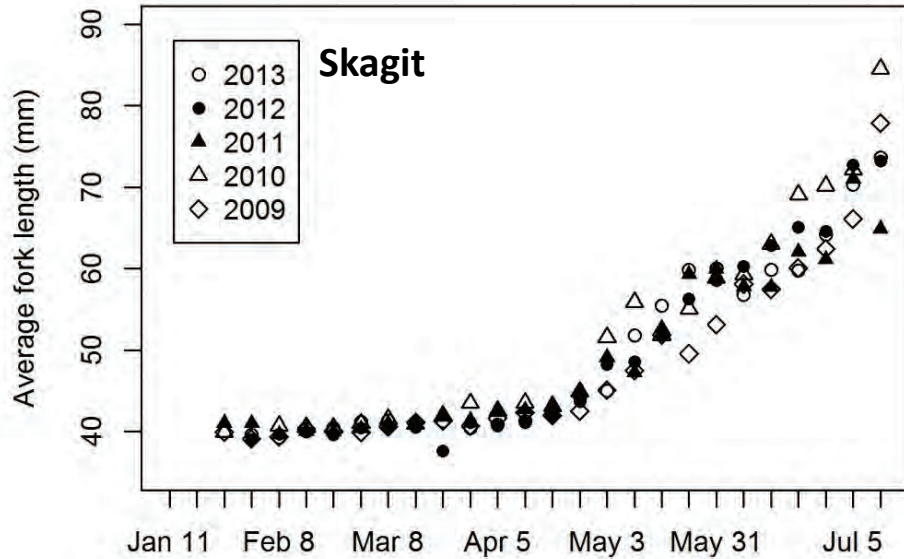
Subyearling Chinook abundance



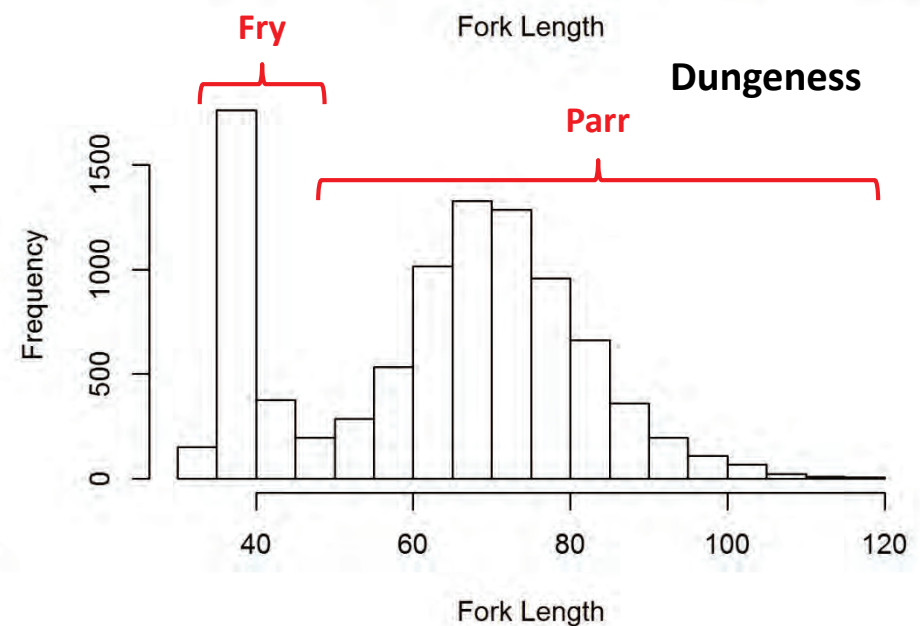
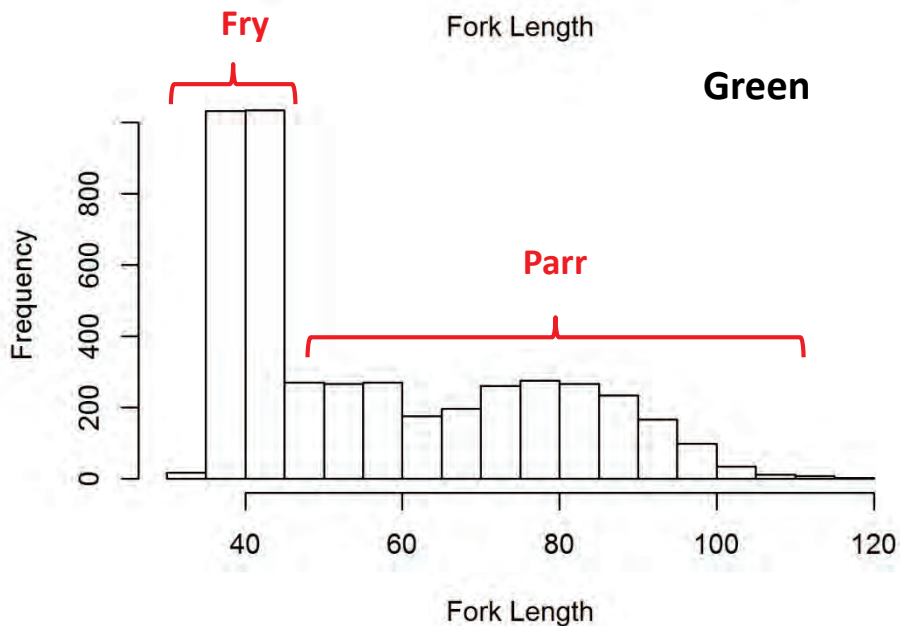
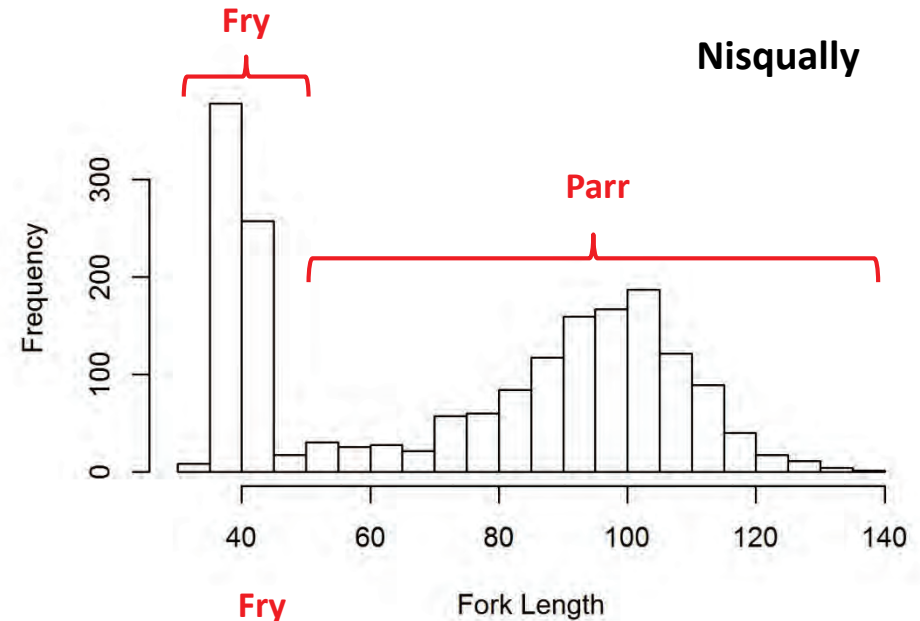
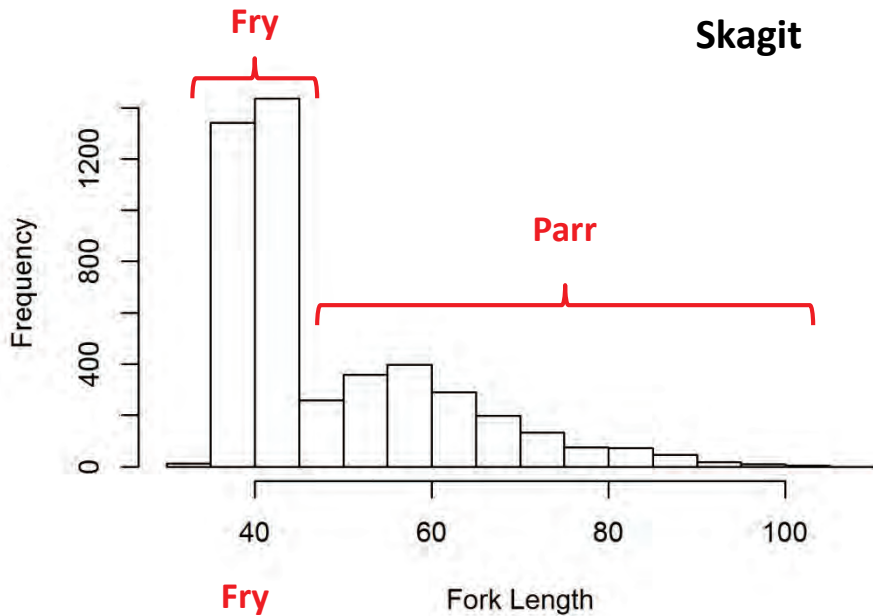
Chinook salmon migration timing



Subyearling Chinook salmon body size

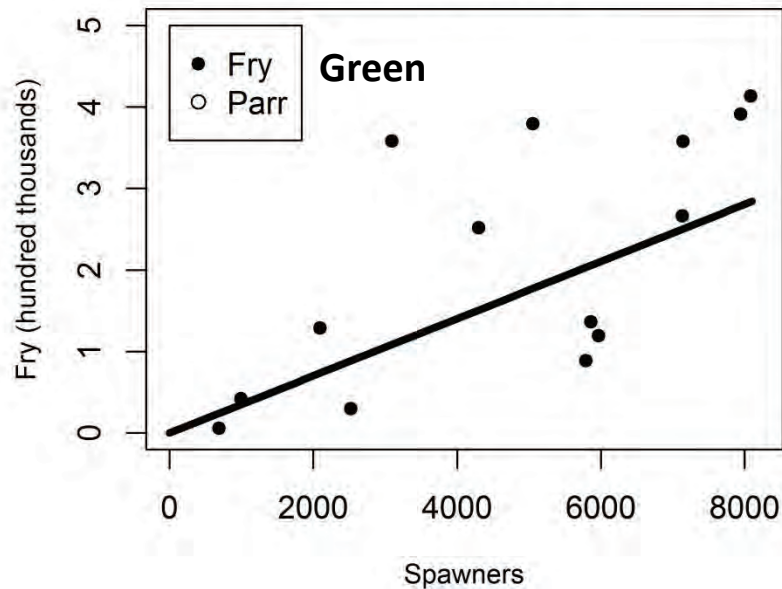
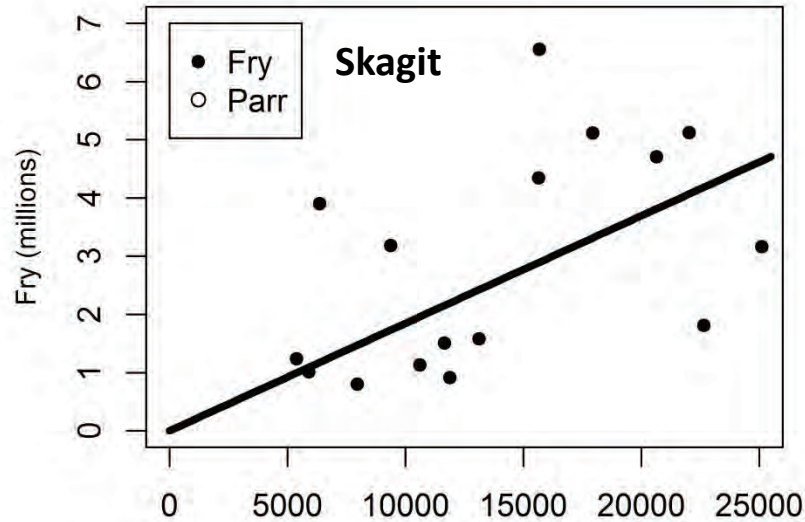


Subyearling Chinook salmon body size



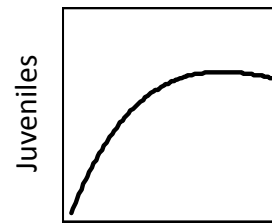
Chinook productivity

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



Ricker density dependent

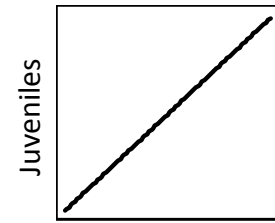
$$\log\left(\frac{J}{S}\right) = a - \frac{a}{b}S$$



Spawners

Density independent

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

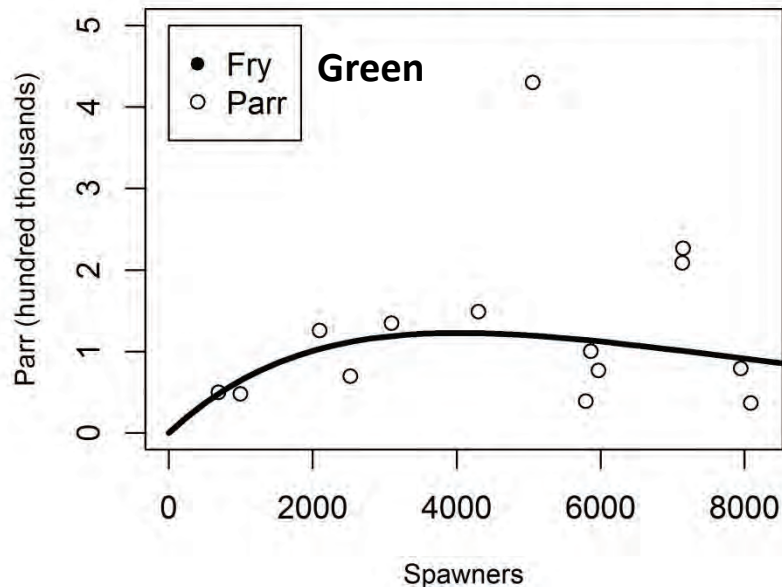
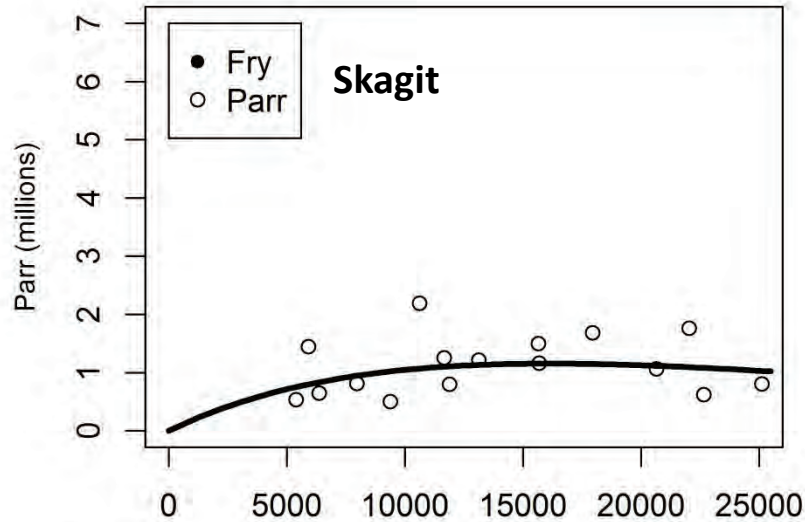


Spawners

Population	Migrant life-history	Best model	$\Delta AICc$
Skagit	Fry	Density independent	2.7
Green	Fry	Density independent	2.6

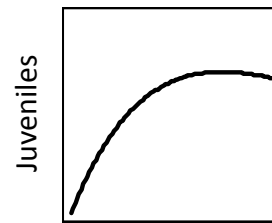
Chinook productivity

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



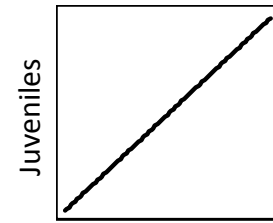
Ricker density dependent

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



Density independent

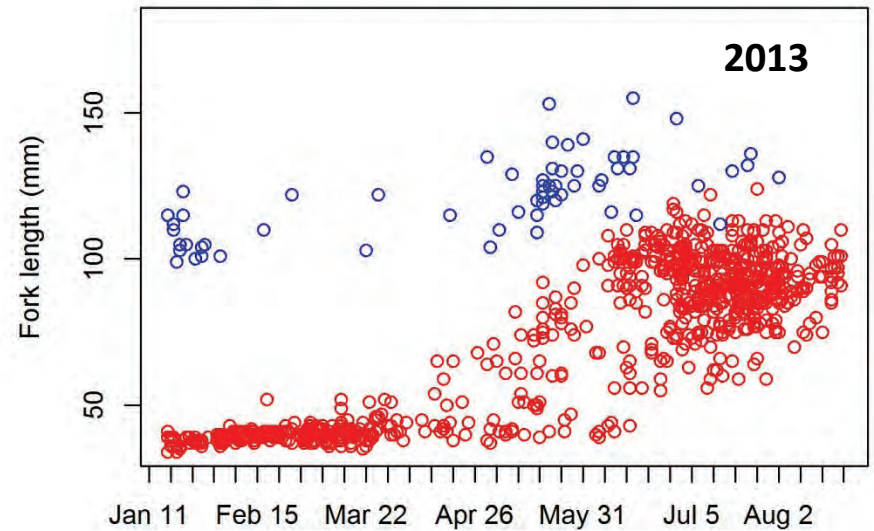
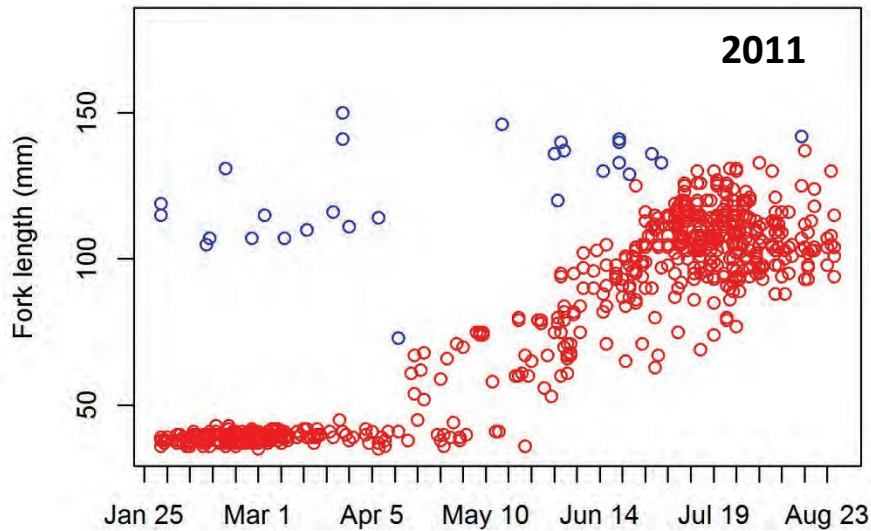
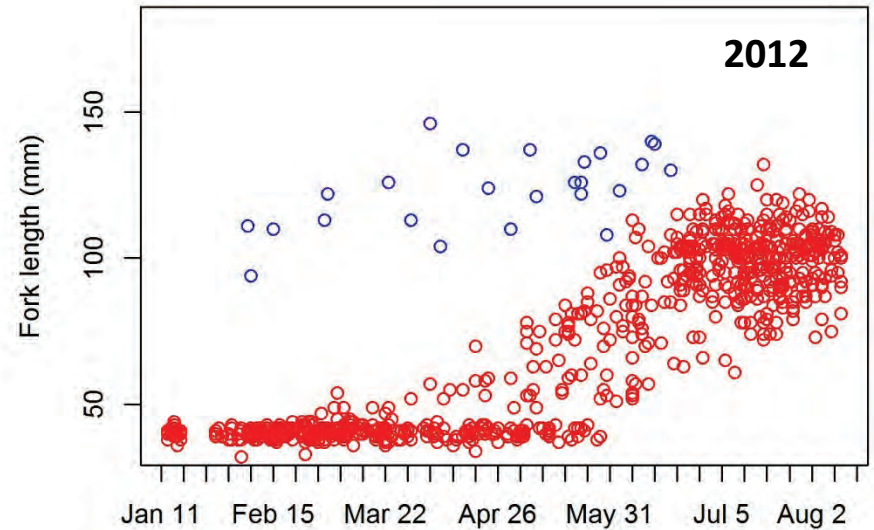
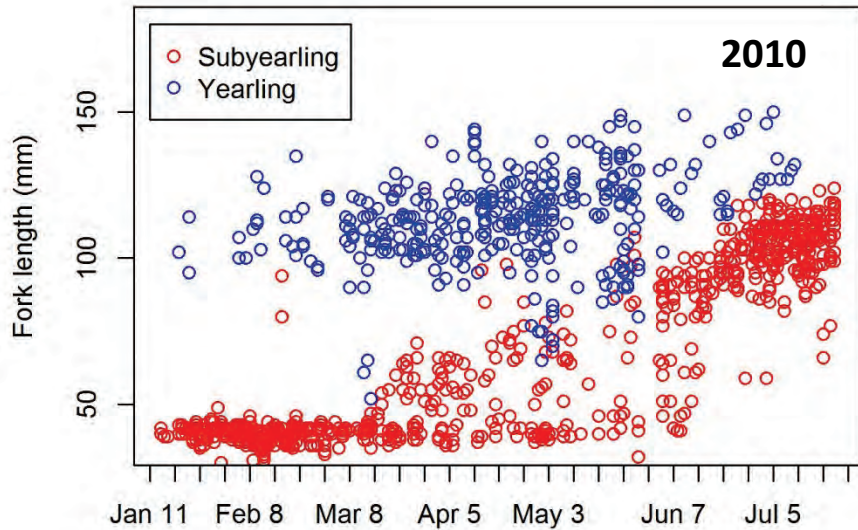
$$\log\left(\frac{J}{S}\right) = a$$



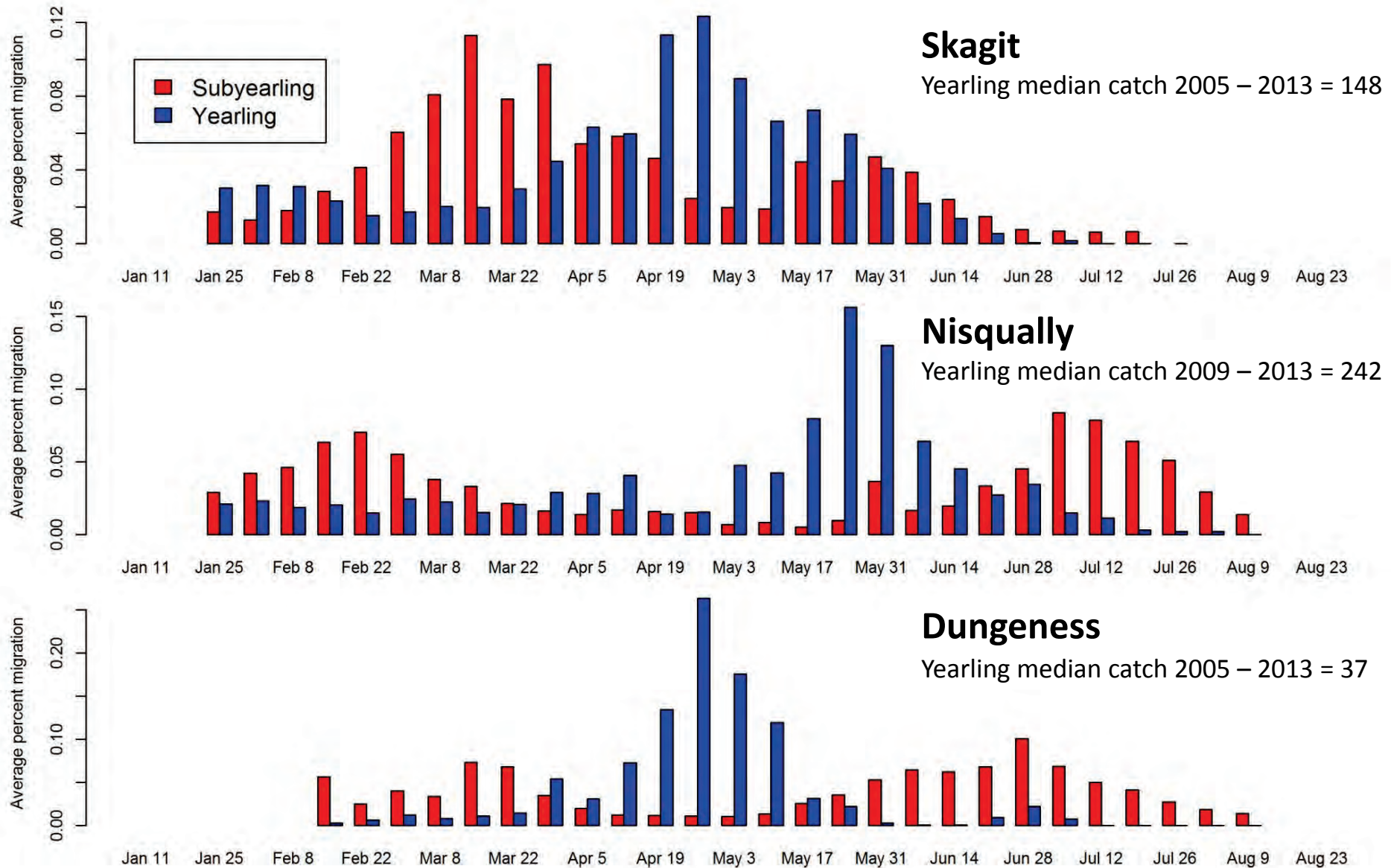
Population	Migrant life-history	Best model	$\Delta AICc$
Skagit	Fry	Density independent	2.7
Green	Fry	Density independent	2.6
Skagit	Parr	Ricker density dependent	7.4
Green	Parr	Ricker density dependent	6.0

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?

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