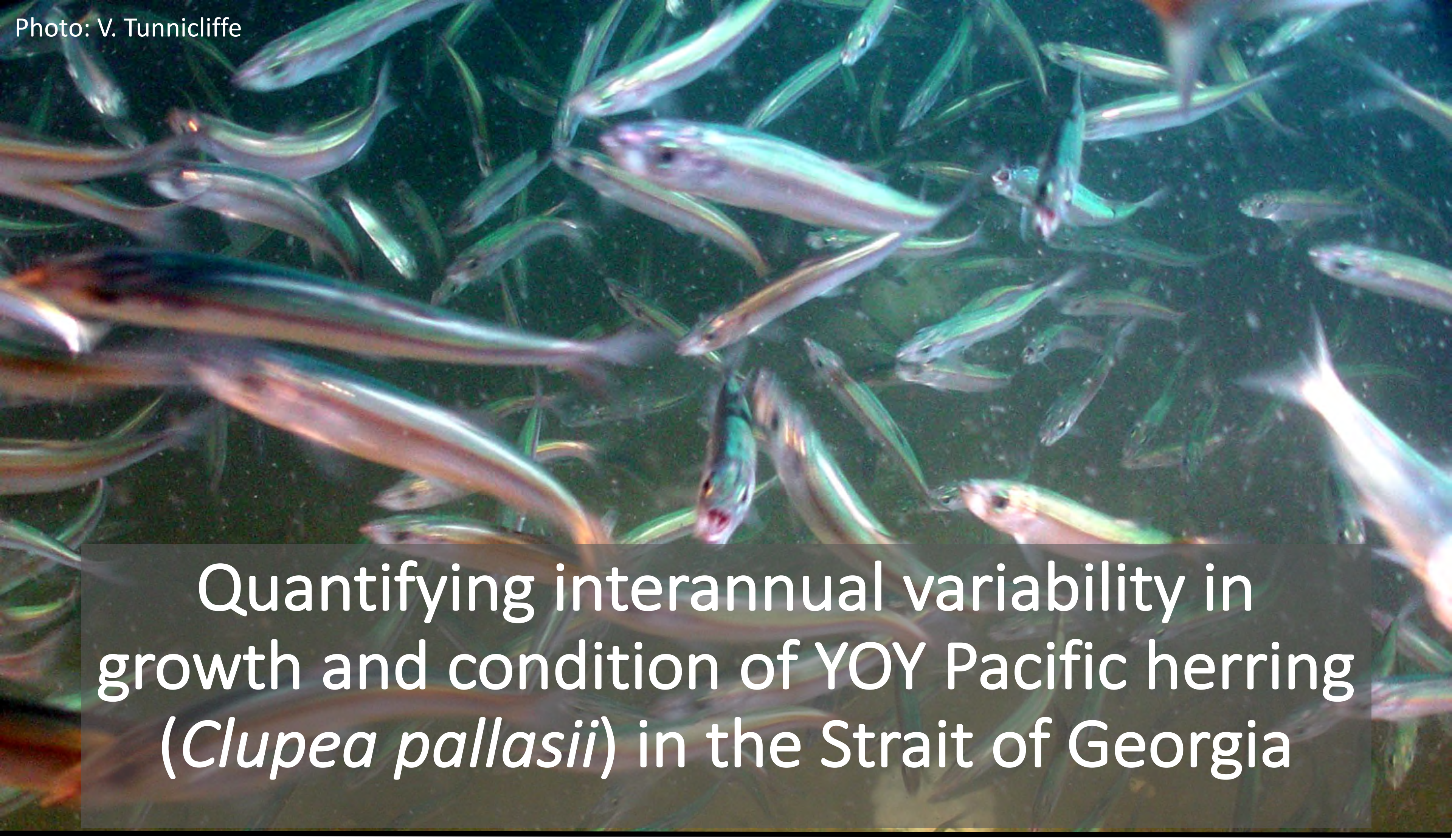

Quantifying interannual variability in growth and condition of YOY Pacific herring (*Clupea pallasii*) in the Strait of Georgia

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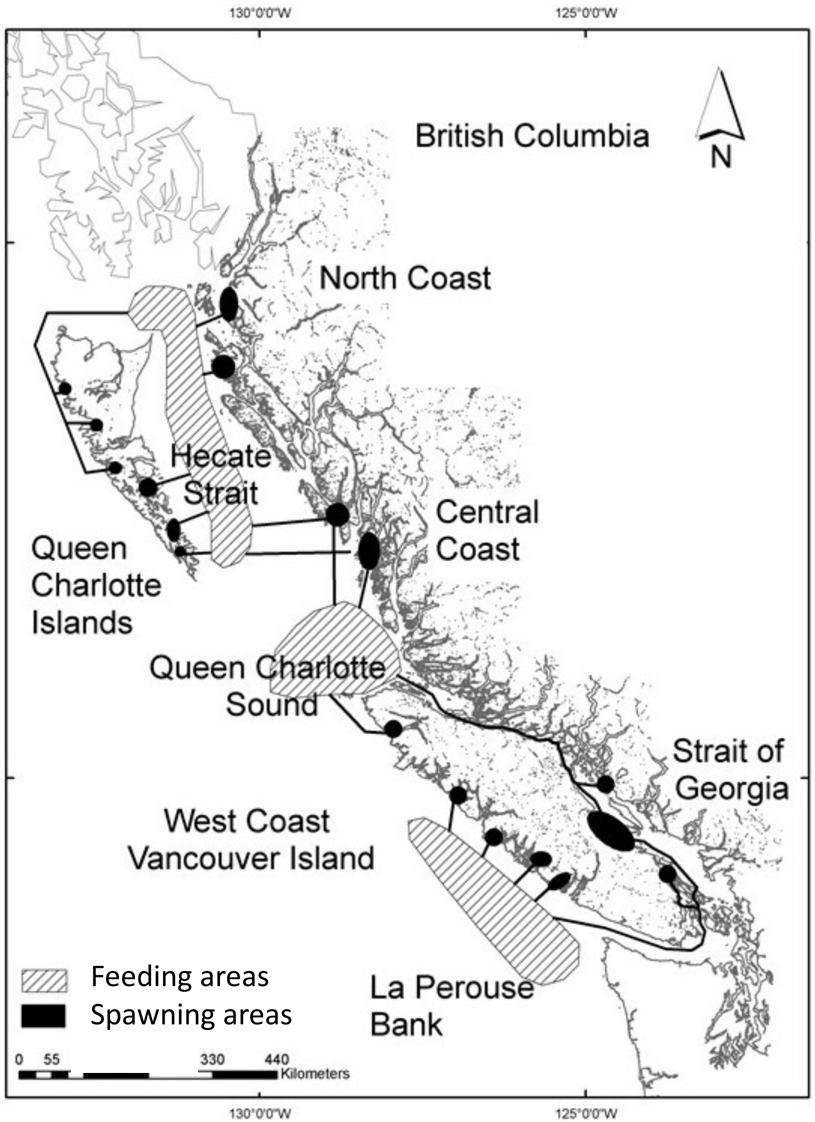
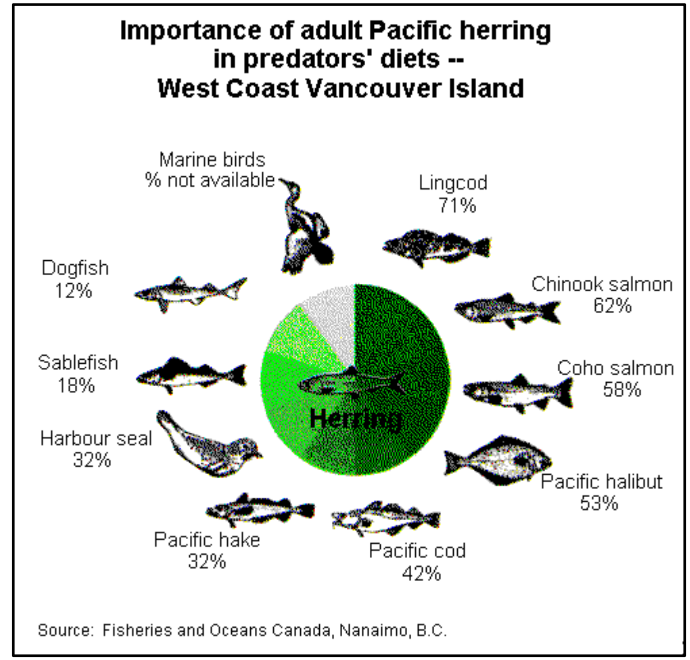
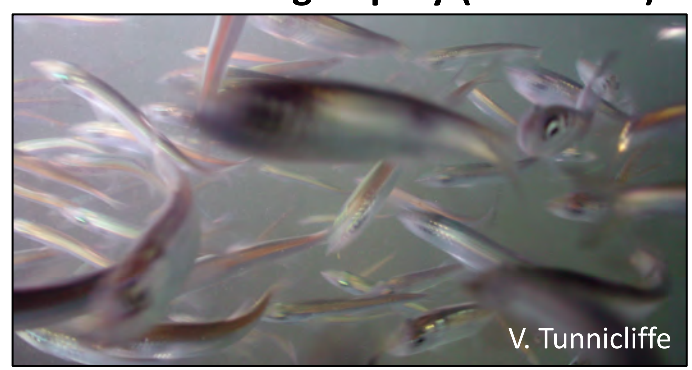
Pacific herring (*Clupea pallasii*)



Pacific herring migration (DFO 2014)



Pacific herring as prey (DFO 2014)



Growth and condition in Pacific herring

First-order effects – Physical effects, e.g. temperature

Second-order effects – Spring bloom; prey abundance and quality

Table 1. Possible mechanisms controlling brood year strength in the marine environment for Pacific salmon.

Hypothesis	Explanation	Prediction	Potential Metrics
Prey availability	Fish that grow quickly survive better because they can escape predators or survive winter better	Marine survival increases with prey production. Growth and food consumption rates increase with prey production.	Zooplankton biomass; Ichthyoplankton biomass; herring/sandlance recruitment; Stable isotopes of carbon as a proxy for productivity; Diet Feeding rate determine using cesium; Growth determined with RNA:DNA ratio, otolith and/or IGF
Junk-food/Prey-quality	Growth of juvenile salmon is affected by the nutritional content of their food.	Marine survival and growth increases with the availability of preferred (fat/nutritious) prey.	Growth determined with RNA:DNA ratio, otoliths and/or IGF; Lipid concentration/composition in zooplankton/ichthyoplankton; Stable isotopes of nitrogen; Carbon-to-nitrogen ratio in plankton

Questions…

1. How do patterns of growth and condition of young-of-year Pacific herring in the Strait of Georgia vary between years?

2. To what extent are four commonly used metrics of growth and condition correlated within individuals?


Photo: I. McAllister

Measuring growth and condition

1. Morphometric – Fulton's K

Weeks

Measure of length and weight

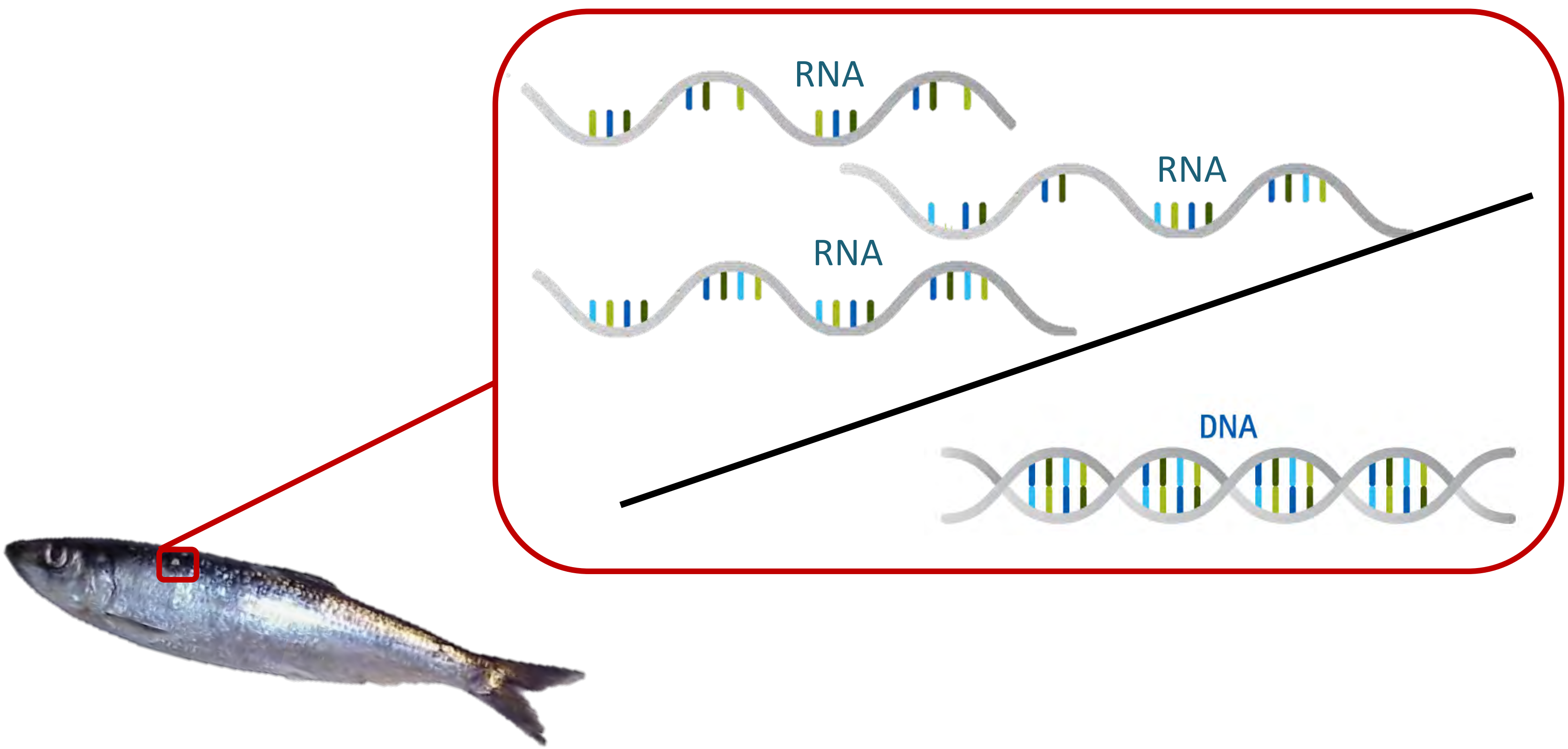
Fulton's K = $100*W/L^3$

Measuring growth and condition

1. Morphometric – Fulton's K ⌛ Weeks

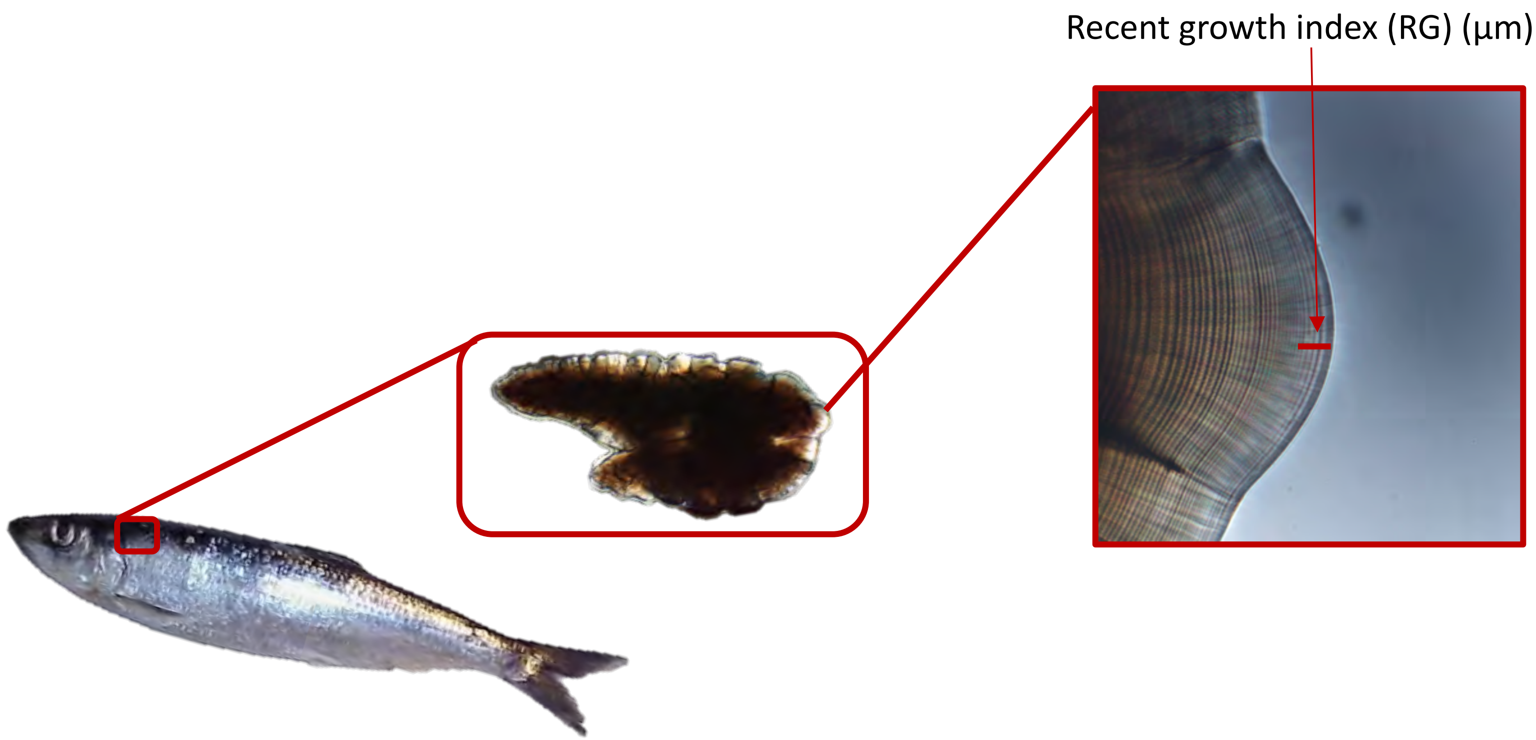
2. Biochemical – RNA:DNA ⌛ 4-5 days

- Measure of **growth and condition** based on protein production – previous 4-5 days



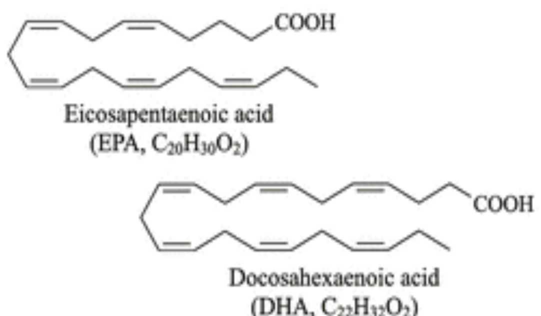
Measuring growth and condition

1. Morphometric – Fulton's K ⌛ Weeks
2. Biochemical – RNA:DNA ⌛ 4-5 days
3. **Physiological – Otolith microstructure** ⌛ ~10 days
    - Recent growth index: Total length of past 10 daily increments



Measuring growth and condition

1. Morphometric – Fulton's K ⌛ Weeks
2. Biochemical – RNA:DNA ⌛ 4-5 days
3. Physiological – Otolith microstructure ⌛ ~10 days
4. **Nutritional – Lipid analysis** ⌛ Weeks
    - Can affect the "food quality" that herring represent to predators such as salmon



From Li et al. 2014

Data collection

	2013	2014	2015	2016	Total
Total collected	291	50	305	85	731
Used for analysis	80	50	80	80	290
May-July	-	10	32	40	82
Aug-Oct	80	40	48	40	208

CCGS Neocaligus

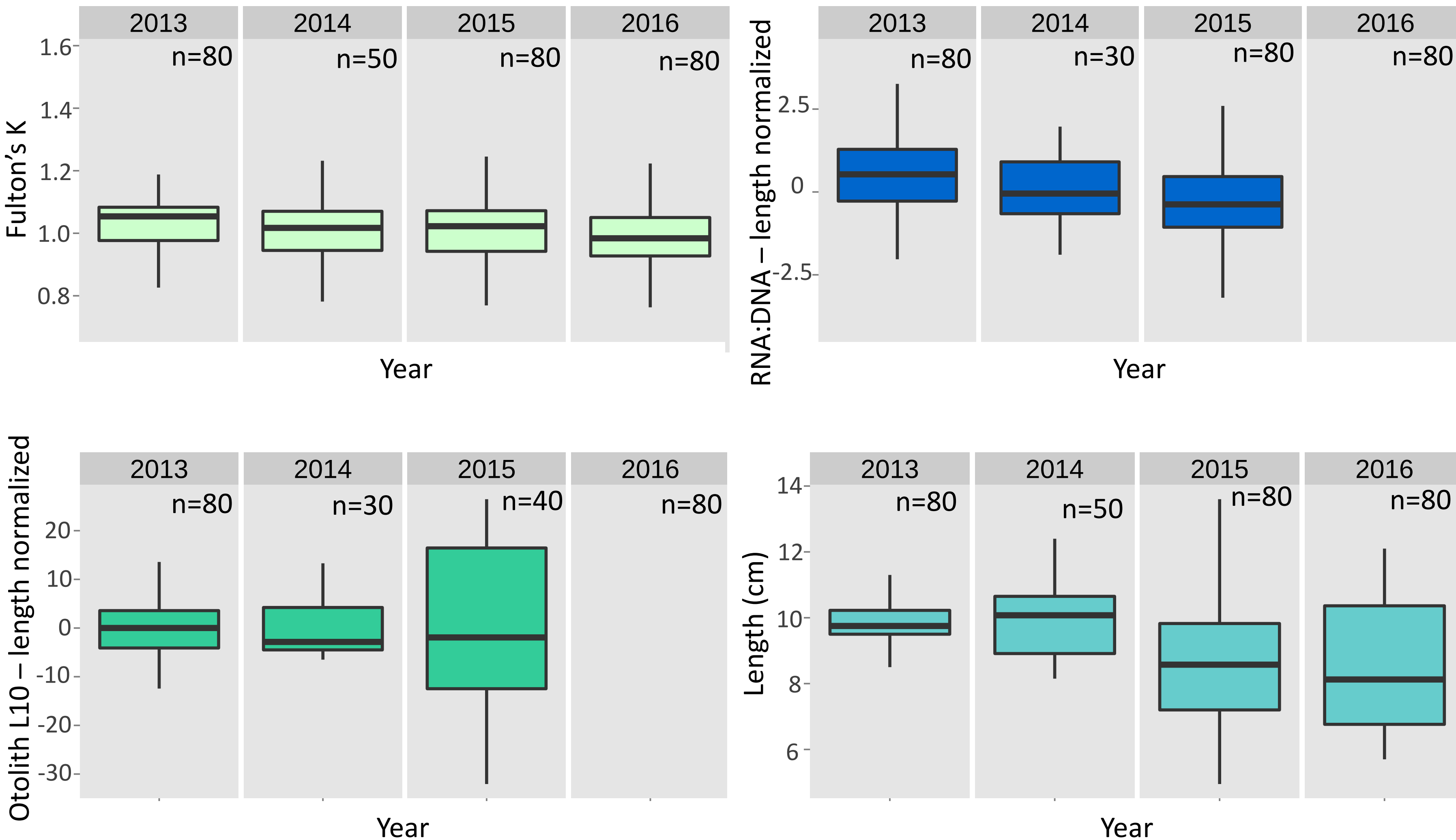
CCGS W. E. Ricker

Progress to date

1. Morphometric – Fulton's K ✓
2. Biochemical – RNA:DNA ✓
3. Physiological – Otolith microstructure (In progress)
4. Nutritional – Lipid analysis (Summer 2017)

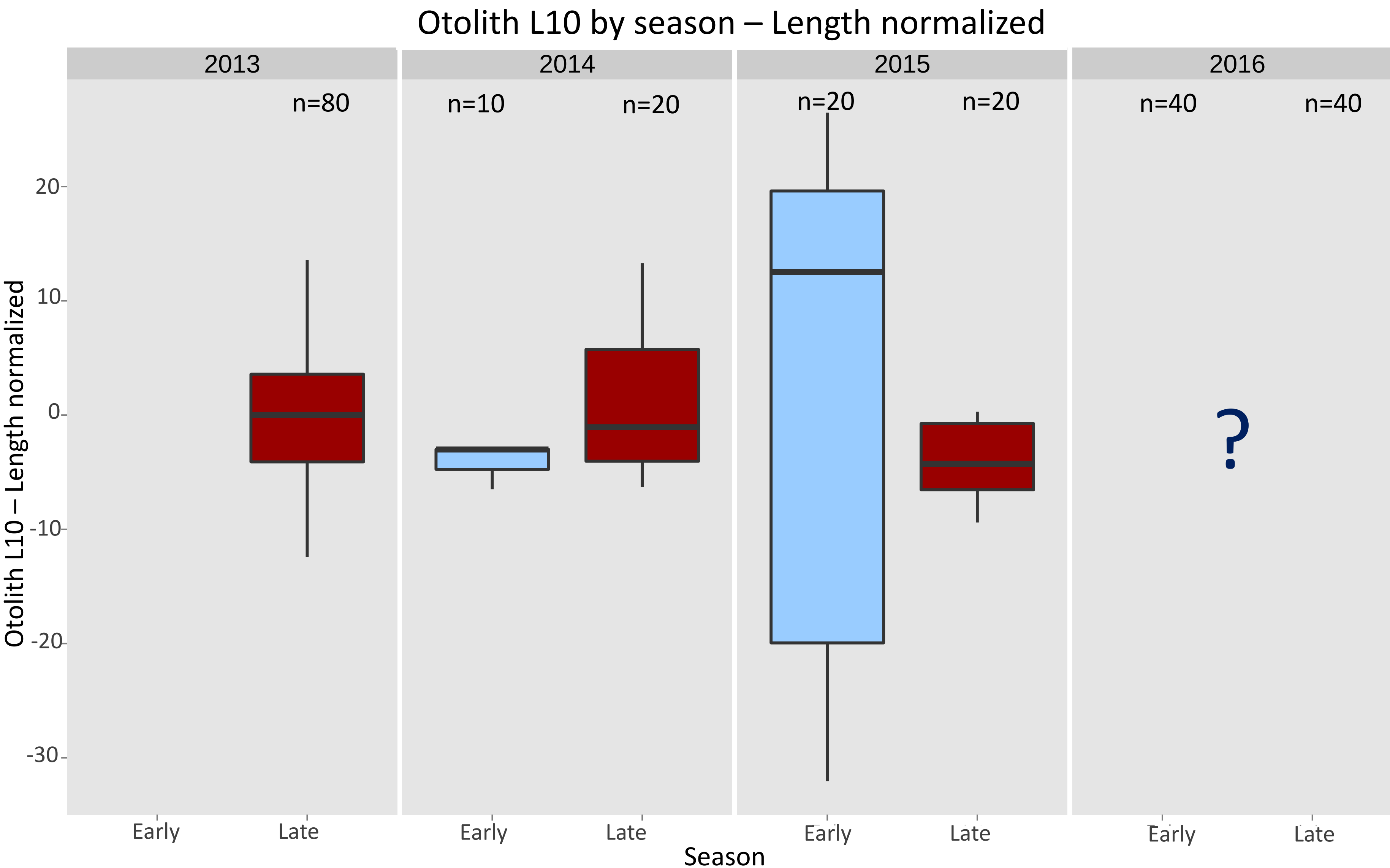
Photo: I. McAllister

Objective 1: Interannual variability



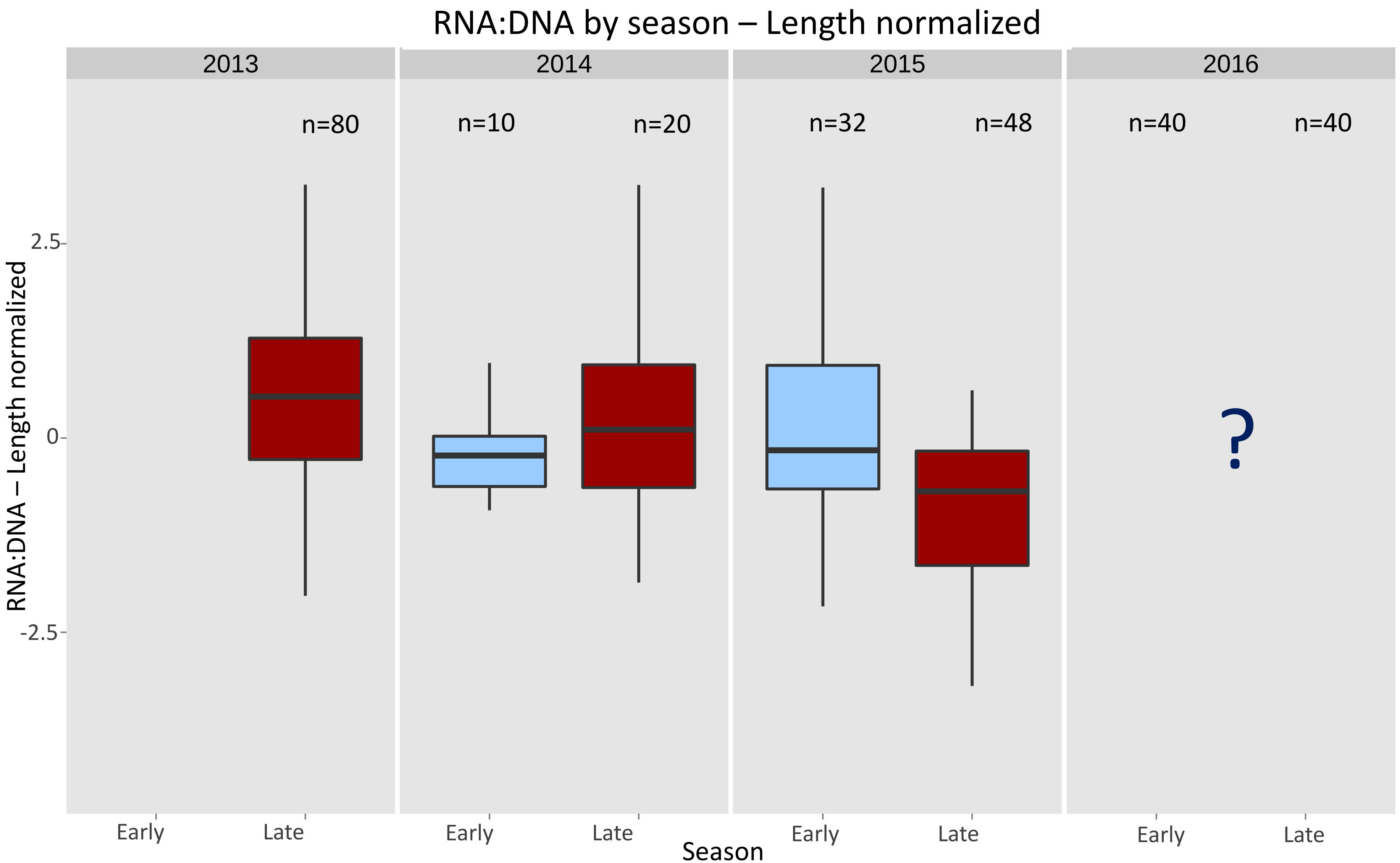
KEY POINT: High variability in 2015 otolith growth rate, and 2015&2016 lengths

Objective 1: Interannual variability



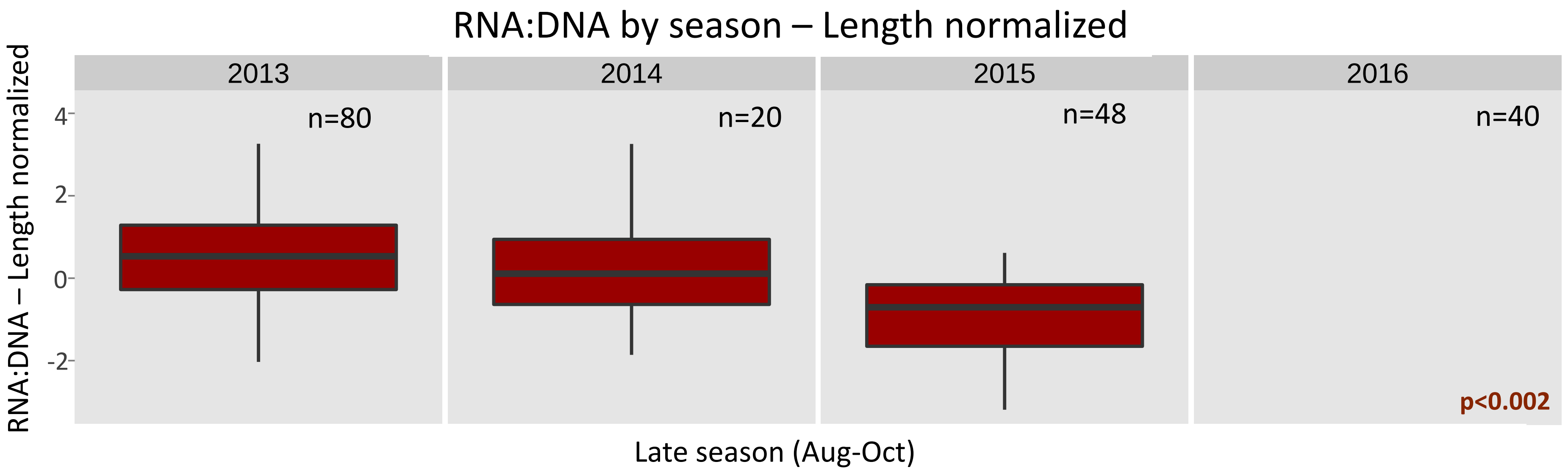
KEY POINT: Fish collected early in the season are growing rapidly

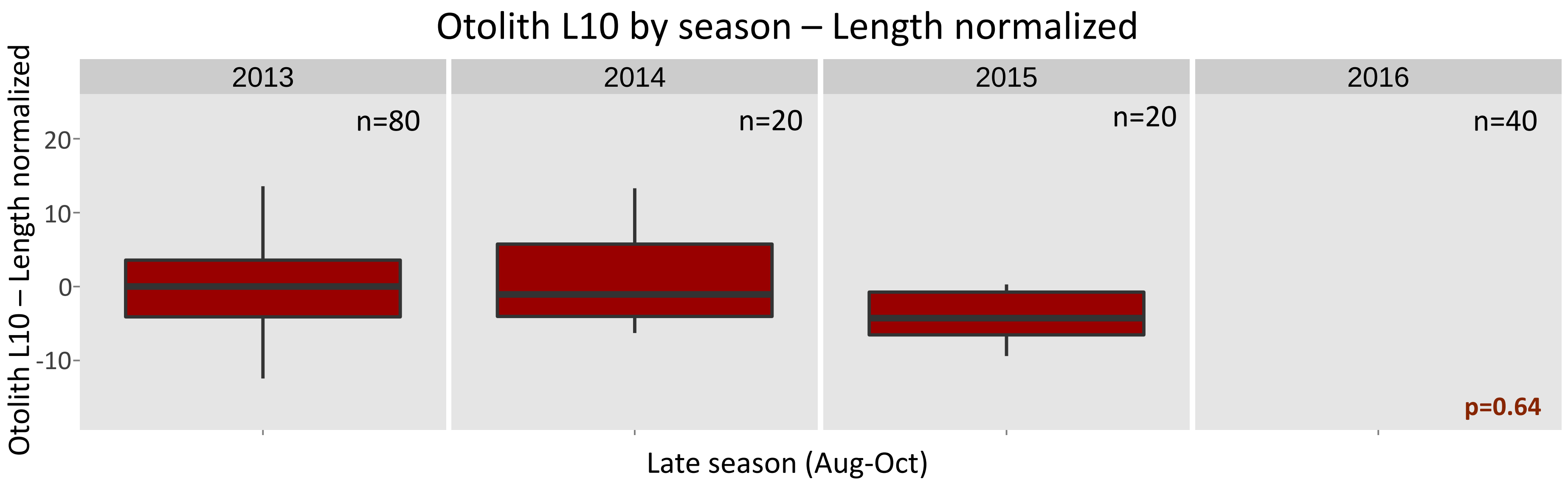
Objective 1: Interannual variability



KEY POINT: Lowest RNA:DNA ratio in late summer 2015

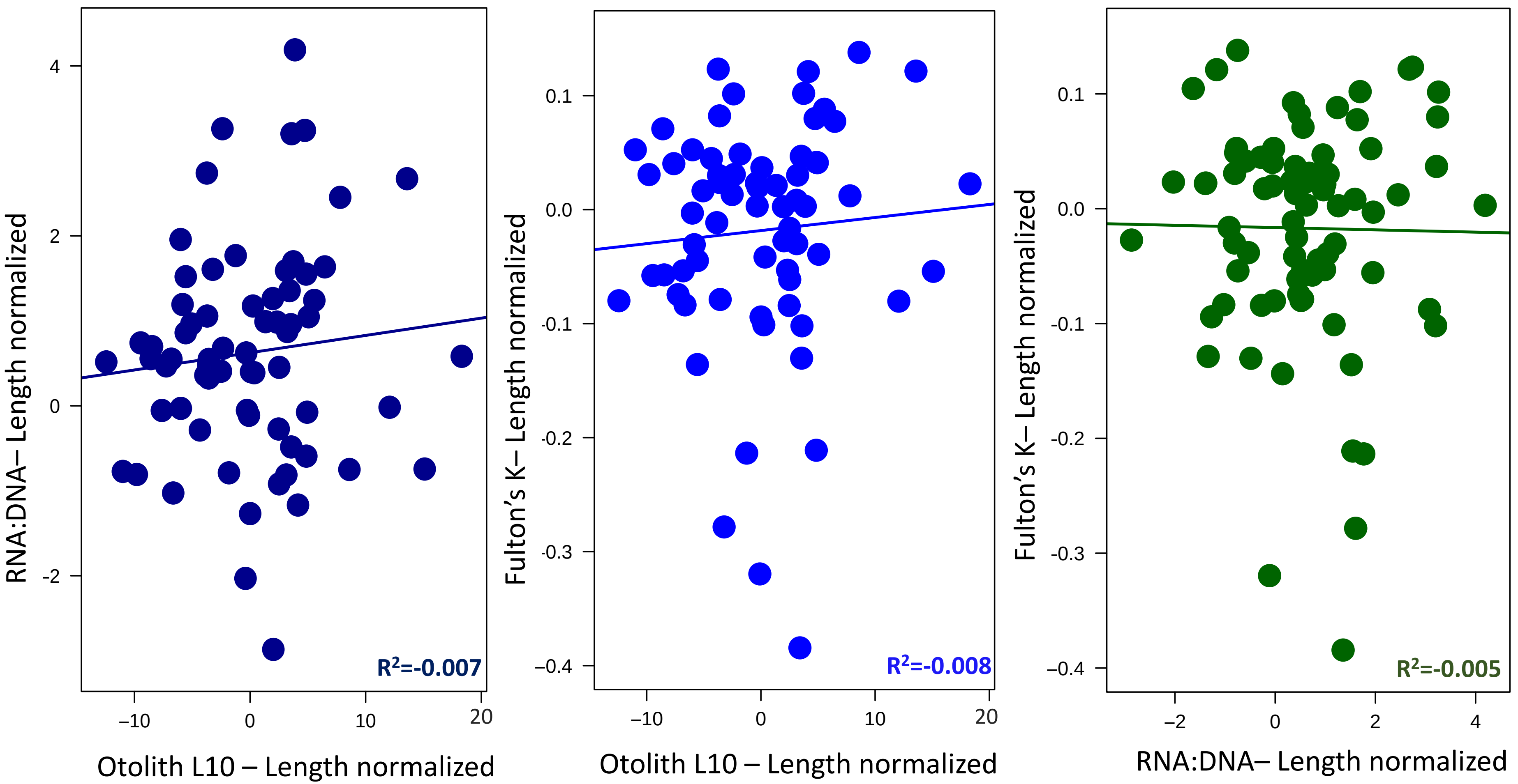
Objective 1: Interannual variability





KEY POINT: Metrics capture different aspects of growth/condition

Objective 2: Intercorrelation



KEY POINT: Metrics poorly correlated because they capture different aspects of growth/condition

Potential significance

Ecological: Implications for predators of herring

Metrics of condition: Growth and condition vary at different scales within individuals

Next steps…

1. Finish otolith analysis on 2015 YOY herring
2. Otolith and RNA:DNA analysis on 2016 YOY herring
3. Lipid profiles on all YOY herring

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Pacific Salmon Foundation

University of Victoria

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