



# Variation in early male maturation and smolting of juvenile summer Chinook salmon and varying over-winter temperature regimes

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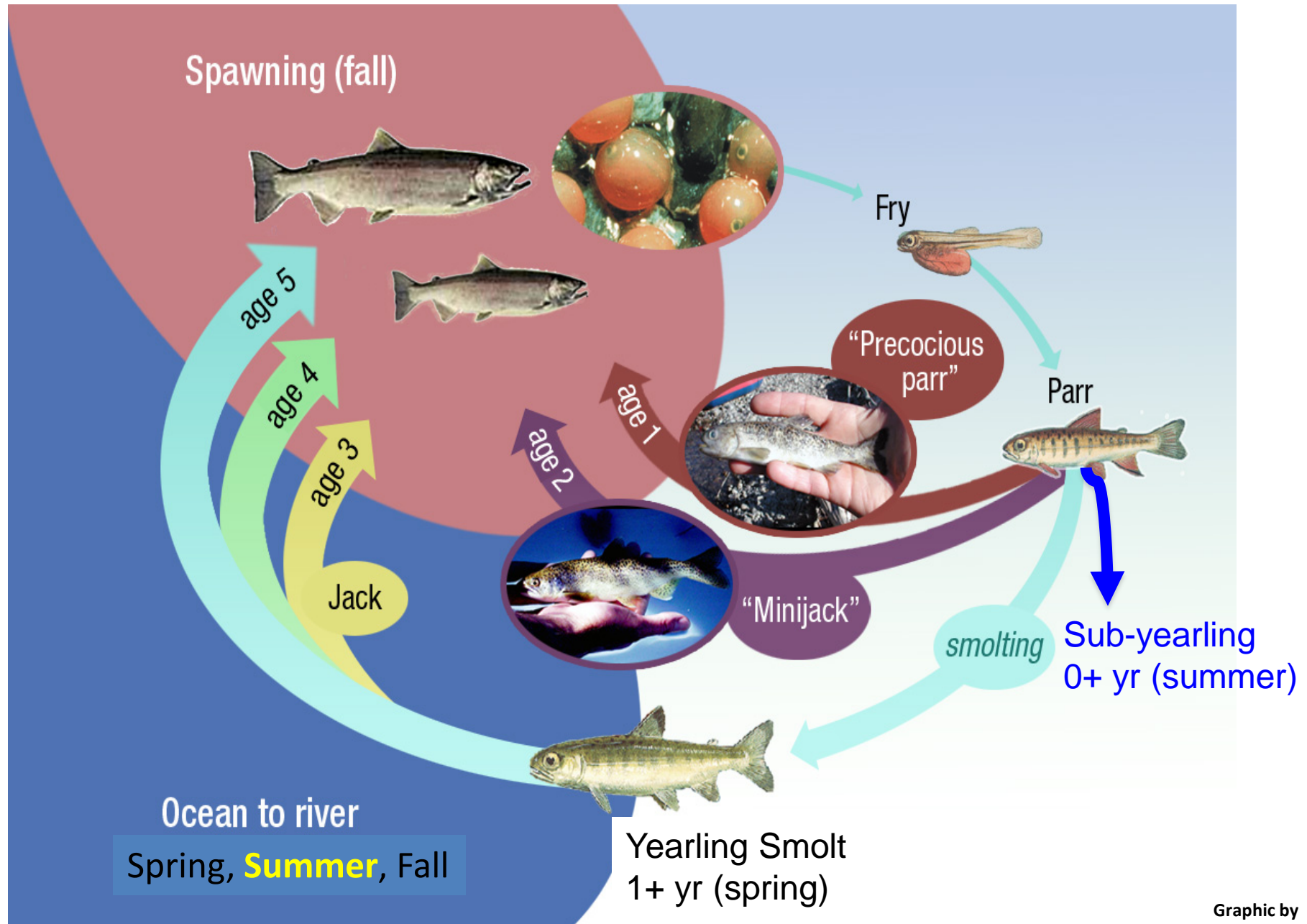


# OUTLINE

- Background: Chinook Life History Variation & Early Male Maturation**
- Study Objectives & Design**
- Part 1 Methods & Results: Minijack Screen**
- Part 2 Methods & Results: Intensive Monthly Monitoring**
- Conclusions**



# Chinook stream-type life history



# Early Male Maturation

-Age of maturation is phenotypically plastic and can occur at:

age-1 (Precocious parr or microjack)

age-2 (Minijack)

age-3 (Jack)

age-4 or 5

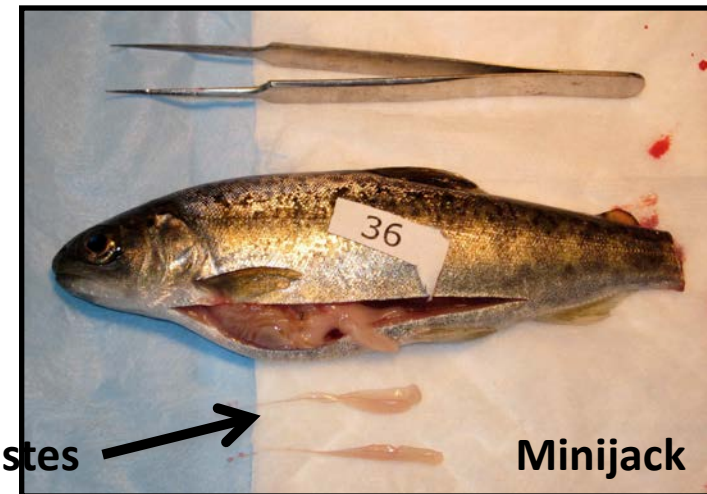
-Age of maturation is influenced by:

emergence timing

(Beckman et al. 2007)

energy stores and growth rate

(Vollestad et al. 2004; Hopkins and Unwin 1997; Silverstein et al. 1998; Shearer and Swanson 2000; Campbell et al. 2003; Shearer et al. 2006; Larsen et al. 2006)





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# STUDY OBJECTIVES

**Part 1:** Quantify occurrence of minijacks in several populations of yearling summer Chinook salmon released in Upper Columbia Basin

**Part 2:** Quantify growth and smoltification profiles of same populations

\*(Data originally collected as part of Reuse Study)

# Two Sampling Methodologies

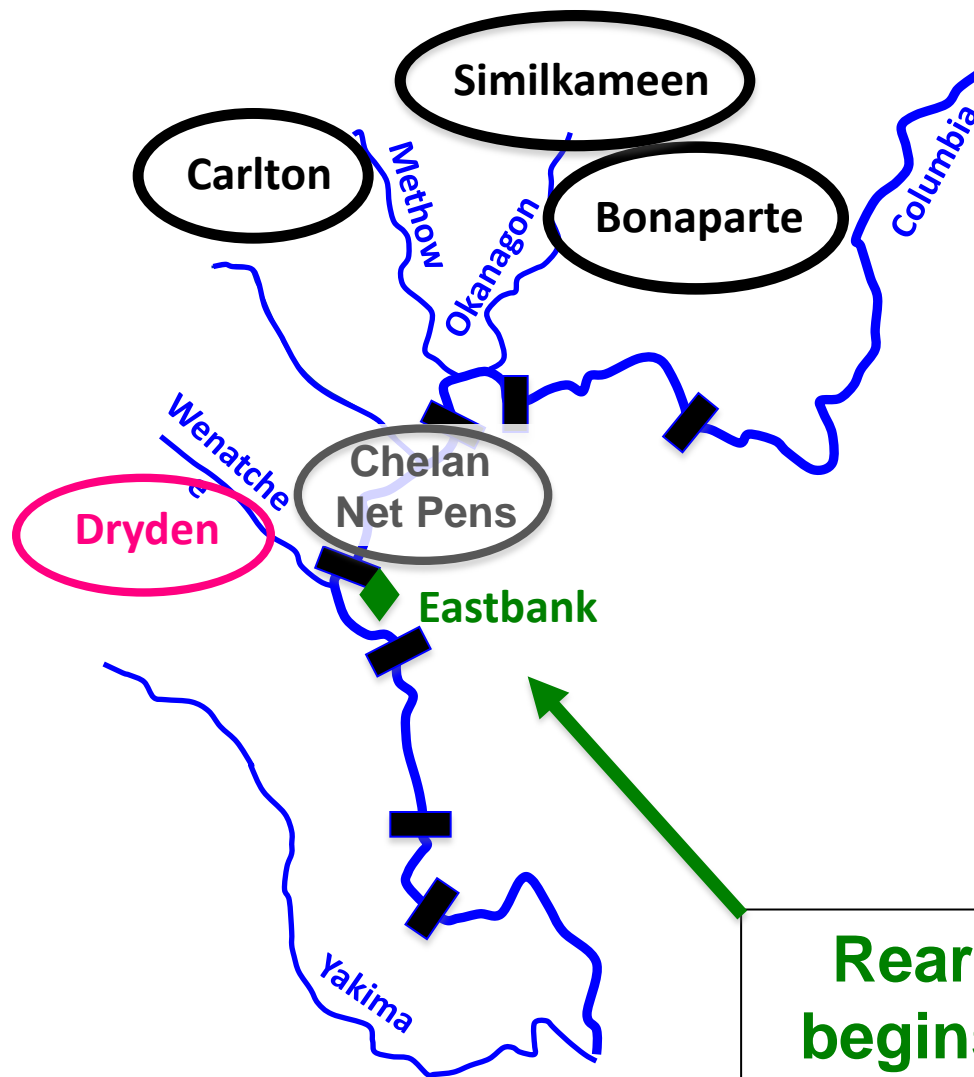
## 1. Minijack Screen

- Sampled in Spring just before release
  - a. Size
  - b. Maturation status

## 2. Intensive Monthly Monitoring

- Sampled Fall through Spring prior to release
  - a. Growth Rate (size)
  - b. Maturation status
  - c. Smoltification

# STUDY LOCATIONS



## 3 Genetic Stocks:

- Wenatchee R.
- Wells
- Methow/Okanogan

**Rearing for all populations  
begins at Eastbank Hatchery**





**Eastbank**



**Chelan Net Pens**  
BY 2008



**Dryden Pond**  
BY 2006-2009



**Carlton Pond**  
BY 2006-2009

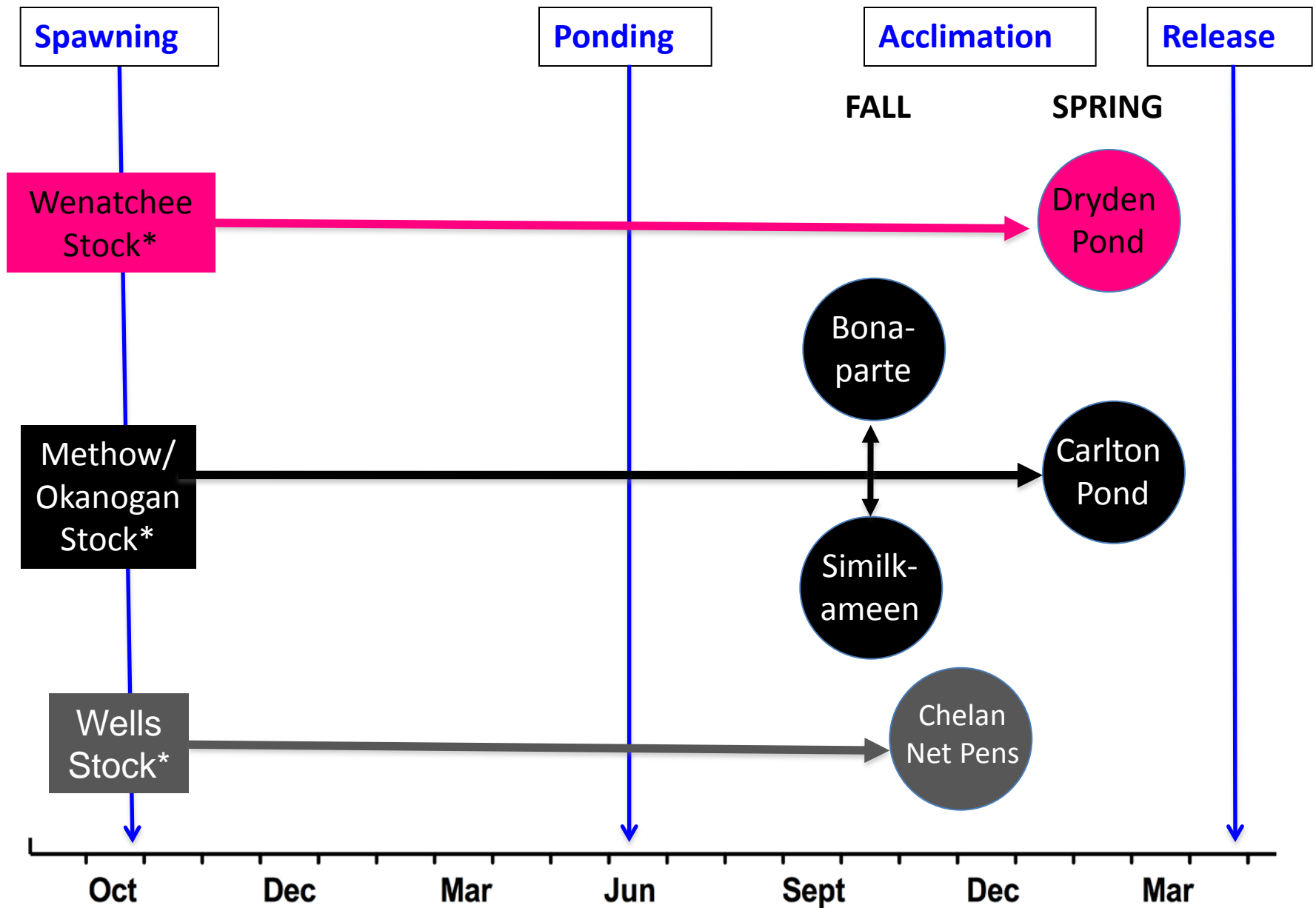


**Similkameen Pond**  
BY 2006-2009



**Bonaparte Pond**  
BY 2008-2009

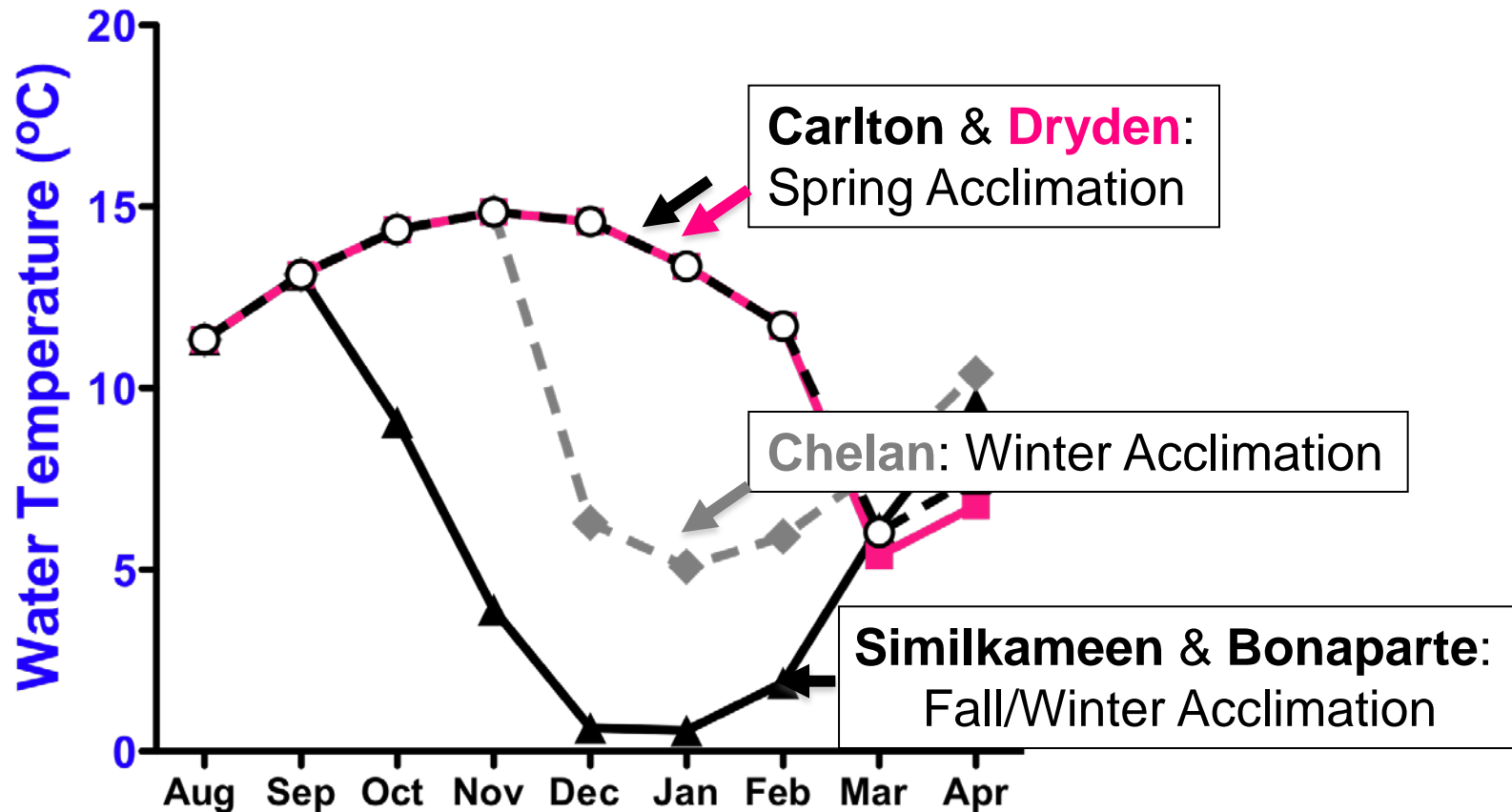




\* All stocks spawned and reared at Eastbank Hatchery prior to acclimation



# Differences in acclimation timing and location creates differences in fall/winter growth potential





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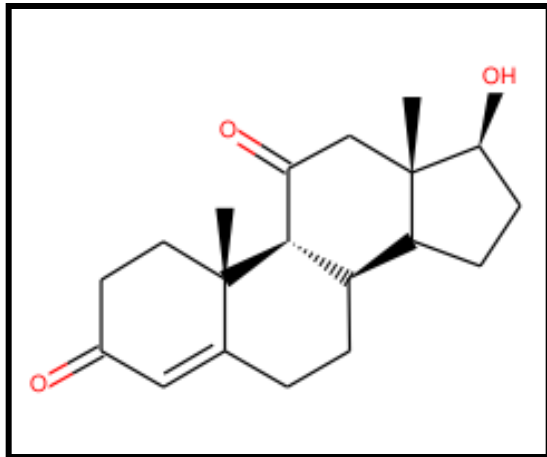
# Part 1 Methods: Minijack Screen (All Locations/Brood Years Sampled)

## 1. Growth

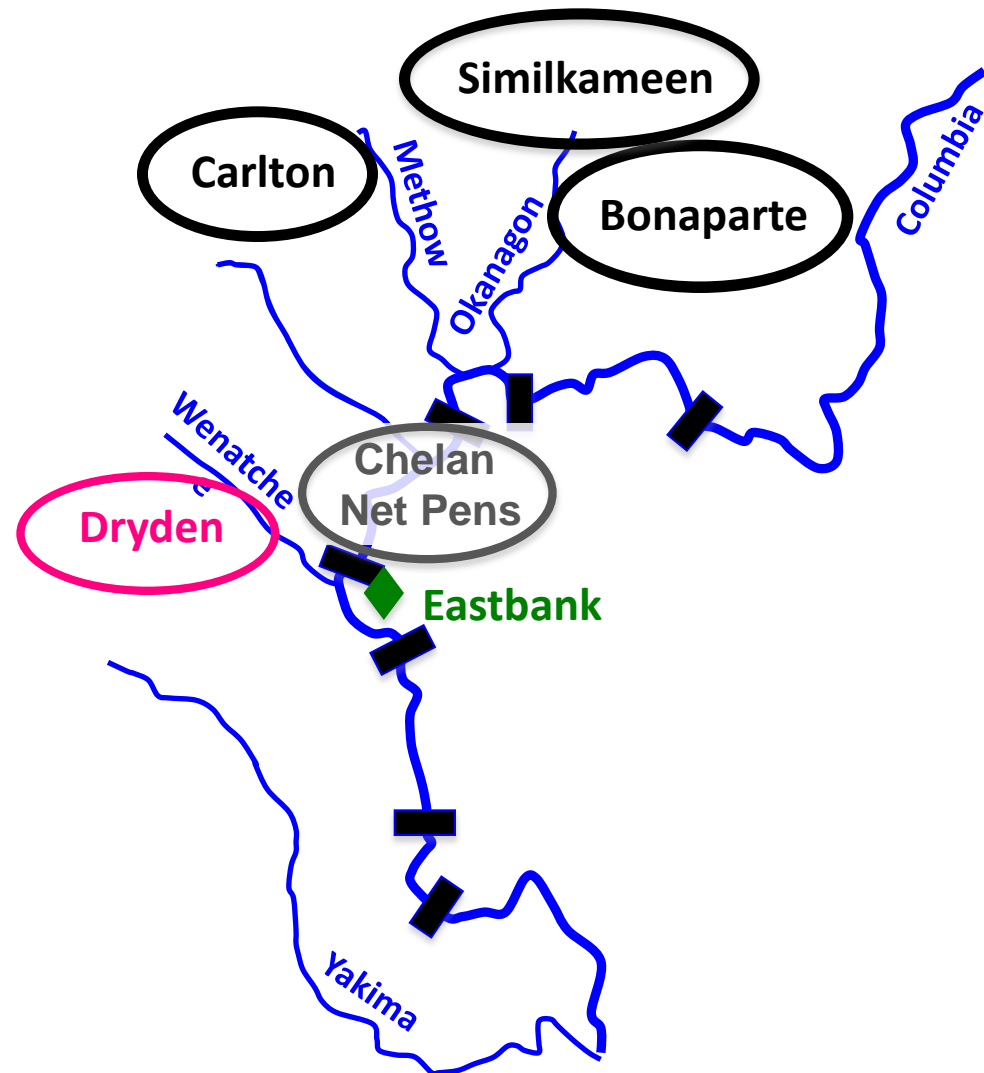
- Size at release (n=300)

## 1. Minijack Rates

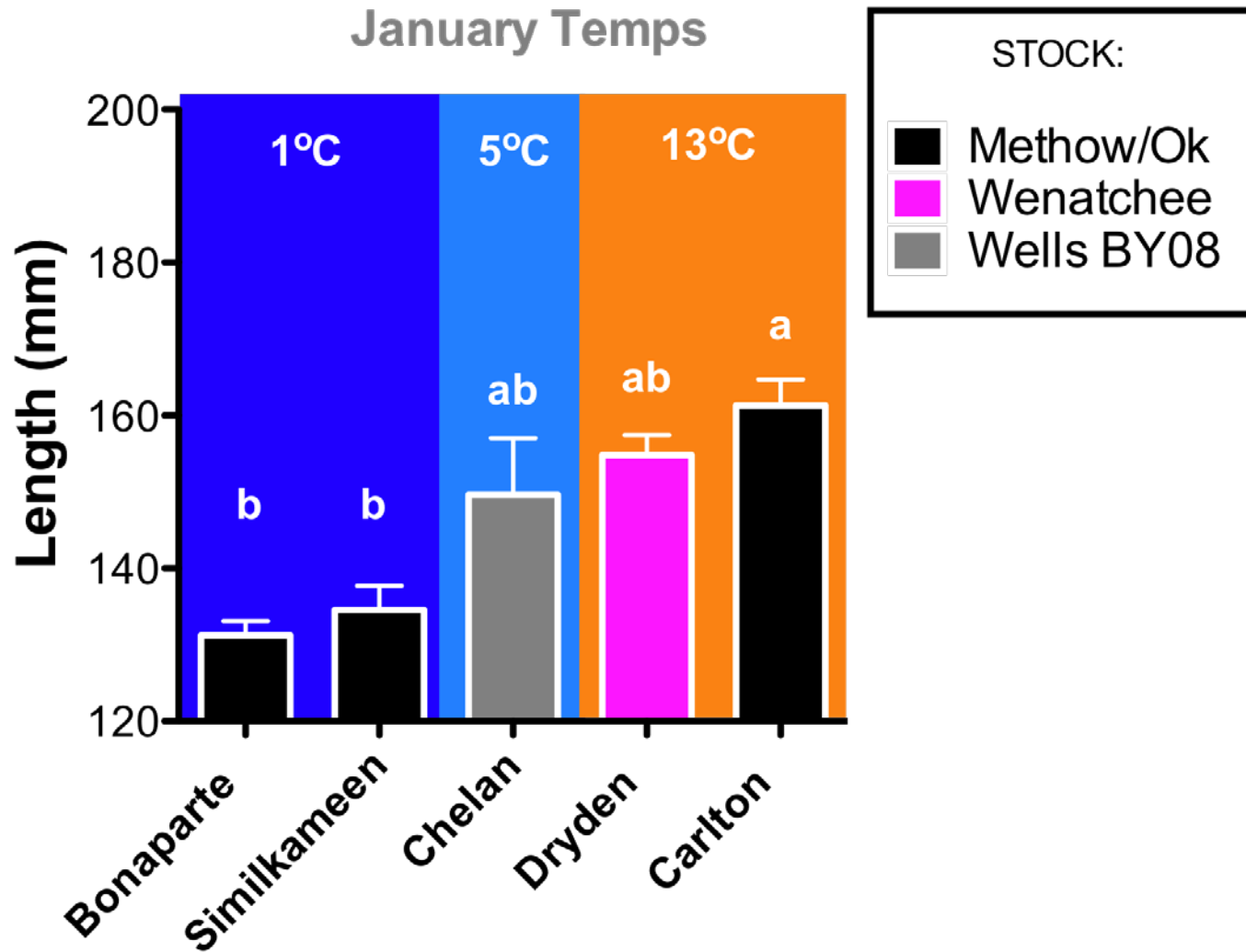
- 11-ketotestosterone (11KT) – male androgen found in blood plasma



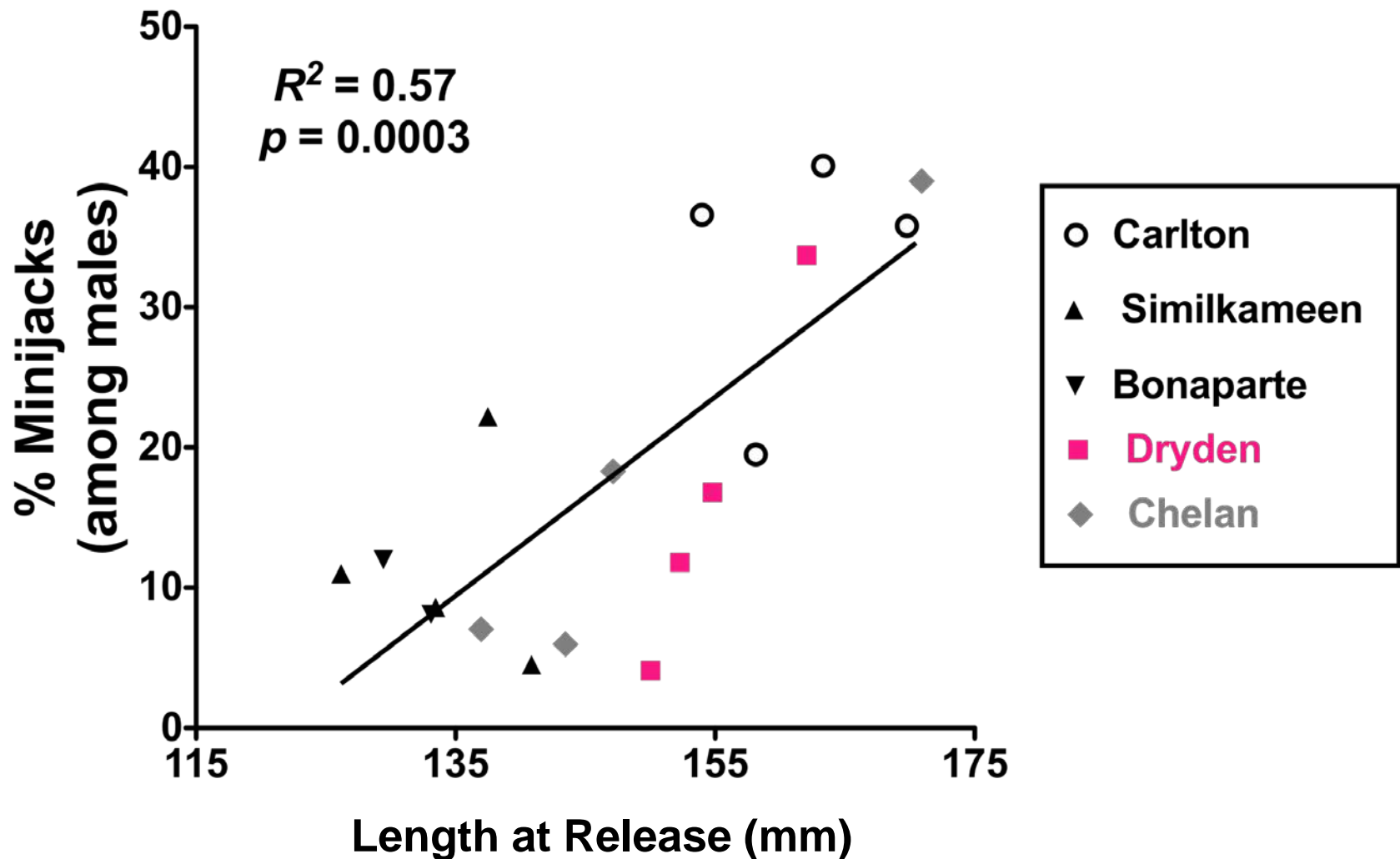
see Larsen et al. 2004 TAFS



# Part 1 Results: Size at release changes with winter rearing temperatures



# Part 1 Results: Size at release is correlated with minijack rate



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# Part 2 Methods:

## Intensive/Monthly Monitoring

### 1. Growth

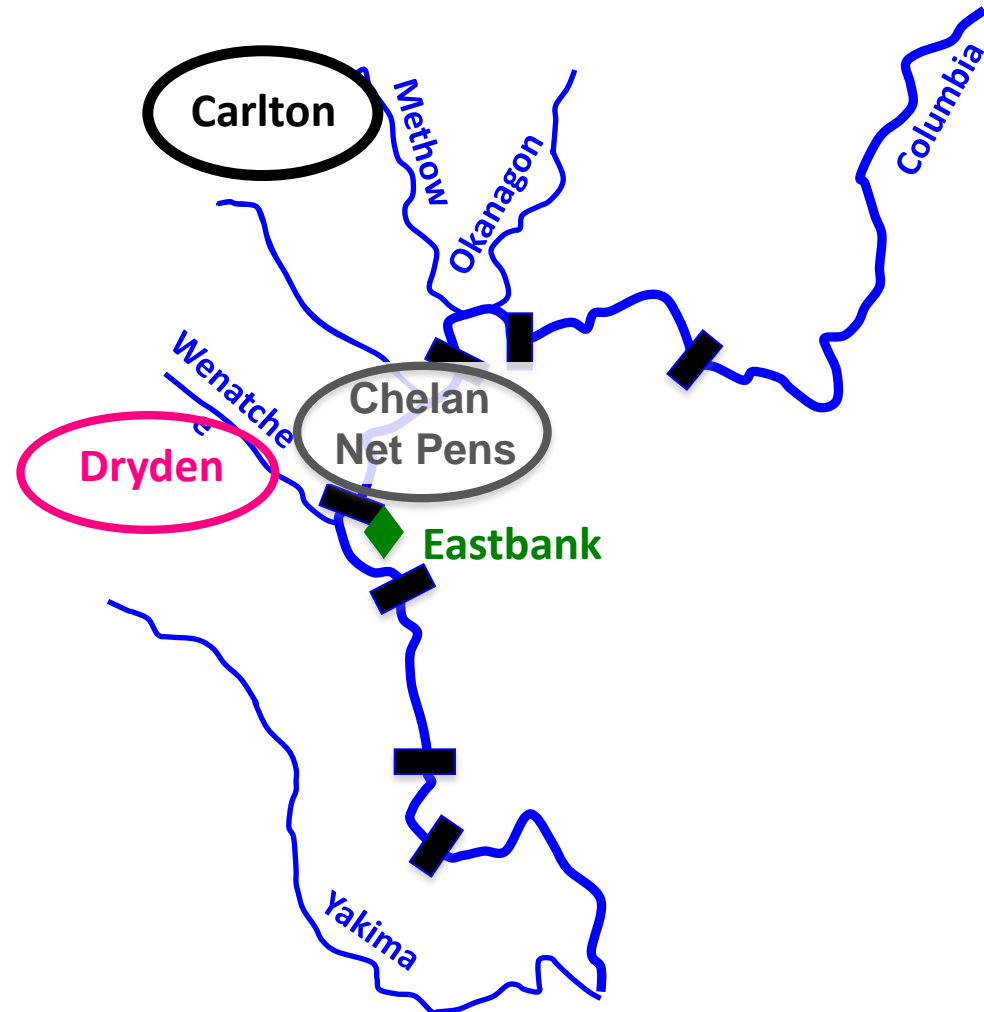
- Size at release
- **Growth Rates**

### 2. Minijack Rates

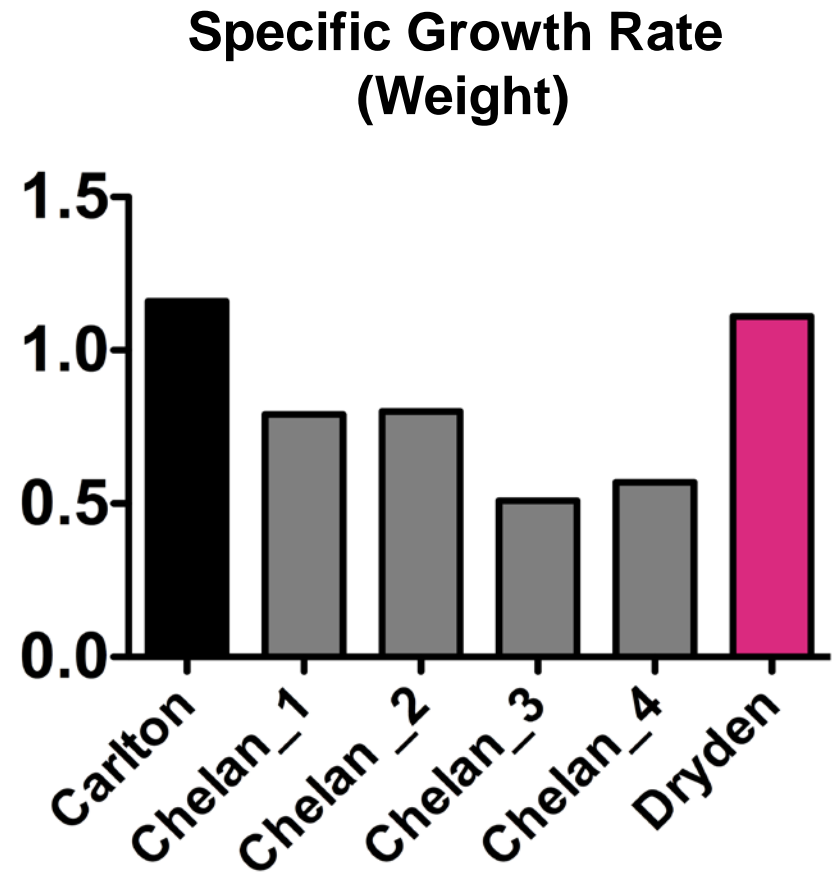
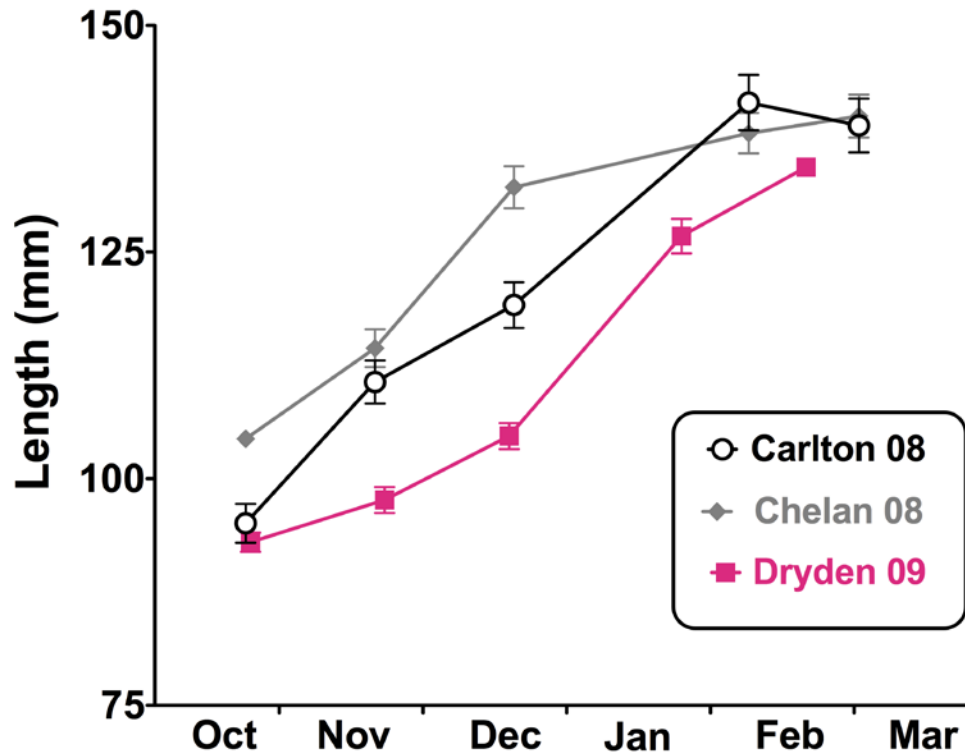
- 11-ketotestosterone (11KT)

### 3. Smoltification

- **Gill Na/K ATPase activity**

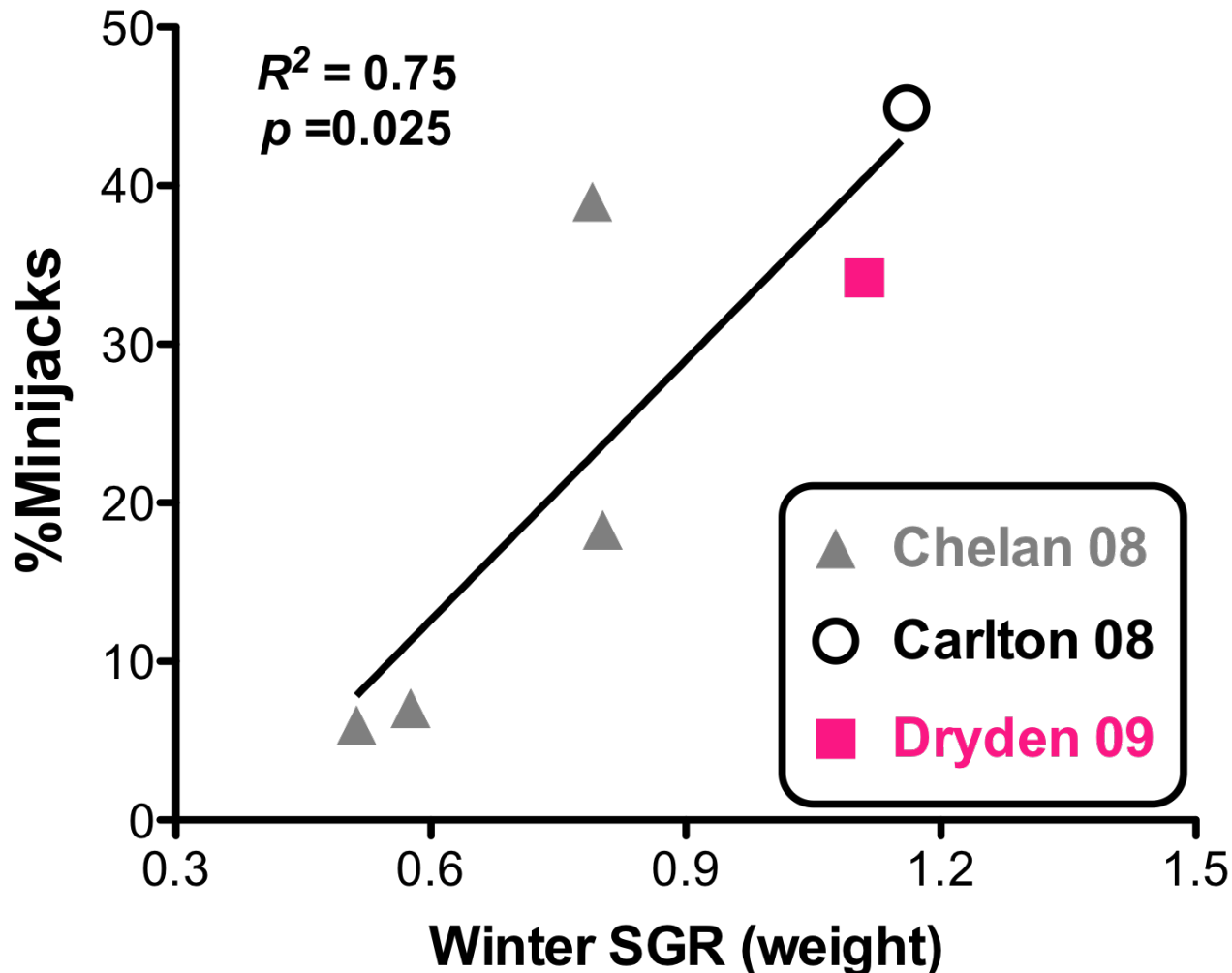


# Results Part 2: Dryden had similar fall/winter growth rates to Carlton; Chelan net pens had variable growth

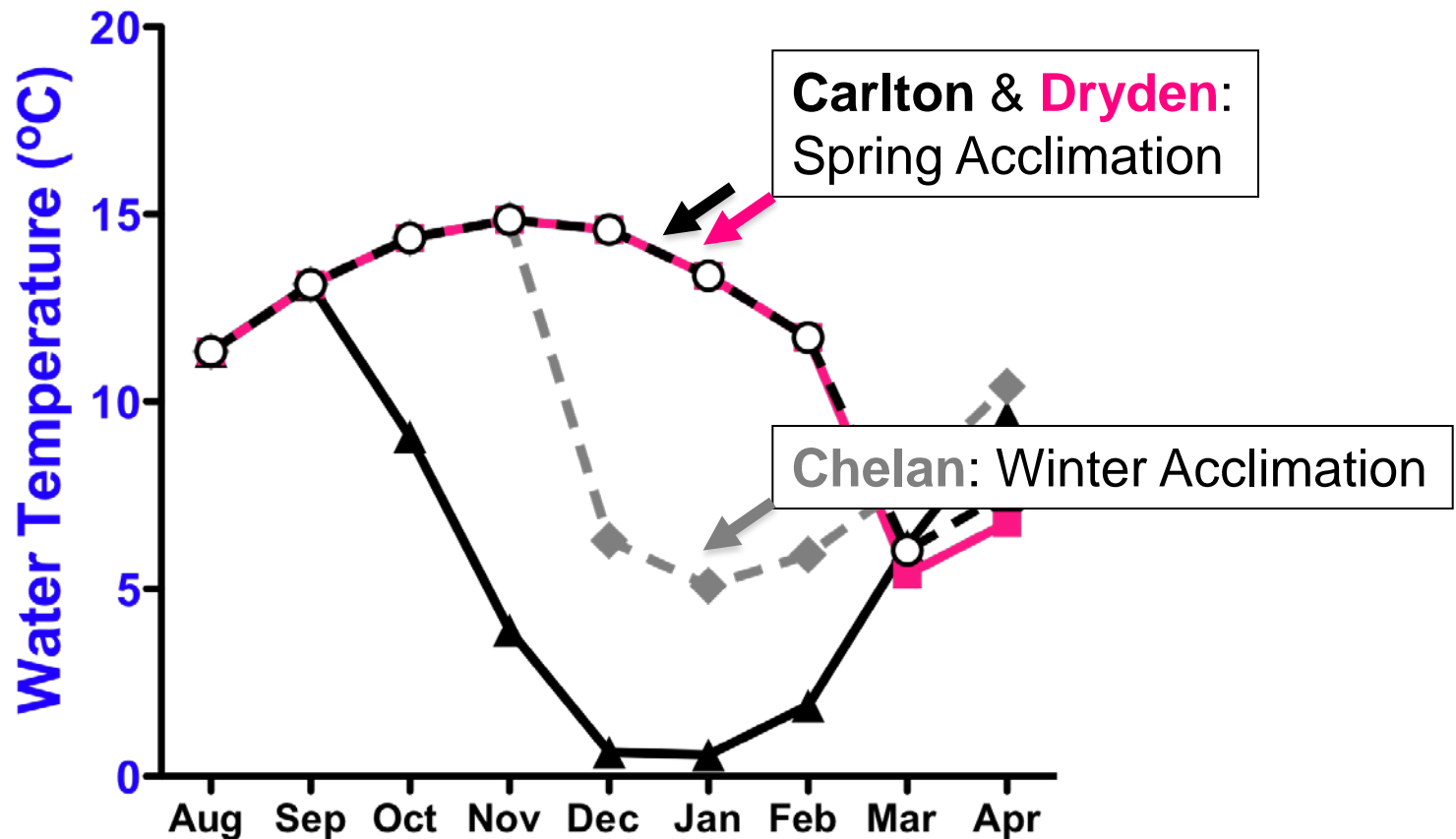


# Why do we care about winter growth?

## Because it may trigger early male maturation

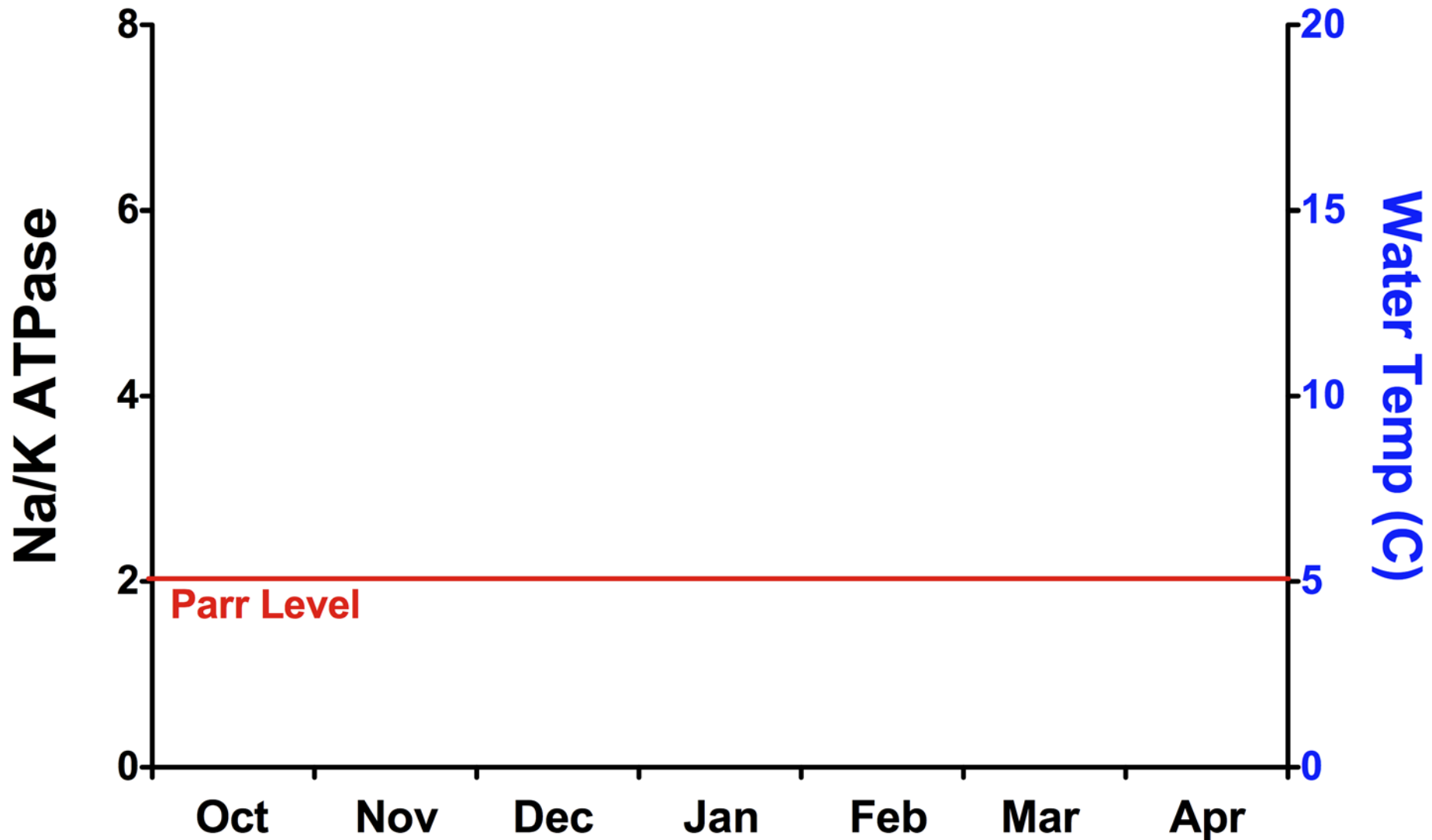


# Other effects of winter rearing temperature: Smolting

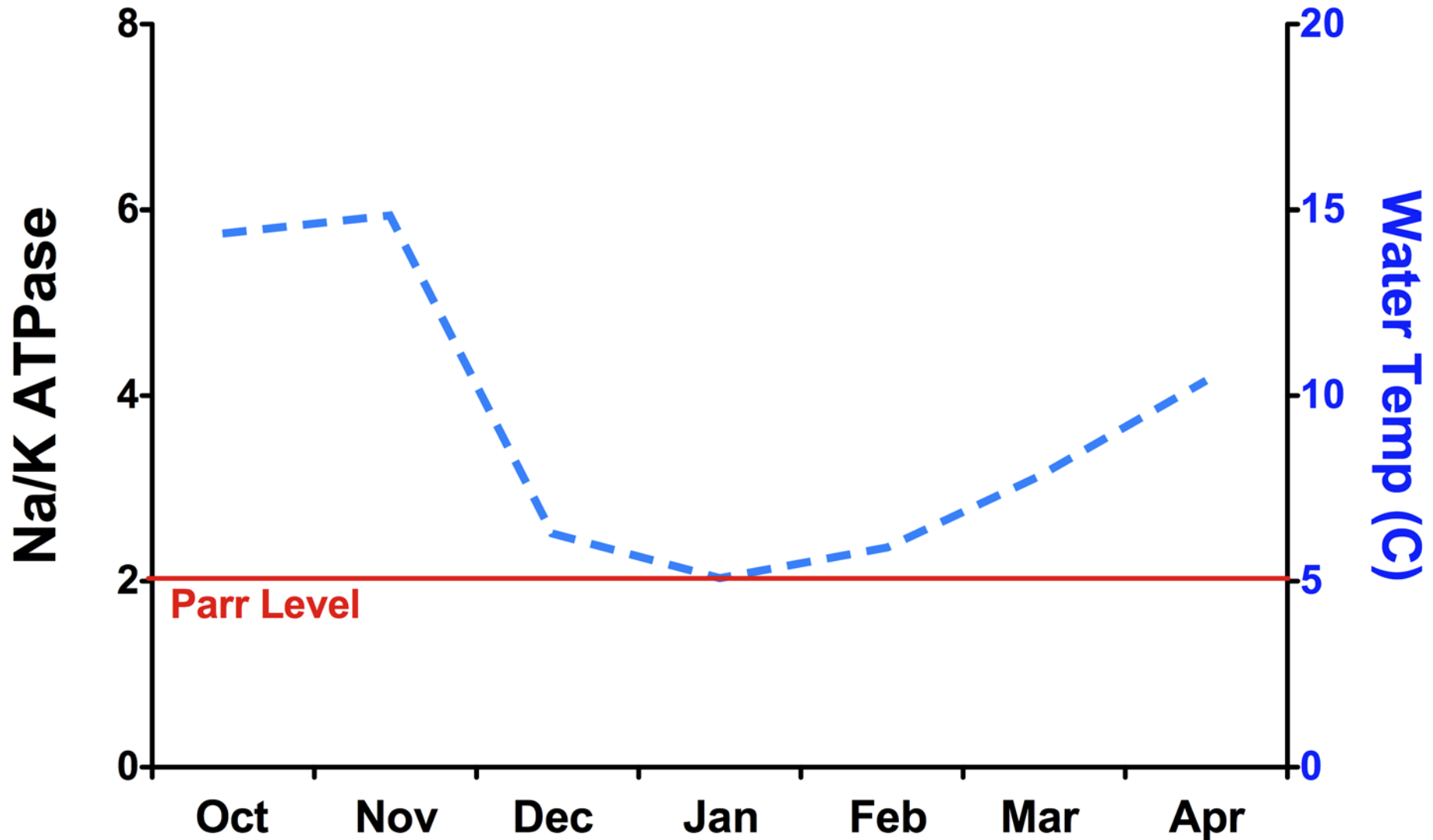




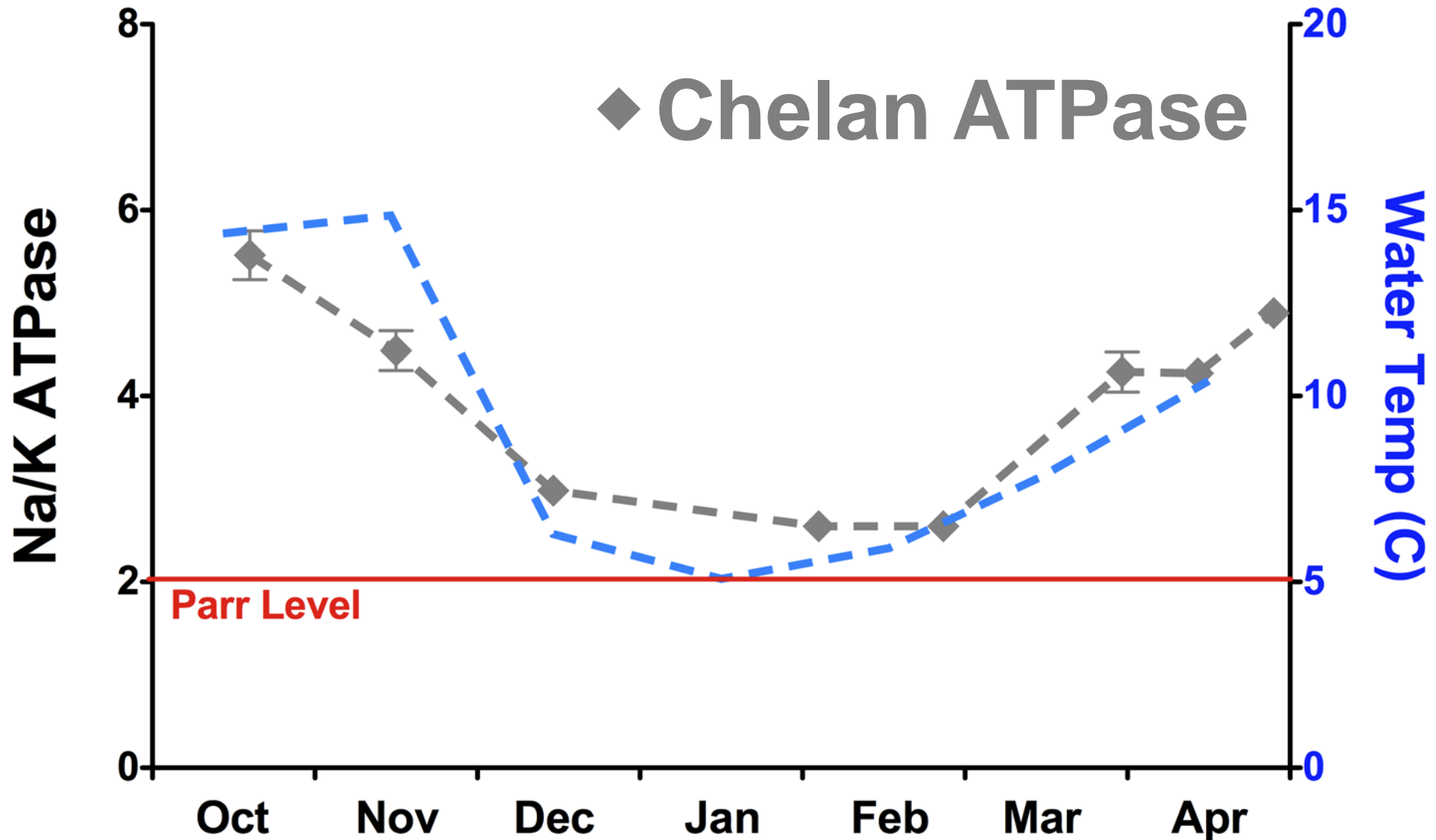
# Smoltification: How does water temperature affect Gill ATPase activity?



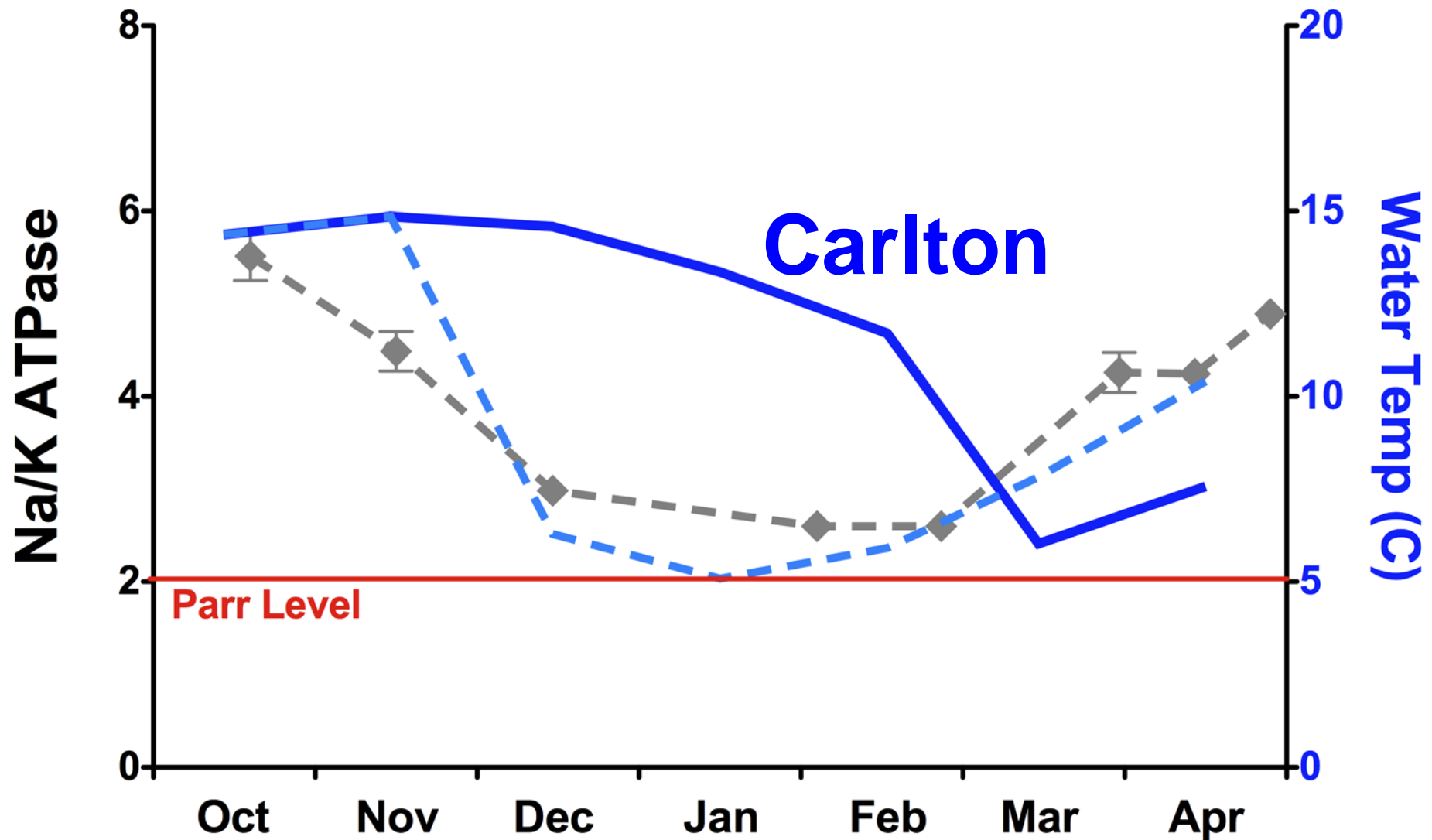
# Chelan Net Pens: Intermediate winter rearing temperatures



# Chelan: ATPase levels mirrored the rearing temperature

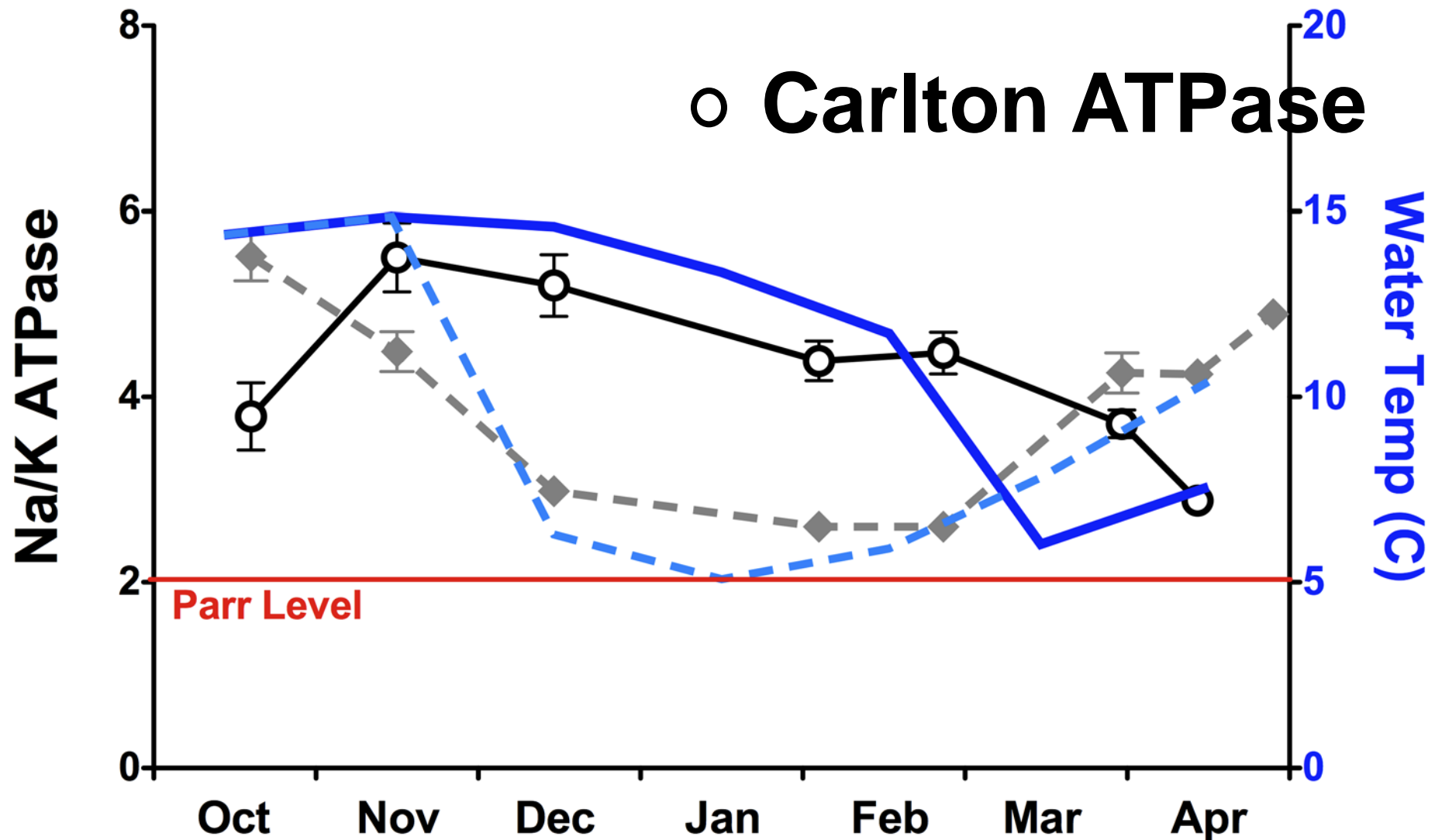


# Carlton Pond: An example of Out of Basin winter rearing





# Carlton Pond: ATPase levels mirrored the rearing temperature



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# Conclusions

- **Size at release is correlated with minijack rate**
- **Cold winter water temperatures reduce winter growth and consequently, minijack rates**
- **Timing of smoltification is affected by water temperature**

# ***Moving Forward***



# Future Studies: to examine trade offs in Summer Chinook Rearing

## Dryden Pond: Spring Acclimation

- Circular-Reuse vs. Raceway (at Eastbank Hatchery)
- 2 Feed Treatments

**Experimental construct for BYs 2012, 2013:**

<b>Treatment</b>	<b>Target Size at Release [fpp (grams)]</b>	<b>Pond Type</b>	<b># of Fish/ Treatment</b>
Big-Circular	10 (45 g)	Circular-Reuse	50 K
Small-Circular	15 (30 g)	Circular-Reuse	50 K
Big-Raceway	10 (45 g)	Raceway	150 K
Small-Raceway	15 (30 g)	Raceway	150 K



# Future Studies: to examine trade offs in Summer Chinook Rearing

## Chelan Falls: Winter Acclimation

- 4 size targets at release

Experimental construct for BYs 2012, 2013:

Treatment	Target fish size at release [fpp (grams)]	# of fish/ treatment
A	10 (45)	150 K
B	13 (35)	150 K
C	18 (25)	150 K
D	22 (20)	150 K



# THANKS!



- Chelan PUD
- Eastbank Hatchery
- Chelan Hatchery
- WDFW
- Colville Tribes

- NOAA/ University of Washington Field & Lab Assistants:
  - Abby Tillotson
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  - Larissa Felli
- Ian Adams



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