Predicting Coastal Cutthroat Trout Smolt Productivity from Physiographic Variables at a Watershed Scale

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Presentation Outline

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Background

Value to Canadians
- Ecologically and economically important species

Problem
- Blue-listed species
- Population declines
- Populations not routinely monitored

Challenges
- Monitoring difficult
- Watershed scale abundance assessments not financially or logistically feasible

Purpose

Approach
- Correlative analysis
- Watershed
- 1:20,000 scale
- Model the relationship of selected physiographic variables on cutthroat smolt abundance

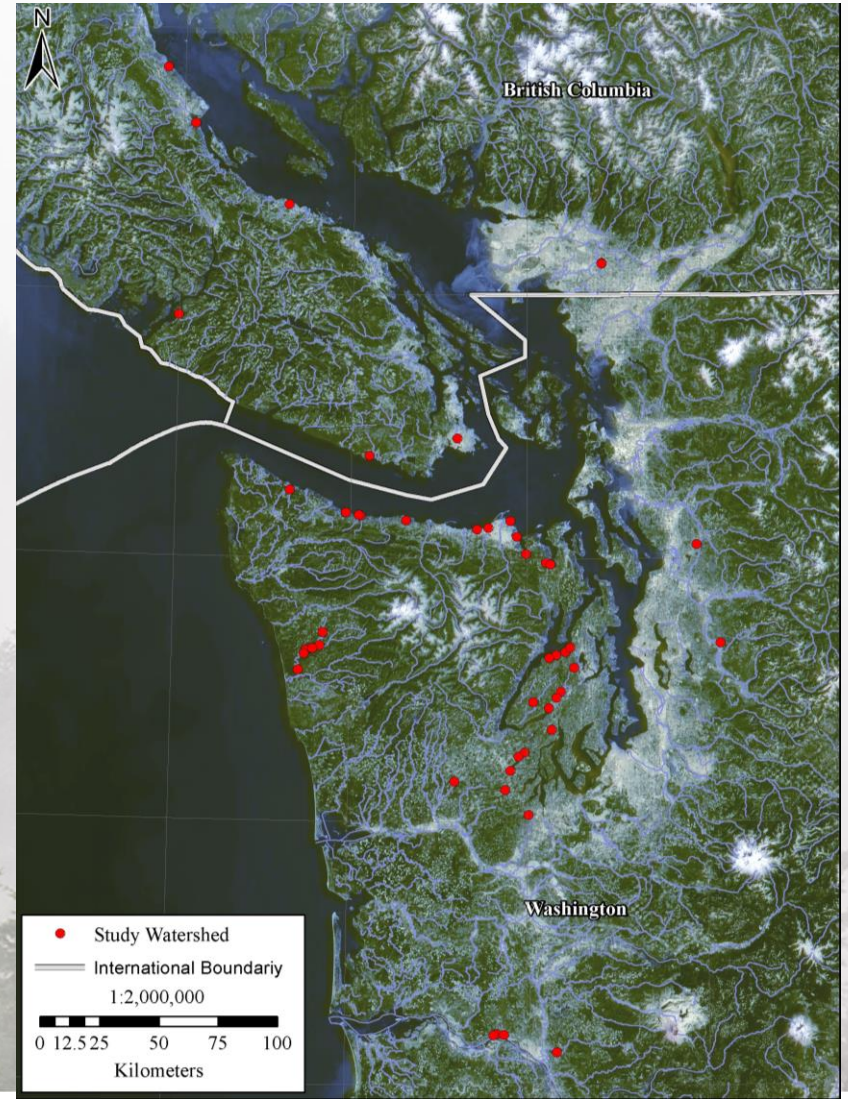
Research Question
- Can the productive capacity of cutthroat smolts be predicted from physiographic variables?

Intention
- Smolt abundance characteristics
- Limits to cutthroat smolt productivity
- Simple and practical method to predict productive capacity

Methods

Study Area
- Southern British Columbia and Washington State

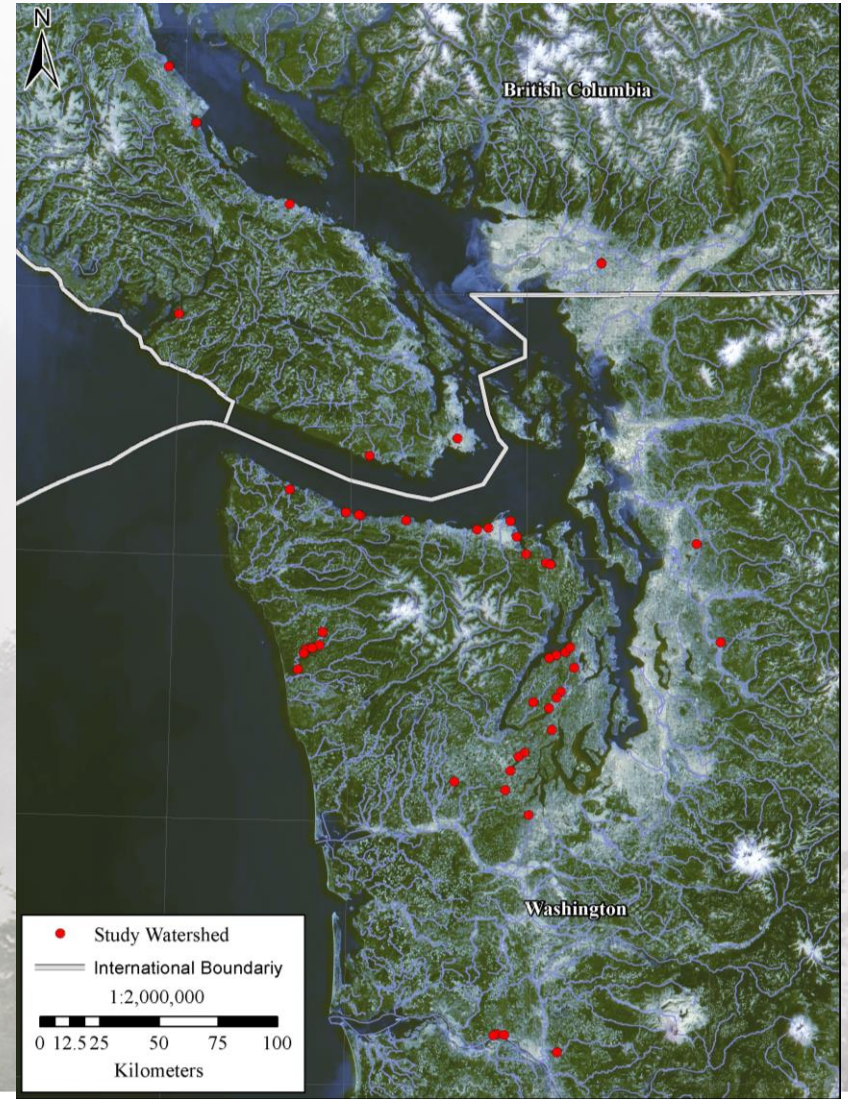
Smolt Data Review
- Metadata collection
- Watershed studies using fence and rotary screw traps
- 170 potential study watersheds reviewed
  - BC – 68 watersheds
  - WA – 102 watersheds



Methods

Smolt Data Selection

- 50 study watersheds selected
  - BC – 8 watersheds
  - WA – 42 watersheds
- Three or more years of abundance estimates
- 653 annual estimates of smolt abundance from 50 study watersheds
  - 31 watersheds > 10 years of smolt abundance data
  - 25 watersheds > 10 years of consecutive smolt abundance data
- Smolt determination



Methods

Hydrological and Spatial Data

- Calculated LT MAD
- Identified cutthroat dominated reaches using LT MAD ≤ 630 L/s
- Permanent barrier identification
- Separation of stream length into gradient zones (USGS 10 m DEM; Provincial 25 m DEM)
- Lake area

Statistical Analysis

- Abundance data
  - Shapiro-Wilk test for normality
  - Durbin-Watson test
  - Linear regression

Methods

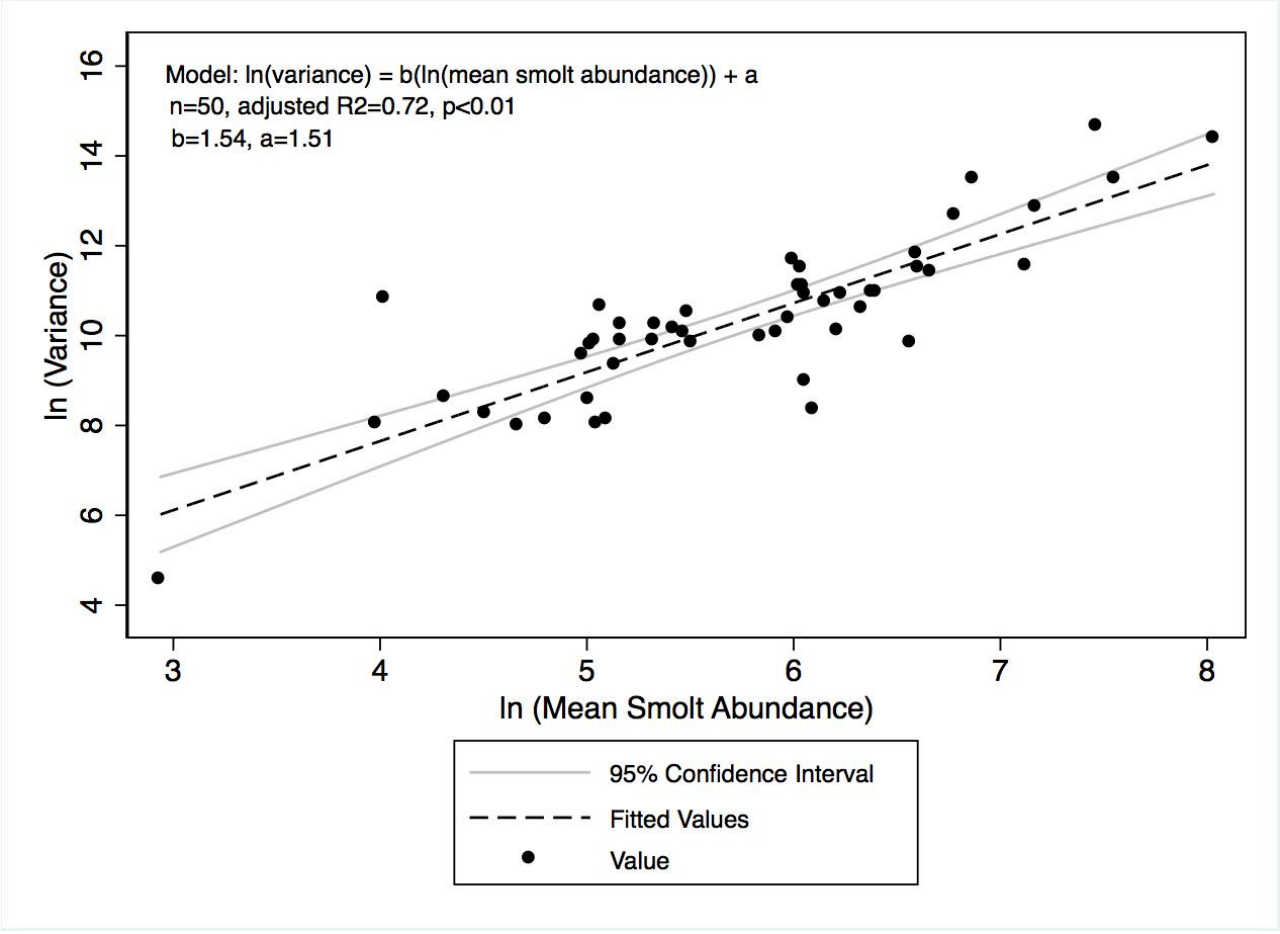
Statistical Analysis

- Model fitting
  - Pearson product-moment correlation coefficient matrix
  - Random effects model
    - Maximum likelihood
    - Least squares
  - GSREG
  - AIC

Results and Discussion

Smolt Frequency Distribution, Annual Correlation and Variance

- Annual abundance normally distributed
  - 23 of 31 watersheds
- Annual abundance not serially correlated
  - 20 of 25 watersheds
- Annual variation was strongly correlated with mean abundance
  - $R^2 = 0.72$



Results and Discussion

Model Predictors, Selection, and Performance

- Pearson product-moment correlation coefficient matrix
- 7 predictor variables

- GSREG – 127 model combinations

Predictor Variables
p.stream04
i.stream04
p.stream48
i.stream48
lake.class1
lake.class2
lake.class3

Results and Discussion

Model No.	Predictor Variables	Model χ^2	χ^2 p- value	AIC	R^2
1	p.stream04 + i.stream04 + lake.class1 + lake.class2	15.33	0.004	567.71	0.21
2	p.stream04 + i.stream04 + lake.class1 + lake.class3	15.33	0.004	567.71	0.21
3	p.stream04 + i.stream04 + lake.class2 + lake.class3	15.33	0.004	567.71	0.21
4	p.stream04 + lake.class1	10.46	0.005	568.57	0.16
5	p.stream04 + i.stream04 + lake.class1	12.09	0.007	568.94	0.16

Results and Discussion

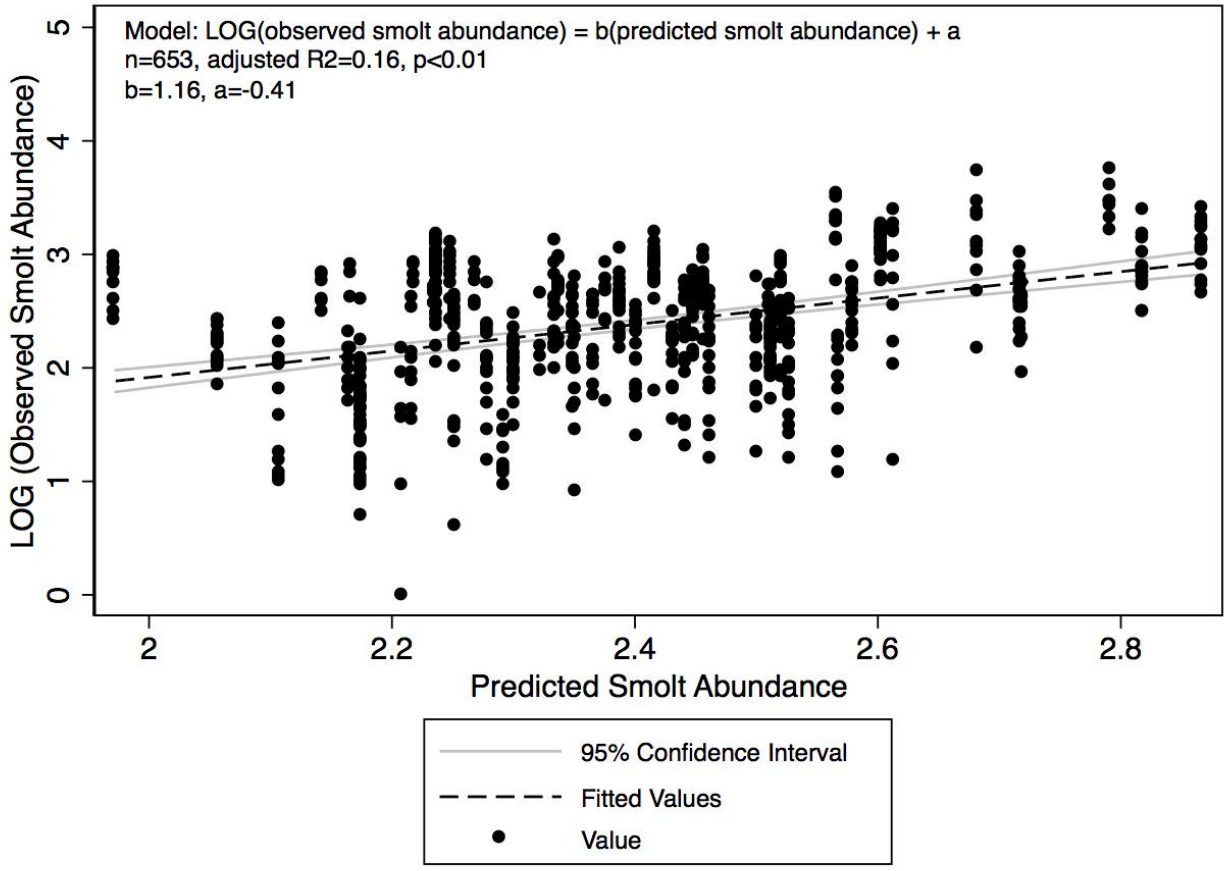
Model Predictors, Selection, and Performance

- Permanent stream length of 0-4% channel gradient
- Lake area of 0-5 ha
- Smolt abundance is limited at least partially by the availability of physical habitat
- Large proportion of the variance in smolt abundance remained unexplained
    - Habitat quality
    - Invertebrate production
    - Adult spawning success or abundance
    - Juvenile survival

Results and Discussion

Model Predictors, Selection, and Performance

- Uncertainties
  - Species lie history diversity
  - Ambiguity of cutthroat smolt
  - Incorrect species identification
  - Spatial scale
  - Barriers to fish movement



Conclusion and Recommendations

Recommendations

- 1. Re-evaluation of watersheds included in the model
  - Near tide line traps reduce uncertainty of seward migrating juveniles
- 2. Mapping re-evaluation
  - Watershed and reach-specific knowledge
  - Use temporary barrier not just permanent barrier classifications
  - Use the latest 3D national hydrography dataset to derive stream gradients
- 3. Consistent approach in species identification and smolt classification

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  - Lower Elwha Klallam Tribe
  - Squaxin Island Tribe