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

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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

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## Results and Discussion

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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 seaward 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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