Habitat potential for juvenile Chinook Salmon (*Oncorhynchus tshawytscha)* in the Chena River basin, Alaska.

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Background

- Less than 50% of potential waterbodies in Alaska have been documented as supporting anadromous fishes
- The Chena River has historically supported one of the largest spawning Chinook salmon populations in the Yukon River. In recent years, runs have declined dramatically statewide.
- Identification and protection of unsampled waterbodies are critical owing to fishing pressure, climate change, and land development

Project Objectives

1. Develop an Intrinsic Potential (IP) model to classify habitat potential for juvenile Chinook salmon in the Chena River. (Spring 2014)
2. Use environmental DNA to assess presence/absence of juveniles among tributary habitats. (Summer 2014/2015)
3. Confirm spatial distribution of rearing Chinook within tributaries using calibrated snorkel surveys. (Summer 2015)

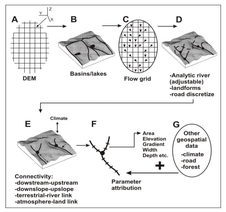
Intrinsic Potential Model (IP)

Estimate of habitat potential (0-1; Burnett et al. 2007)

- Based on preference curves
  - Channel gradient (GRAD; %; Figure 1)
  - Valley Constraint (VC; ratio; Figure 2)
  - Mean annual flow (MAF; m^3/s; Figure 3)
- IP = (MAF * GRAD * VC)$^{1/3}$
- Characterized watersheds by IP

Digital Landscape Model

- NetMap (Benda et al. 2007)
  - System of digital landscapes for conducting environmental assessments
- Digital Landscapes
  - Terrain model where all riverine and terrestrial surfaces are characterized along relevant pathways.



Study Area

- Basin area = 5,300 km^2
- Clearwater - surface runoff hydrologic regime
- Boreal Forest Ecoregion
- 5 major tributaries
- Among largest Chinook escapements in U.S. portion of Yukon River basin (Eiler et al. 2014)


North Fork Chena River


Chena River Mainstem


Chena River Side-Channel


Monument Creek

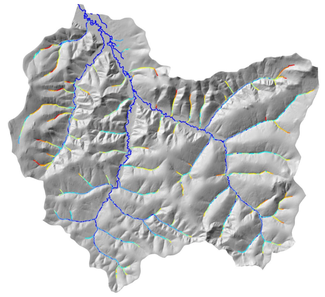

Chena Slough

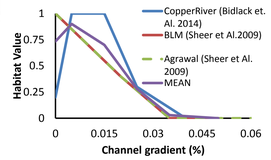

Colorado Creek

Attributes

Reach Gradient (Figure 1.)

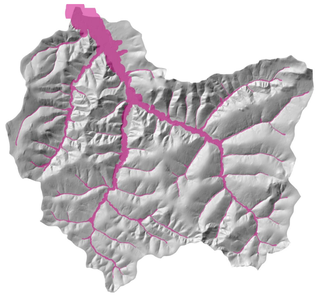
- Limits migration because barriers more likely (velocity, wood, waterfalls, etc.)
- High gradient = high flow velocity = energetically costly
- Characteristic of headwaters, may be farther from spawning sites
- Coarse substrate

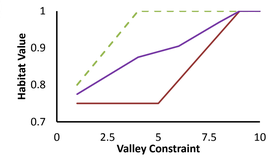




Valley Constraint (Figure 2)

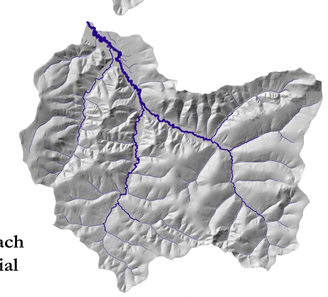
- Confined reaches lack in-stream processes that promote development of suitable habitats
- Backwaters and off-channel habitats more likely in unconfined reaches
- Lower gradient in unconfined reaches may promote large wood accumulation

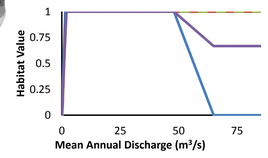




Mean Annual Discharge (Figure 3)

- Reaches with low discharge are less likely to rear juveniles





Other Attributes

- Various other attributes may be important for the IP model:
  - Distance from hatching reach
  - LWD accumulation potential

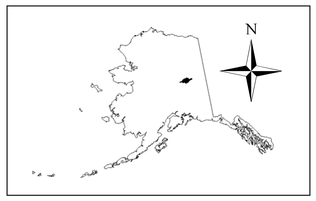
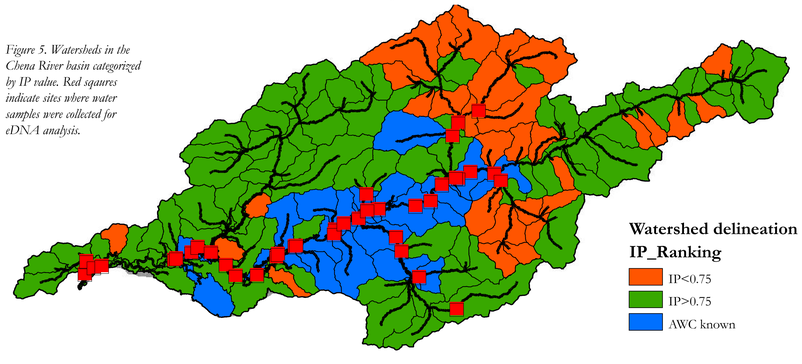


Figure 4. The full IP model applied to the Chena River Basin

Figure 5. Watersheds in the Chena River basin categorized by IP value. Red squares indicate sites where water samples were collected for eDNA analysis.



Environmental DNA

- Rapid, noninvasive assessment method
- May originate from sloughing of target species cells

Field Methods

- Water samples collected in the current above tributary confluence with mainstem.
- 3 independent samples from each site.

Laboratory Methods

- Water filtered using cellulose nitrate membrane filter in lab.
- Species-specific primers will be used to amplify DNA
- Analysis will be conducted to estimate presence of amplified Chinook DNA

Results

- The model classified ~930.8 stream-km as having high rearing habitat potential (Figure 4).
- Watersheds characterized by >20 km^2 surface area, (*N*=149; Figure 5)
  - High IP > 0.75; *N*=86
  - Low IP <0.75; *N*=31
  - Known rearing AWC; *N*=32
- Ten sites from each category will be sampled via snorkeling in 2015
- N=40 sites sampled for eDNA analysis (Figure 5)

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