Linking place, process and strategy: Basin-scale view of salmon and steelhead habitats and restoration projects in the Willamette Valley

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Publications and Restoration Program Information
http://pubs.usgs.gov/of/2013/1246/
http://www.mmt.org/willamette-river-basin-restoration
https://digital.osl.state.or.us/islandora/object/osl:510619/datastream/OBJ/view
Overview

Basin-scale view of salmon and steelhead habitats in Willamette Valley

Examples of habitat-enhancement projects underway across the basin

Ability to address salmon habitat limitations varies across the landscape

New science will help identify locations, flow conditions when habitat is limiting, setting stage for local and basin-scale prioritization
Willamette Basin salmon and steelhead Critical Habitats:

Restoration focus is rearing habitats

Limiting factors include temperature, velocity, depth, cover

During summer, temperature limits habitat availability

Range expansion fall through spring when depth, velocity, cover become limiting

Steelhead
Chinook
Steelhead and Chinook

Critical Habitat
(NOAA, 2005)

Estimated mean August temperatures
NORWEST estimates for 2005 for basins > 50 km² (Isaak and others, 2017)
Summer stream temperatures in rearing corridors

Percentage of summer days with suitable rearing temperatures:

- **Cold**, almost always less than 16 deg C
- **Cooler**, less than 25% days above 18 deg C
- **Transitional**, 25-50% of days above 18 deg C
- **Warmer**, 50-70% of days above 18 deg C
- **Hot**, >70% days above 18 deg C

Based on 7 day average of daily maximum stream temperatures 2010-2017,
Map by Gabe Gordon, USGS; https://waterdata.usgs.gov/nwis
Geomorphic conditions in major spring Chinook rearing corridors

"Habitat restoration efforts will be more likely to foster salmon resilience if they consider processes that generate and maintain natural variability in fresh water." (Bisson et al. 2009)

Presently dynamic reaches
(Diverse channel features, active habitat formation)

Historically dynamic, presently stable
(Habitat formation limited, many relict features)

Intrinsically stable reaches

Geomorphological reaches from Wallick and others, 2013
Suitable velocities vary with morphology and flow. Single-thread channel reaches may provide suitable velocities at low flows and during local overtopping at high flows. Example from Middle Willamette River near Independence.

Preliminary, uncalibrated 2D hydraulic model results using HEC-RAS 2D Willamette River between Independence and Salem. Modeling by James White, USGS.
Strategies to improve rearing habitats

**Flow Management Actions**

- Improve temperatures
  - Most effective near dams

- Maximize existing habitats
  - Create suitable depths, velocities or inundate key habitat features.
  - Most effective in complex areas

- Provide flows to support habitat-forming processes
  - Create new habitats in dynamic reaches

**Restoration Projects**

- Enhance habitats
  - Address site-specific limitations in areas where temperature not limiting factor.

- Initiate habitat-forming processes
  - Modify channel morphology or revetments so present-day flows can create diverse habitats
Addressing limiting factors for juvenile spring Chinook in tributary basins

**Tributaries and Upper Watershed**
Temperatures typically suitable for year-round rearing
Velocity, cover are limiting factors in these high-gradient reaches
Projects can also support enhance spawning habitat

Phase 1 of USFS-MWSC South Fork McKenzie River ‘Stage Zero’ project, 2018.
Addressing limiting factors for juvenile spring Chinook on Upper Willamette

**Upper Willamette**
Temperature limiting for short periods; many cold water refuges
Rest of year: Velocity, depth, cover locally limiting factors
Habitat-forming processes relatively intact

Conservation to protect areas where habitat-forming processes intact

**Geomorphic reaches of large gravel bed rivers**
- Dynamic
- Presently stable
- Inherently stable

**Temperature ranges**
- Cold, almost always less than 16 deg C
- Cooler, less than 25% days above 18° C
- Transitional, 25-50% of days above 18° C
- Warmer, 50-70% of days above 18° C
- Hot, >70% days above 18 °C

**Address barriers to inundation**

Snag Boat Bend, USFWS and LongTom WSC collaboration, map courtesy of RDG

Geomorphic reaches from Wallick and others, 2013; Temperatures based on 7day average of daily maximum stream temperatures 2010-2017, Map by Gabe Gordon, USGS; https://waterdata.usgs.gov/nwis
Addressing limiting factors for juvenile spring Chinook on Middle Willamette

**Middle segment of Willamette River**

Summer temperatures routinely limiting; few cold water refuges
Rest of year: Velocity, depth, cover are limiting factors
Geomorphic stability limits habitat-forming processes

Restoration site at Luckiamute State Natural Area, photograph by River Design Group.

Vegetation enhancement site at Willamette Mission State Park, photograph by Willamette River Keeper

Geomorphic reaches from Wallick and others, 2013; Temperatures based on 7-day average of daily maximum stream temperatures 2010-2017, Map by Gabe Gordon, USGS; https://waterdata.usgs.gov/nwis
Linking place, process and strategy

Suitable rearing habitat conditions vary spatially and seasonally.

Ability to address habitat limitations varies across the landscape.

Variety of restoration projects to enhance rearing habitat underway.

Flow, temperature modeling and habitat availability analyses underway will help identify locations, flow conditions when habitat is limiting, setting stage for local and basin-scale prioritization.

Additional process needed to turn new science into strategic, basin-wide plan.

Courtesy Freshwaters Illustrated
Additional questions

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