An Evaluation of Fish Habitat Suitability In Association with Proposed Anadromous Overlay Alternatives

based on

Habitat Intrinsic Potential

by

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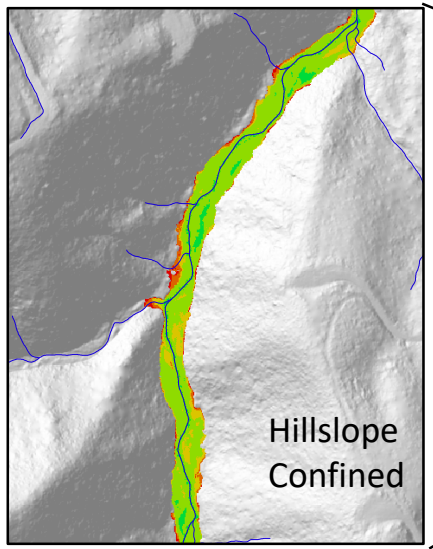
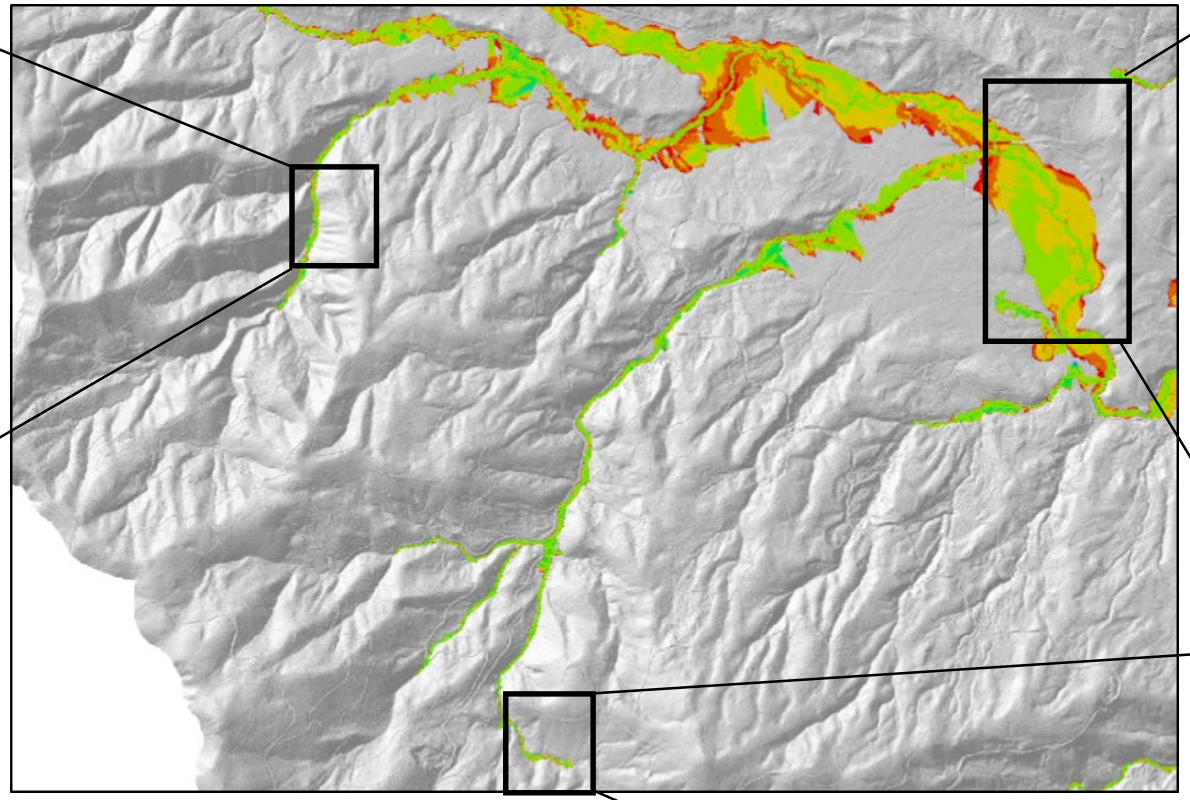
July 17, 2019

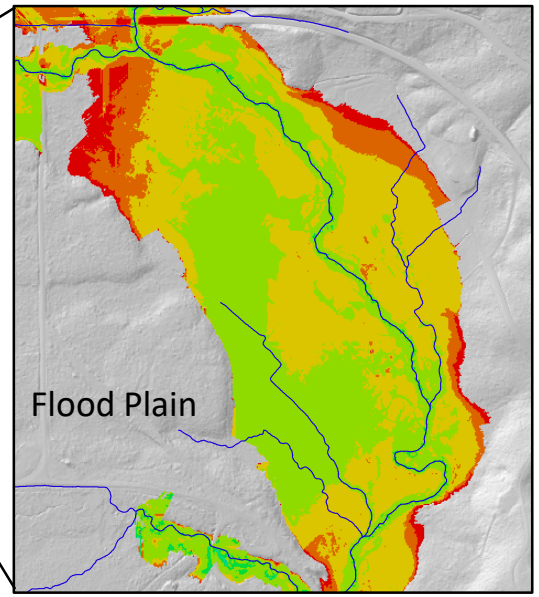
What is Habitat Intrinsic Potential (HIP)?

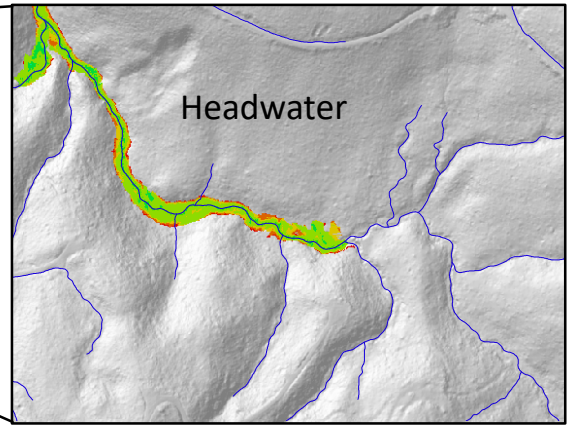
Intrinsic potential, reflects species-specific associations between fish use and persistent stream attributes (Burnett et al. 2007)

What is Habitat Intrinsic Potential (HIP)?





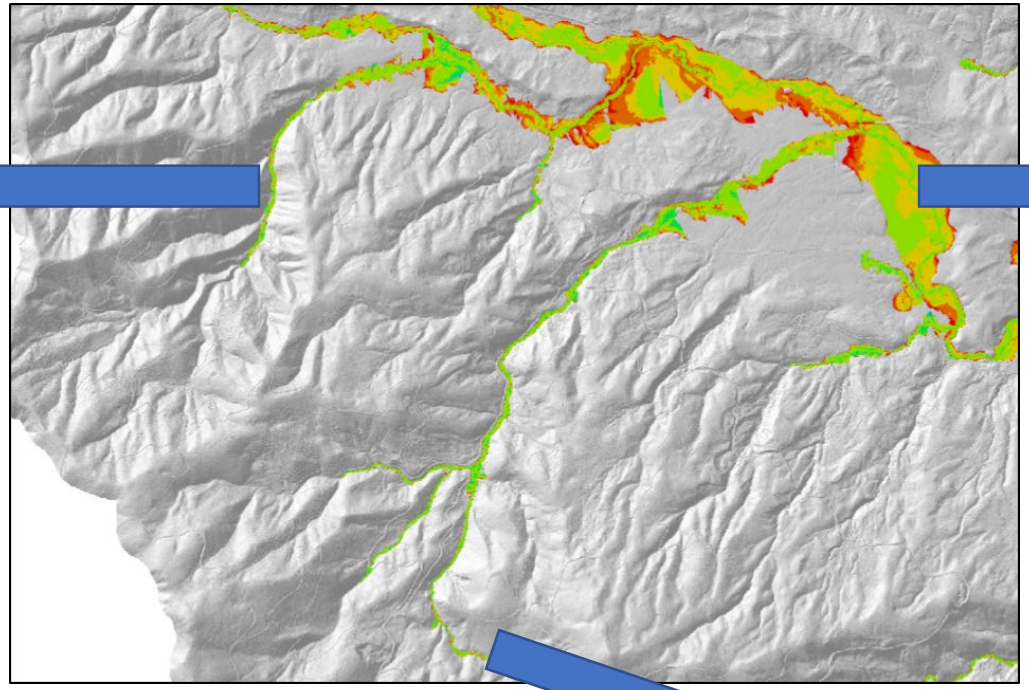




- Geology and precipitation coupled with hydrologic & geomorphic processes form the physical template for the stream network and channel characteristics of basins:
  - flood plains
  - canyons
  - waterfalls

What is Habitat Intrinsic Potential (HIP)?

Moderate Gradient, Mod- Constrained



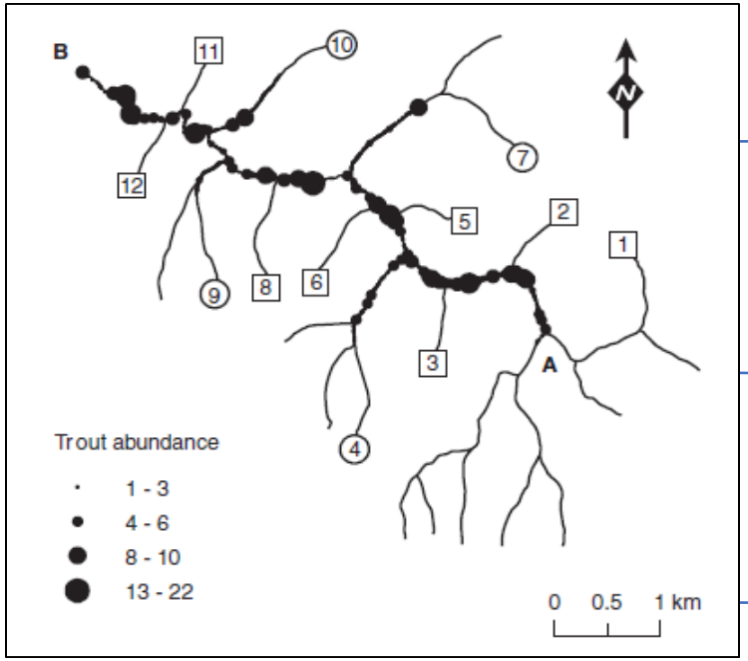
Low Gradient, Un-constrained

- Geophysical processes control the formation, spatial organization, and persistence of channel features
- Spatial patterns and physical characteristics of channel features determine the distribution, quantity, and quality of habitats

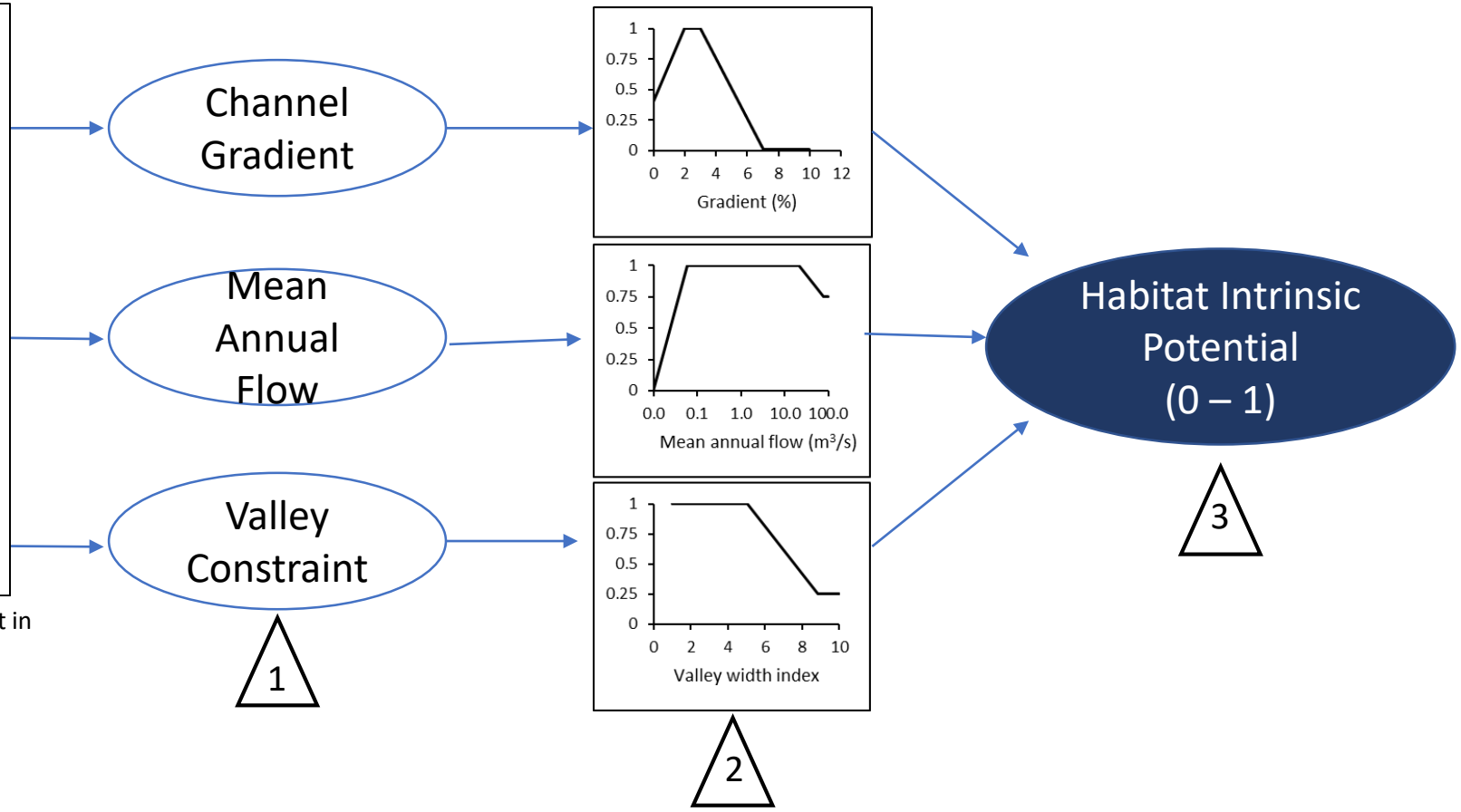
- Spawning gravel and rearing pool habitat are components of relatively immutable landforms

High Gradient, Constrained

What is a Habitat Intrinsic Potential (HIP) model?



Spatial distribution of abundance for coastal cutthroat trout in Camp Cr, OR. (from Torgersen et al. 2008)



1. Spatial patterns of habitat use by fish are associated with persistent reach specific attributes
2. Habitat suitability modeling is used to explain the observed distribution and quality of suitable habitats based on reach attributes
3. Statistical model incorporates habitat suitability cures into one model that rates habitat intrinsic potential

Intrinsic Potential Models

Citation	Species	Location	Predictor Variables	Purpose
Burnett 2001 Burnett et al. 2007	coho steelhead	western Oregon	mean annual flow gradient valley width index	Identify location of stream reaches with the potential to provide high-quality habitat Prioritize salmonid conservation at locations with likelihood to succeed.
Bidlack et al. 2014	chinook	Alaska south central	mean annual flow gradient glacial influence	To investigate utility of IP modeling for prioritizing conservation planning across large landscapes (Copper River) where knowledge of fish distribution and habitat are limited.
Romey 2018	pink chum	Southeast Alaska	mean annual flow gradient valley width index	To define and map the spatial patterns of habitat suitabilty for pink and chum across multiple basins. To priortize habitat restoration and conservation planning at the landscape scale.
Romey and Martin 2018	coho	Southeast Alaska	mean annual flow gradient valley width index	To define and map the spatial patterns of habitat suitabilty for pink and chum across multiple basins. To priortize habitat restoration and conservation planning at the landscape scale.
PSMFC no date	coastal cutthroat	northern California	mean annual flow gradient channel width	To provide an approach for identify historical habitat and to serve as a foundation for future assessments of coastal cutthroat populations

NOAA Assessments of Evolutionary Significant Units (ESUs)
Historic Salmon Distribution Guided by Intrinsic Potential Approach

NOAA Technical Memorandum NMFS

JUNE 2005

PREDICTING THE POTENTIAL FOR HISTORICAL COHO, CHINOOK AND STEELHEAD HABITAT IN NORTHERN CALIFORNIA

A. Agrawal
R. S. Schick
E. P. Bjorkstedt
R.G. Szerlong
M. N. Goslin
B. C. Spence
T. H. Williams
K. M. Burnett

NOAA-TM-NMFS-SWFSC-379

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

"We used the IP modeling framework to estimate the likelihood—strictly speaking, the relative likelihood—that a stream reach will exhibit suitable habitat for juveniles of a particular species. "

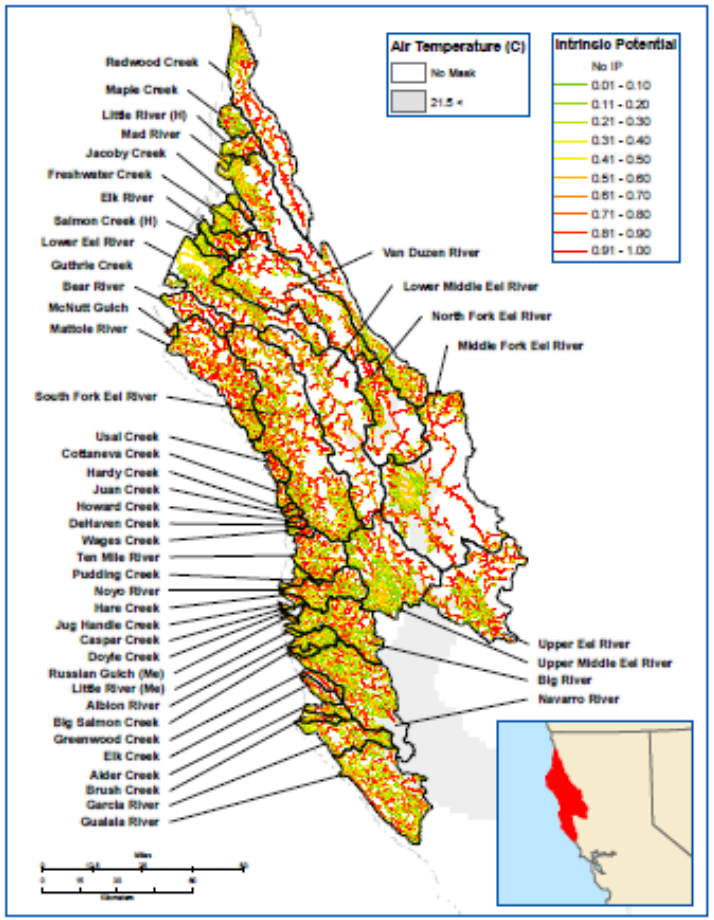


Plate 14. Intrinsic potential for steelhead across the range of the NC-Steelhead ESU, including areas where coho salmon are likely to be excluded by temperature.

NOAA Technical Memorandum NMFS

OCTOBER 2005

AN ANALYSIS OF HISTORICAL POPULATION STRUCTURE FOR EVOLUTIONARILY SIGNIFICANT UNITS OF CHINOOK SALMON, COHO SALMON, AND STEELHEAD IN THE NORTH-CENTRAL CALIFORNIA COAST RECOVERY DOMAIN

Eric P. Bjorkstedt
Brian C. Spence
John Carlos Garza
David G. Hankin
David Fuller
Weldon E. Jones
Jerry J. Smith
Richard Macedo

NOAA-TM-NMFS-SWFSC-382

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

"We use predictions from the IP model as the basis for our habitat-based population proxy, and assume that carrying capacity of winter steelhead populations is linearly proportional to the integrated length of accessible habitat within a watershed weighted by the intrinsic potential for habitat suitable for juvenile rearing (IP-km)."

NOAA Assessments of Evolutionary Significant Units (ESUs)
Salmon Historical Abundance Estimated by Intrinsic Potential Approach

NOAA Technical Memorandum NMFS-NWFSC-79

Identification of Historical Populations of Coho Salmon *(Oncorhynchus kisutch)*
In the Oregon Coast Evolutionarily Significant Unit

Peter W. Lawson, Eric P. Bjorkstedt[1], Mark W. Chilcote[2], Charles W. Huntington[3], Justin S. Mills[4], Kelly M.S. Moore[5], Thomas E. Nickelson[6], Gordon H. Reeves[7], Heather A. Stout, Thomas C. Wainwright, and Laurie A. Weitkamp

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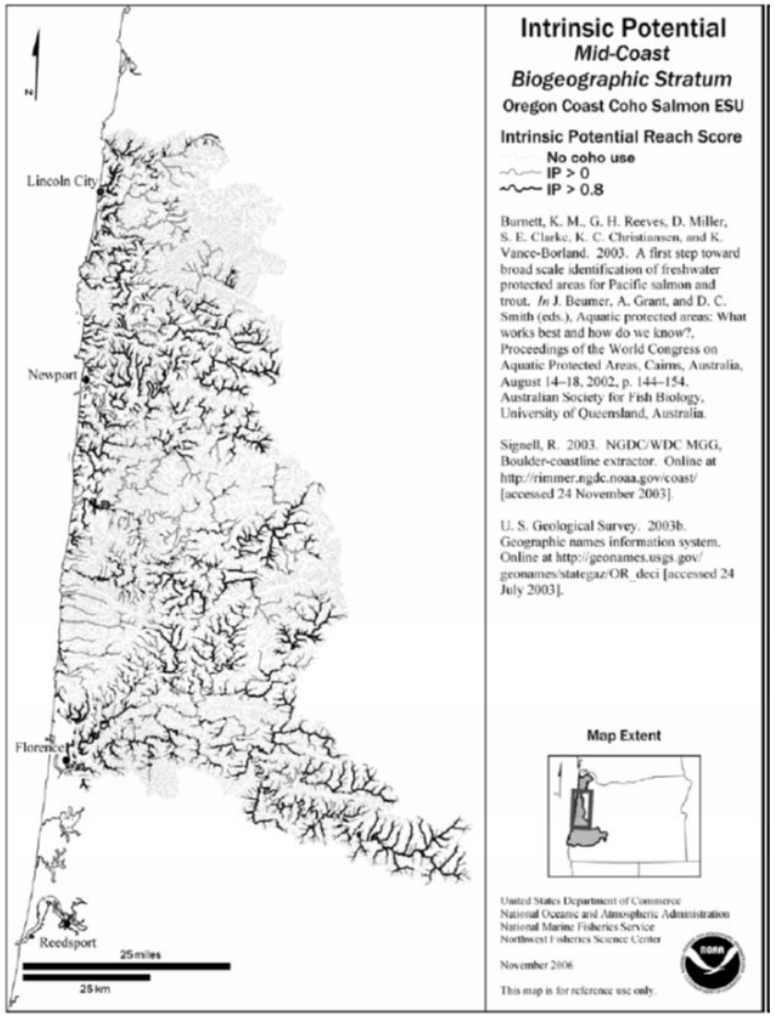
January 2007

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service



Burnett, K. M., G. H. Reeves, D. Miller, S. E. Clarke, K. C. Christiansen, and K. Vance-Borland. 2003. A first step toward broad scale identification of freshwater protected areas for Pacific salmon and trout. *In* J. Beumer, A. Grant, and D. C. Smith (eds.), Aquatic protected areas: What works best and how do we know?, Proceedings of the World Congress on Aquatic Protected Areas, Cairns, Australia, August 14–18, 2002, p. 144–154. Australian Society for Fish Biology, University of Queensland, Australia.

Signell, R. 2003. NGDC/WDC MGG, Boulder-coastline extractor. Online at http://rimmer.ngdc.noaa.gov/coast/ [accessed 24 November 2003].

U. S. Geological Survey. 2003b. Geographic names information system. Online at http://geonames.usgs.gov/geonames/stategaz/OR_deci [accessed 24 July 2003].

Figure C-3. Intrinsic potential of rivers and streams on the mid-coast segment of the Oregon Coast Coho Salmon ESU.

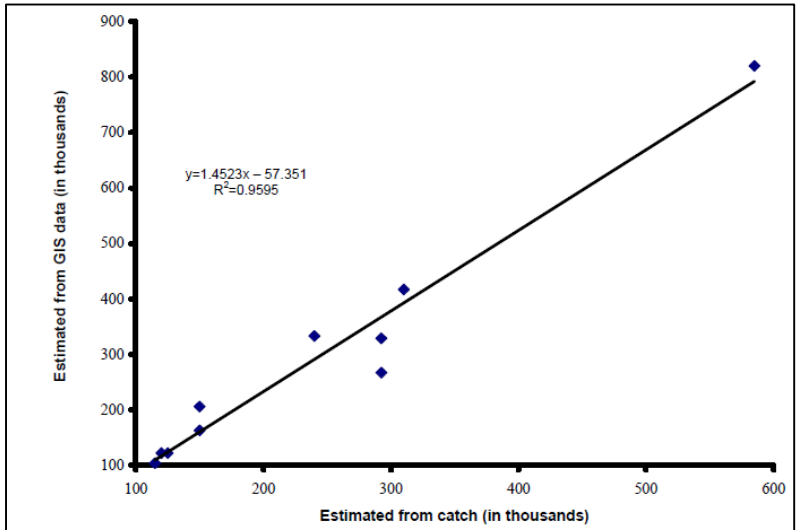


Figure C-1. The relationship between historical potential coho salmon adult abundance estimated by historical catch records and adult abundance calculated from GIS data (data from Table C-1).

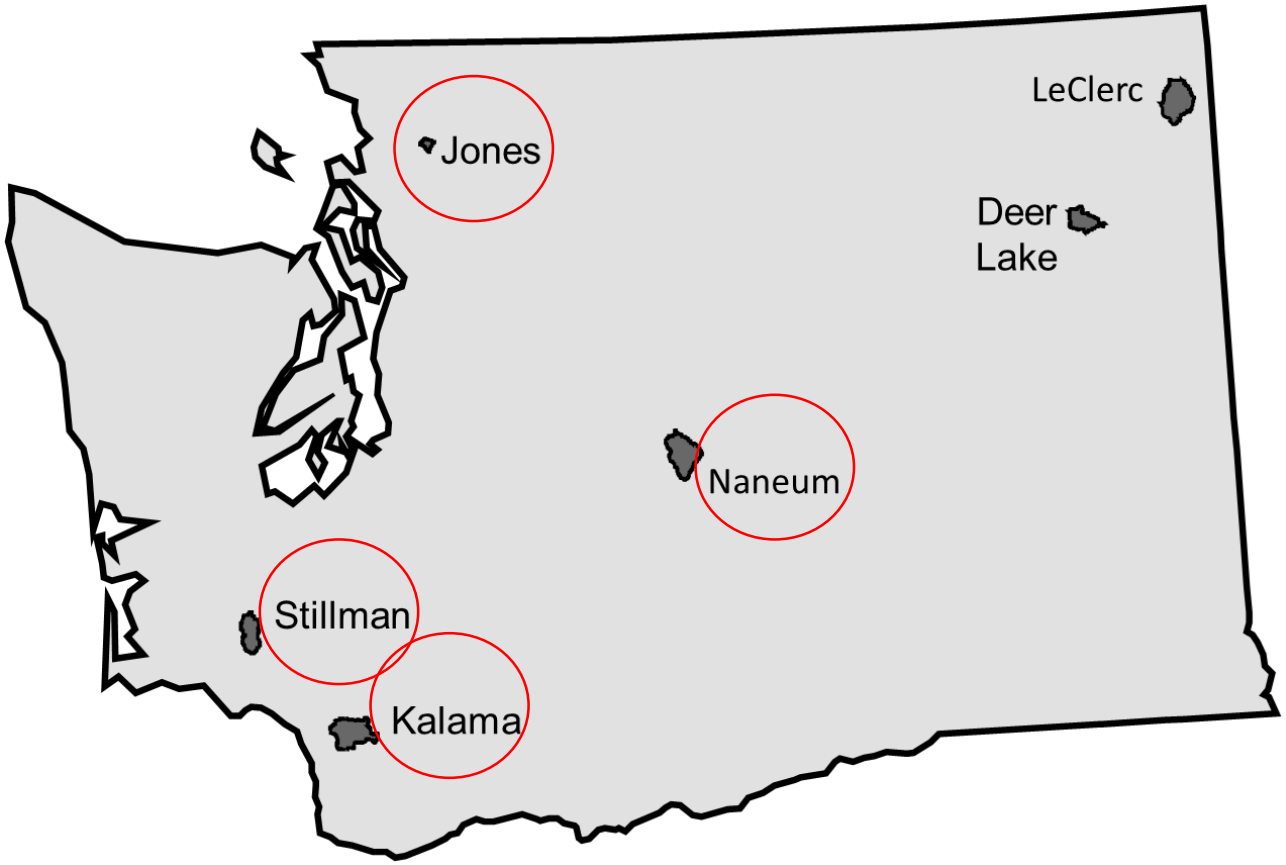
"To estimate historical abundance, we combined key geomorphic measures (gradient, valley width, and active channel width) from the DEMs with habitat intrinsic potential (an integrated measure of habitat quality described in Burnett et al. 2003"

"The advantage of calculating adult abundance from computed intrinsic potential is that estimates can be made for basins where there are no historical fishery data."

Assessments that Demonstrate Utility of Intrinsic Potential Approach

Citation	Species	Location	Purpose	Findings
Bennett and Wecker 2012	coho chinook steelhead chum sockeye	Washington coast	To Identified restoration needs and opportunities and to prioritize protection and restoration based on the potential value to salmon populations	The University of Washington / Olympic Natural Resources Center (UW/ONRC) GIS team along with the Wild Salmon Center (WSC) collaborated on applying Habitat Intrinsic Potential (IP) models for five species of salmonid anadromous fish to stream reaches in 4 coastal watersheds
Flitcroft et al. 2014	coho	western Oregon	To investigate interannual patterns of distribution by juvenile coho and how they relate to biological and physical factors	Our results indicate that the distribution of juvenile coho is related to the location of areas with high IP
Steel et al. 2016	coho	western Oregon	To quantify the ability of immutable attributes of the landscape to explain the observed distribution of pool habitats and to explain the observed density of juvenile coho salmon within pools.	We found that pool surface area is well described by relatively immutable landform attributes.
			To evaluate the explanatory capacity of coho IP index (Burnett et al. 2007)	Landscape models in this study corroborated the management relevance of the concept of “intrinsic potential”

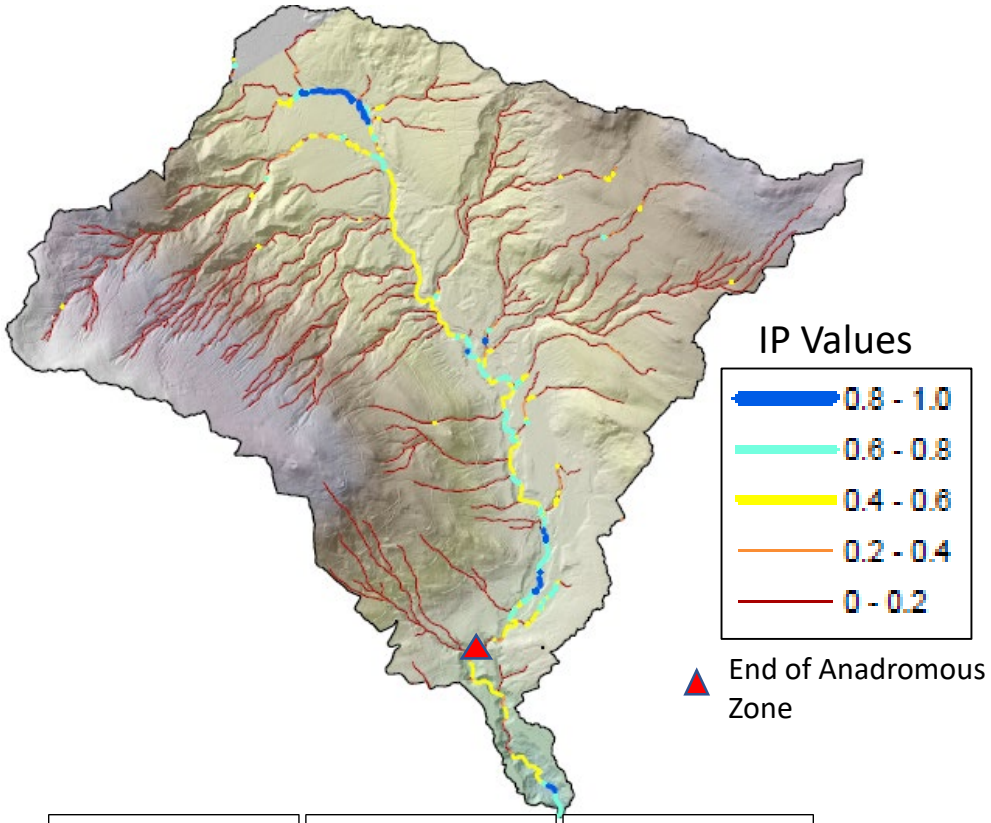
Location of Study Basins and PHB Surveys

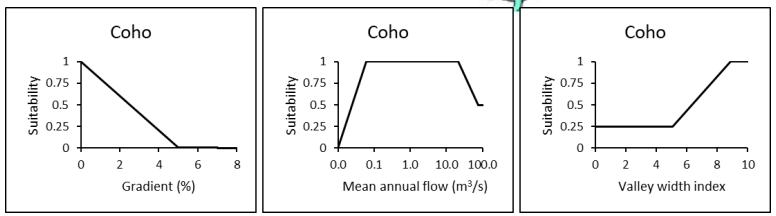


Basin name	DNR Region	Basin area (mi^2)	Number of EOF Surveys			EOF data source
			Terminal	Lateral	Total	
Jones	Northwest	8.0	14	2	16	Sierra Pacific Ind.
Stillman	Pacific Cascade	45.4	69	44	113	Weyerhaeuser
Kalama	Pacific Cascade	148.7	86	197	283	Weyerhaeuser
Naneum	Southeast	68.5	37	51	88	Cupp 2002
Deer Lk	Northeast	41.9	17	27	44	Cupp 2002
LeClerc	Northeast	74.9	42	62	104	Cupp 2002

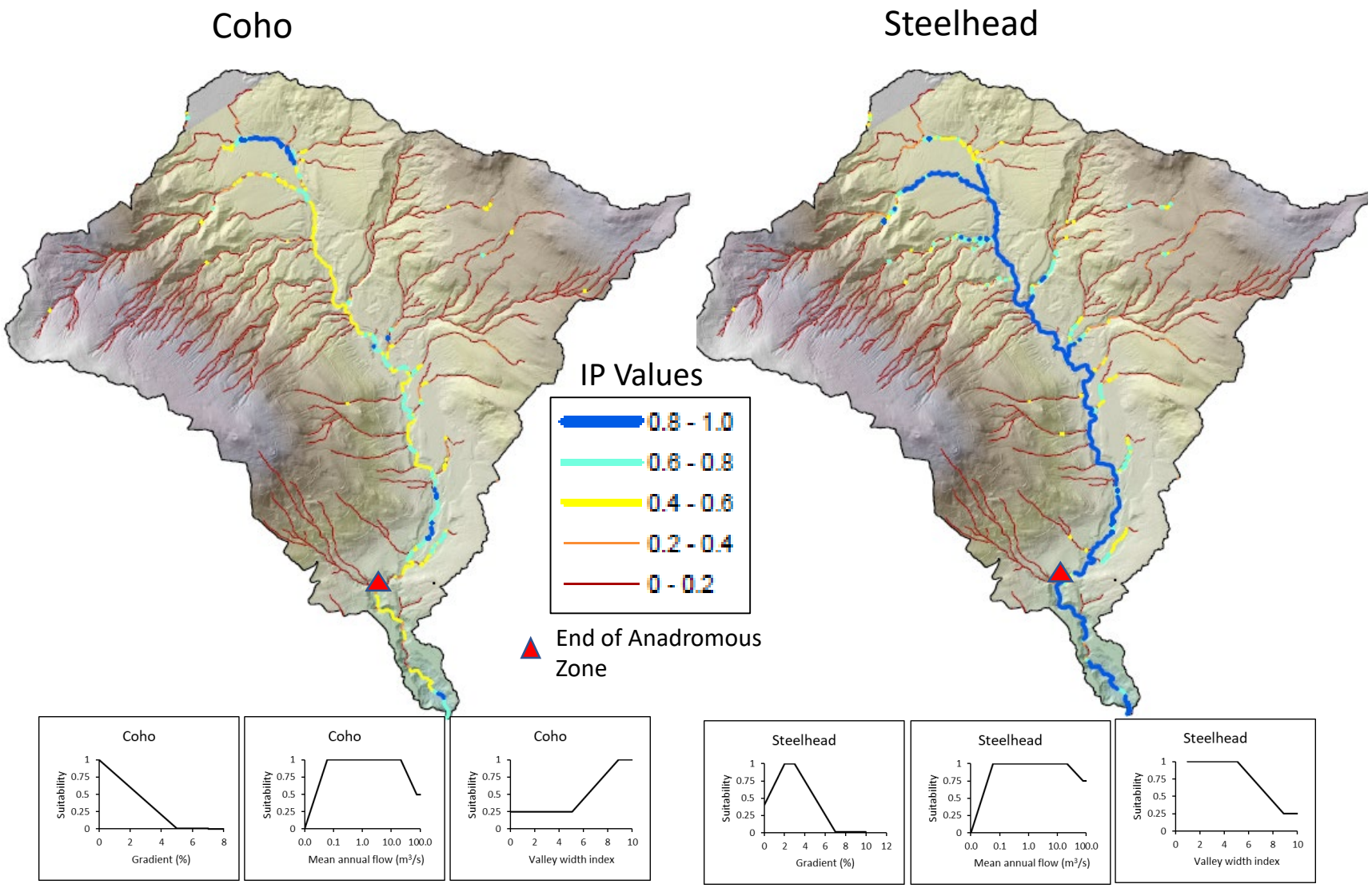
Spatial Distribution of Habitat Intrinsic Potential for Salmonids in Jones Basin

Coho





Spatial Distribution of Habitat Intrinsic Potential for Salmonids in Jones Basin

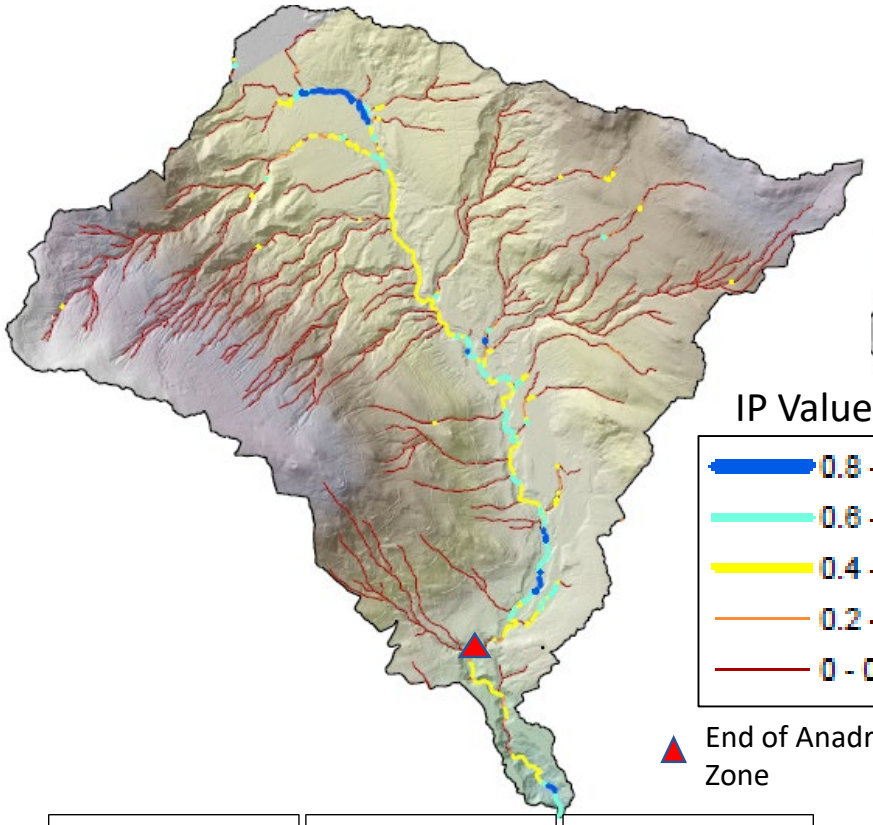


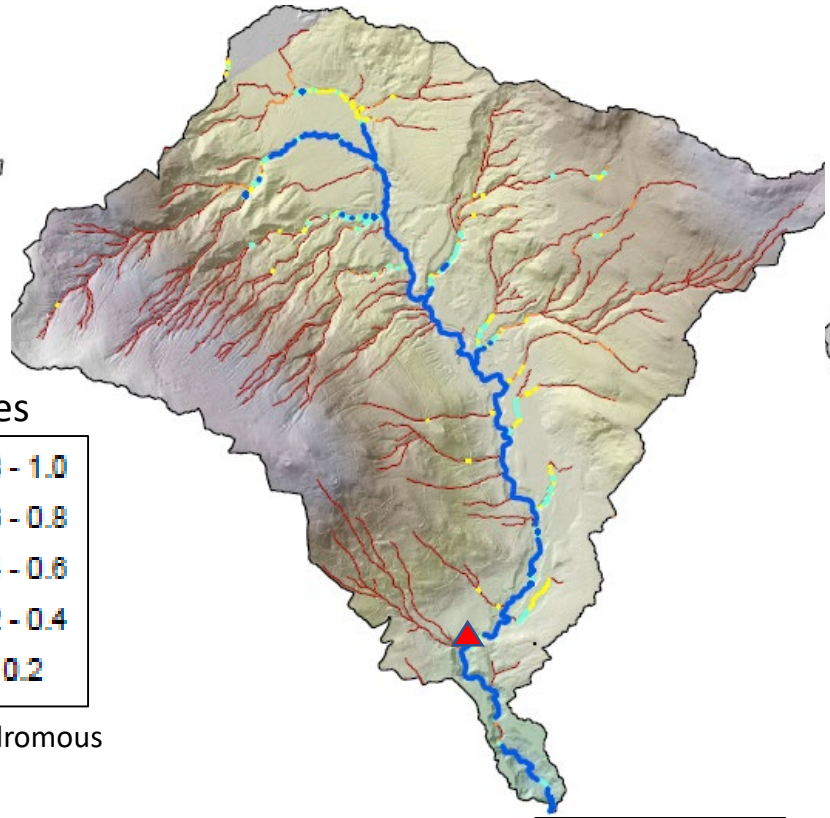
Spatial Distribution of Habitat Intrinsic Potential for Salmonids in Jones Basin

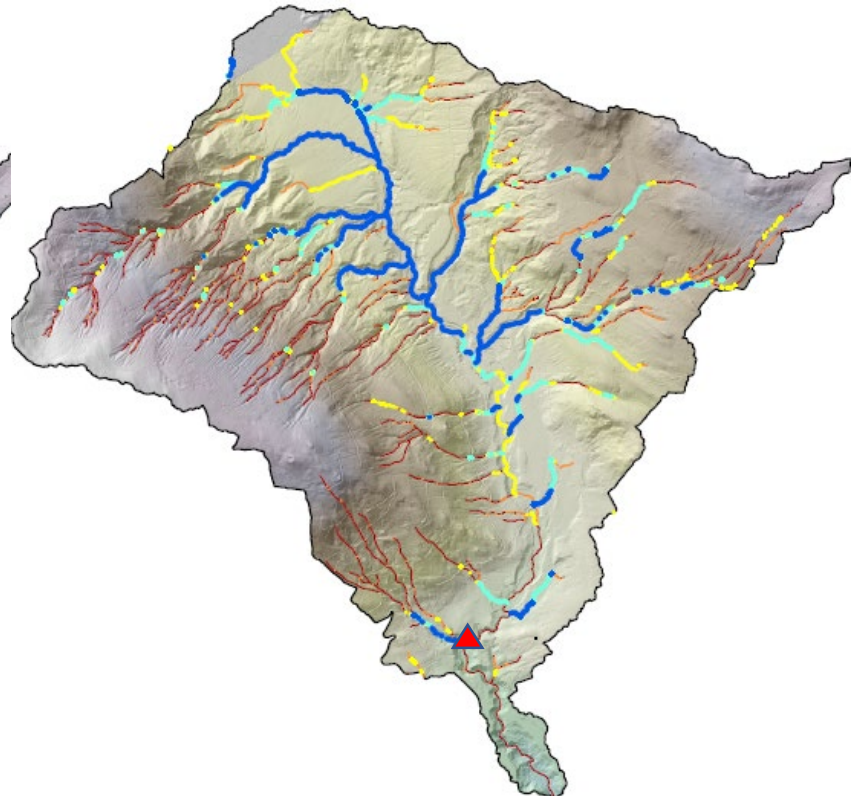
Coho

Steelhead

Coastal Cutthroat



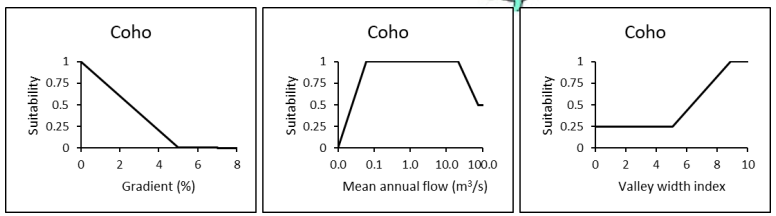


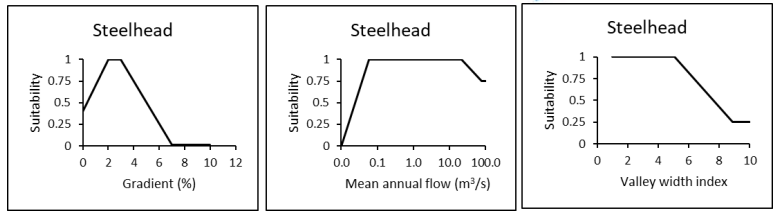


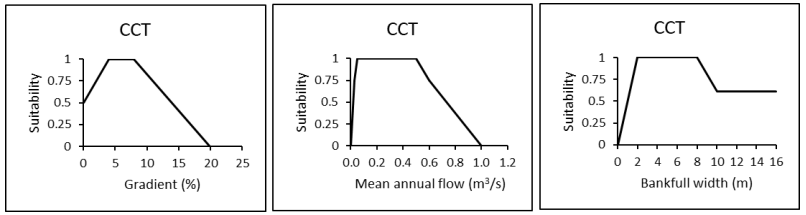
IP Values

- 0.8 - 1.0
- 0.6 - 0.8
- 0.4 - 0.6
- 0.2 - 0.4
- 0 - 0.2

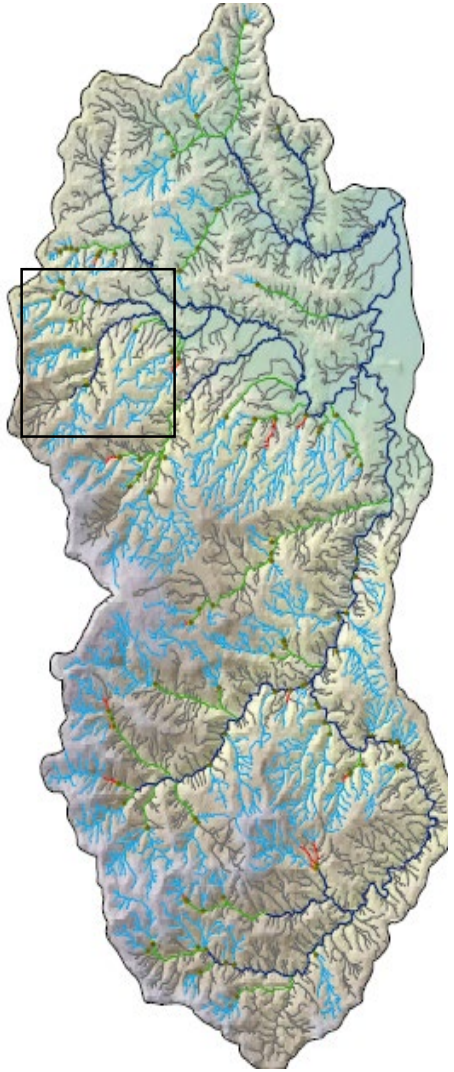
End of Anadromous Zone







Stillman Basin Intrinsic Potential for Anadromous Core (SWIFD) Compared to Proposed Anadromous Overlay Alternatives for Coho and Steelhead



Channel Type

- Unknown
- Known Anadromous
- Surveyed Fish Use
- Estimated Fish Habitat
- Surveyed No Fish

IP Values

- 0.8 - 1.0
- 0.6 - 0.8
- 0.4 - 0.6
- 0.2 - 0.4
- 0 - 0.2

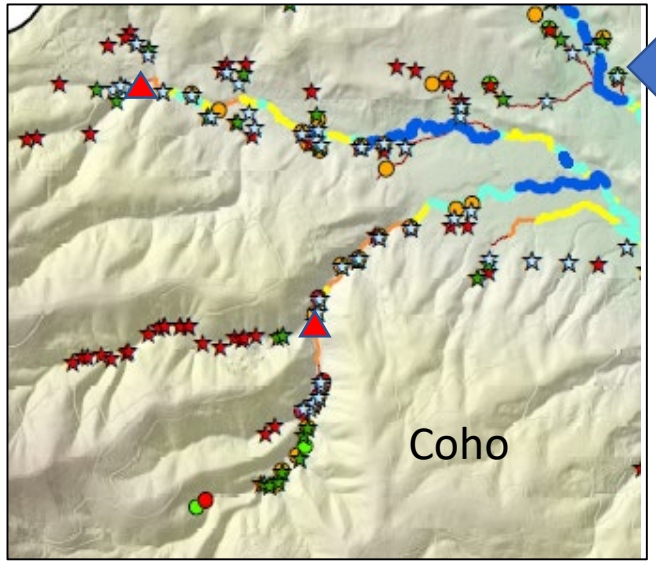
EOA

Upstream Extent

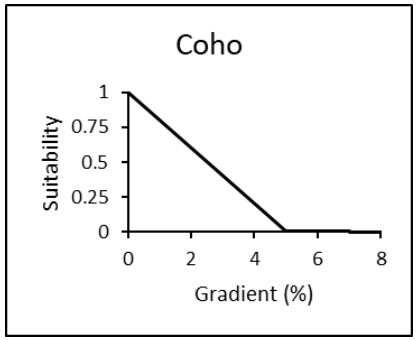
- 5% Gradient
- 7% Gradient
- 10% Gradient

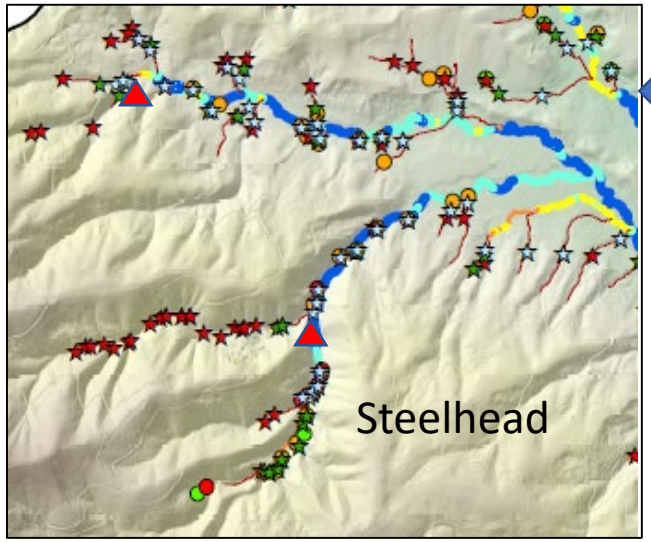
Alternative 1 PHB

- Size Break > 20%
- Step > 3 ft
- Obstacle > 1 BFW
- Gradient Break > 5%
- End of Fish
- End of Habitat

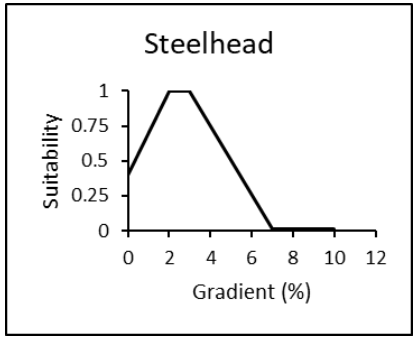


Coho moderate to high IP (> 0.6) mostly occurs downstream of 5% gradient

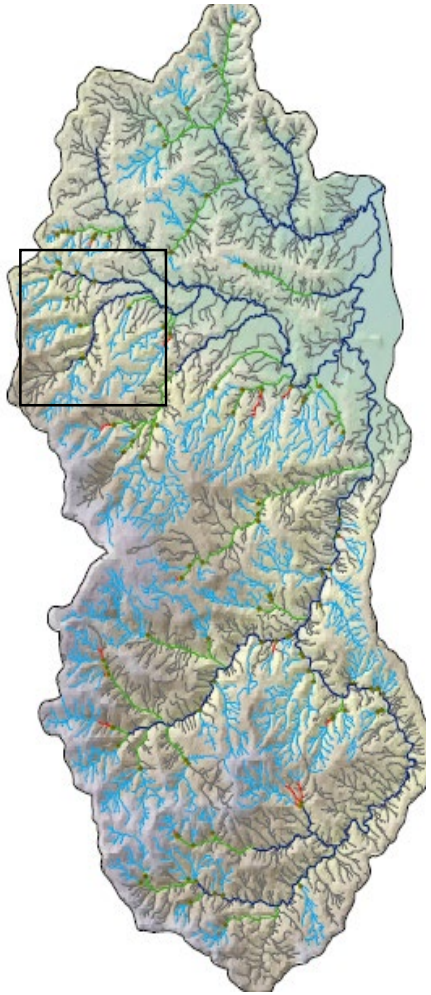




Steelhead moderate to high IP (> 0.6) mostly occurs downstream of 7% gradient



Stillman Basin Intrinsic Potential for Anadromous Core (SWIFD) Compared to Proposed Anadromous Overlay Alternatives for Coho and Steelhead



Channel Type

- Unknown
- Known Anadromous
- Surveyed Fish Use
- Estimated Fish Habitat
- Surveyed No Fish

IP Values

- 0.8 - 1.0
- 0.6 - 0.8
- 0.4 - 0.6
- 0.2 - 0.4
- 0 - 0.2

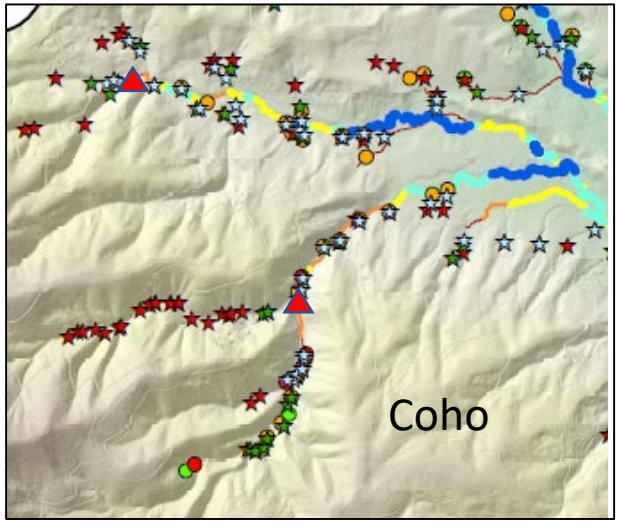
EOA

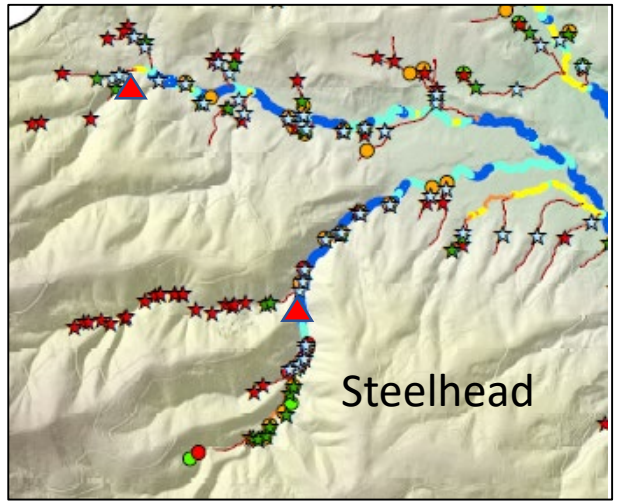
Upstream Extent

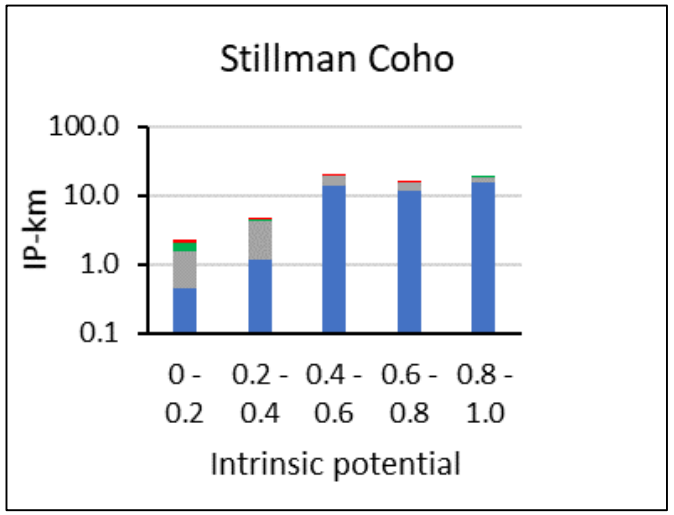
- 5% Gradient
- 7% Gradient
- 10% Gradient

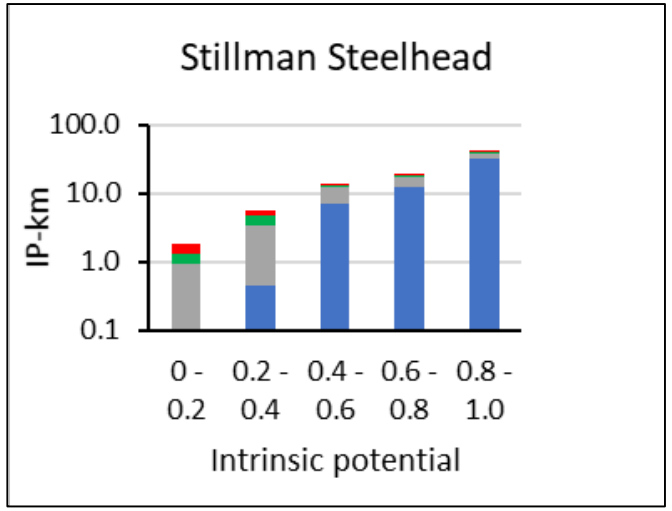
Alternative 1 PHB

- Size Break > 20%
- Step > 3 ft
- Obstacle > 1 BFW
- Gradient Break > 5%
- End of Fish
- End of Habitat

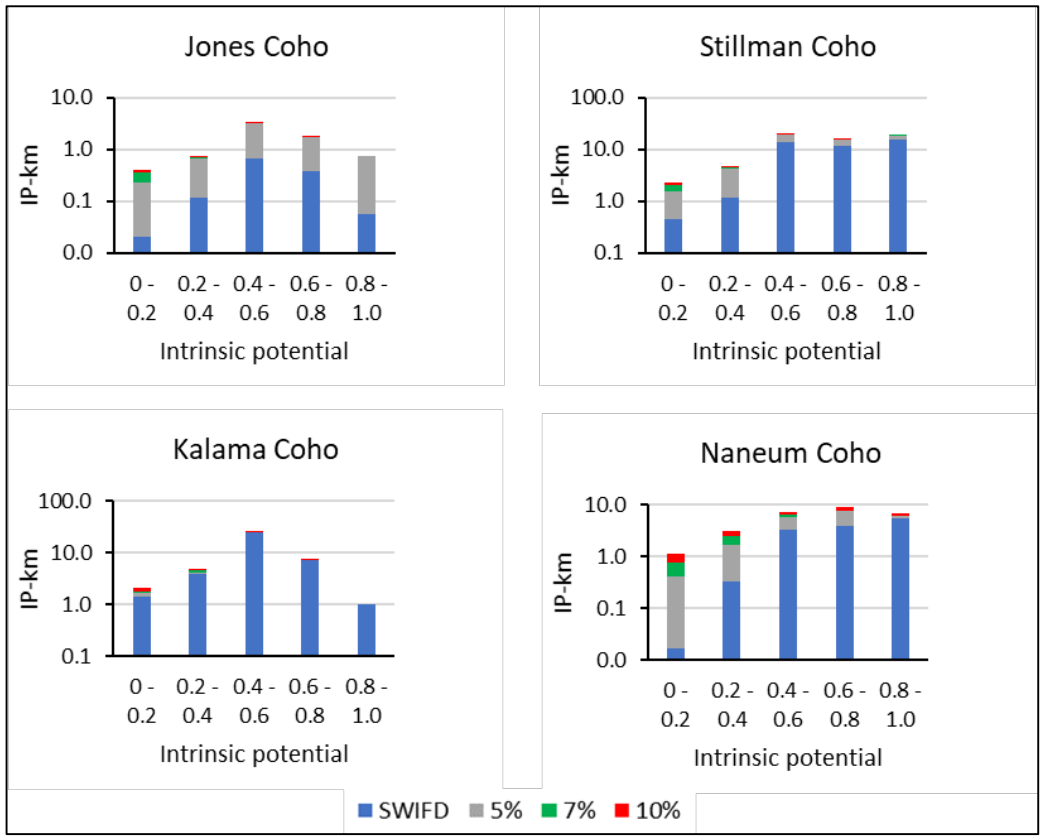


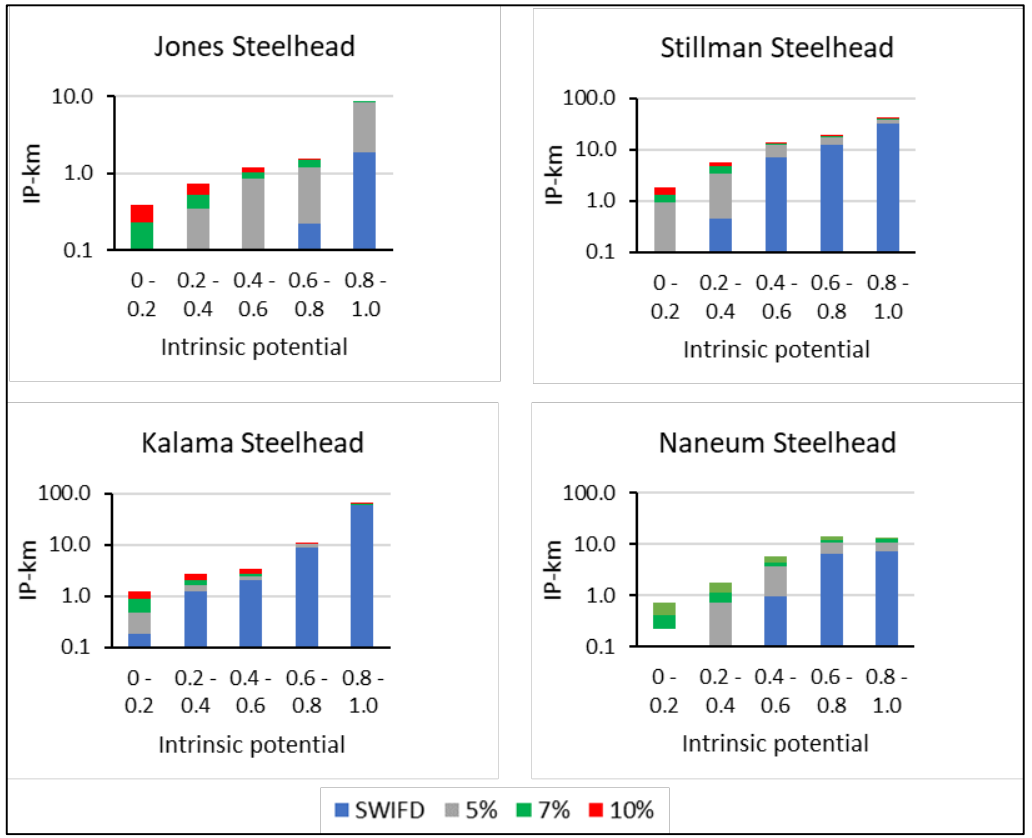






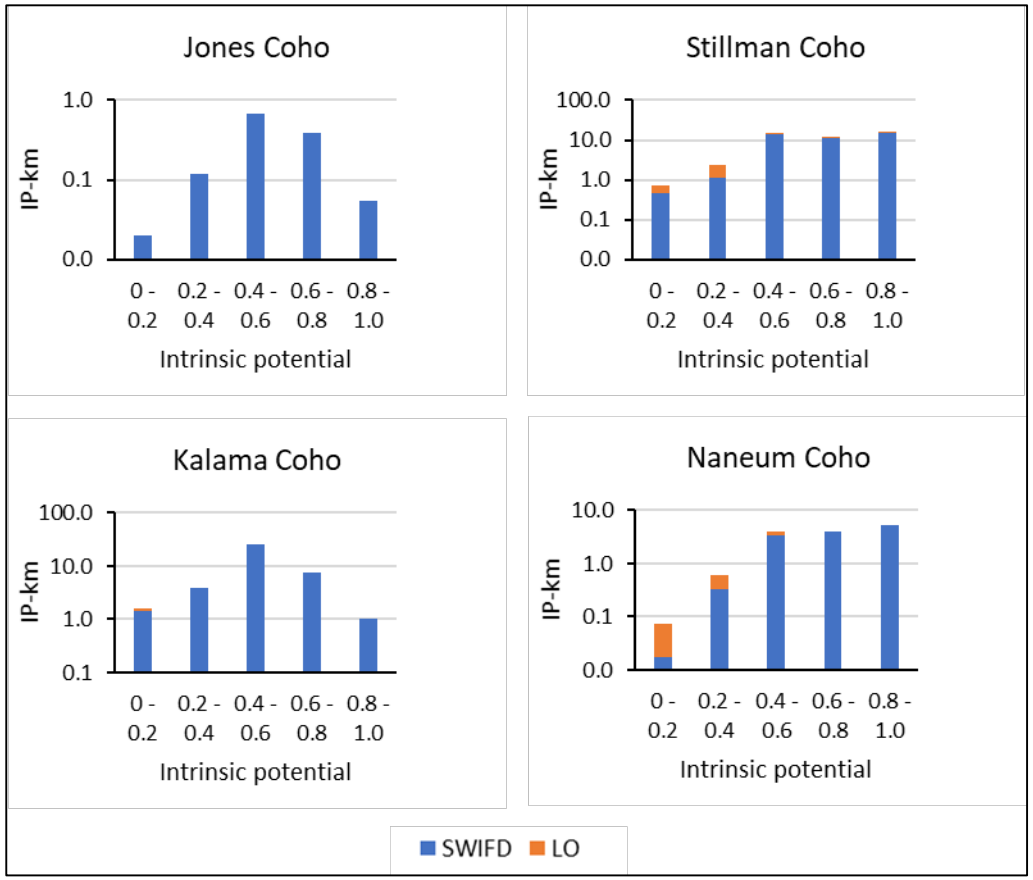
Intrinsic Potential for Anadromous Core (SWIFD) Compared to Proposed Anadromous Overlay (Gradient) Alternatives for Coho and Steelhead

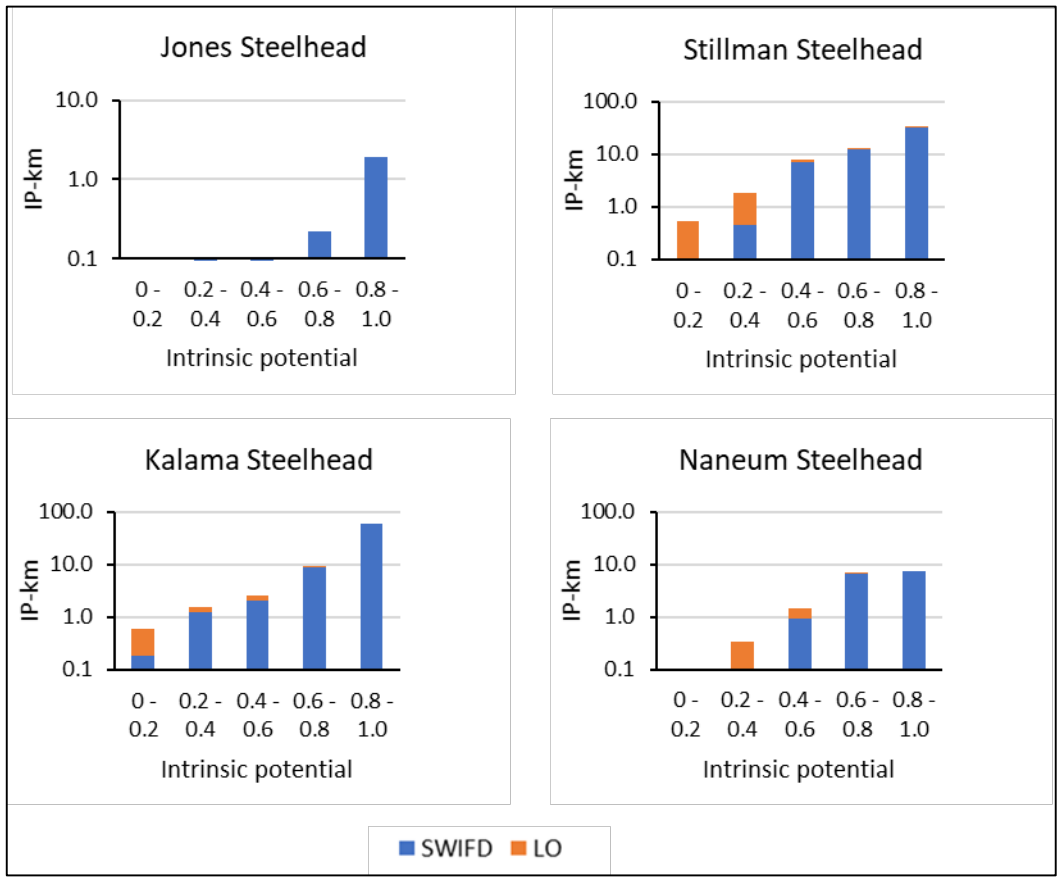




- Most potential habitat above the anadromous core is low quality (IP < 0.4) for 3 of 4 study basins.
- Jones is exception, having moderate to moderately high quality habitat (IP > 0.4) above the barrier.
- Actual habitat above the anadromous core depends on accessibility?

Intrinsic Potential for Anadromous Core (SWIFD) Compared to Proposed Anadromous Overlay (Landowner) Alternative for Coho and Steelhead





- Potential habitat above the anadromous core is low quality (IP < 0.4) for all basins.
-
- Actual habitat above the anadromous core depends on accessibility?