Modeling Potential Chum & Pink Salmon Spawning Habitat in Relation to Landscape Characteristics in Coastal SE Alaska

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Balancing Ecosystem Services With Salmon Conservation

Background

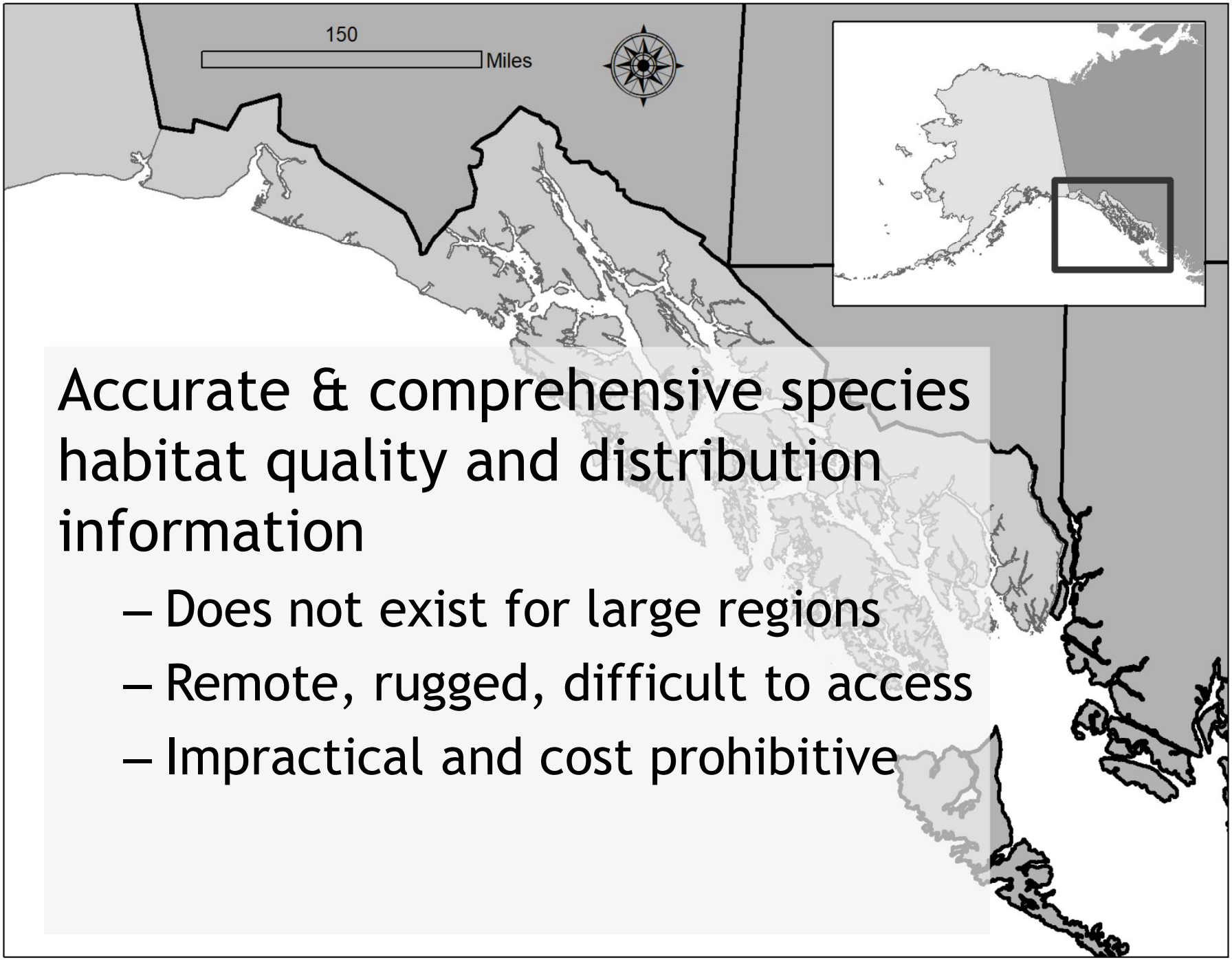
Landscape Level Approach to Watershed Management

- HNFP, POW LLA, KKCFP

– Includes habitat diversity required for sustainable populations

– Requires accurate and comprehensive Pacific Salmon habitat quality & distribution

A landscape perspective is best approach for Pacific salmon conservation *(Anlauf et al. 2011)*



Accurate & comprehensive species habitat quality and distribution information

- Does not exist for large regions
- Remote, rugged, difficult to access
- Impractical and cost prohibitive

Background

Intrinsic Potential Model

Based on Ecosystem Hierarchy Theory

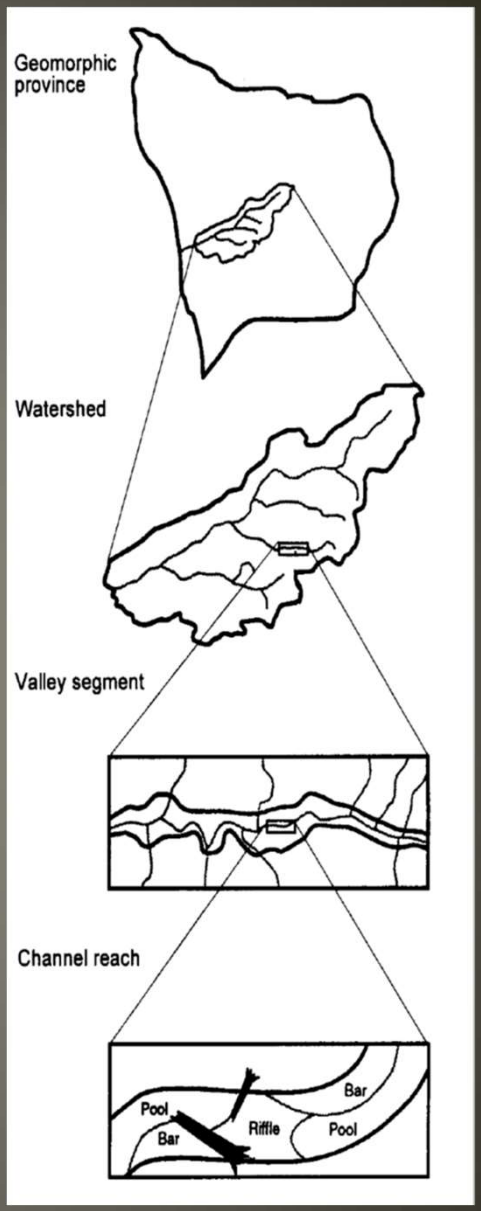
- Geomorphic structure and processes operating at the landscape scale controls formation of important habitat

Model variables

- Persistent geomorphic reach habitat characteristics
- Derived from remote sensing (DEMs)
- Species-specific

Model results

- Predict potential for a reach of stream to provide high quality habitat for a specific life-history



Montgomery-Buffington 1998

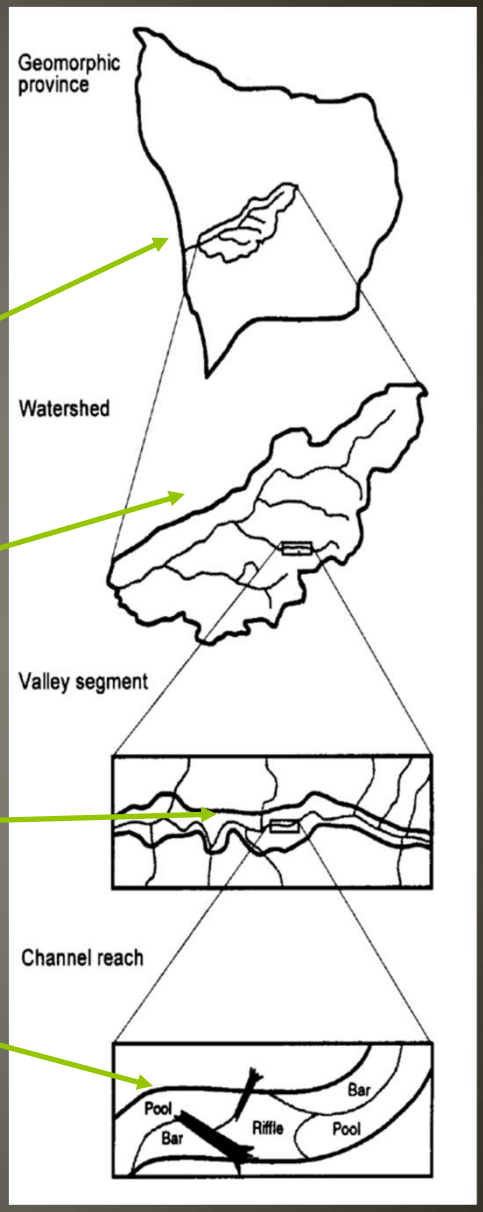
Intrinsic Potential

Background

Persistent = Attributes Not easily altered by anthropogenic influences on a small time scale

Example:
Geology,
Basin area,
floodplain width,
channel gradient

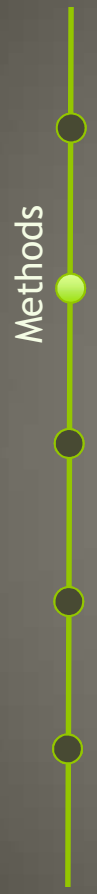
Reach attributes shape habitat features that fish respond to



Persistent

Transient

Montgomery-Buffington 1998



Methods

Chum vs Pink Salmon Life History

Methods

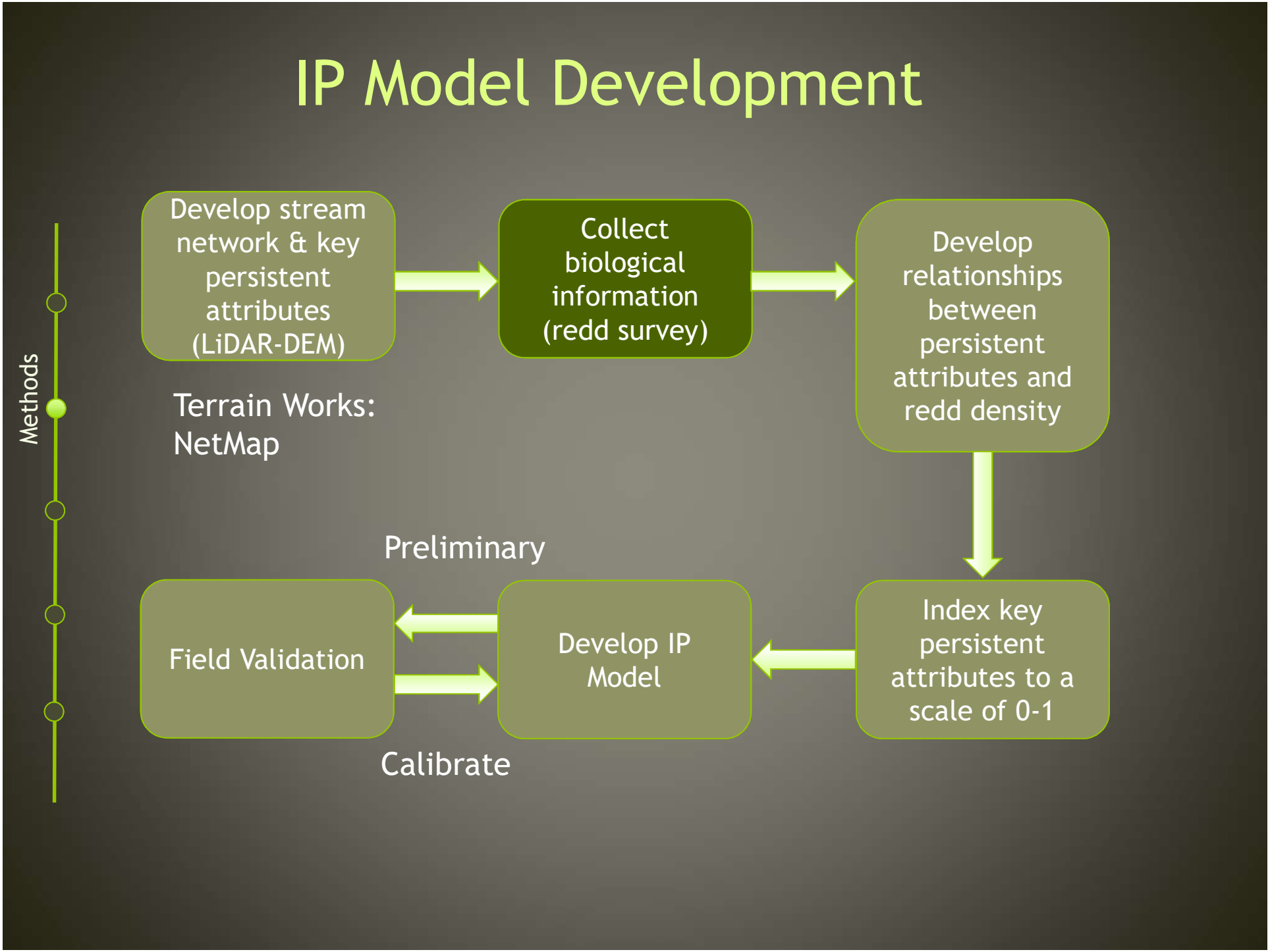
Chum Salmon (*Oncorhynchus keta*)	**Pink Salmon** (*Oncorhynchus gorbuscha*)
• 3 to 4-yr life cycle • 60 cm (24 in) mean length • 2nd largest Pacific salmon • July-August Spawning • Ave redd = 2.3 m^2, up to 4 m^2 • Adult river life ~ 2 weeks • Juvenile outmigration first Spring	• 2-year life cycle (genetically isolated), odd year dominant • 44 cm (18 in) mean length • August-September Spawning • Ave redd = 1.5 m^2 • Adult river life ~ 2 weeks • Juvenile outmigration first Spring

Limiting Factor

Methods

- Viable Population
  - Dependent on successfully depositing gametes in suitable gravel;
  - progeny incubation and survival to emergence, migration to estuary
  - IP driven by persistent reach characteristics influencing amount, distribution, and quality of spawning habitat

IP Model Development



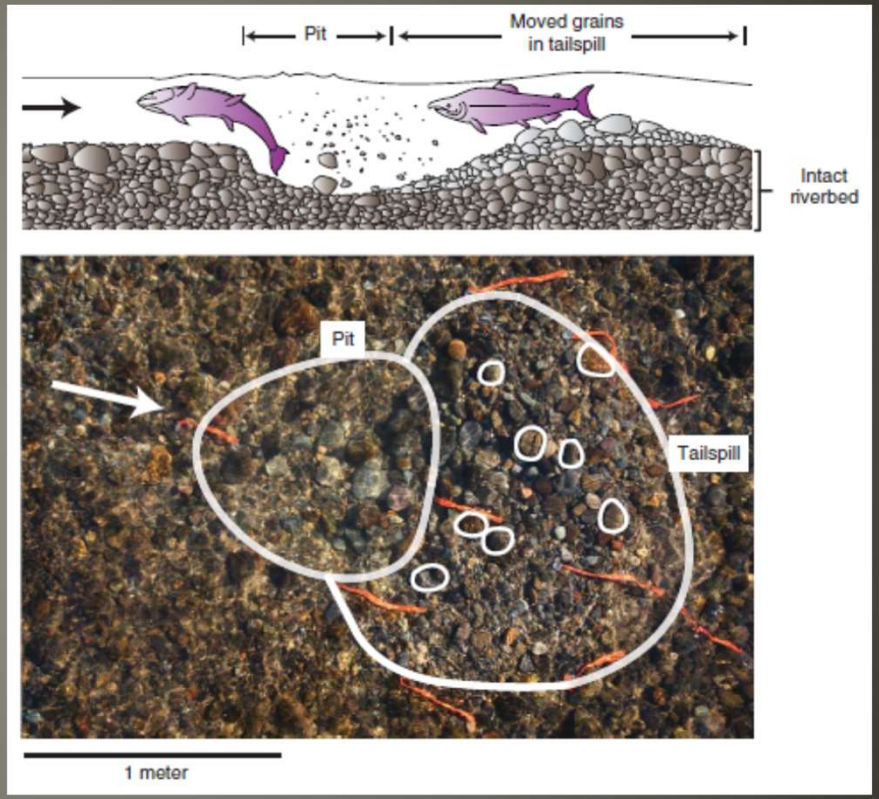
Redd Density (response variable)

Methods

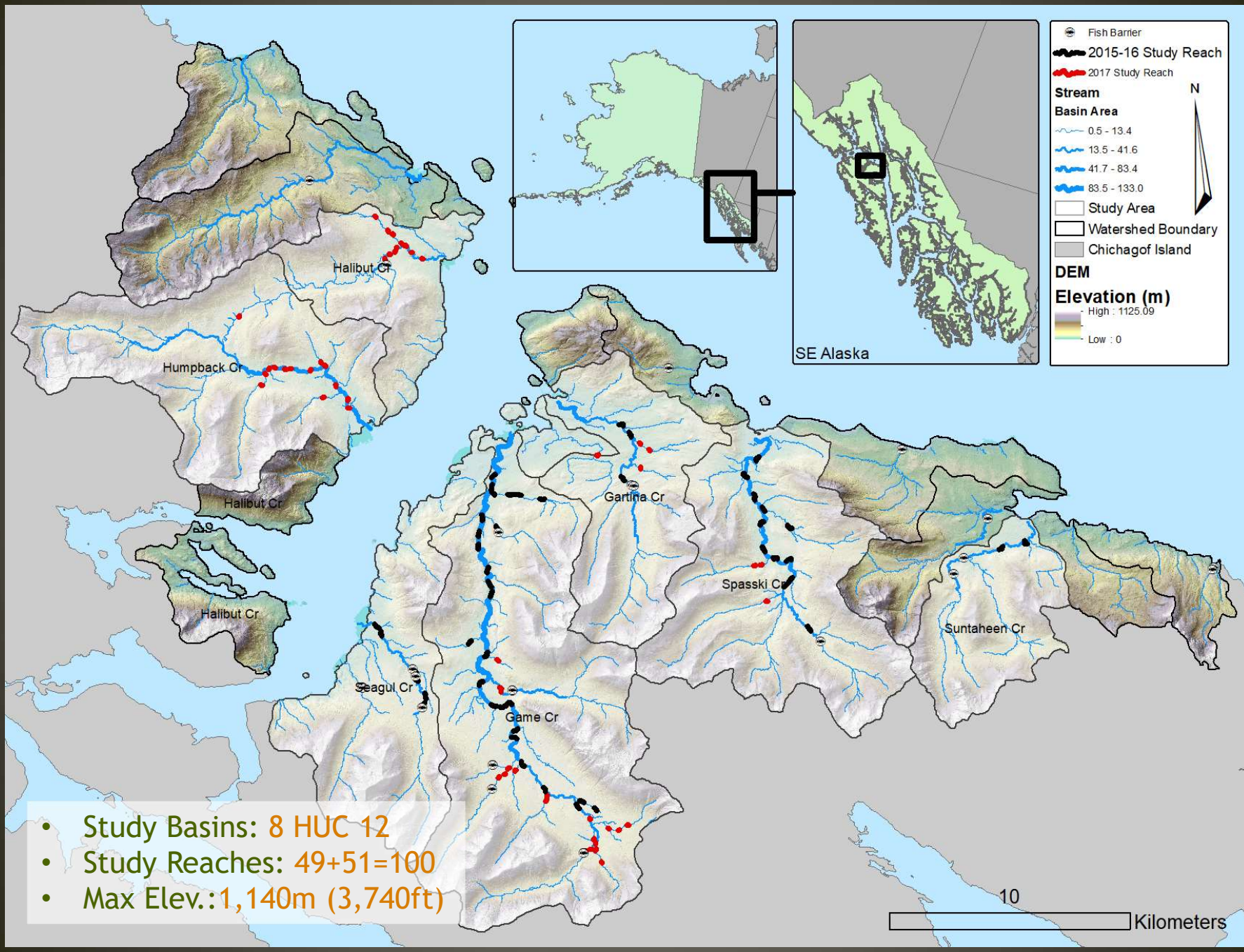
Female body size correlated with redd metrics

- Redd ID:
  - Species present on redd,
  - Redd size,
  - Tailspill substrate

Successful spawning dependent on flow velocity & depth, substrate, overwinter scour depth



Riebe et al 2014



- Study Basins: 8 HUC 12
- Study Reaches: 49+51=100
- Max Elev.:1,140m (3,740ft)

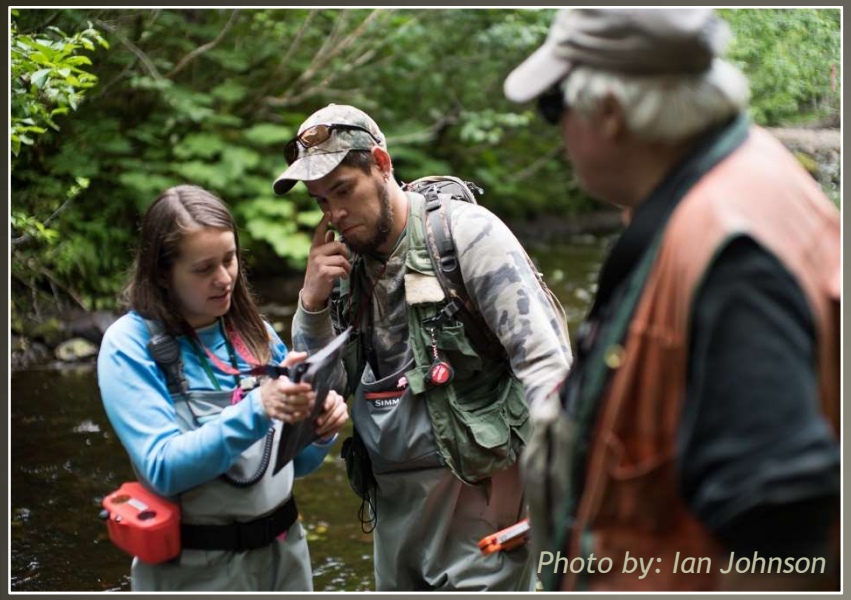


Photo by: Ian Johnson

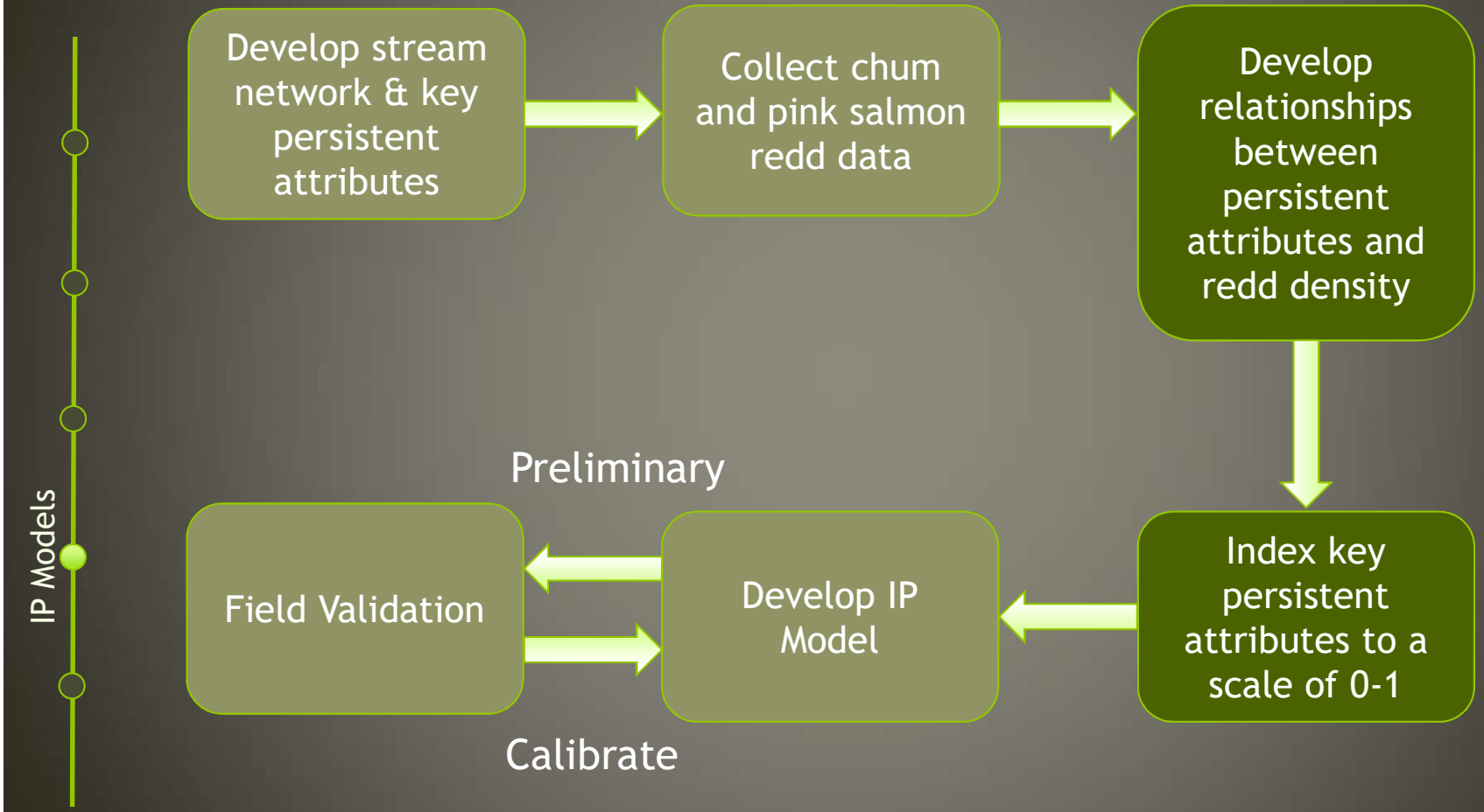

Photo by: Bethany Goodrich


Photo by: Bernard Romey


Photo by: Bethany Goodrich

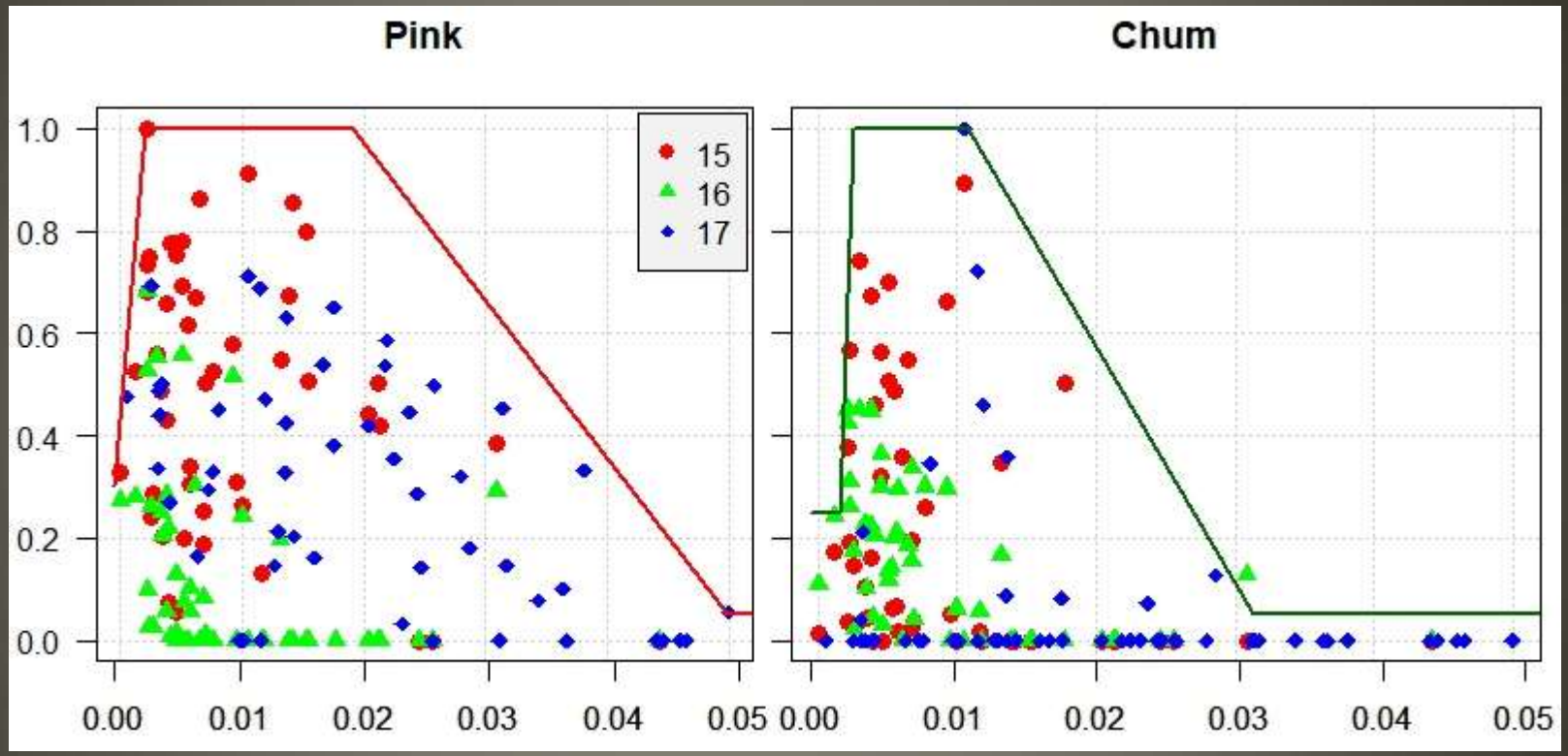
IP Models

IP Model Development

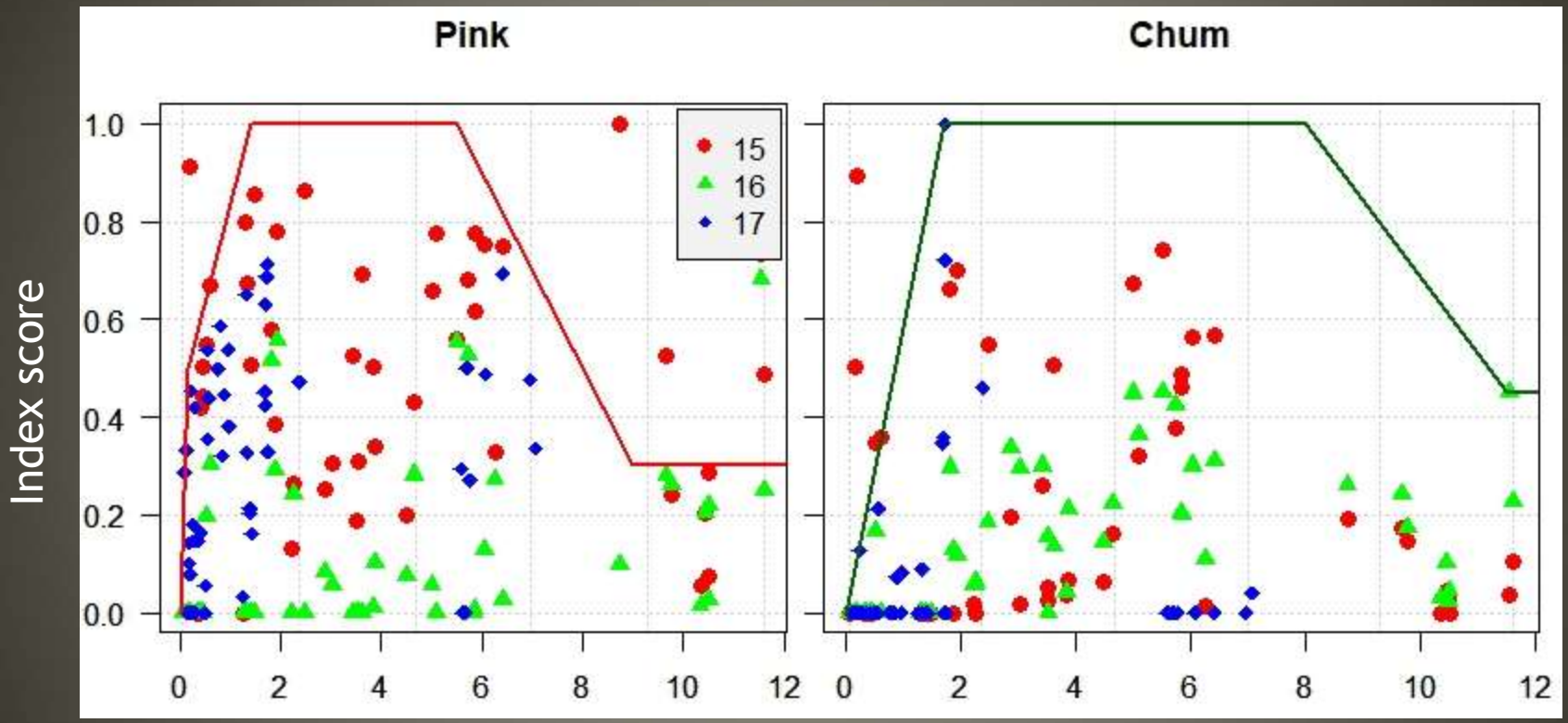


HSI Curves

IP Models

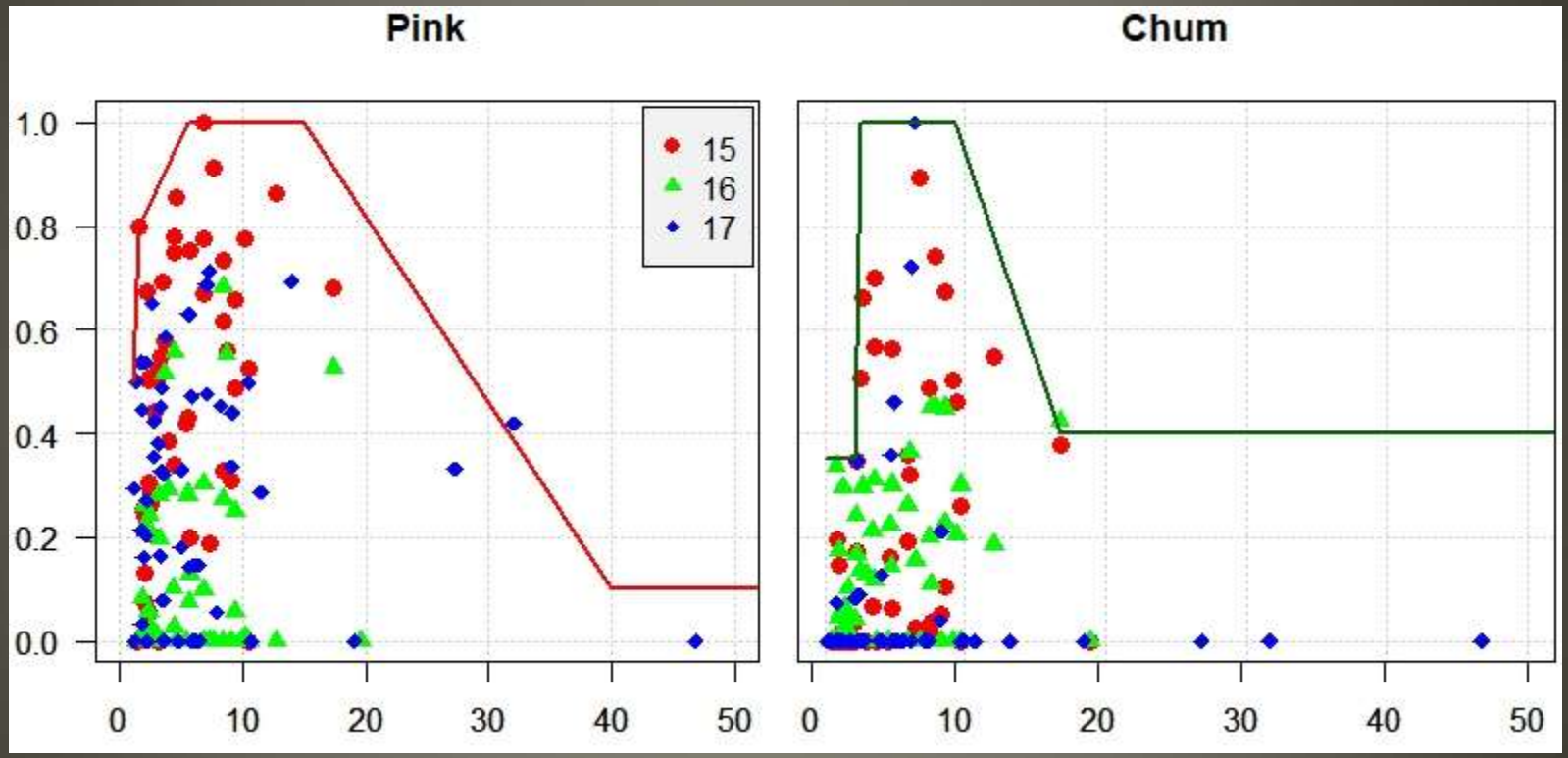


HSI Curves

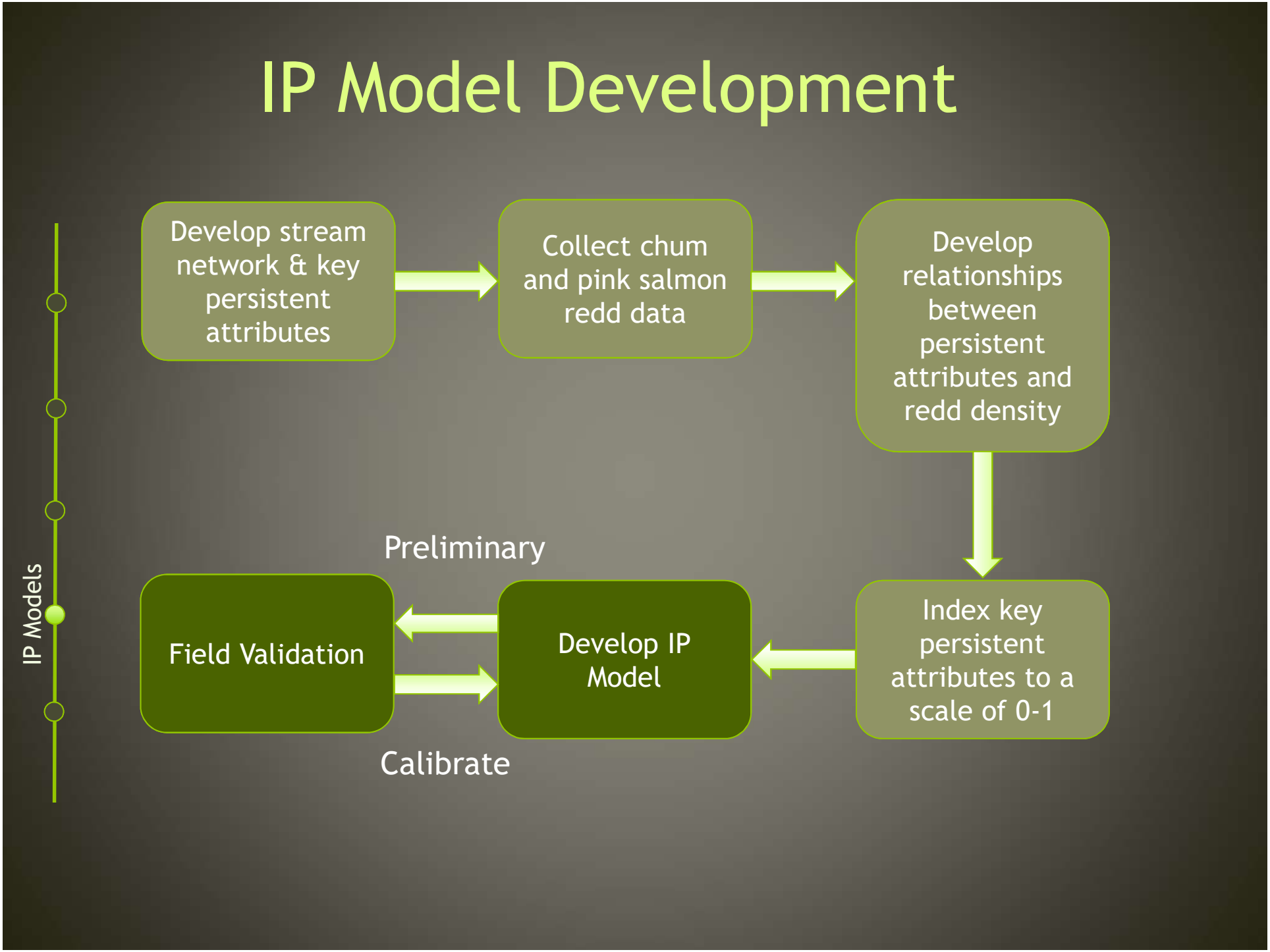

Pink
Chum
Index score
1.0
0.8
0.6
0.4
0.2
0.0
15
16
17
0
2
4
6
8
10
12
Mean annual stream flow (m3/s)

HSI Curves

VWI > 2.9 = Unconstrained Channel

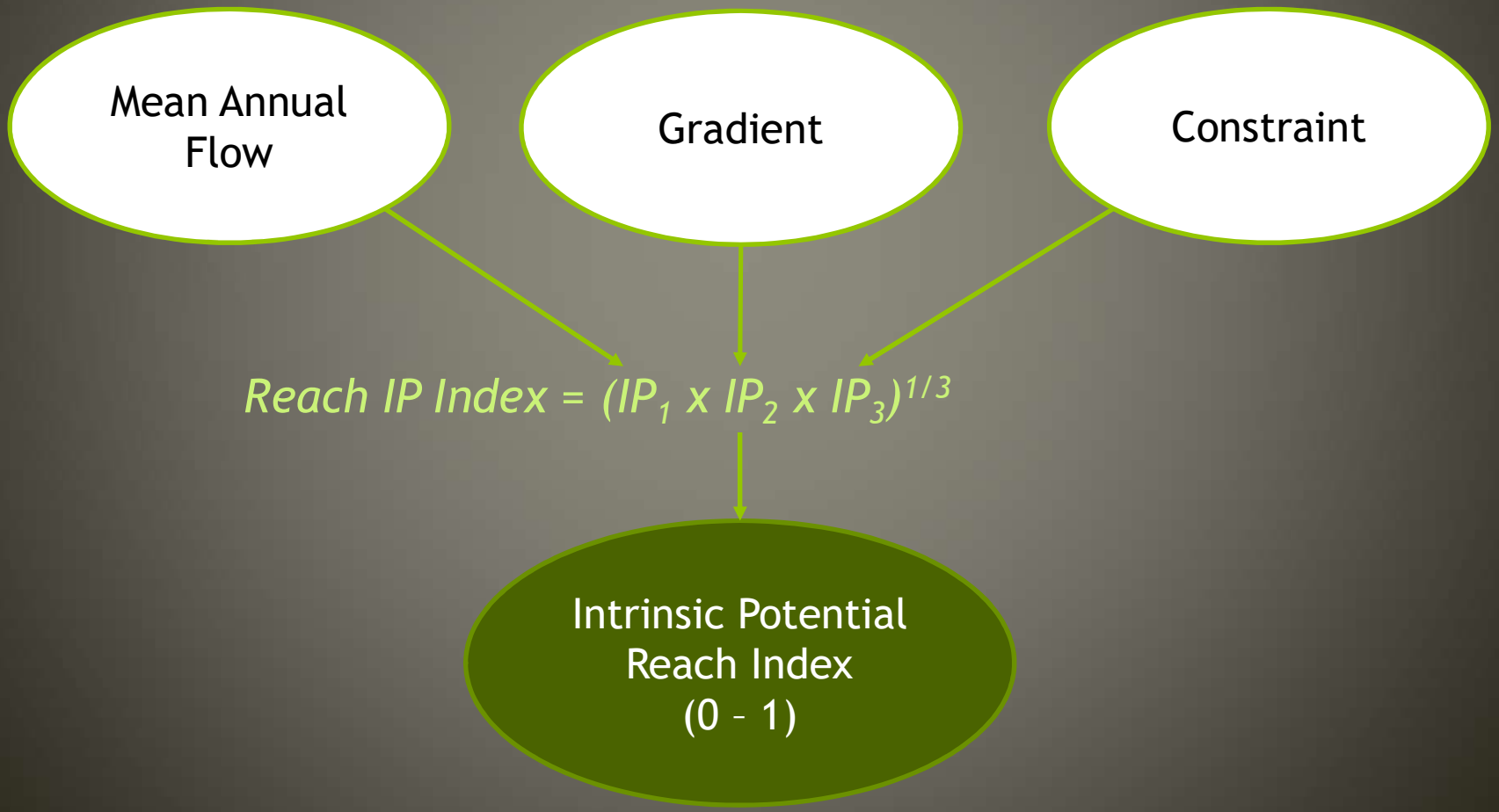


IP Model Development



Intrinsic Potential Model

Program into GIS, or use NetMap



IP Models

Accurate & comprehensive species habitat quality and distribution

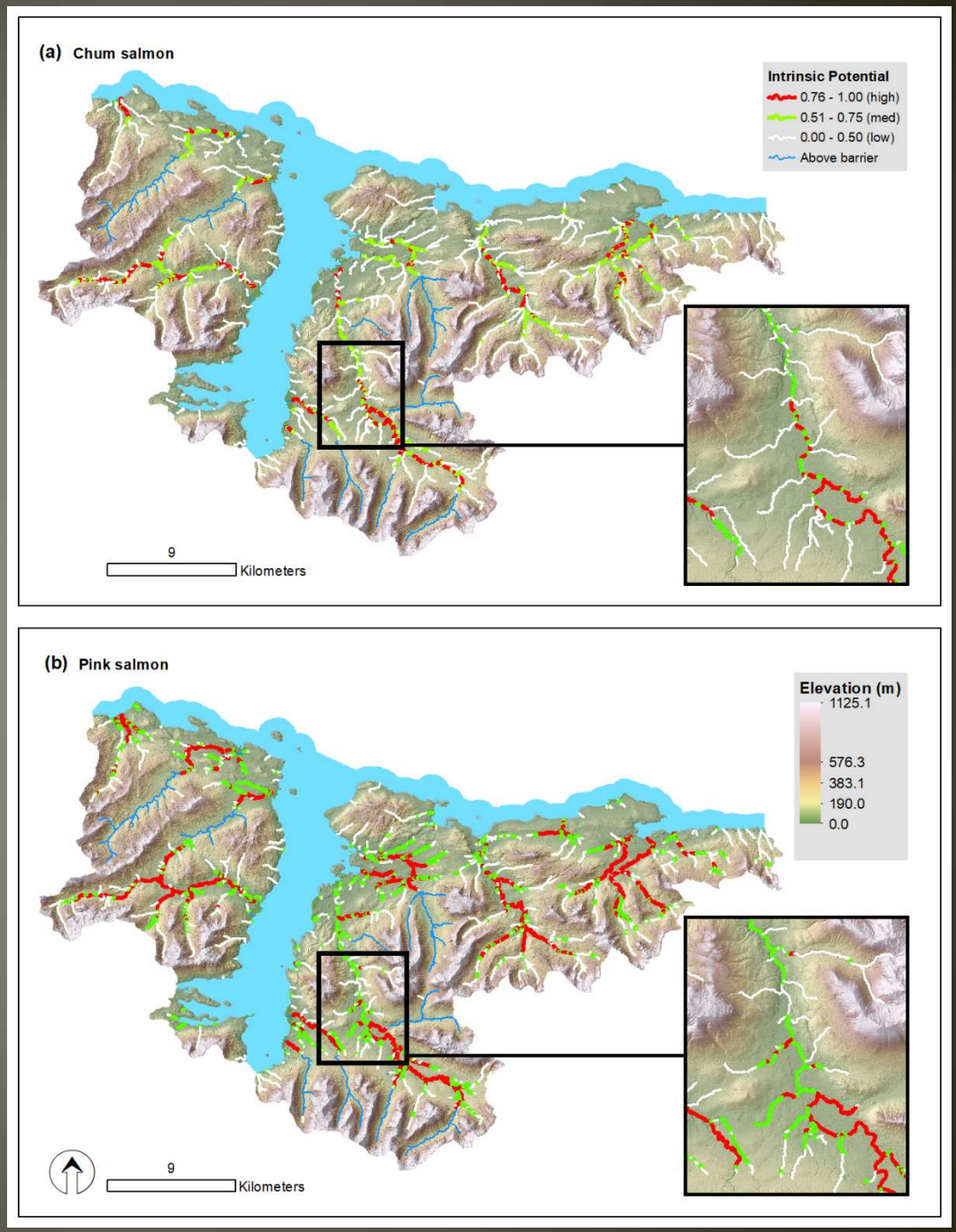
IP Models

Chum salmon:

Low-gradient mainstem channels

Pink Salmon:

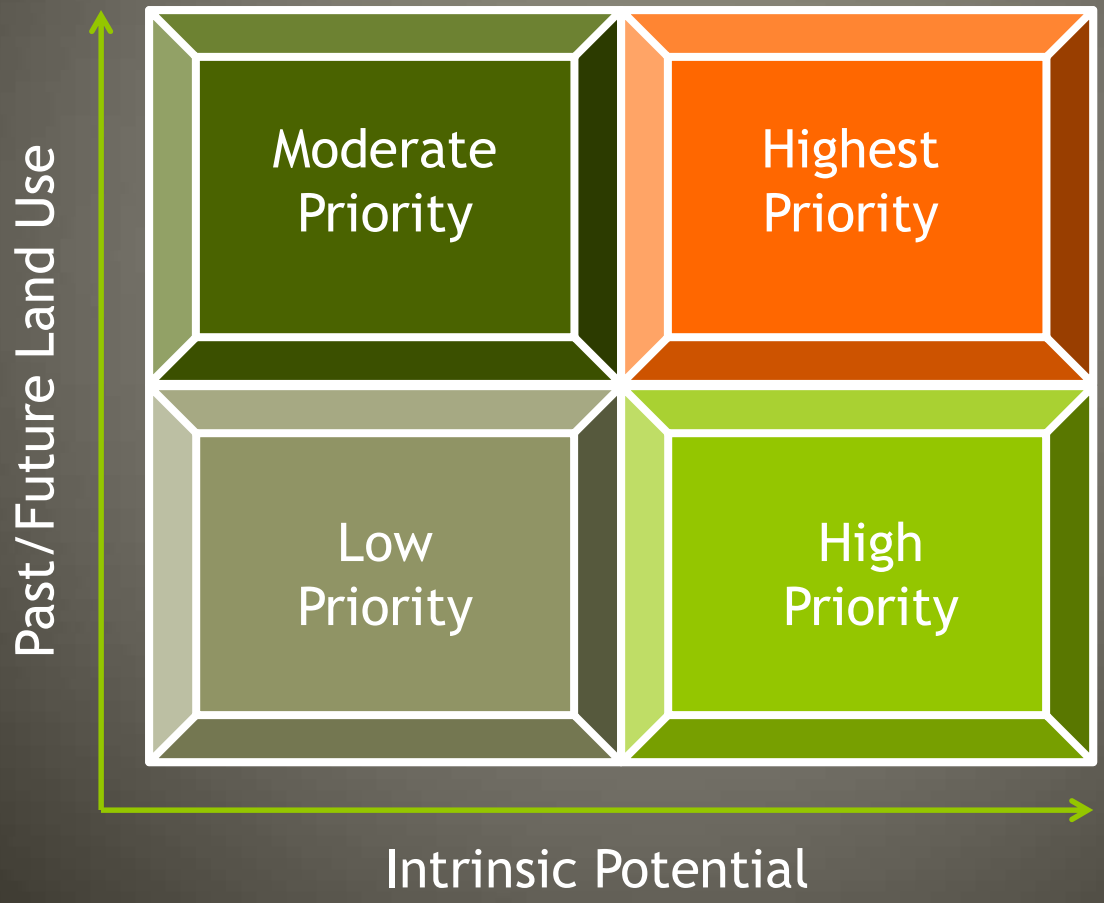
Low-moderate gradient small-medium channels and tributaries



Discussion

Current Habitat Conditions

= *f*(Intrinsic Potential + Management Influences)



Discussion

Management Application

- Help inform monitoring strategies for population
  - Hatchery stray survey reaches
- Identify areas that have the greatest likelihood for improvement/vulnerability
  - Past land use, restoration, management
- Set restoration goals that enhance ecosystem processes with a focus on population persistence
  - Assess if objectives are being met

Climate Change

- Influence on IP model variables
  - Apply predicted precipitation increase to Mean Annual Flow function
  - Primarily low gradient floodplain channels
- Chum, Pink, & Coho spawning habitat *(Sloat 2016)*
  - No significant change in habitat for Chum and Pink salmon
  - Significant decrease in Coho Salmon habitat

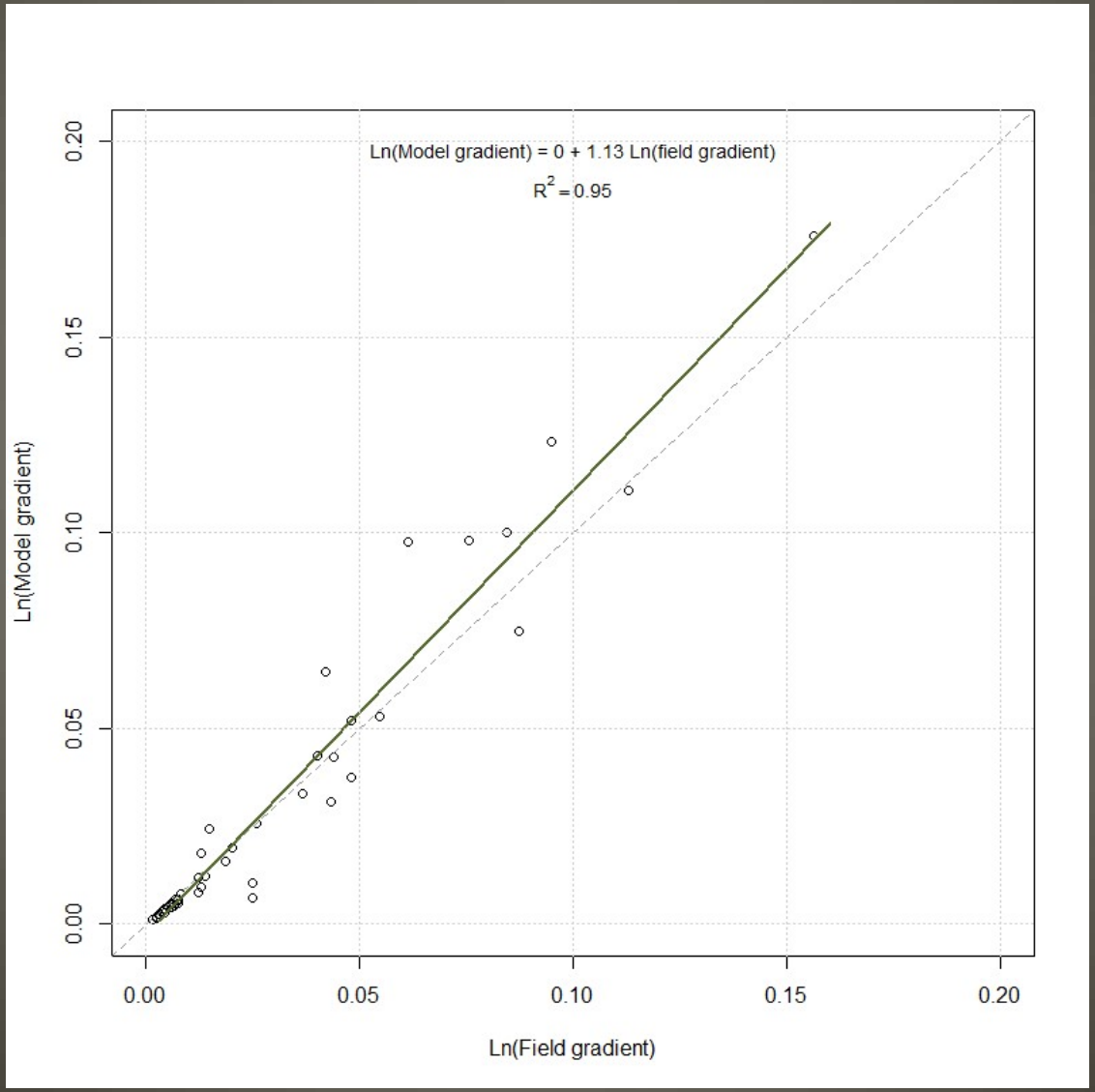
Acknowledgments

These models would not be possible without the pioneering work by Kelly Burnett (2007)

Burnett, K. M., G. H. Reeves, D. J. Miller, S. Clarke, K. Vance-Borland, and K. Christiansen. 2007. Distribution of salmon-habitat potential relative to landscape characteristics and implications for conservation. Ecological Applications 17(1):66–80.

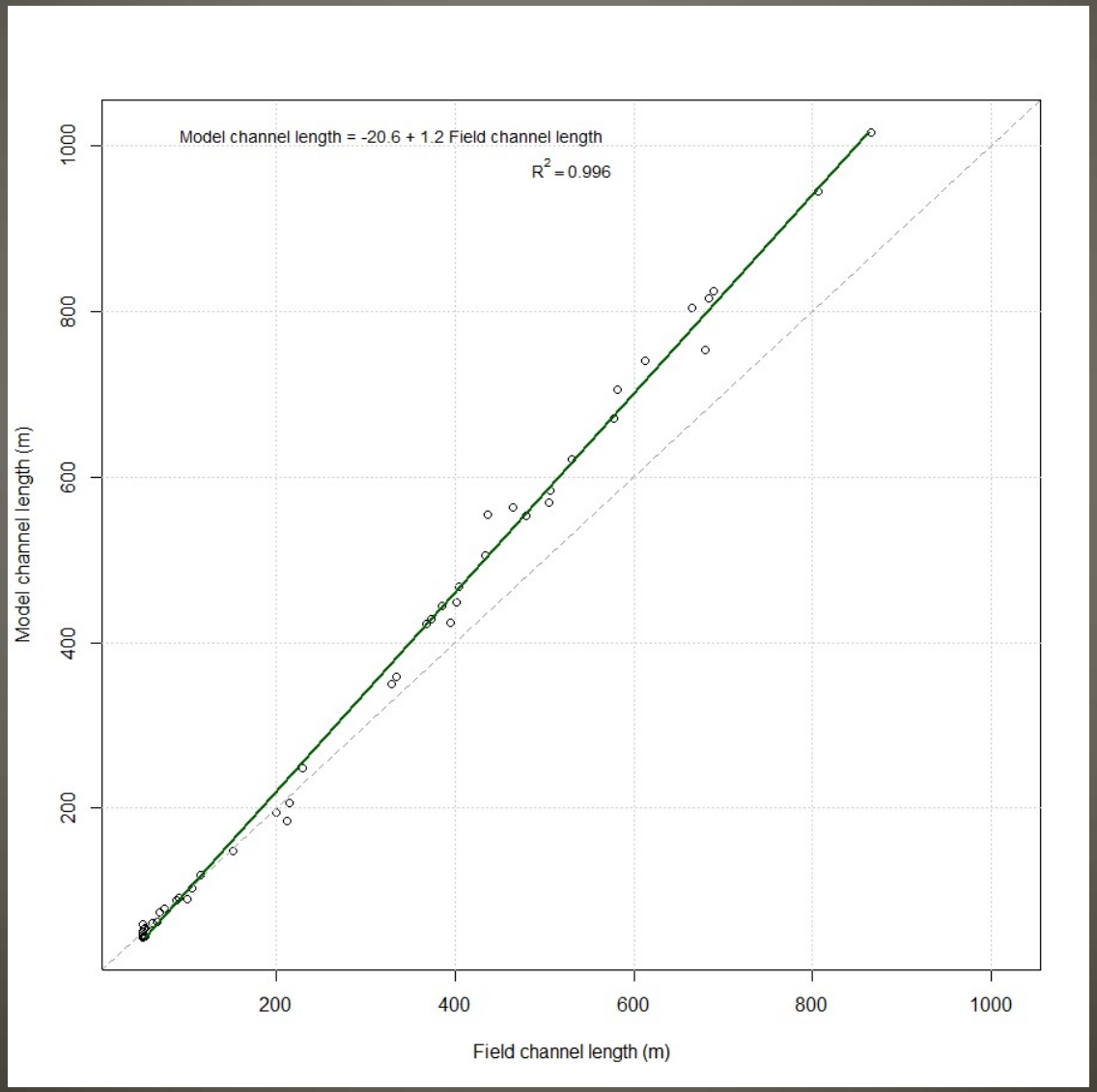

Thanks!
Any questions?

Channel Gradient

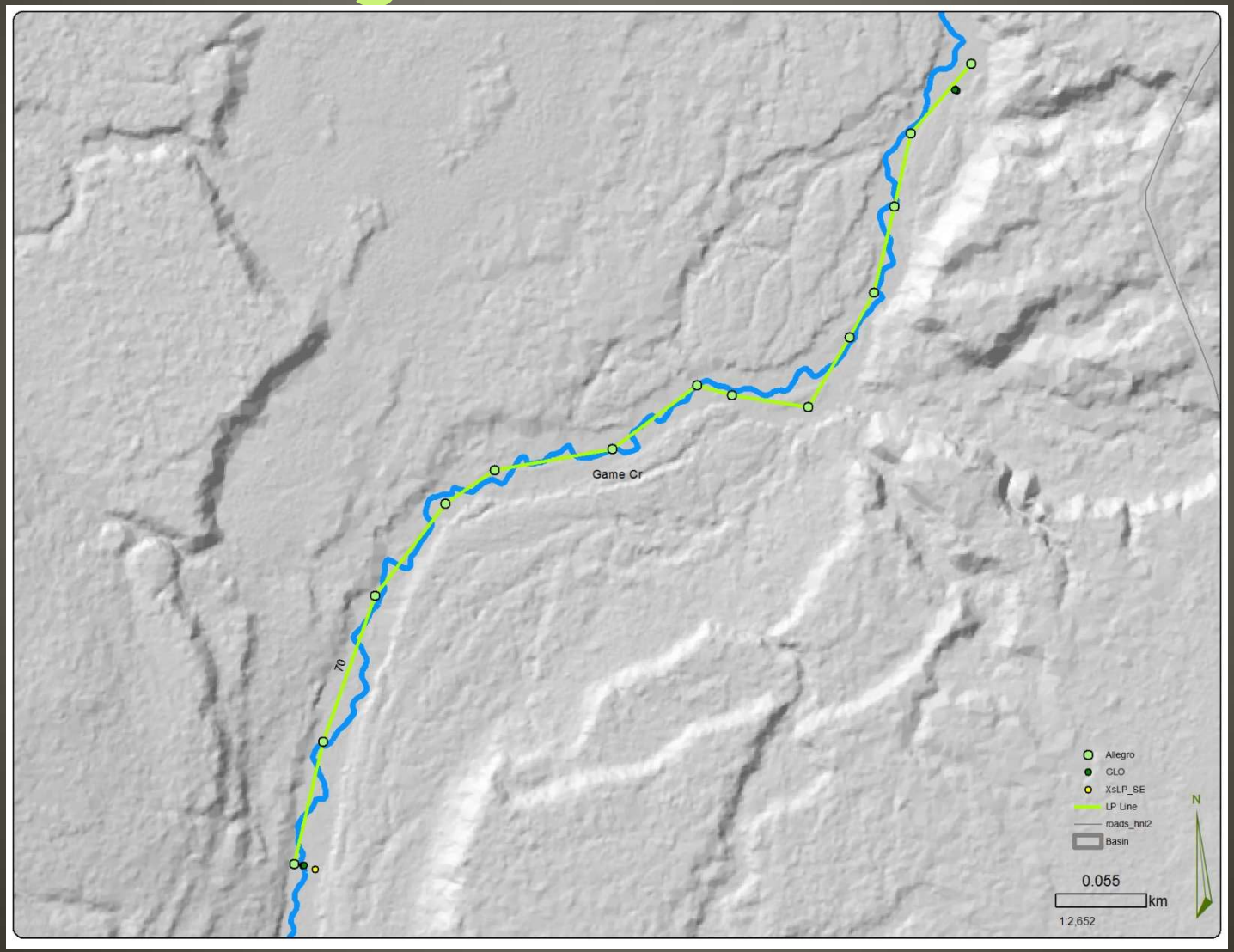


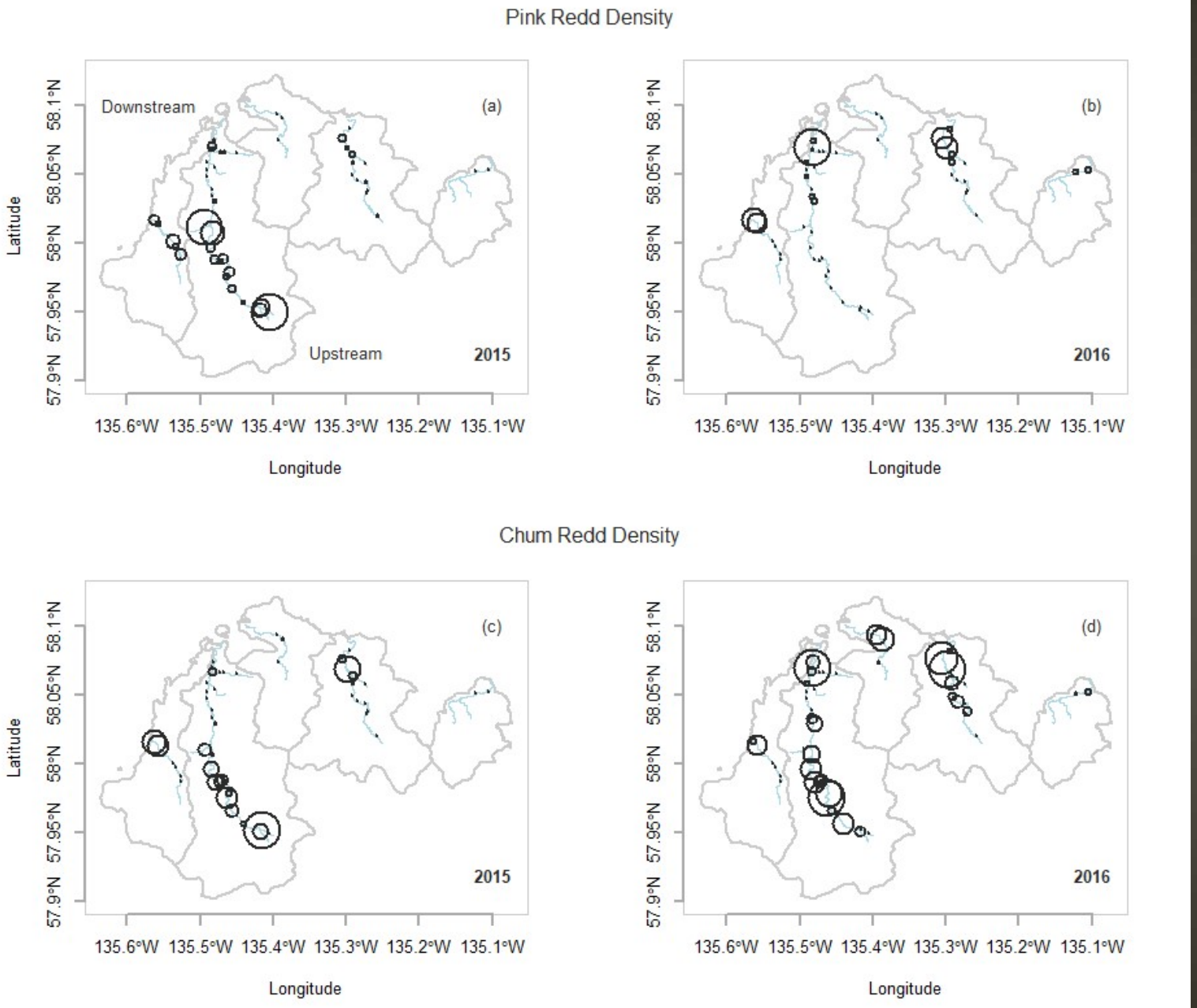
Channel Length

Based on
20 X BFW



Field vs Synthetic Longitudinal Profile




Pink Redd Density
Downstream
(a)
Upstream
2015
(b)
2016
Chum Redd Density
(c)
2015
(d)
2016
Latitude
Longitude
57.9°N
57.95°N
58°N
58.05°N
58.1°N
135.6°W
135.5°W
135.4°W
135.3°W
135.2°W
135.1°W