

# CHaMP Data To Fish Management

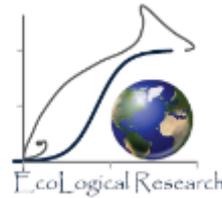
CHaMP Camp 2015 Training

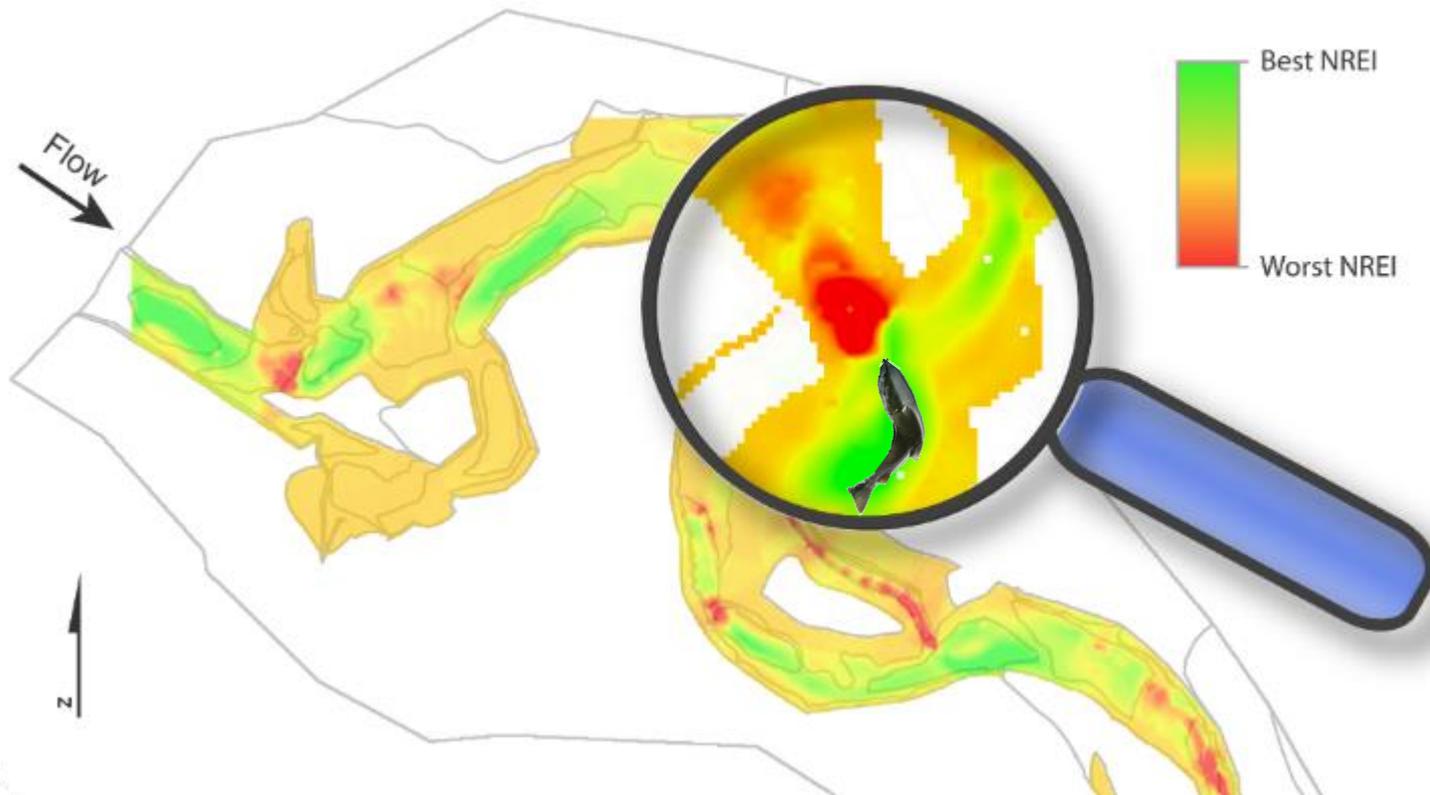
Cove, Oregon

Presenter:

Pete McHugh

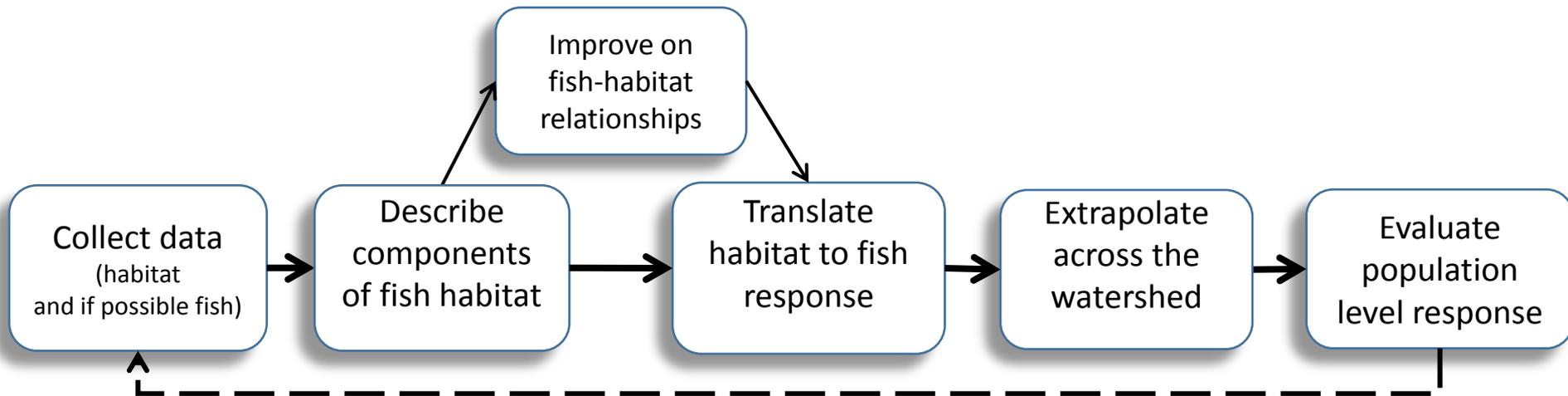
(not Nick Bouwes)



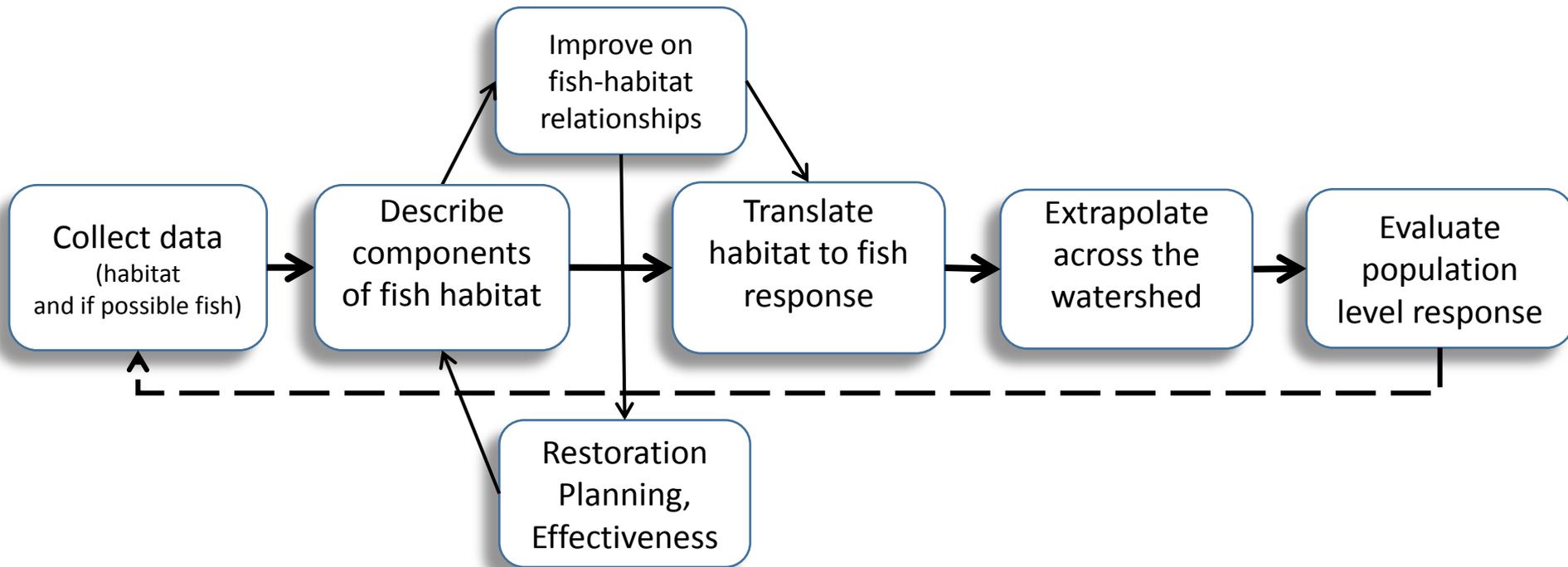




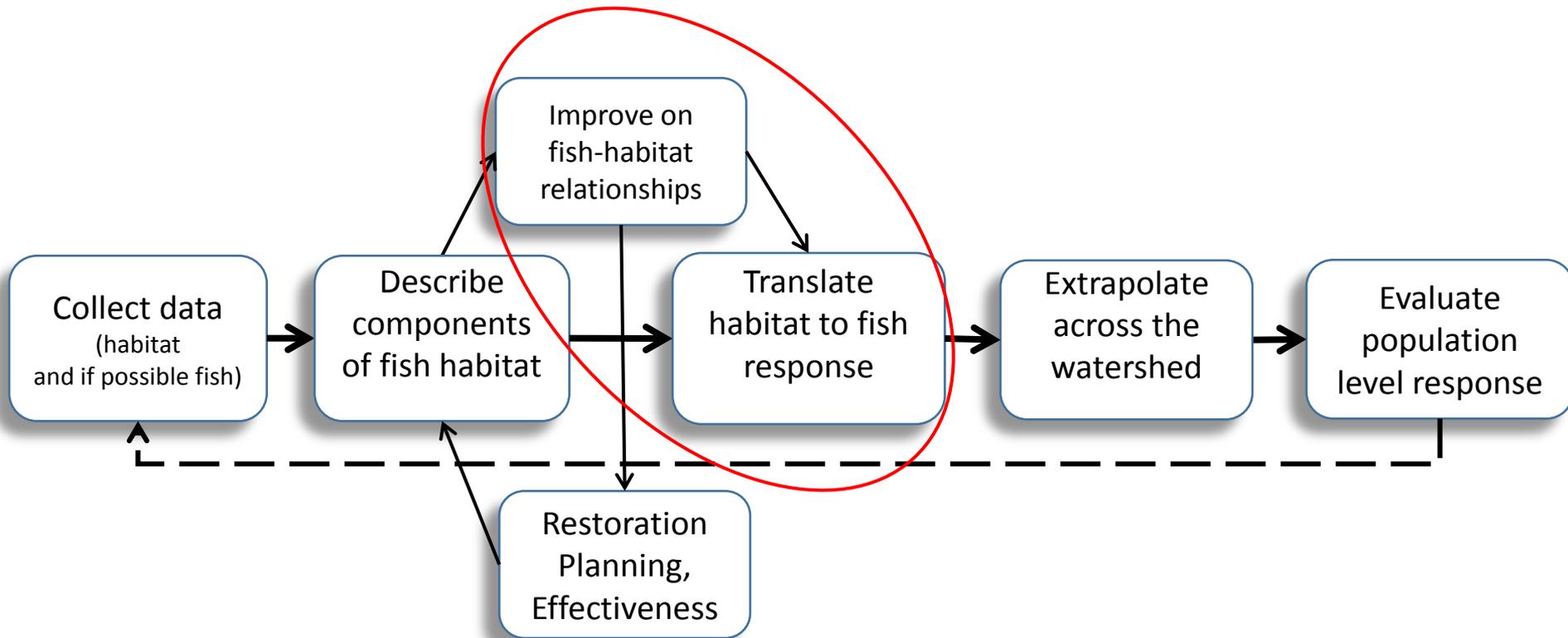
# CHaMP Data To Fish Management Work Flow



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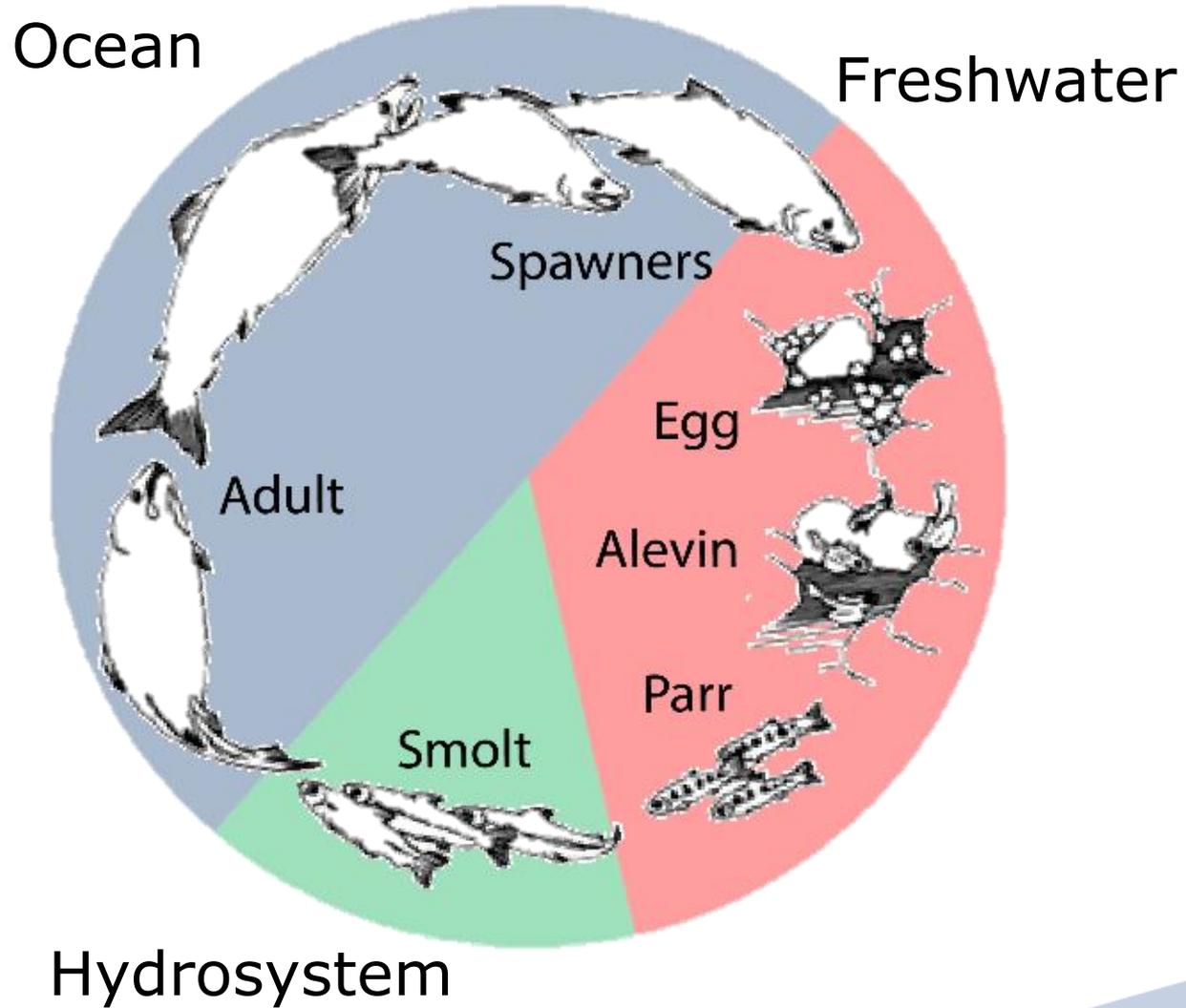


# CHaMP Data To Fish Management Work Flow



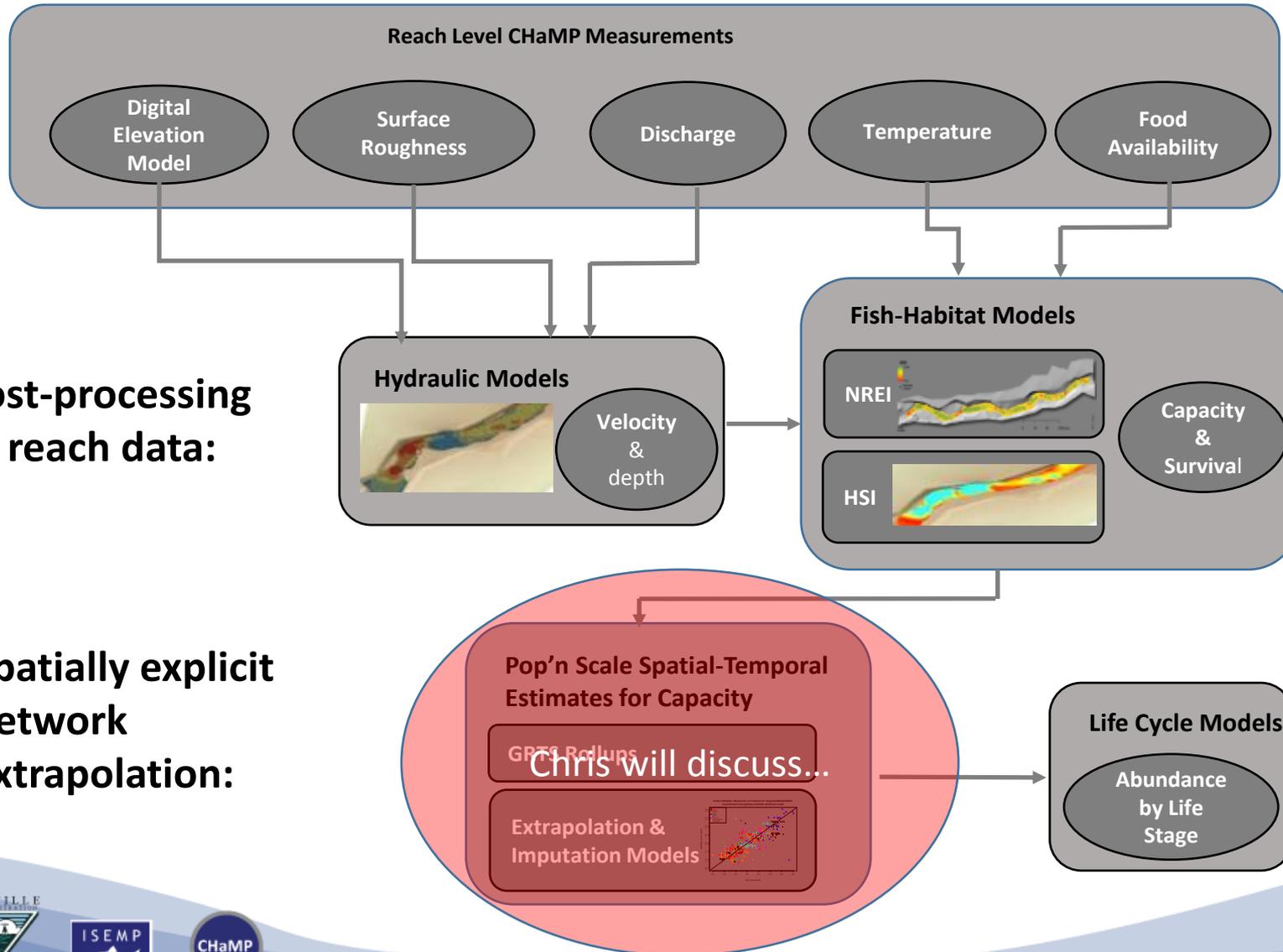
# Salmon/Steelhead Life Cycle

Defining FHRs:  
Life stage?  
Spatial scale?  
Season?  
Temporal scale?



# CHaMP data flow:

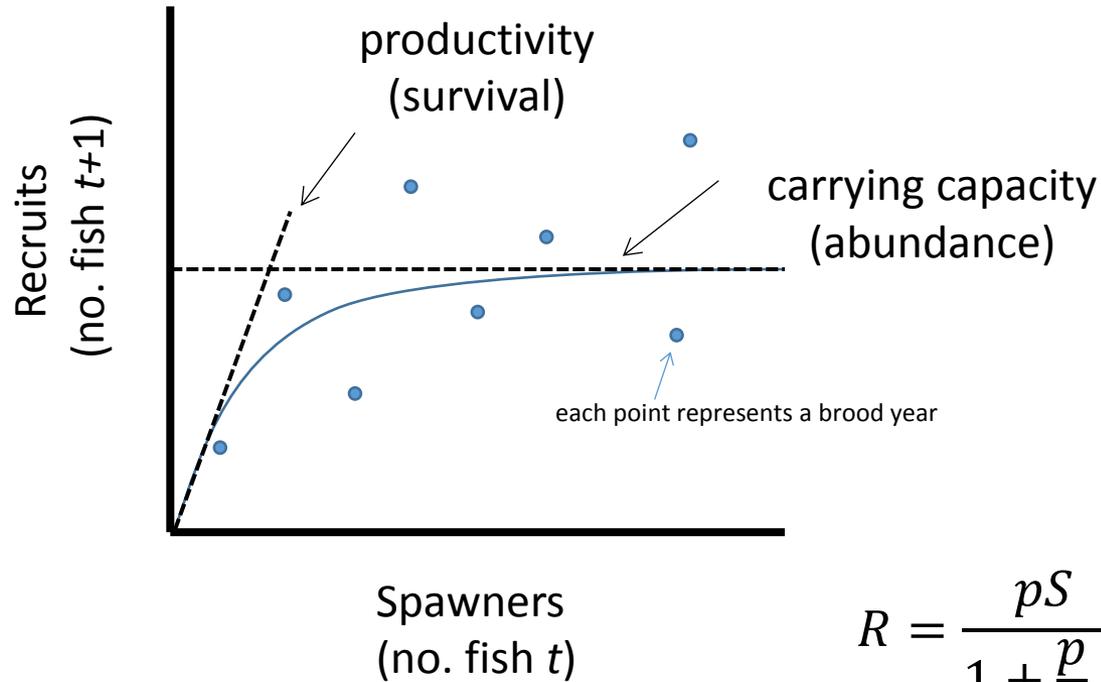
From reach level measurements to life cycle modeling...



Post-processing of reach data:

Spatially explicit network extrapolation:

# Life-cycle Model Context



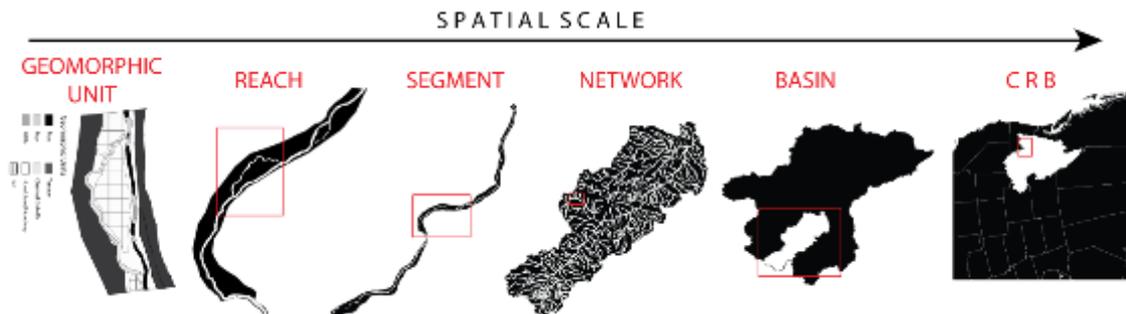
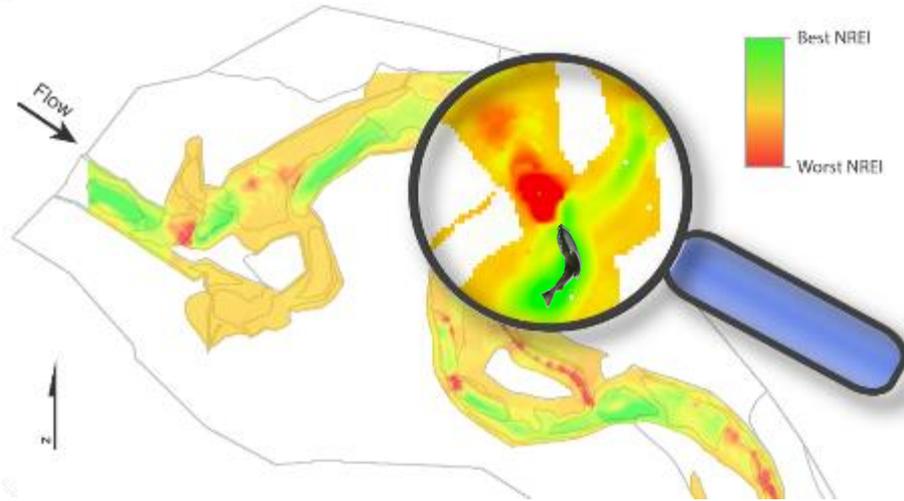
$$R = \frac{pS}{1 + \frac{p}{c}S}$$

These relate to habitat  
quality and quantity

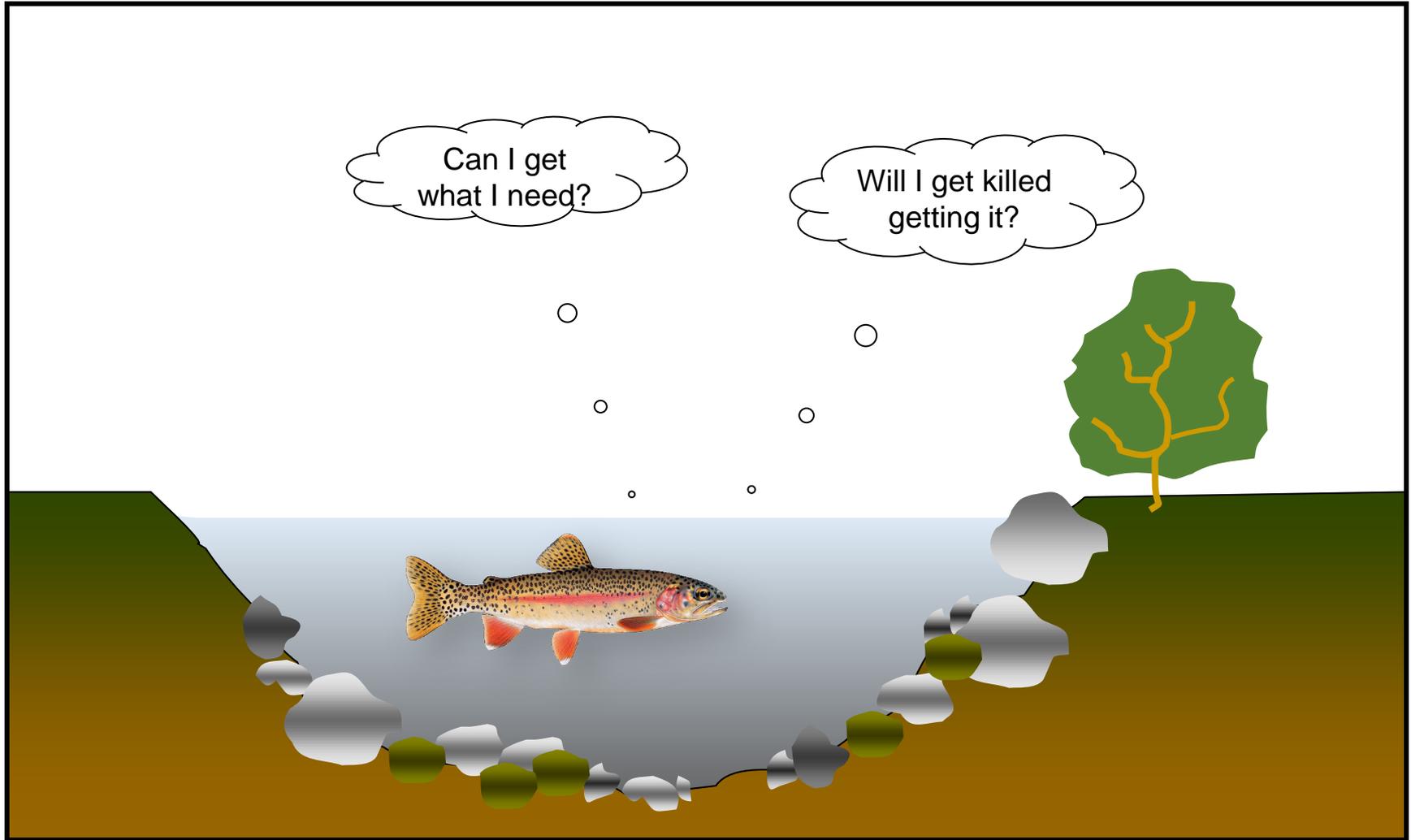
$S$  = spawners  
 $R$  = recruits  
 $c$  = carrying capacity  
 $p$  = productivity

# Presentation Outline

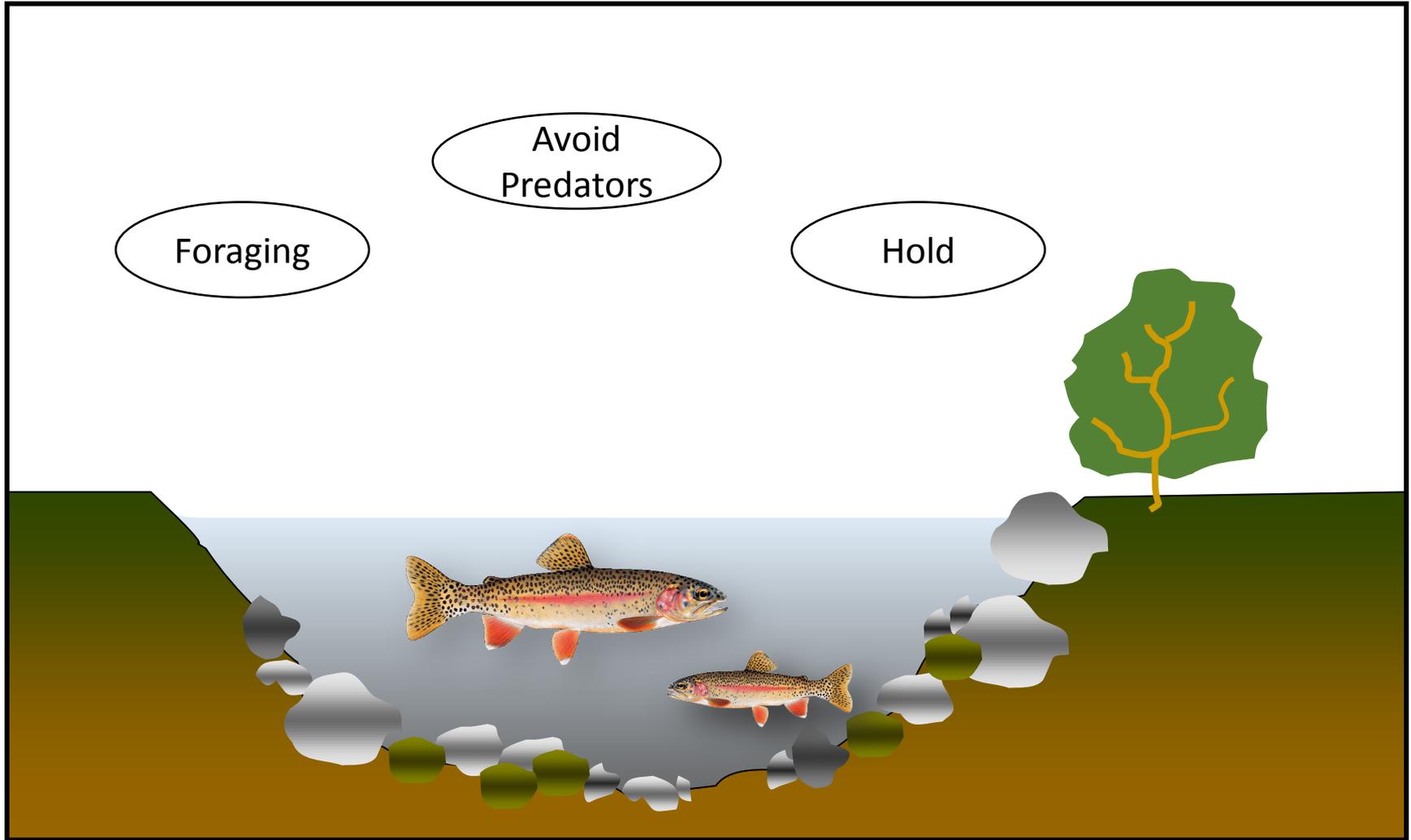
- Context
- What do fish need?
- Using habitat data to inform management
  - Analytical tools
  - Translating across scales (CJ)
  - Key Management Questions



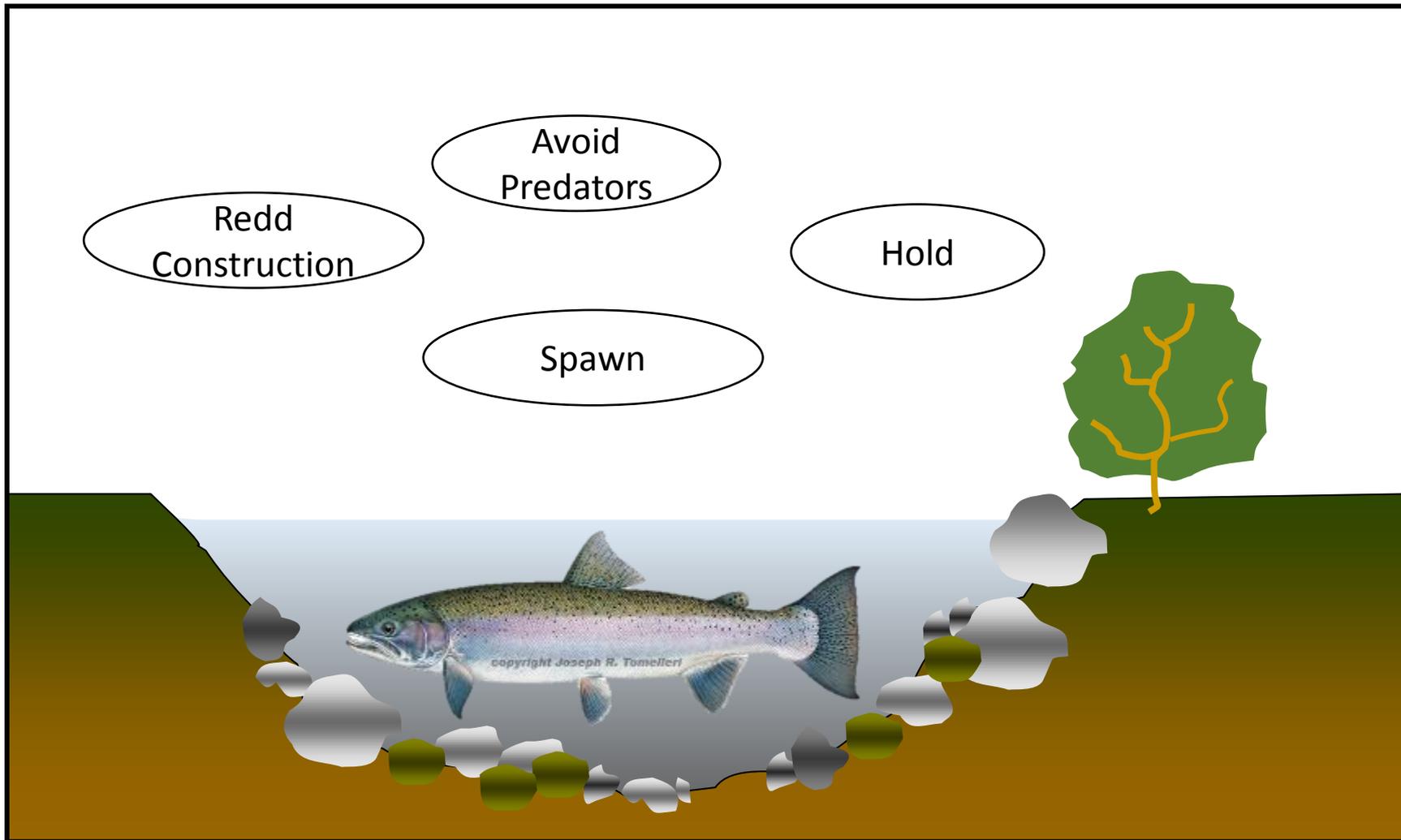
# The objectives of life



# Juvenile salmonids



# Adult salmon & steelhead



# Fish–Habitat Relationships

## Fish Habitat



### Physical Habitat

Valley Setting

Channel Morphology

Substrate Composition

Cover (LWD, UC, etc.)

### Stream Productivity

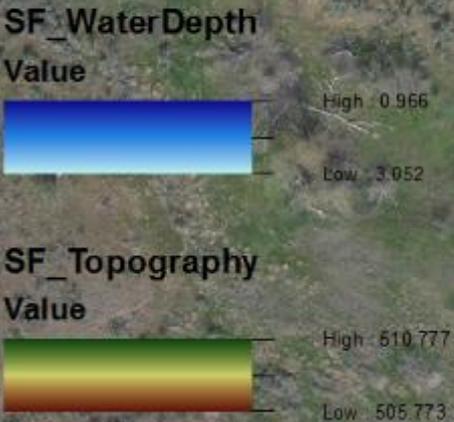
Food Availability

(drift, proxies, etc.)

Stream  
Temperature

# CHaMP PROTOCOL

## Legend



## Site Information

- Riparian Structure
- Solar Input
- Alkalinity
- Conductivity
- Total Drift Biomass
- Temperature
- Discharge



## Legend

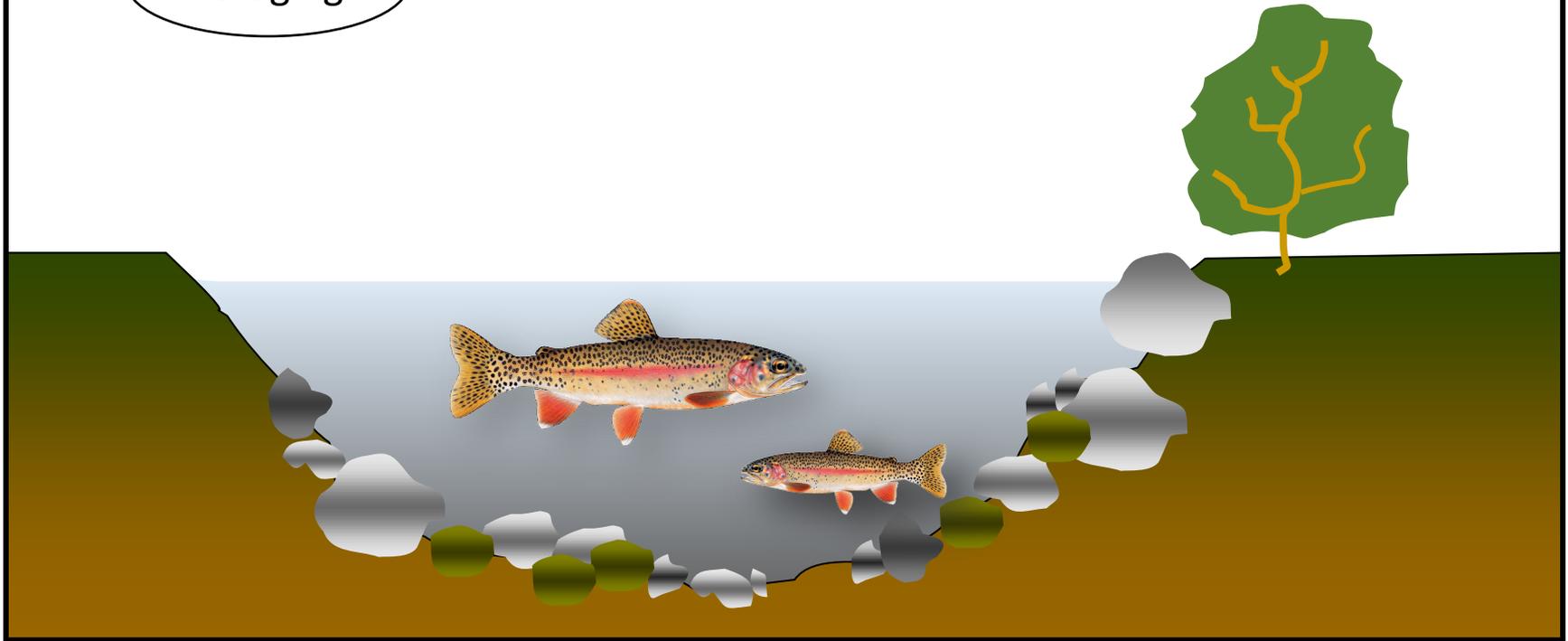


## Channel Unit Information

- Large wood
- Undercut banks
- Fish cover
- Substrate type



Foraging



# Stream Productivity

## Small Scale

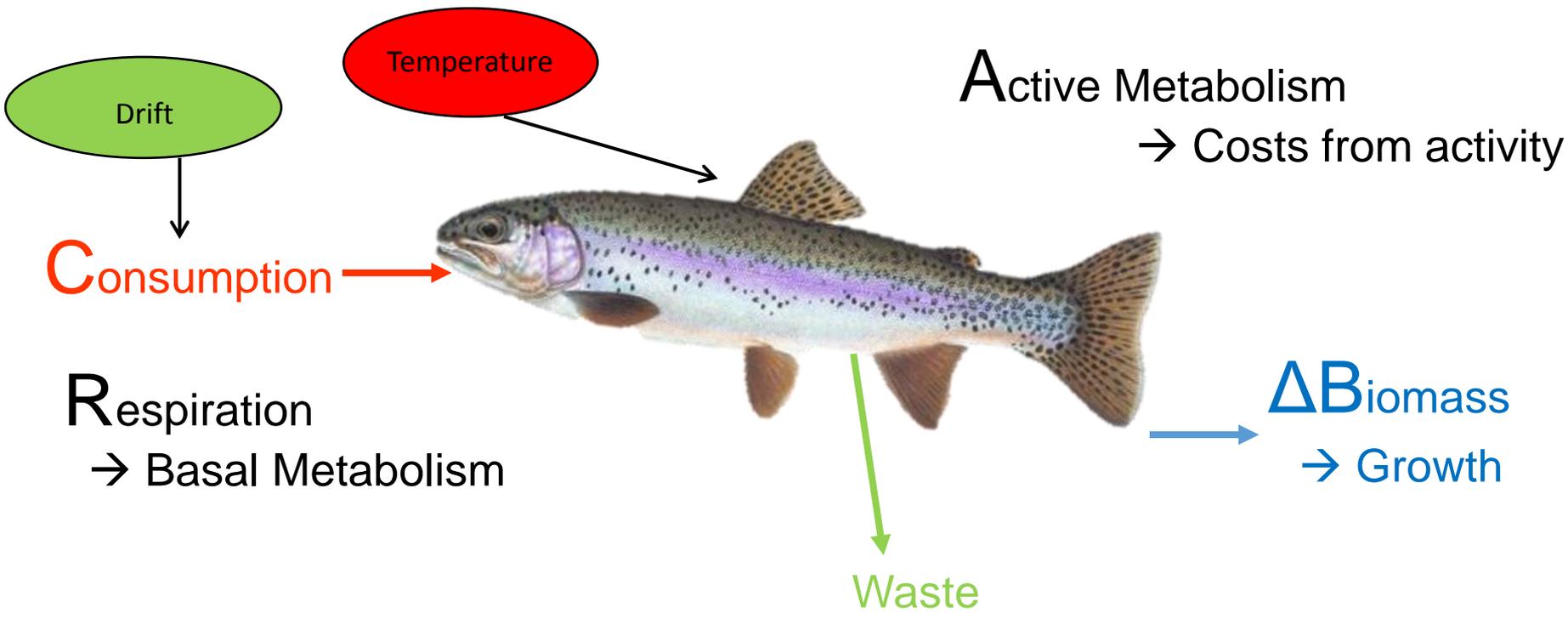


## Invertebrate Drift

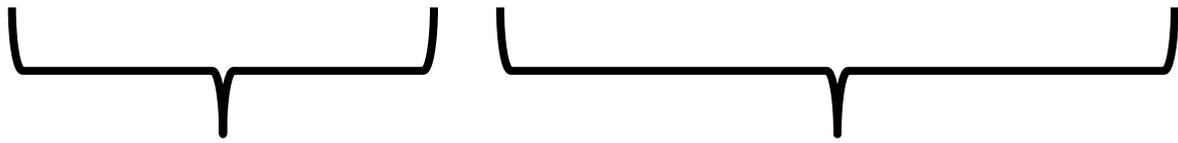
- Direct Measurements of Food Abundance
- Inclusive of Terrestrial Inputs
- Insight on growth potential ( $\sim$ fitness/survival)



# Bioenergetics



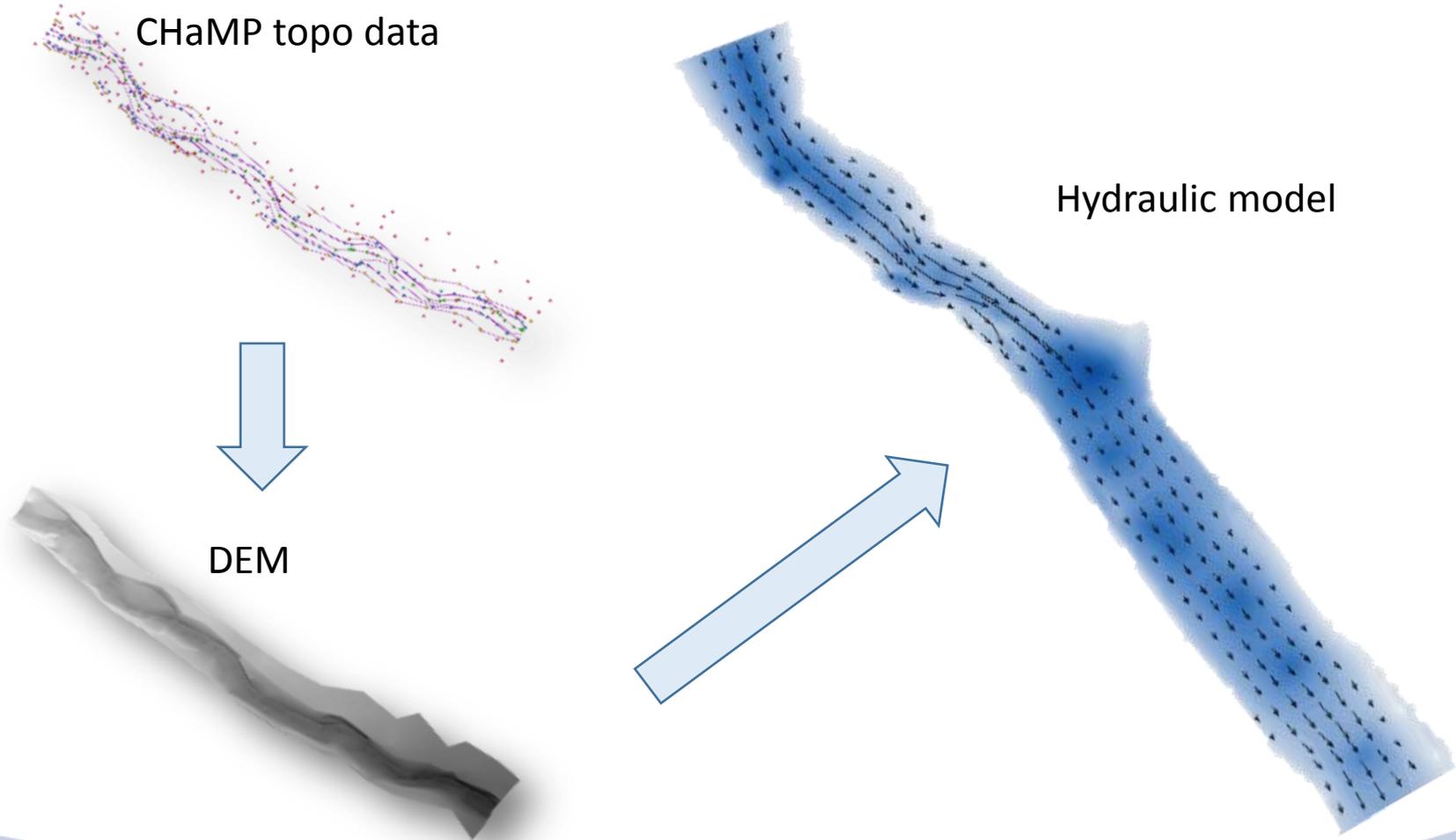
$$\text{Growth} = \text{Consumption} - (\text{Metabolism} + \text{Waste})$$



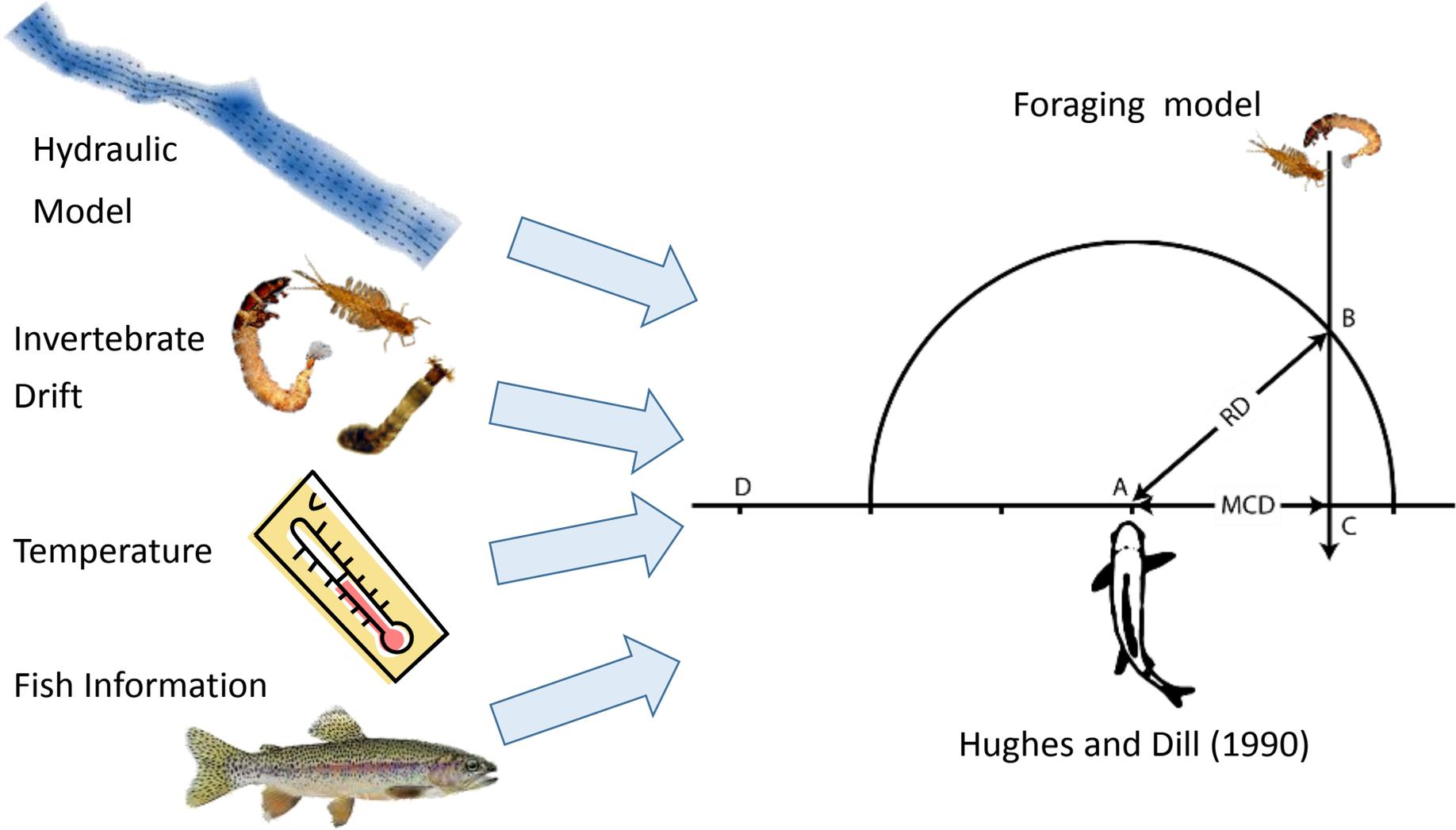
Function of drift

Published parameters

# How to translate this into site capacity? Enter Net Rate of Energy Intake (NREI) models...



# How do NREI models work?

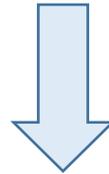


Hayes et al. (2007)

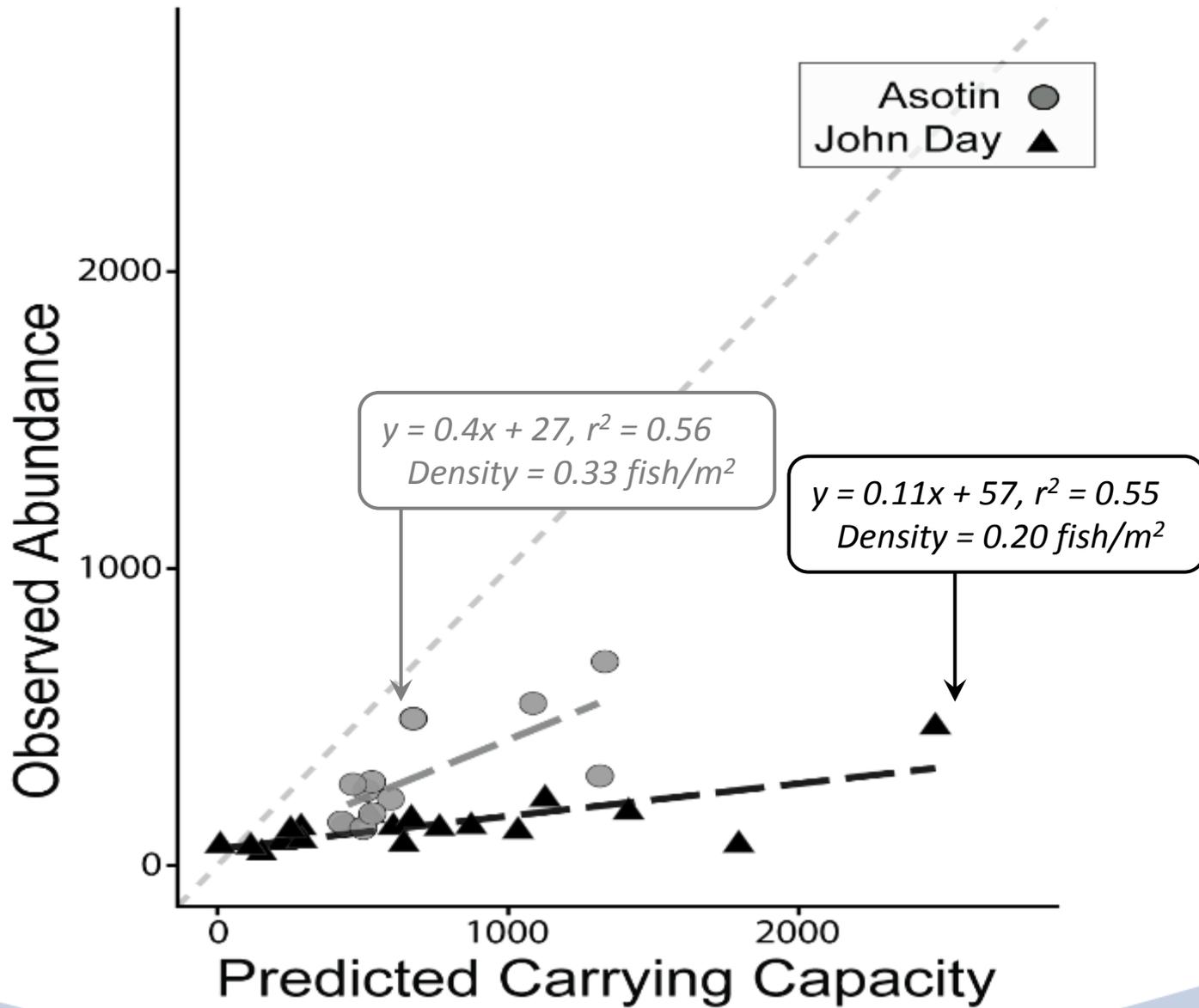


# Estimating site capacity using NREI

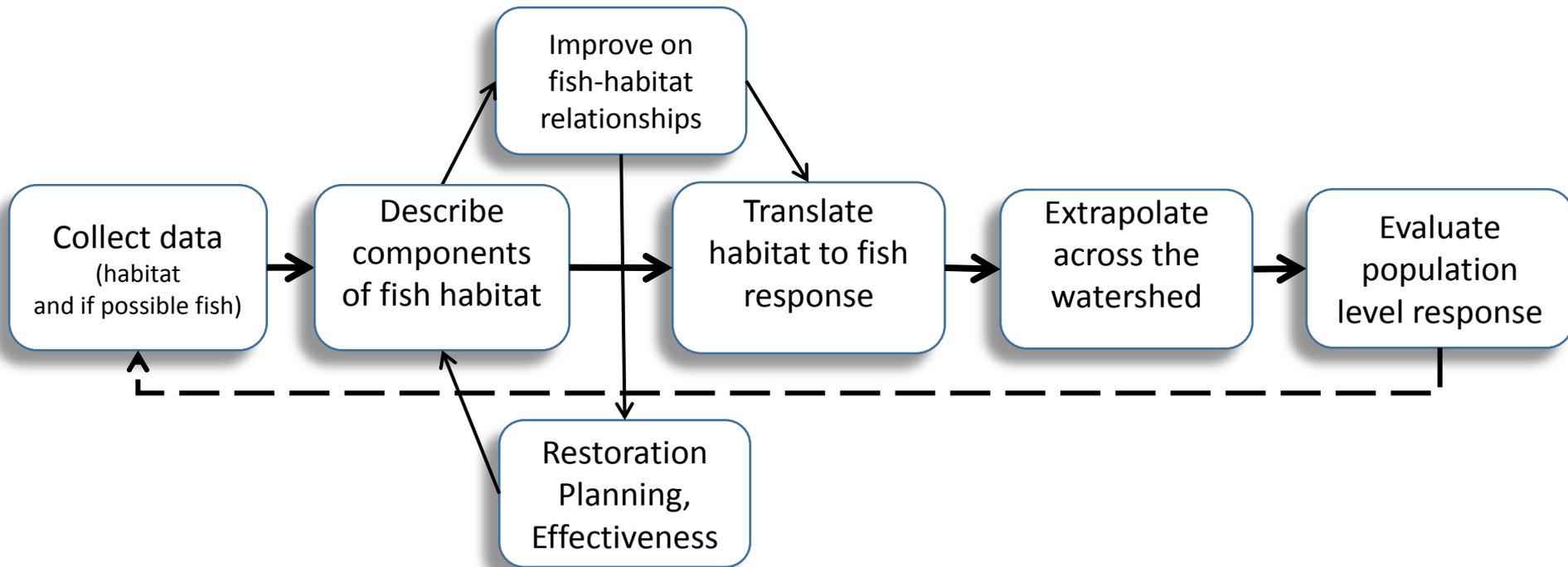
● = Potential foraging locations



● = capable of supporting a fish  
✗ = excluded by territory rules



# CHaMP Data To Fish Management Work Flow



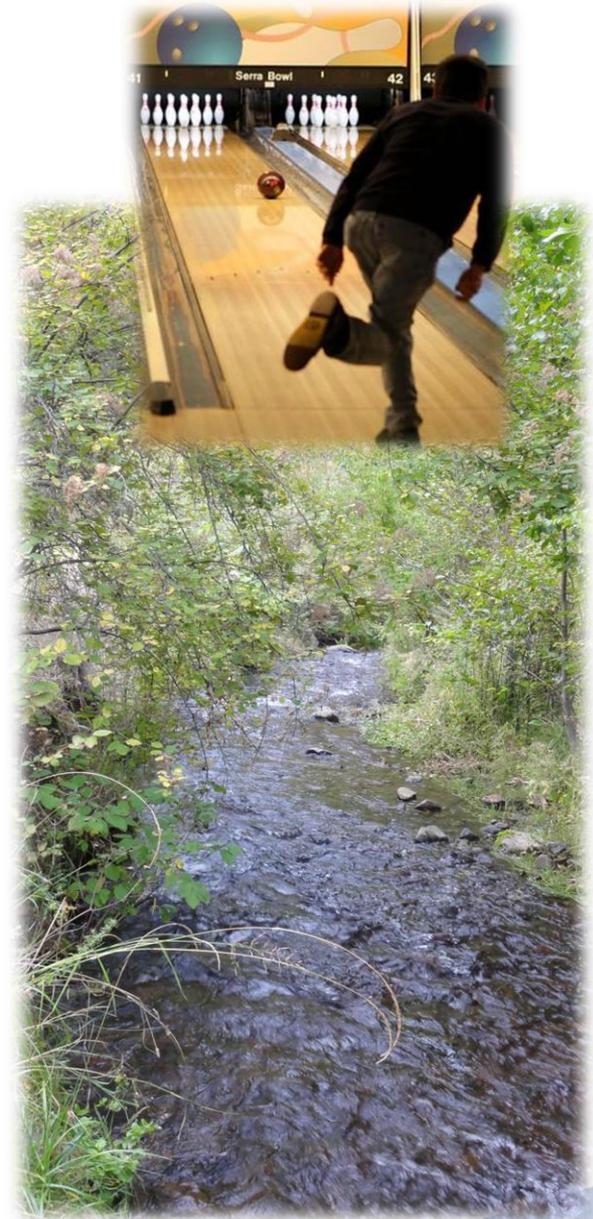
# NREI models and recovery planning



Catherine Creek RM37 – today's site visit.

# MANY PLACES IN CRB

- Riparian not all that bad... compared to some places
- Nothing like what it once was
- Habitat highly simplified
  - Armored
  - Few pools / Not much large wood
  - Few active bars

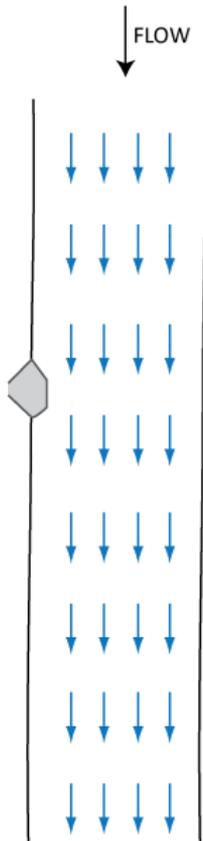


# TYPICAL **HD LWD** STRUCTURES

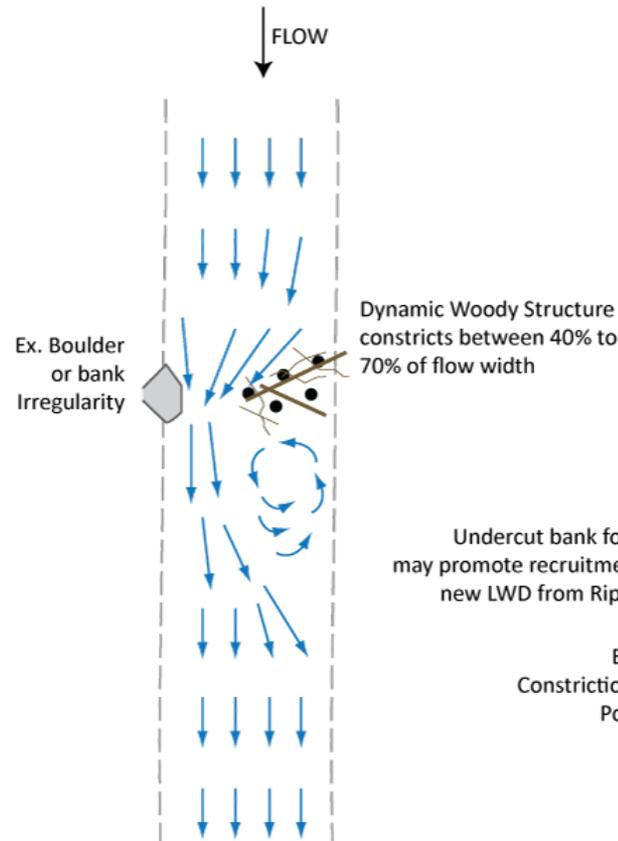


# SIMPLE PALS HYPOTHESIZED RESPONSE

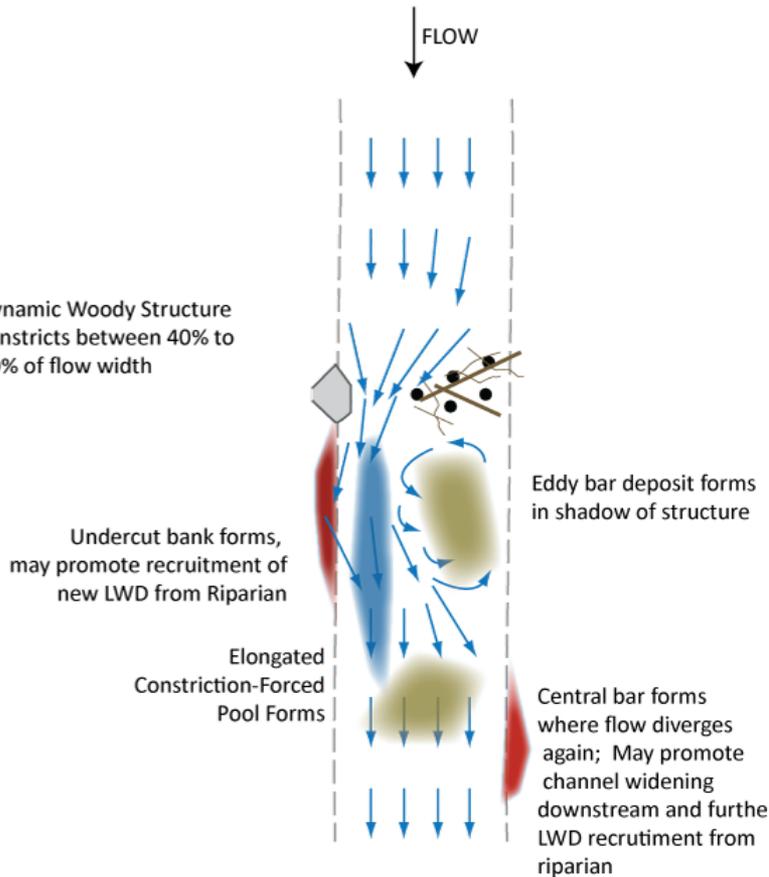
Initial Condition



Design Placement



Dynamic Response

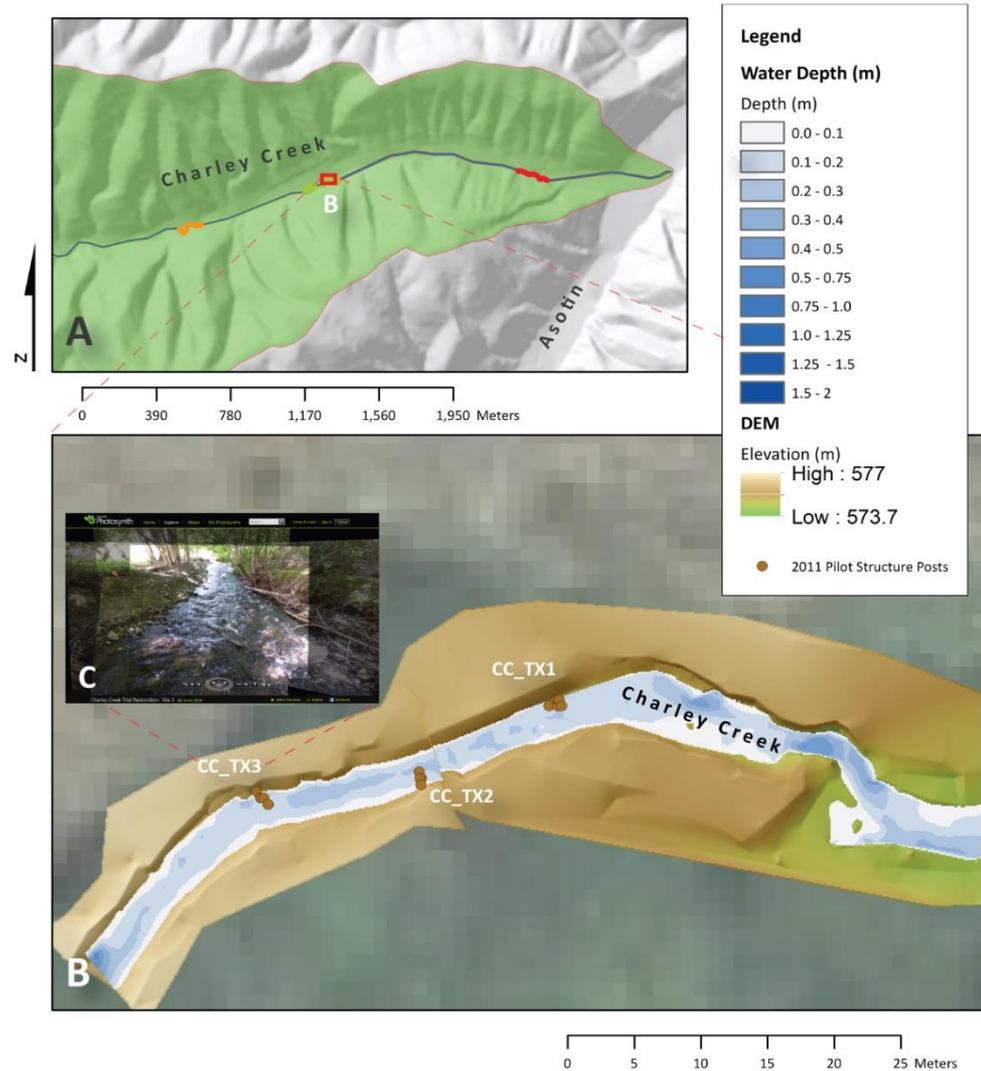


## LEGEND

-  Velocity Vectors
-  Wooden Posts (driven into bed)
-  Woody debris of various sizes, shapes & complexity
-  12" to 18" diameter logs (variable length of 4' to 6' and can be handled by two people)

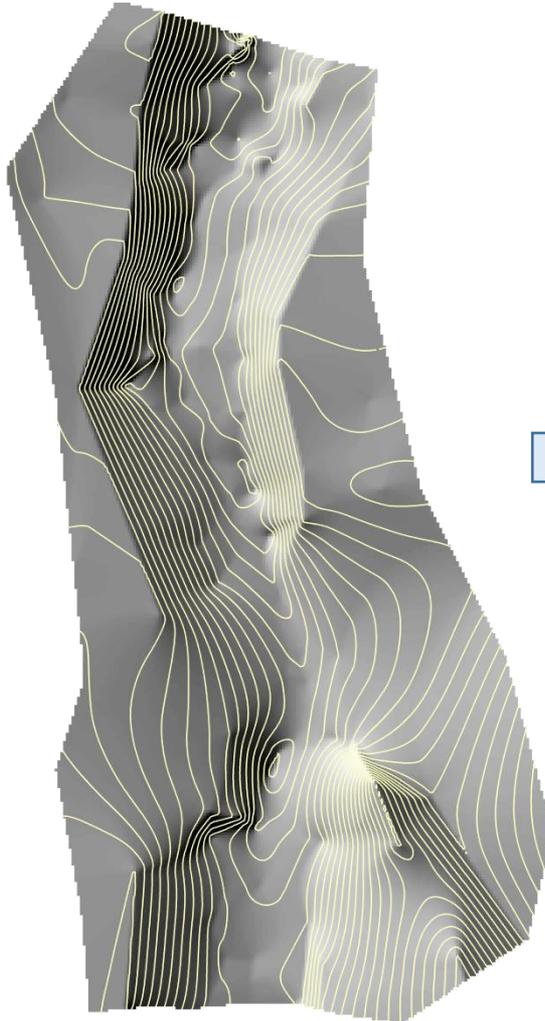
# PILOT OR AEM TESTING VS. DESIGN STAGE

- Do we have to build it to test it?

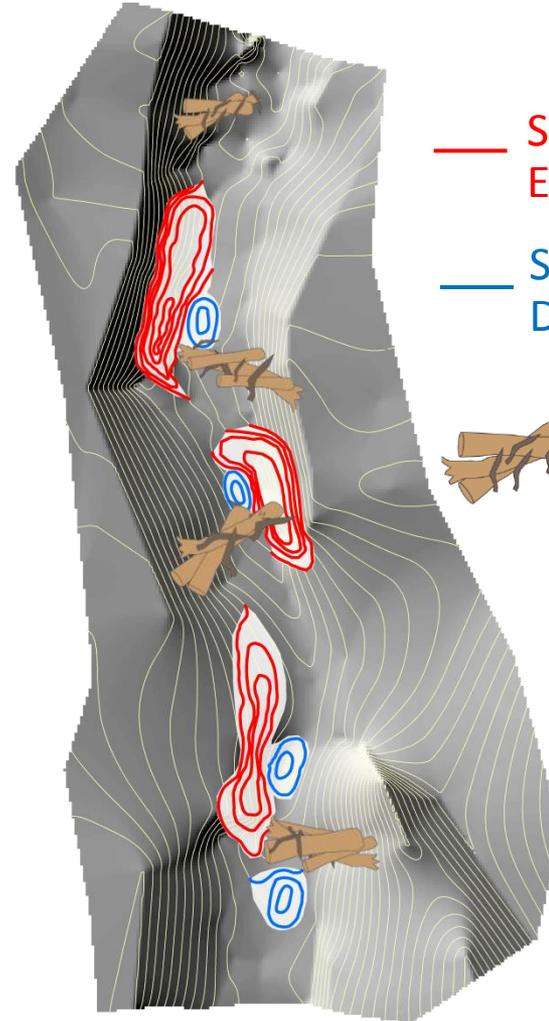


# A DESIGN HYPOTHESIS TEST...

Existing Topography



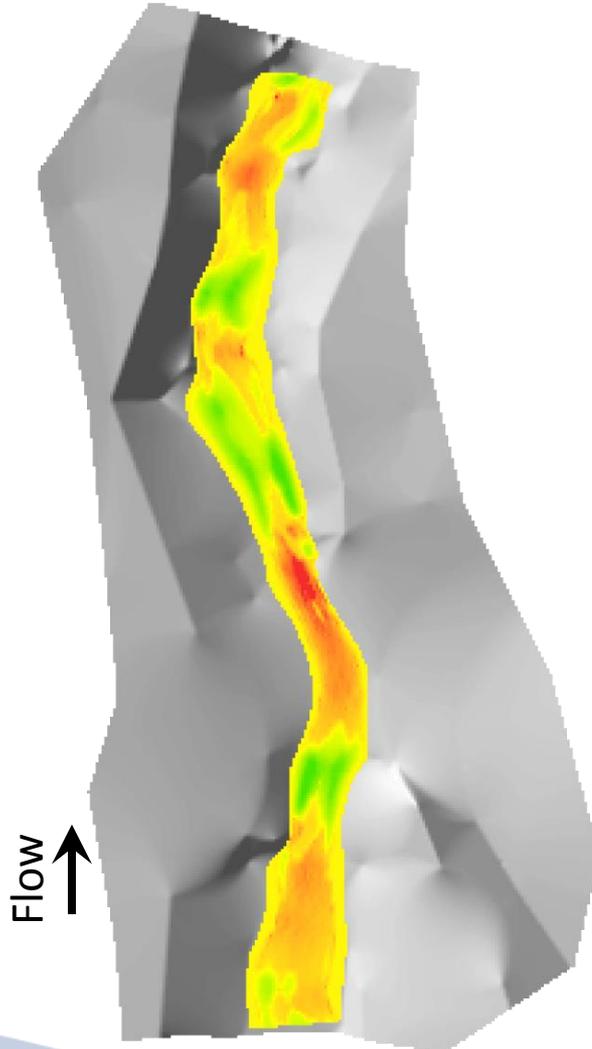
Simulated Change



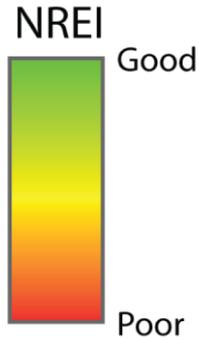
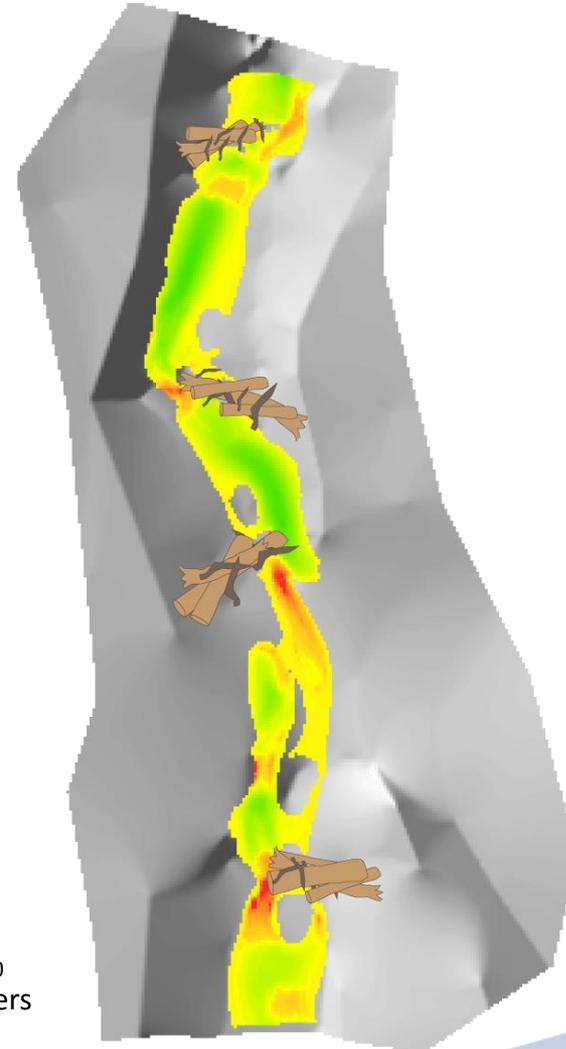
- Simulated Erosion
- Simulated Deposition
-  Wood Structures

# DOES DESIGN PRODUCE INTENDED BENEFIT FOR FISH?

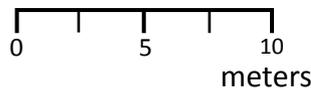
NREI Before LWD Structures



Potential NREI

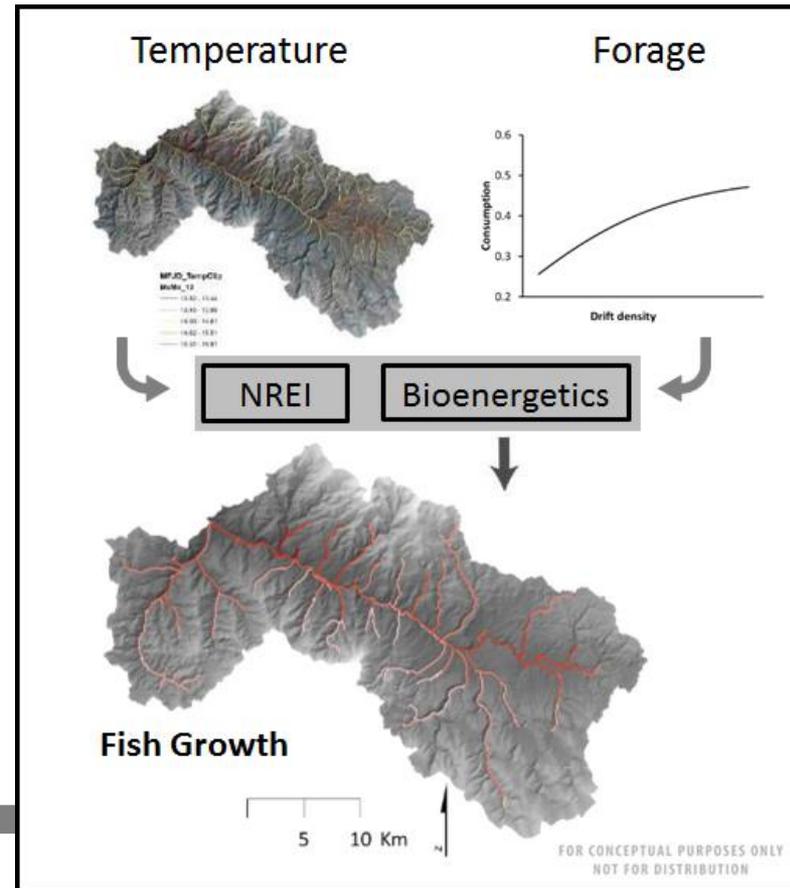
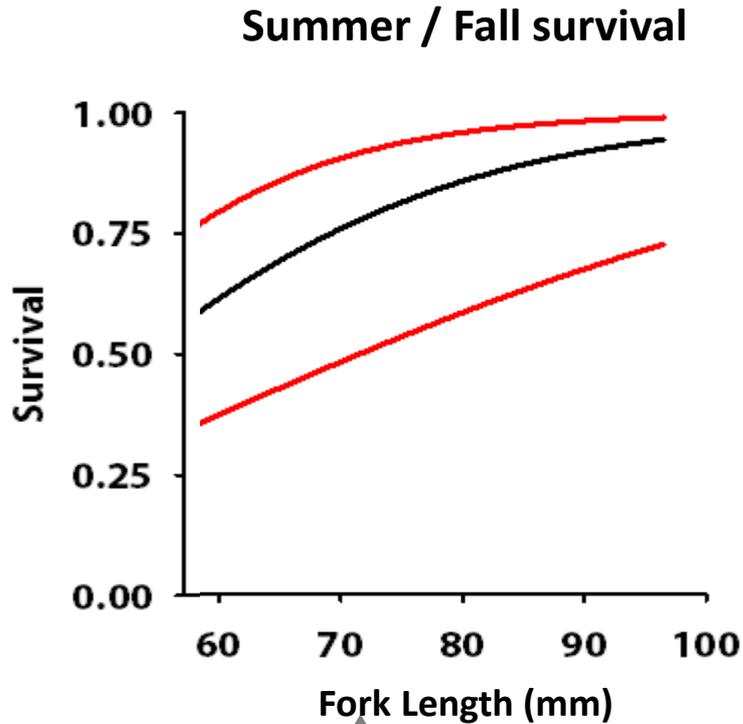


Wood Structures



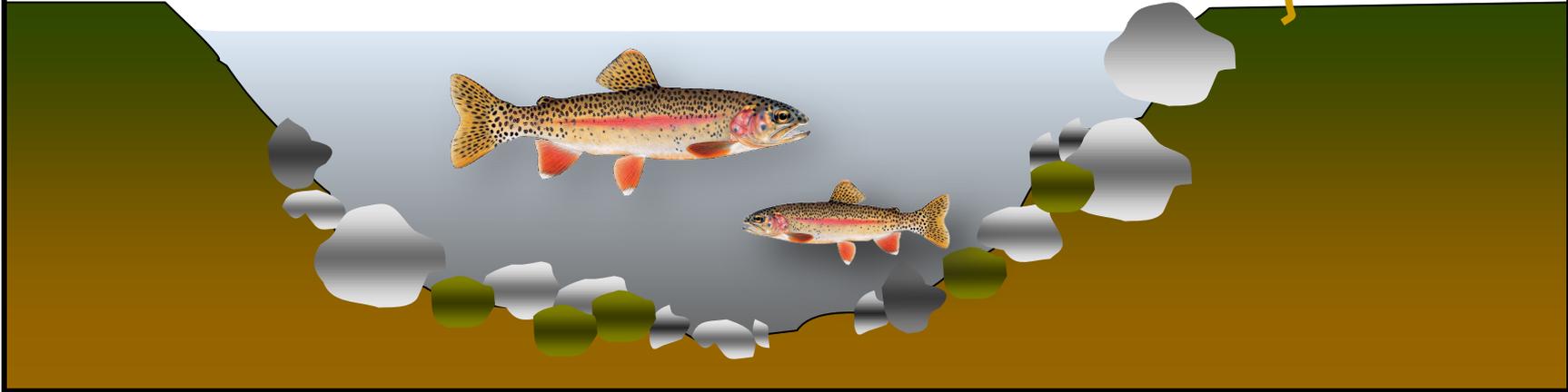


# Linking to population level...



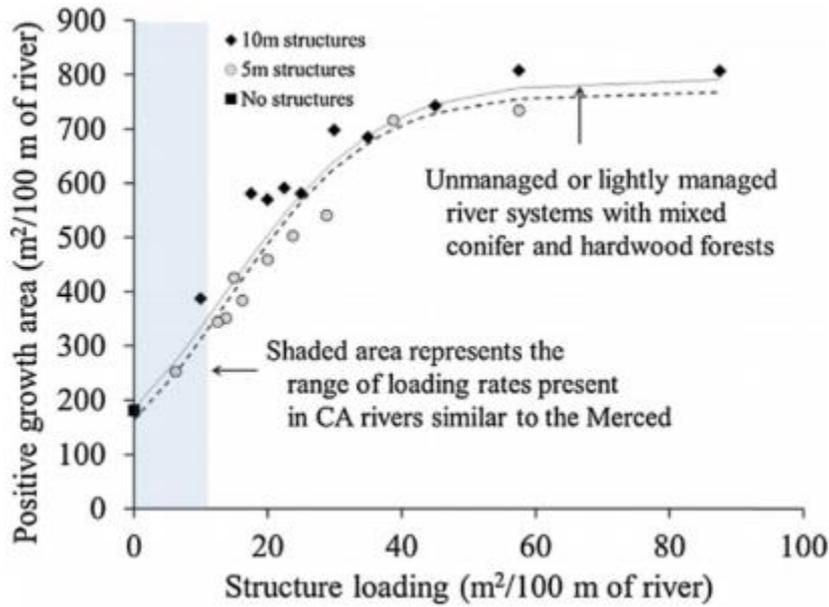
Avoid  
Predators

Hold

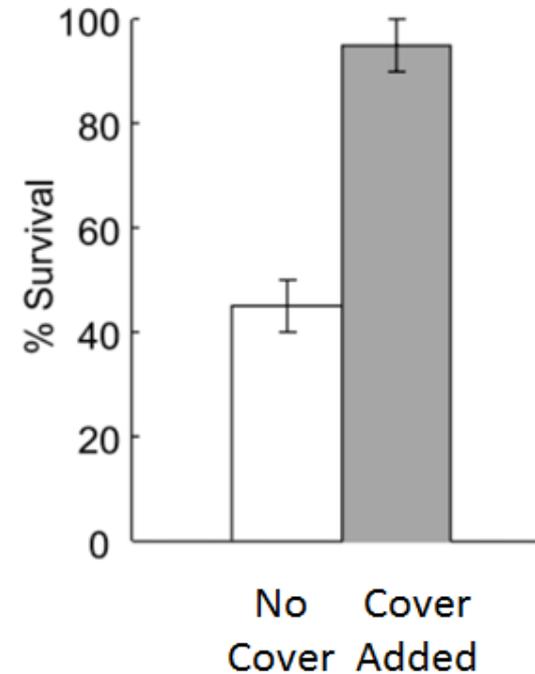


# Quantifying the role of woody debris in providing bioenergetically favorable habitat for juvenile salmon

Andrew W. Hafs<sup>a,d,\*</sup>, Lee R. Harrison<sup>b</sup>, Ryan M. Utz<sup>c</sup>, Thomas Dunne<sup>d</sup>



...and enhances your chance of surviving...



LWD creates hydraulic complexity...

Effects of food and cover on the growth, survival, and movement of cutthroat trout (*Oncorhynchus clarki*) in coastal streams

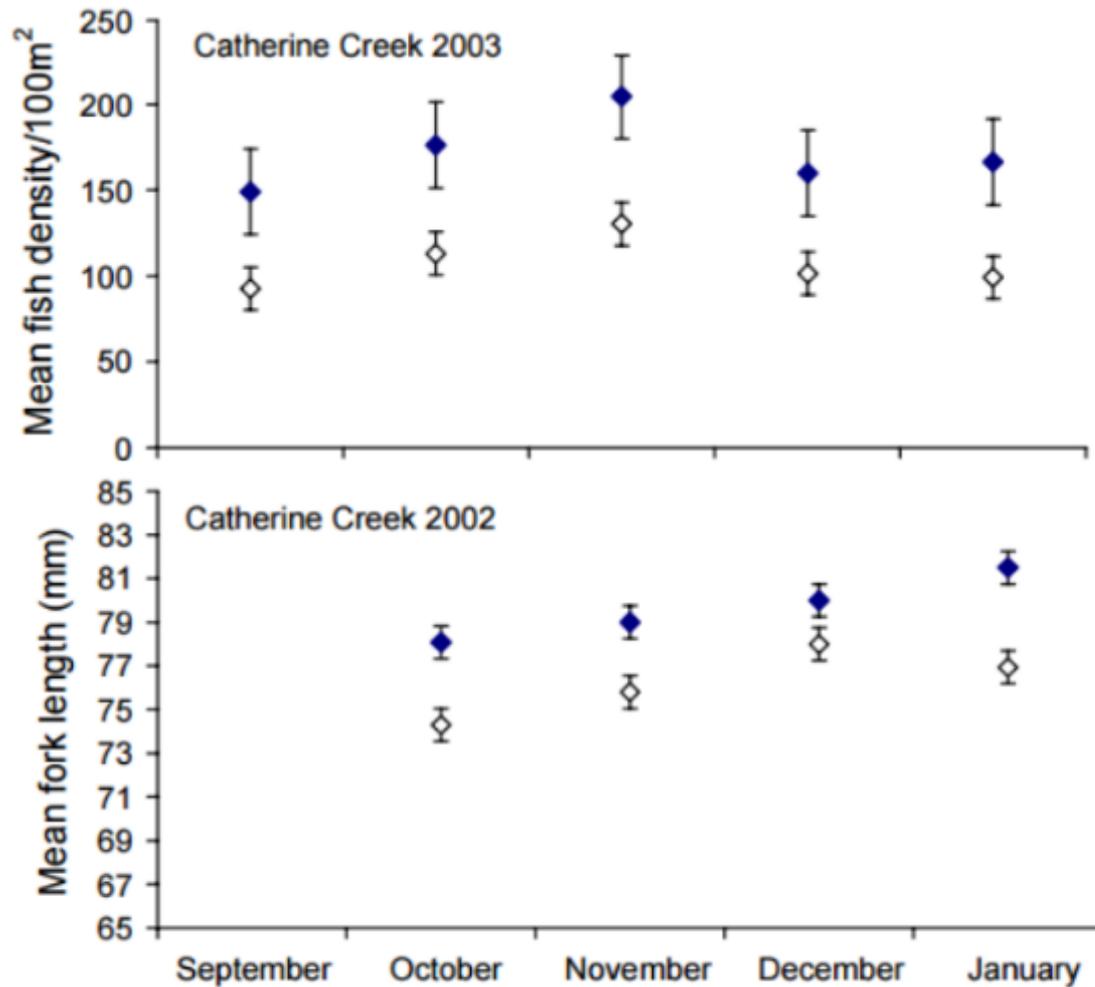
Shelly M. Boss and John S. Richardson

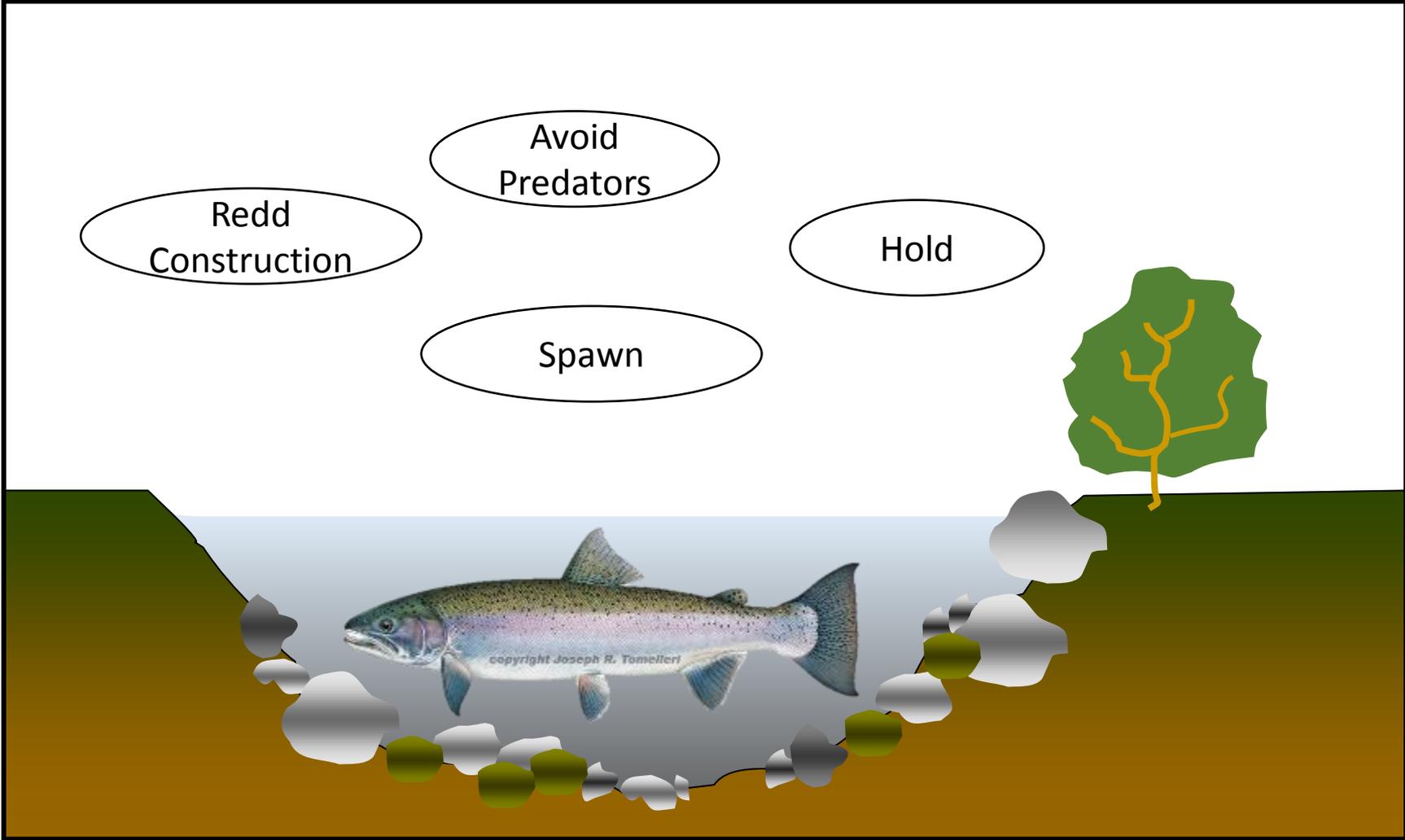
# High Water Refuge Habitat



# Relationship of winter concealment habitat quality on pool use by juvenile spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Grande Ronde River Basin, Oregon USA

Erick S. Van Dyke · Dennis L. Scarnecchia ·  
Brian C. Jonasson · Richard W. Carmichael





Local physical  
habitat

Large-scale habitat  
features



site selection

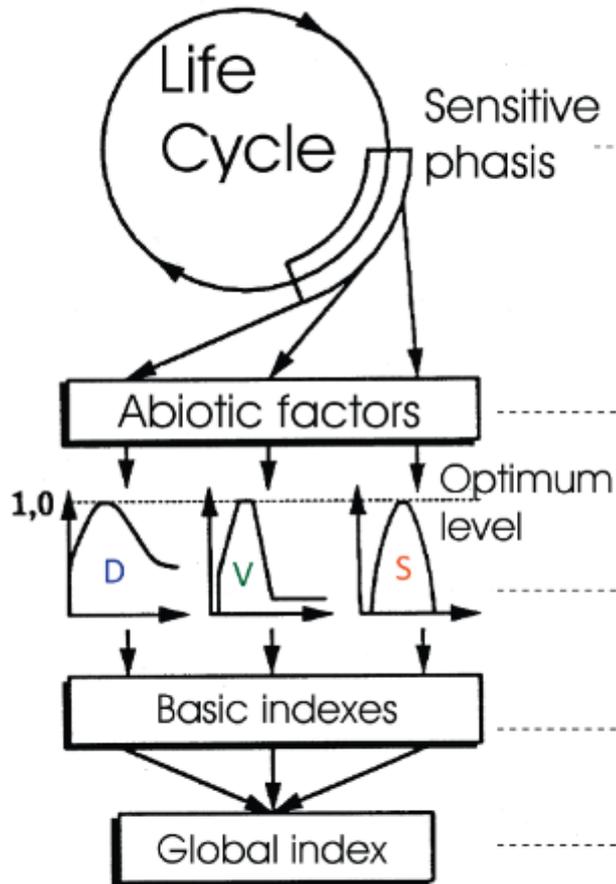


Precise natal site  
homing?

Intra- and inter-  
specific interactions

# Habitat Suitability Modeling

## HSI Model Structure:



## CHaMP Implementation Example:

Spawning



Water Depth (D)

*Hydraulic Model Output*

Water Velocity (V)

*Hydraulic Model Output*

Substrate (S)

*Crew Estimates*

Preference Curves

*From Literature*

*Intermediate Index Scores for Each Input*

HSI Value

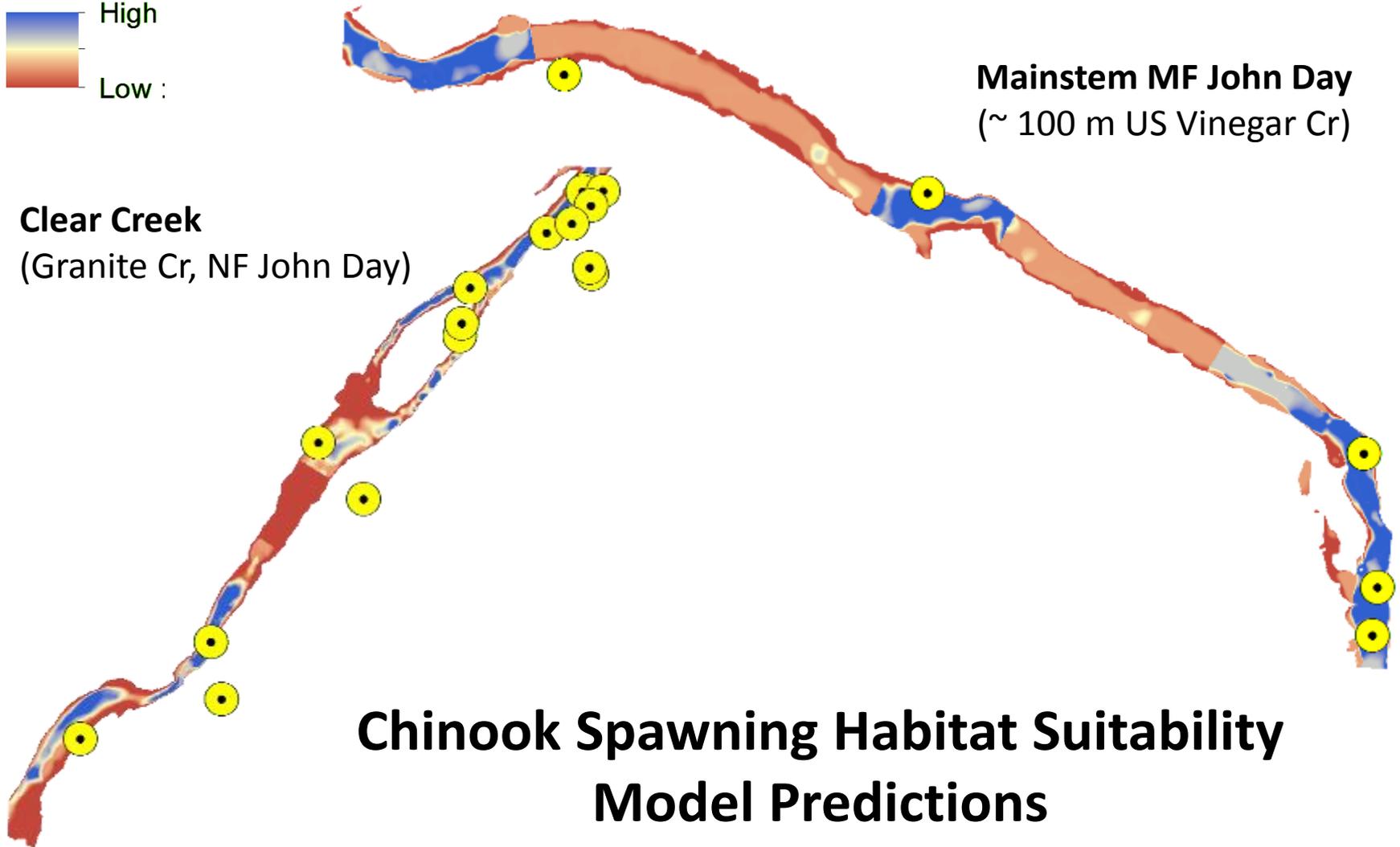
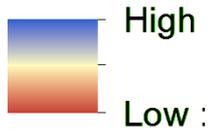
$$HSI_i = I_{D_i}^a * I_{V_i}^b * I_{S_i}^c \quad \text{with } a + b + c = 1.0$$

where:  $I_D, I_V, I_S$  - basic index scores for water depth (D), water velocity (V), and substrate (S)

$a, b, c$  = weights powering the basic indices and importance given to each index in the model

**Provides site quality and capacity info**

Suitability

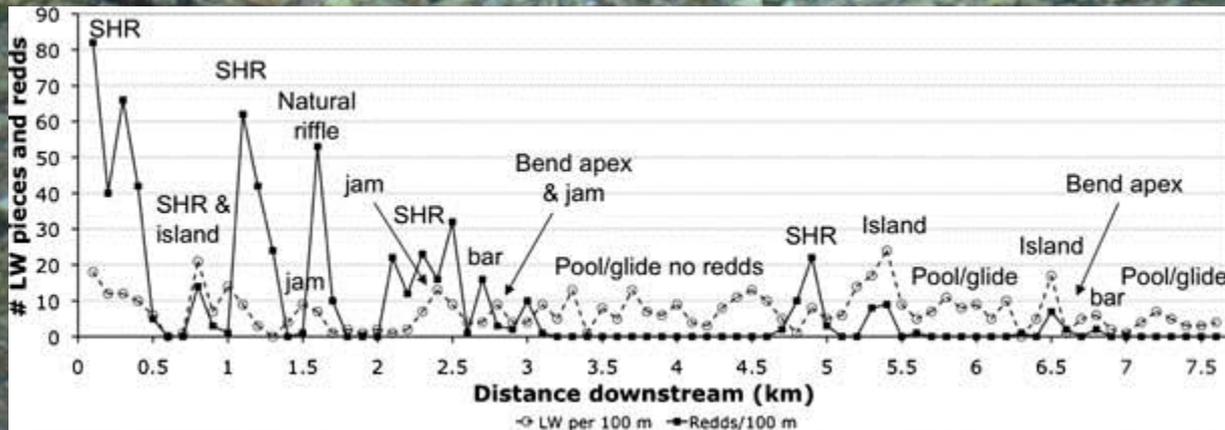


**Mainstem MF John Day**  
(~ 100 m US Vinegar Cr)

**Clear Creek**  
(Granite Cr, NF John Day)

## **Chinook Spawning Habitat Suitability Model Predictions and ODFW Redd Locations (2013,14)**

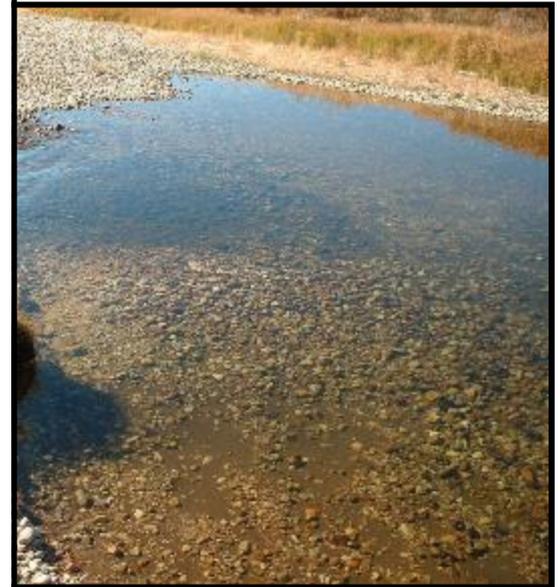
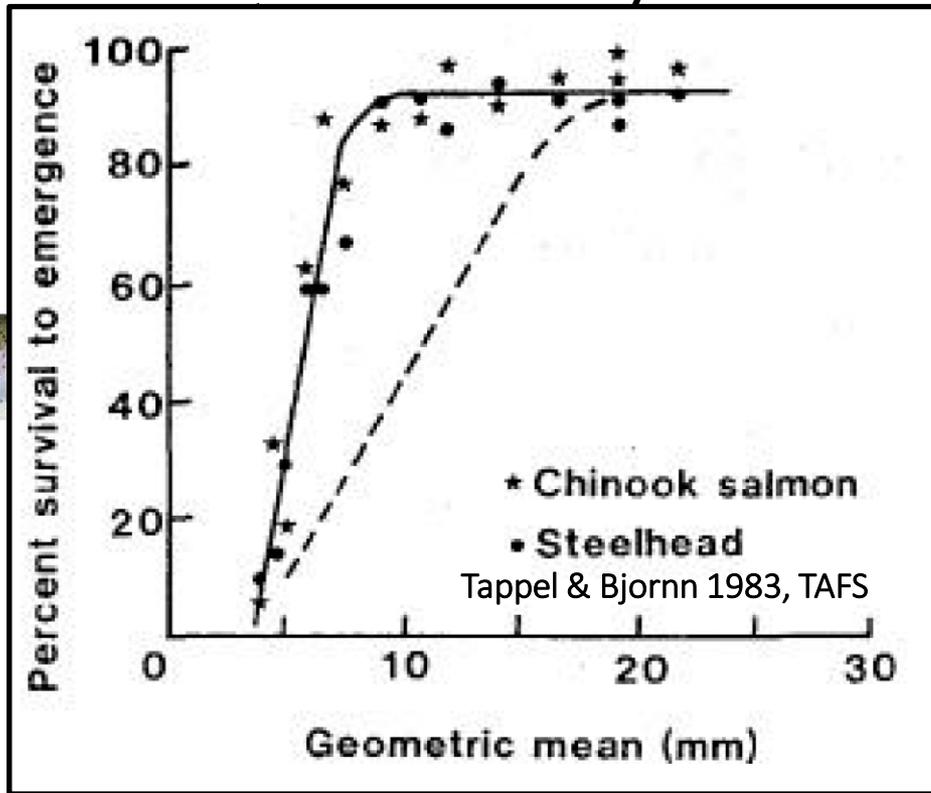
# Cover matters to adults too...



Senter & Pasternak 2010  
*Riv Res Appl*

Local physical habitat

Large-scale habitat features

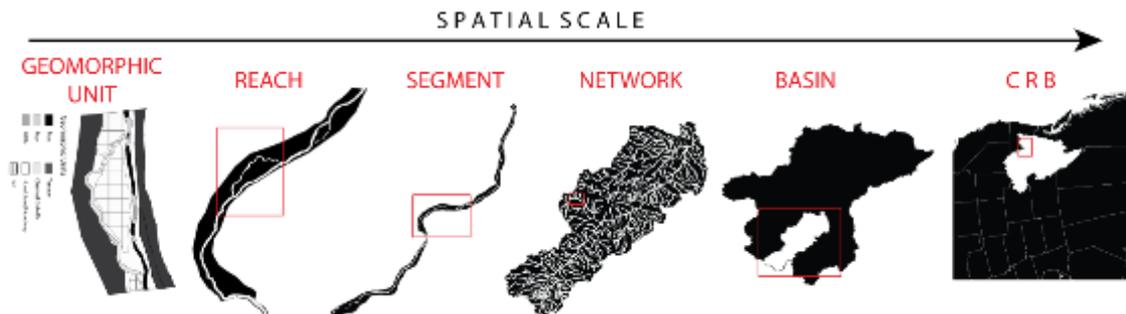
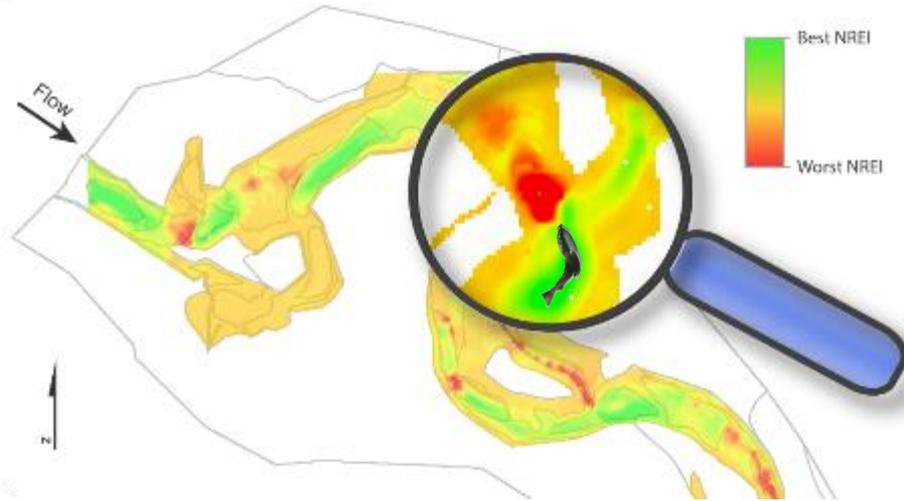


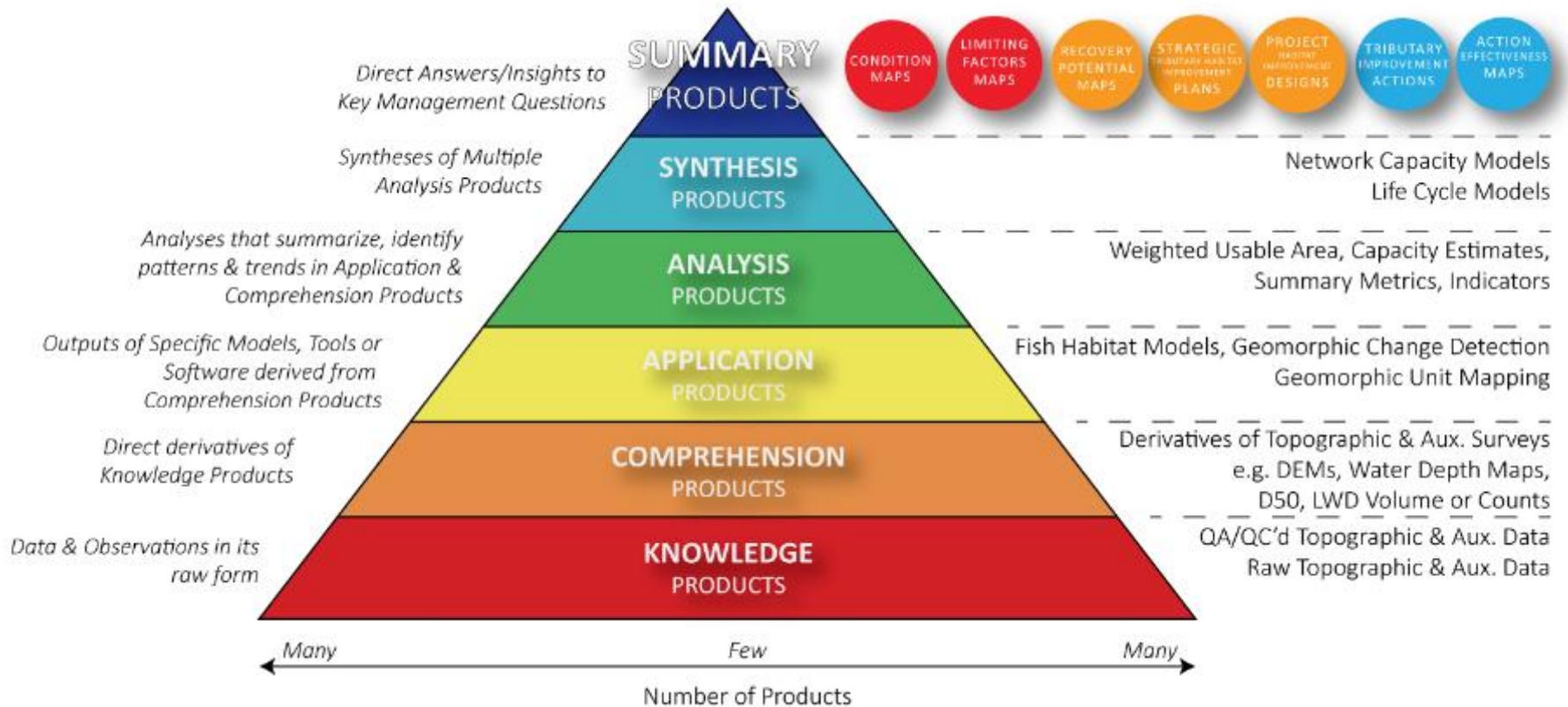
homing?

specific interactions

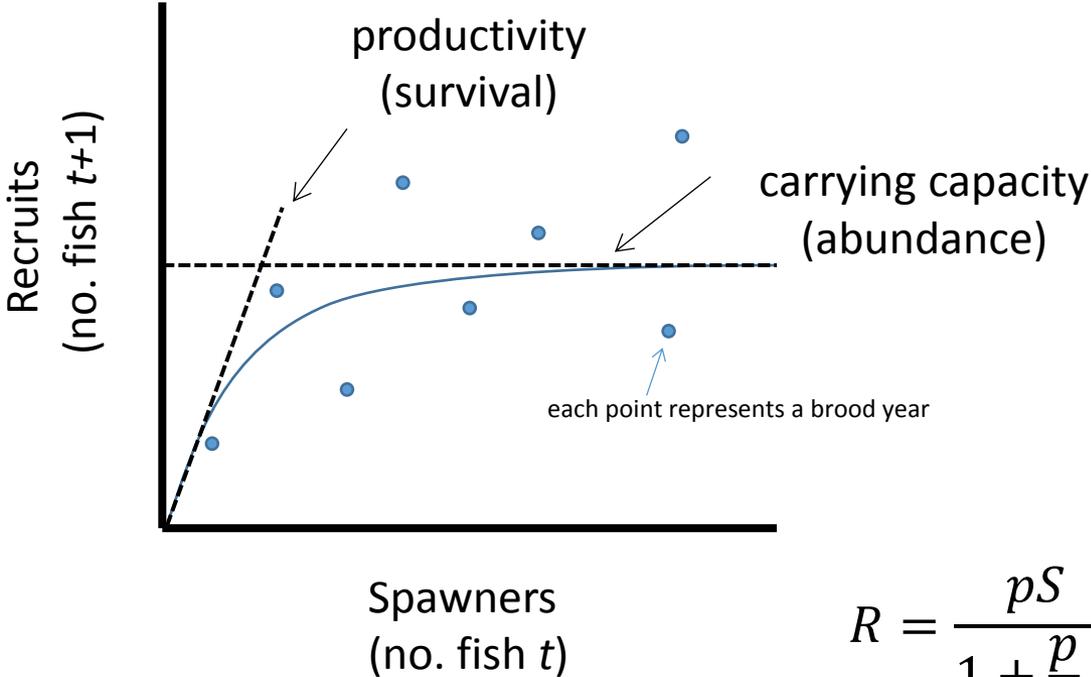
# Presentation Outline

- Context
- What do fish need?
- Using habitat data to inform management
  - Analytical tools
  - Translating across scales (CJ)
  - Key Management Questions





# Life-cycle Model Context

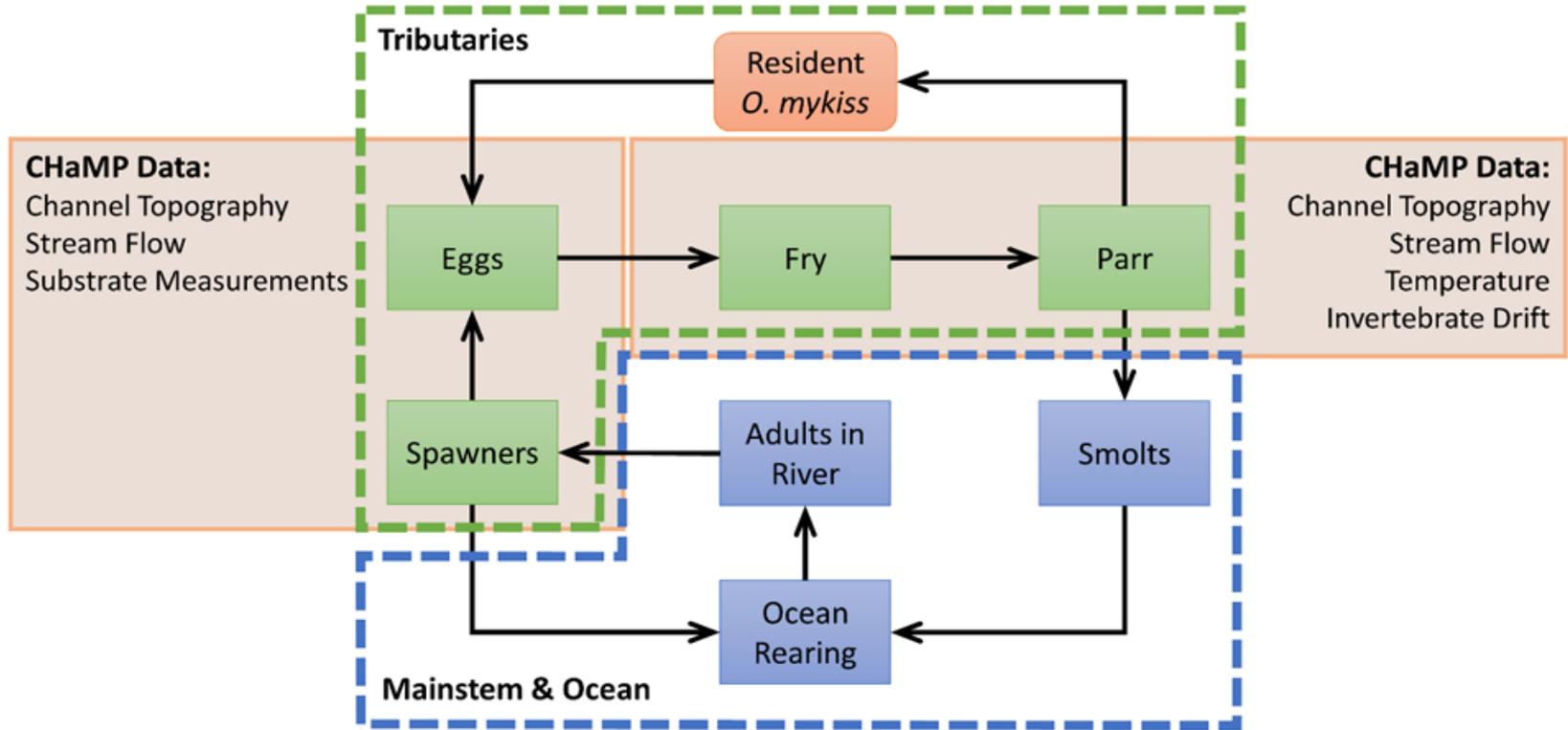


These relate to habitat  
quality and quantity

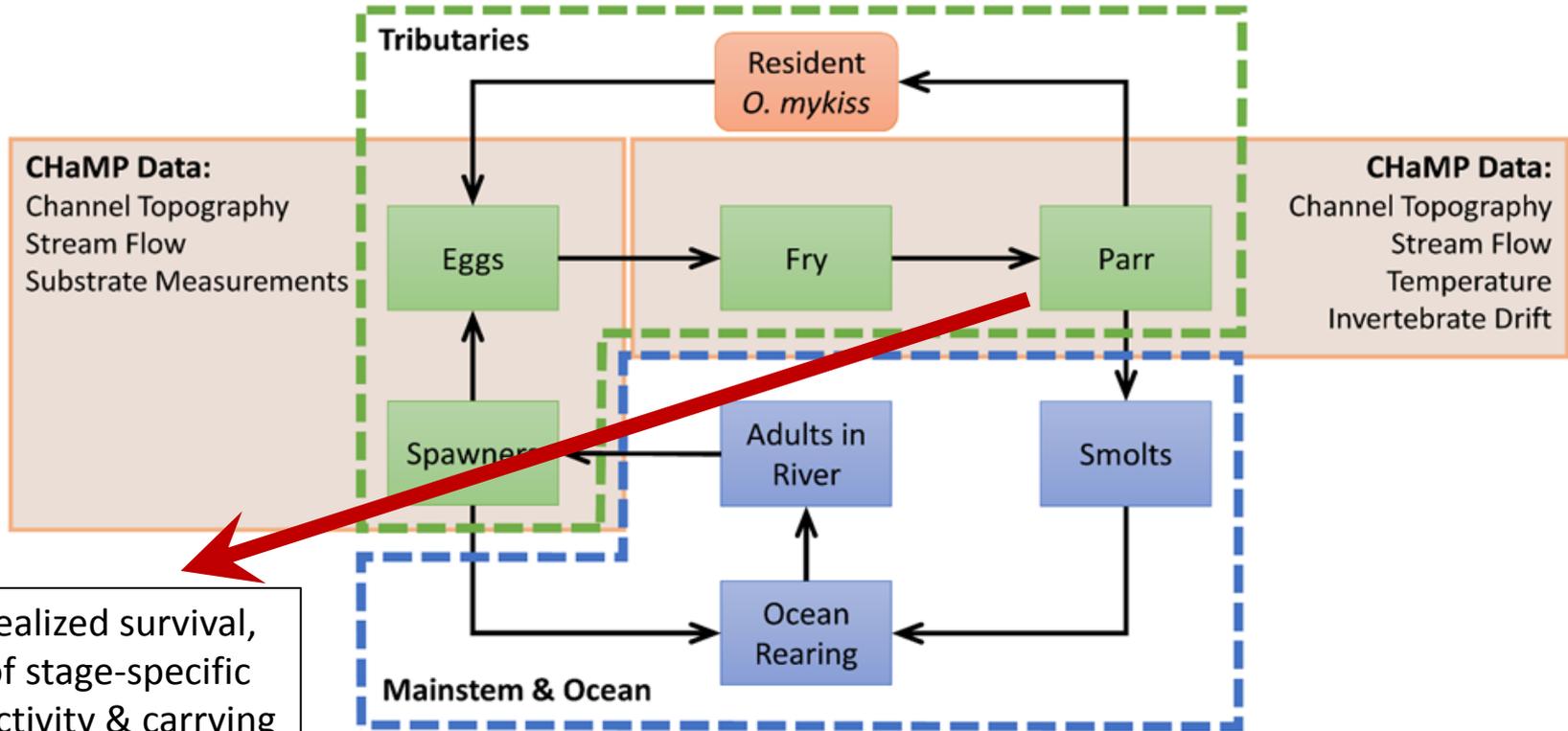
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- $R$  = recruits
- $c$  = carrying capacity
- $p$  = productivity



# Answering KMQs with CHaMP Data: LCMs

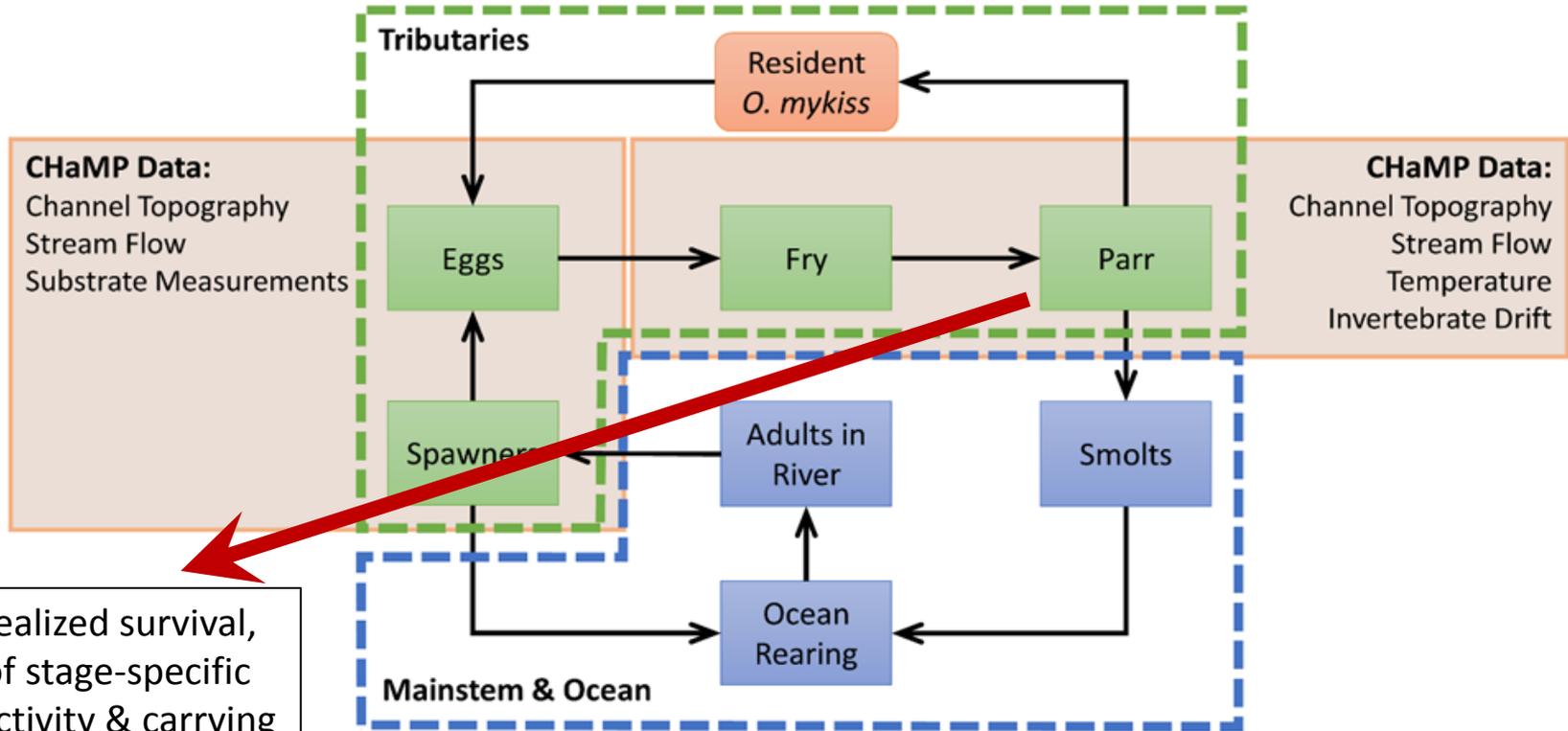


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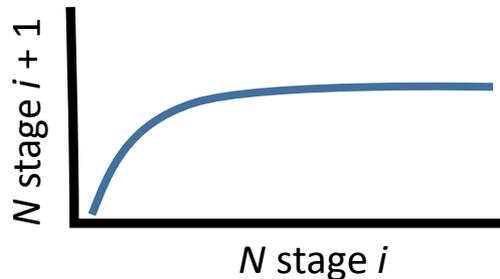


$S_i$  = realized survival, fxn of stage-specific productivity & carrying capacity parameters (Beverton-Holt form)

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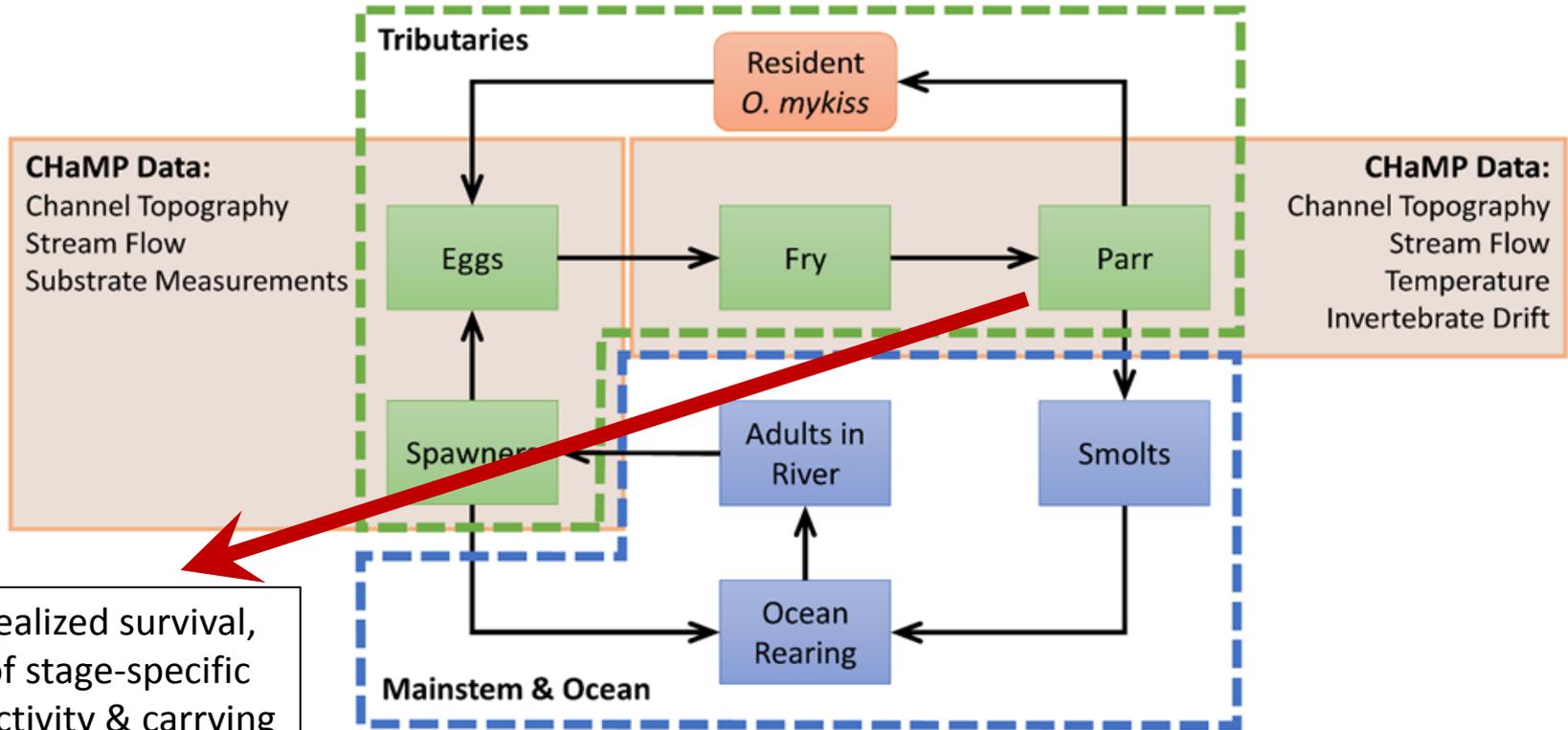


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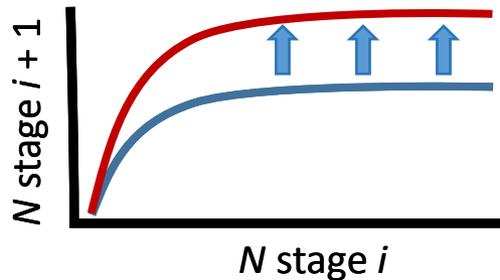


$$N_{i+1} = \frac{N_i}{\frac{1}{prod.} + \frac{1}{capacity} N_i}$$

# Answering KMQs with CHaMP Data: LCMs

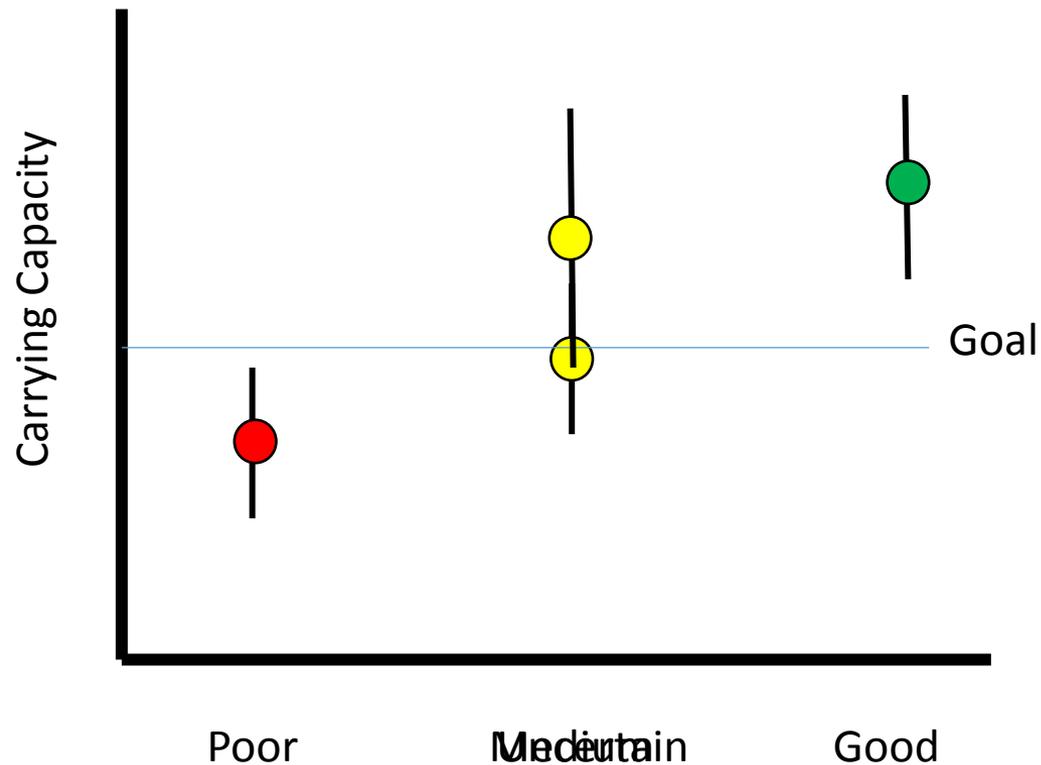


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# Life-cycle models to inform management



# Conclusions

- The CHaMP protocol aims enumerate the quantity/quality of habitat elements that:
  - Are meaningful to fish, with a mechanistic basis
  - Have linkages to population productivity
  - Can be used to prioritize and evaluate restoration
- Data quality matters—sampling error may obscure our perception of status, trends, and potential
- Good data are essential to ongoing ESA-listed salmon & steelhead recovery efforts



