

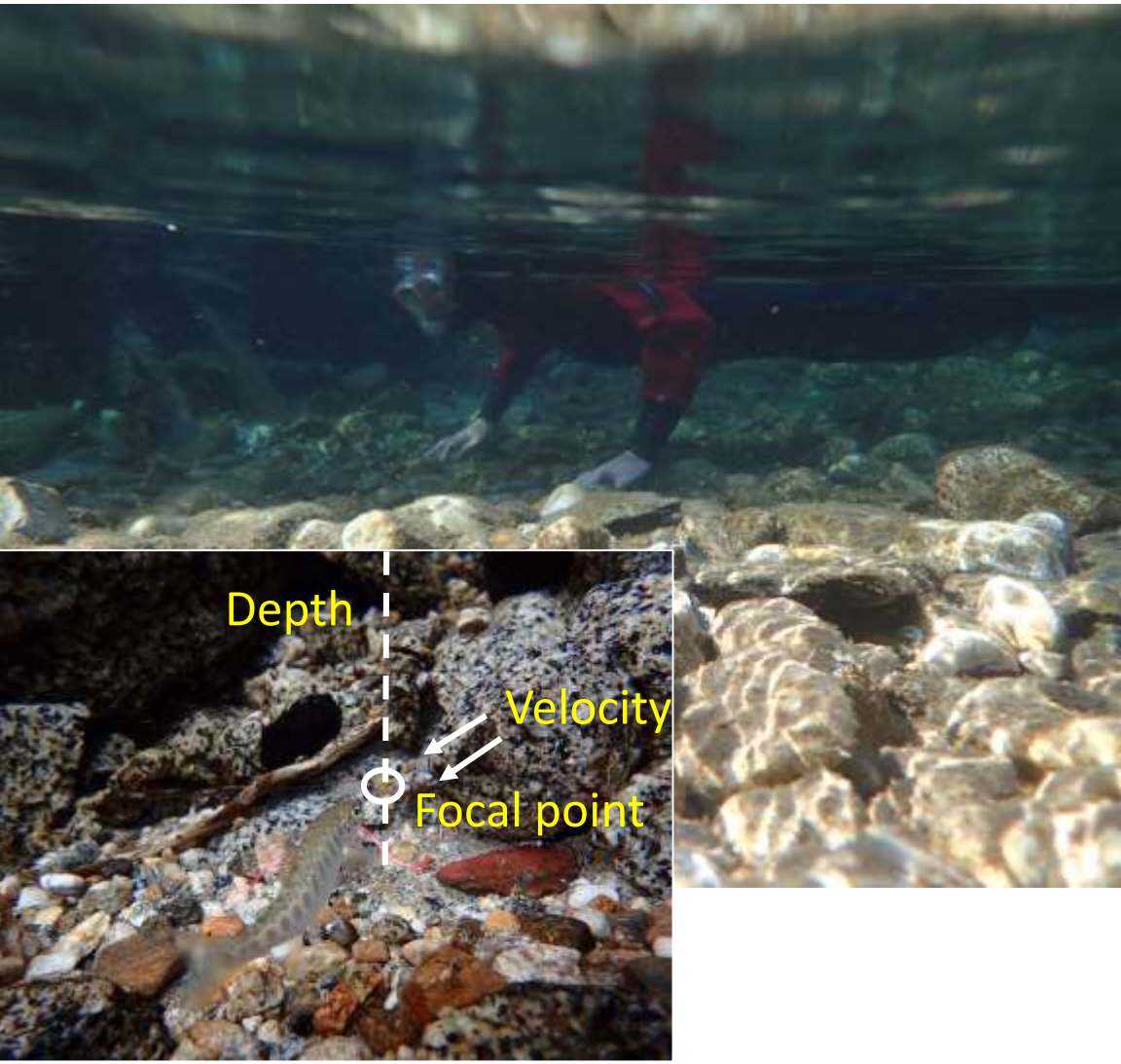
Objectives

- Compare correlative vs. bioenergetic model *predictions*

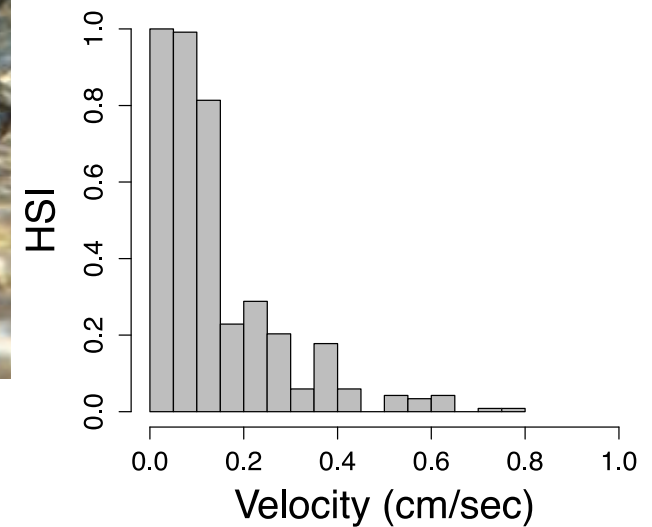
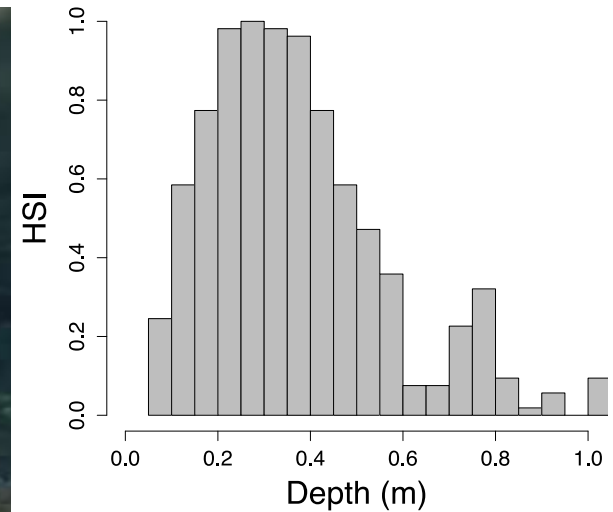
Objectives

- Compare correlative vs. bioenergetic model *predictions*
- Evaluate correlative and bioenergetic model *performance*

Correlative vs. bioenergetic predictions



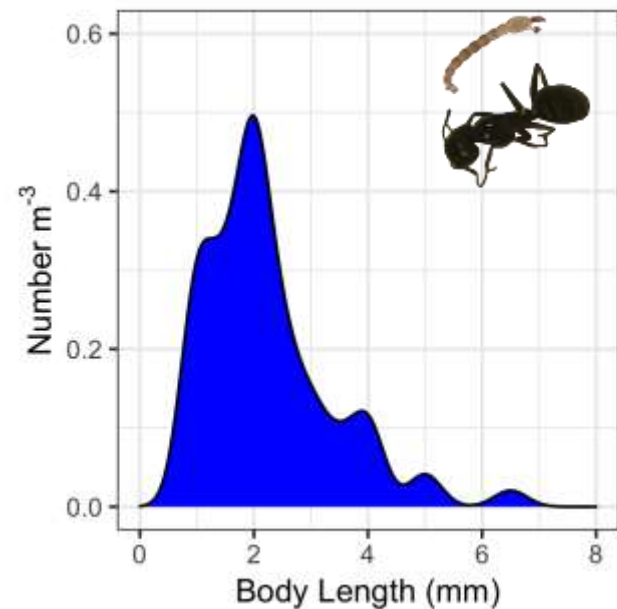
Habitat suitability curves



Correlative vs. bioenergetic predictions

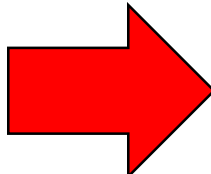
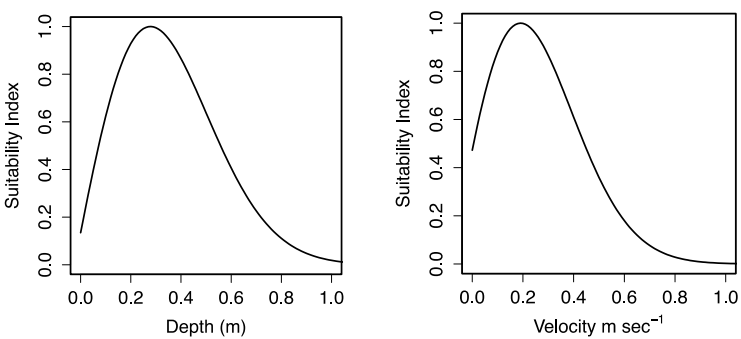
Model Inputs:

Drift concentration/size
distribution
Temperature
Fish size

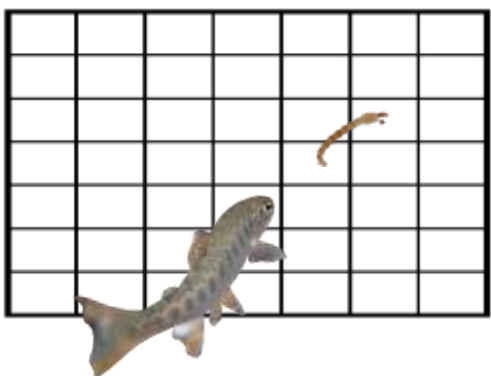


Correlative vs. bioenergetic predictions

Correlative habitat suitability model



Bioenergetic habitat suitability model

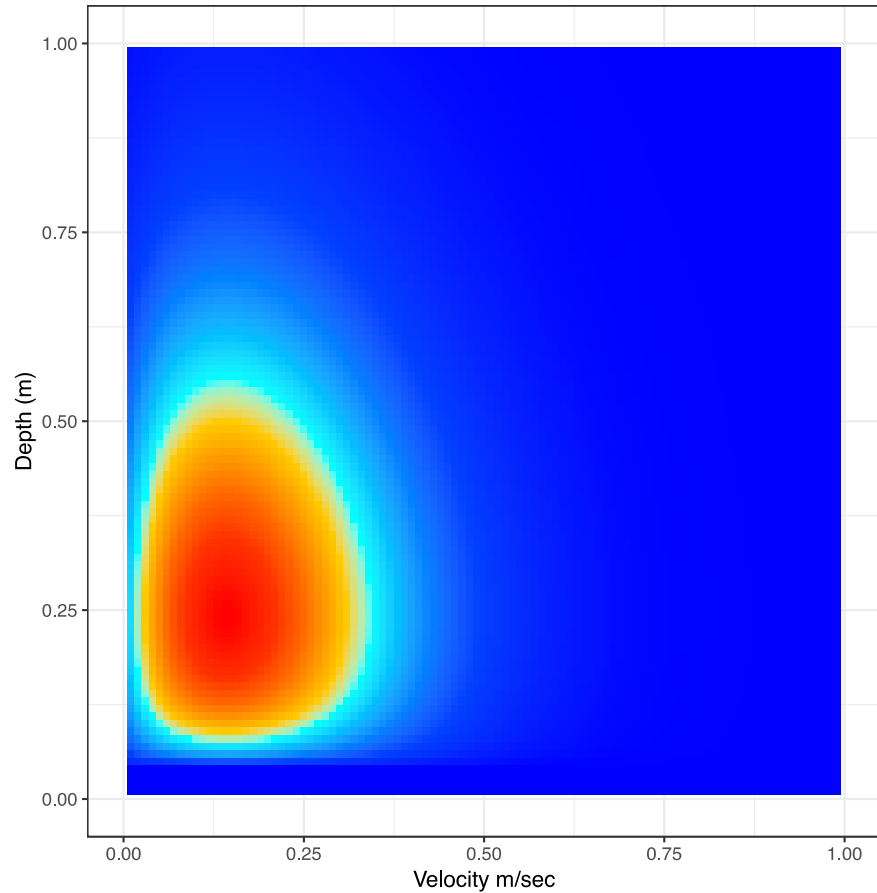


Habitat suitability predictions across range of velocity and depth

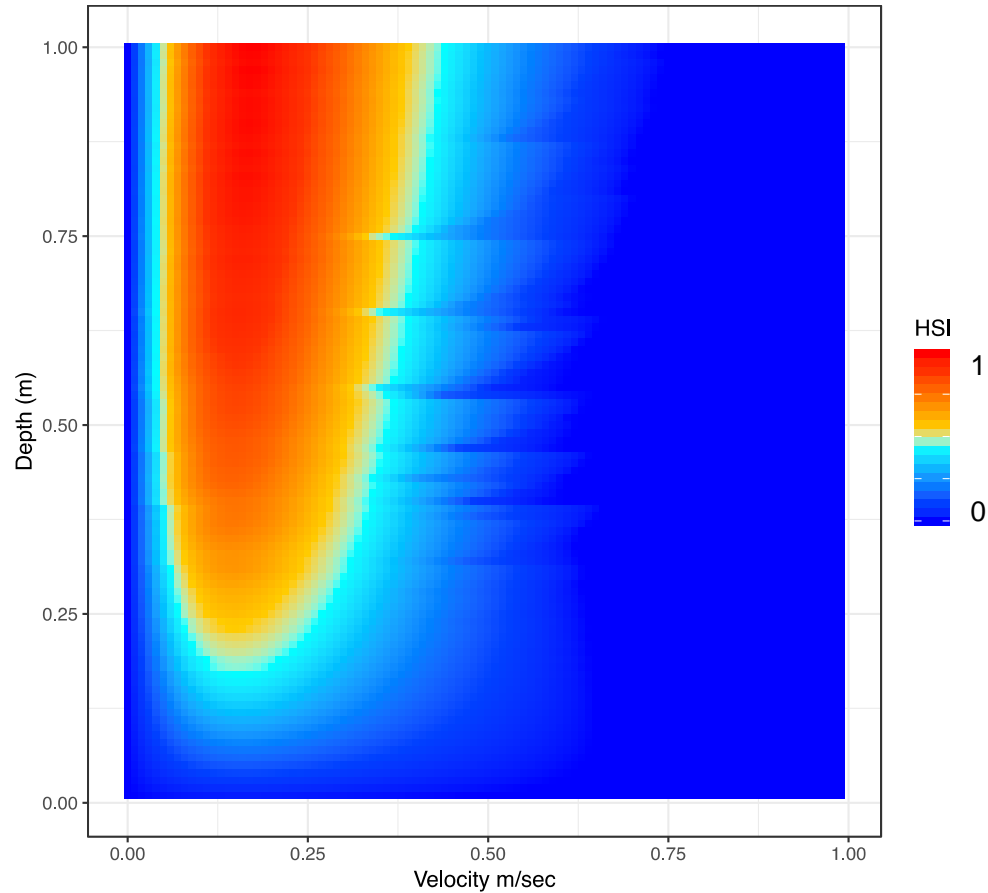
Velocity	Depth	HSI (Correlative)	HSI (Bioenergetic)
0	0
0.1	0.1		
0.2	0.2		
0.3	0.3		
..n	..n		

Results – Correlative vs. bioenergetic predictions

Correlative

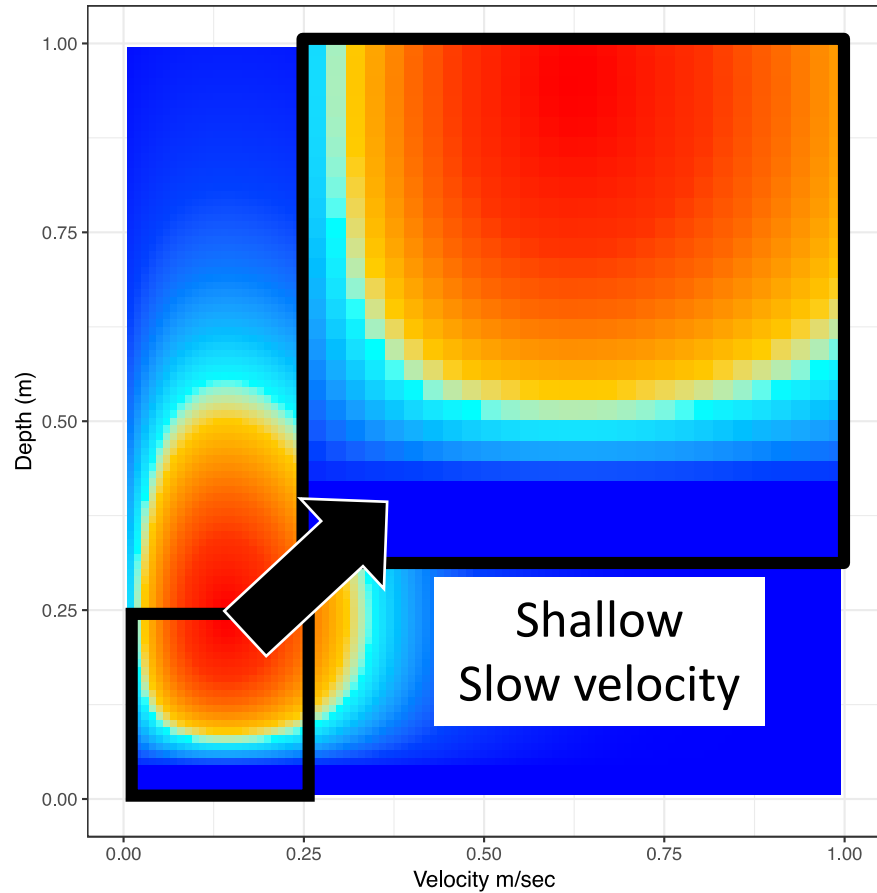


Bioenergetic

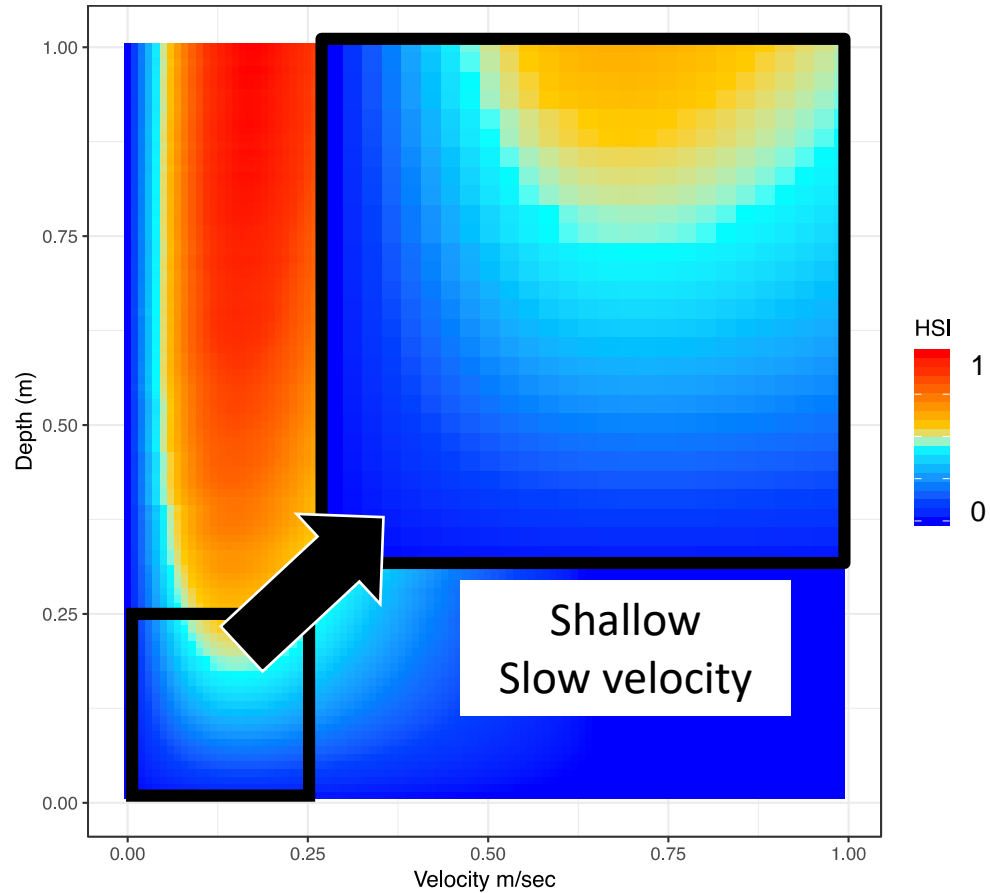


Results – Correlative vs. bioenergetic predictions

Correlative

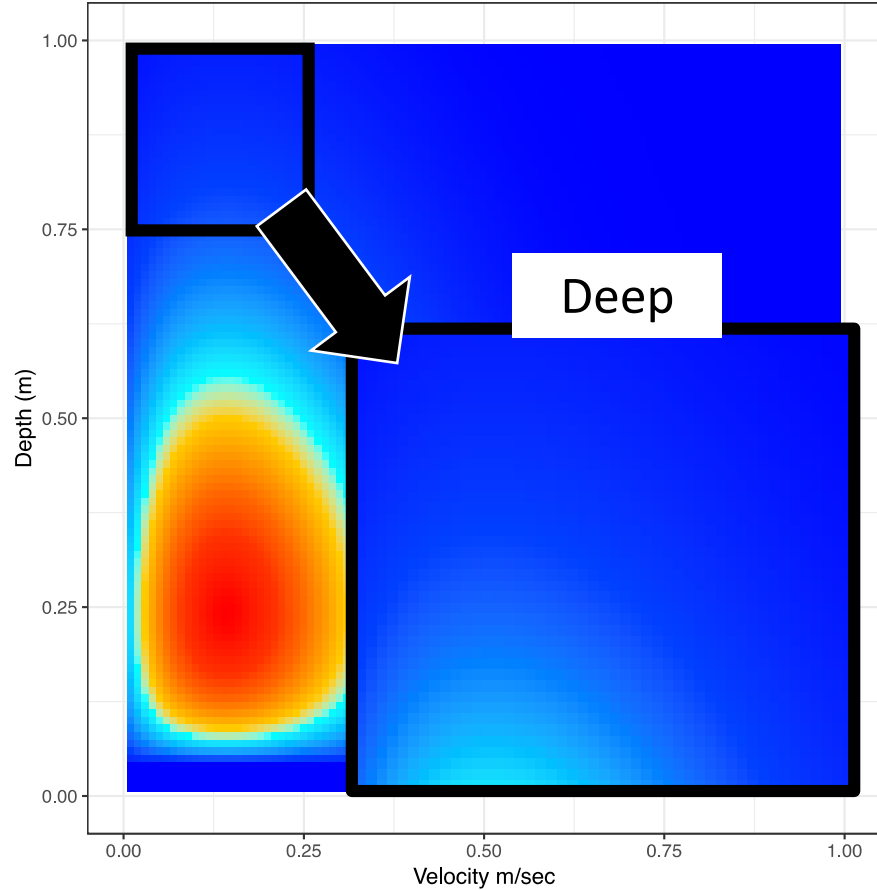


Bioenergetic

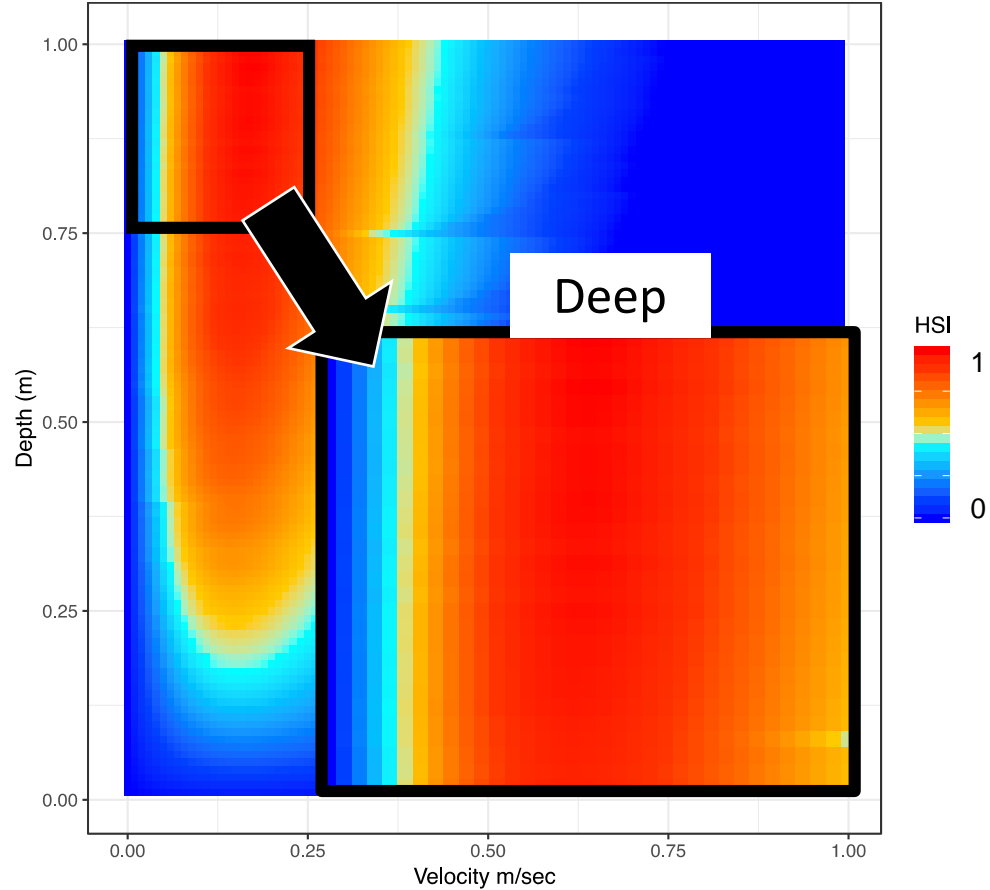


Results – Correlative vs. bioenergetic predictions

Correlative



Bioenergetic



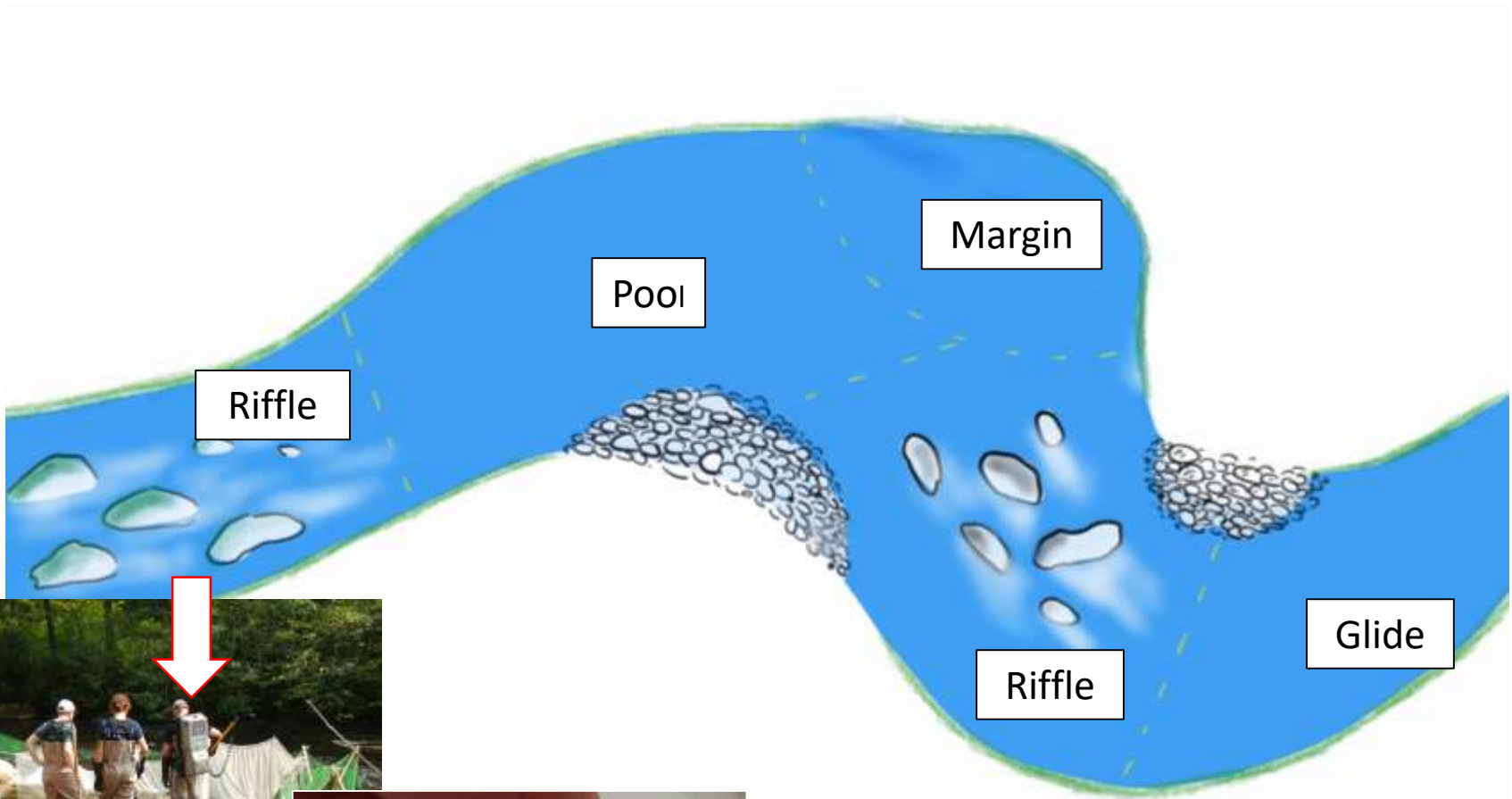
Objectives

- Compare correlative vs. bioenergetic model *predictions*
- **Evaluate correlative and bioenergetic model *performance***

Objectives

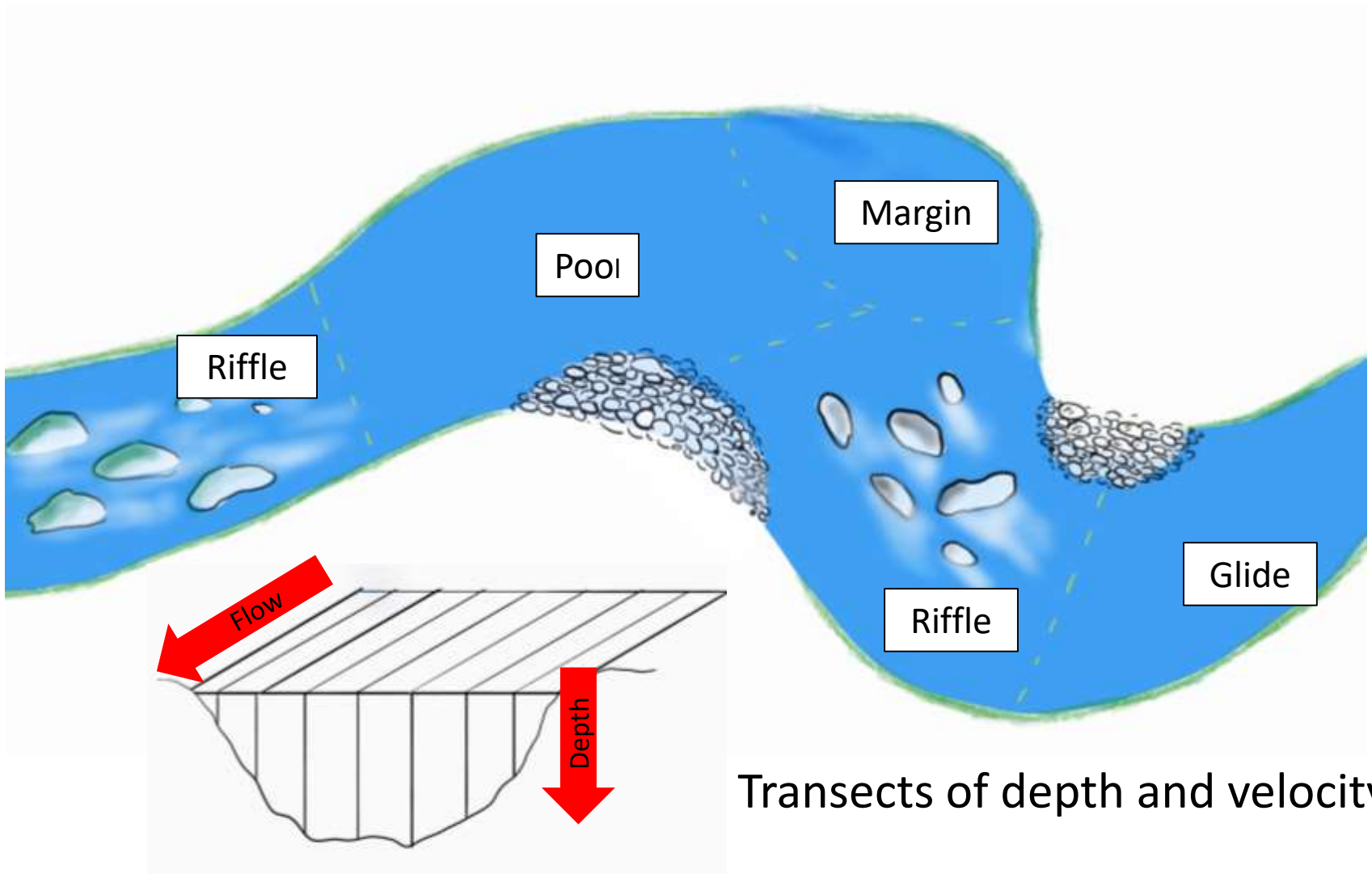
- Compare correlative vs. bioenergetic model *predictions*
- **Evaluate correlative and bioenergetic model *performance***
 - **Channel unit scale densities of juvenile steelhead**
 - **Growth rates of cutthroat trout**

Steelhead density estimation

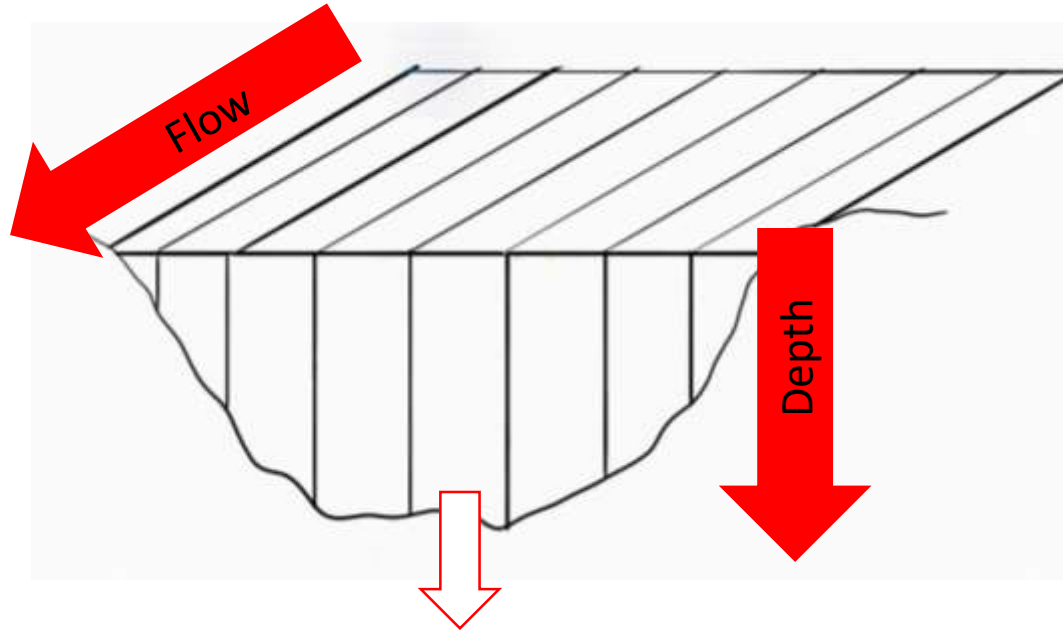


Juvenile steelhead abundance in channel units with contrasting habitat conditions

Habitat characterization



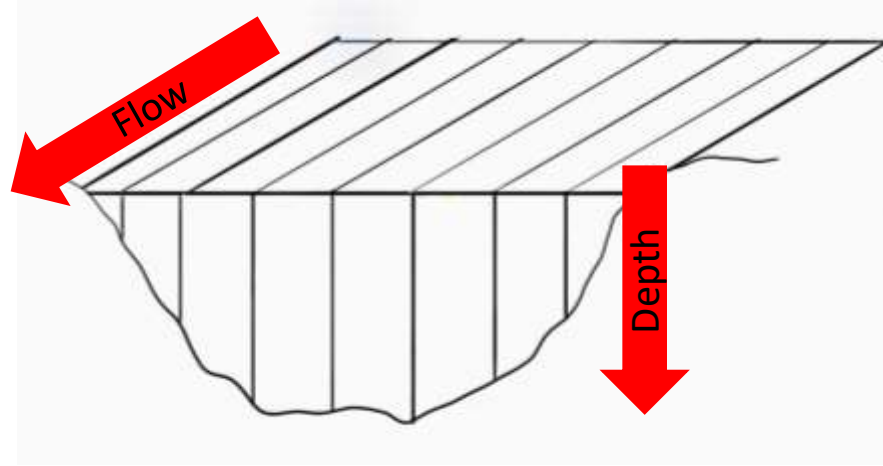
Habitat suitability index comparison



Suitability Index_{Correlative} vs. Suitability Index_{Bioenergetic}

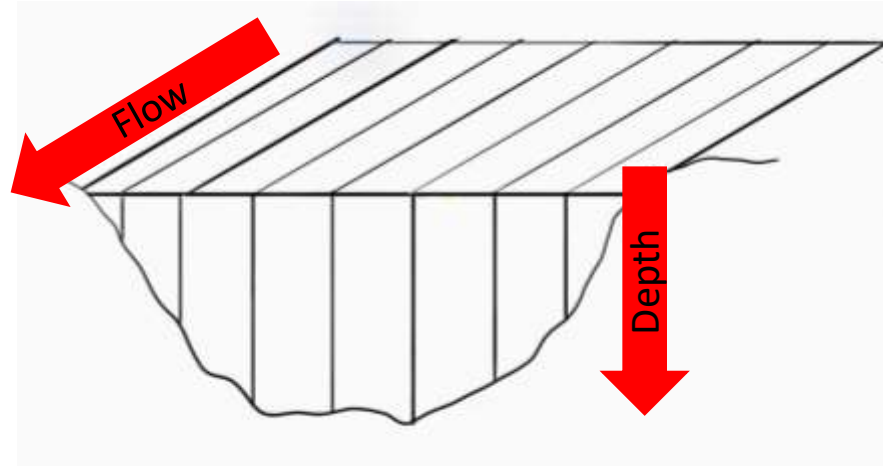
Aggregated habitat suitability metrics

1. Average suitability of all cells in each channel unit

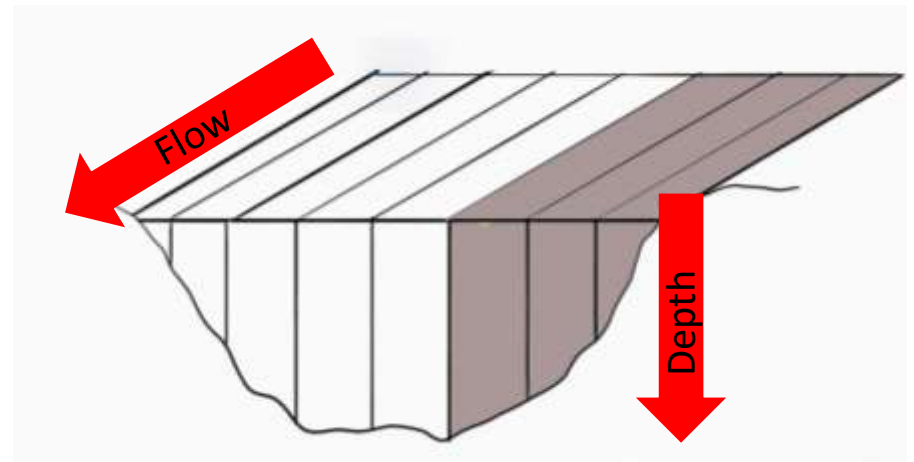


Aggregated habitat suitability metrics

1. Average suitability of all cells in each channel unit

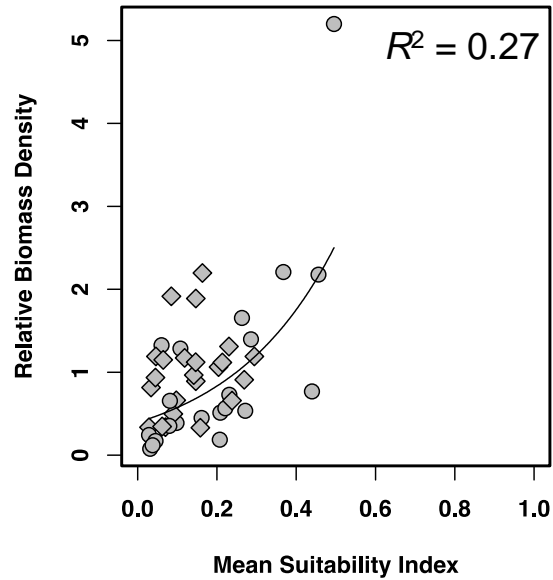


2. Proportion of cells in a channel unit with suitability > 0

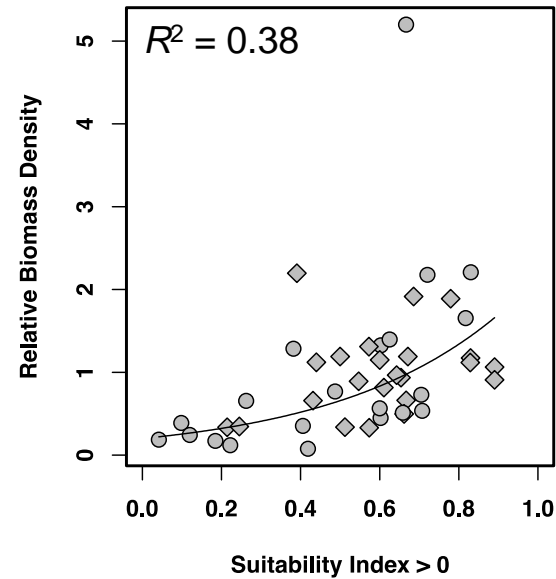
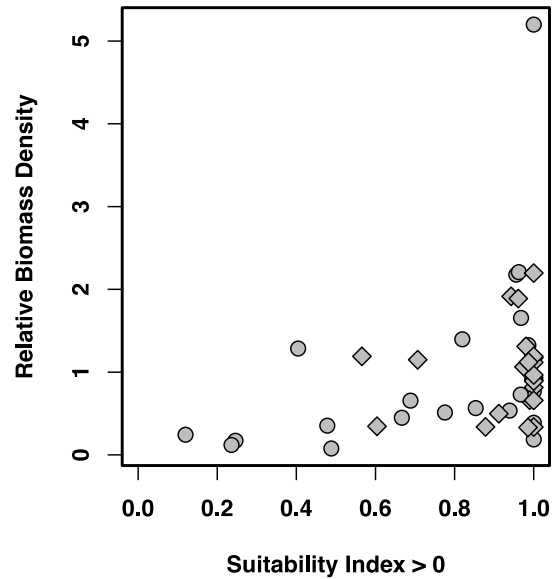
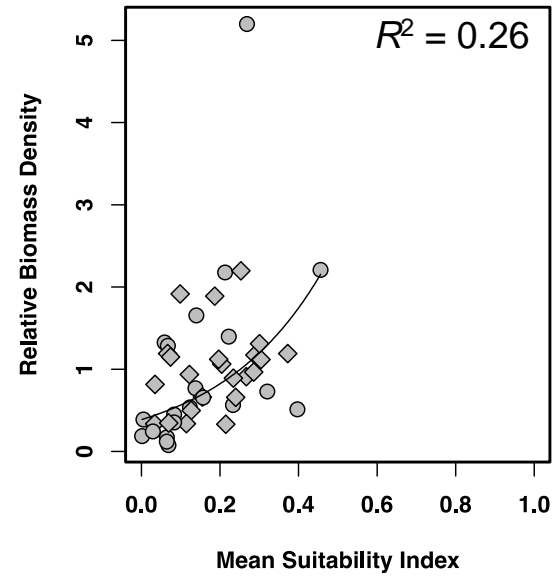


Results

Correlative

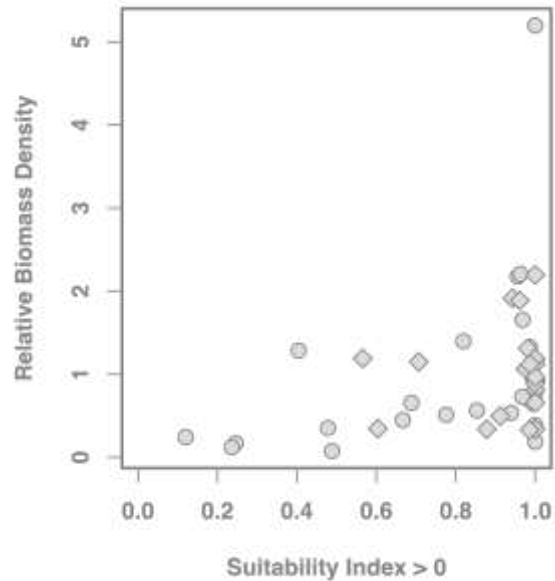
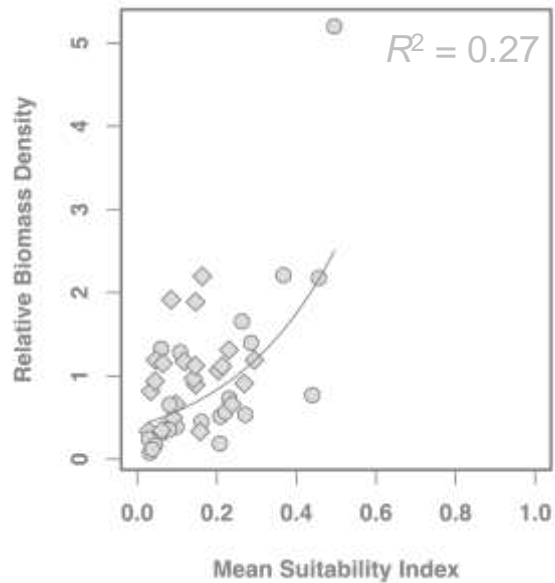


Bioenergetic

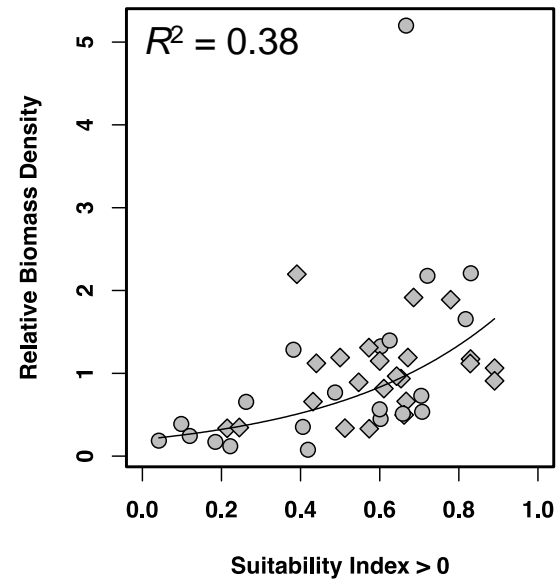
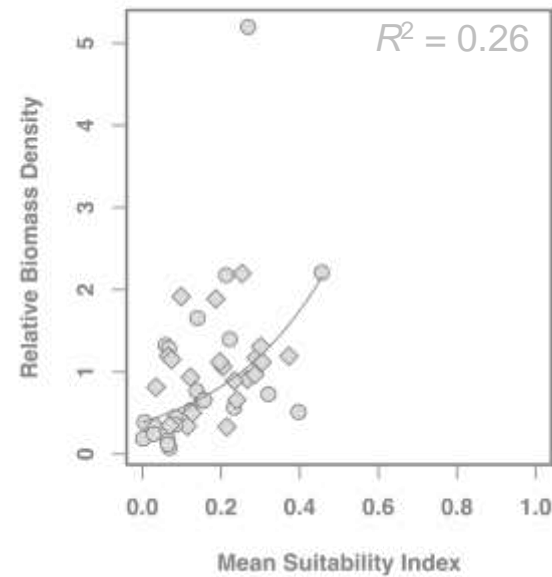


Results

Correlative



Bioenergetic



Model performance predicting cutthroat growth

Density-independent growth of coastal cutthroat trout across contrasting habitat conditions



Rosenfeld and Boss (2001) *CJFAS*

Image: Wild Fish Conservancy

Cutthroat growth experiment



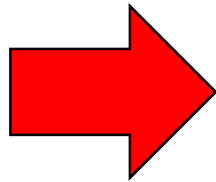
Small and large trout
enclosed in pools or riffles
Observations of focal depth
and velocity

Invertebrate drift and
temperature

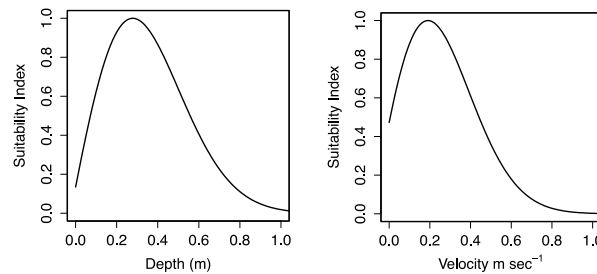
Growth (% day⁻¹) over 1
month

Cutthroat growth analysis

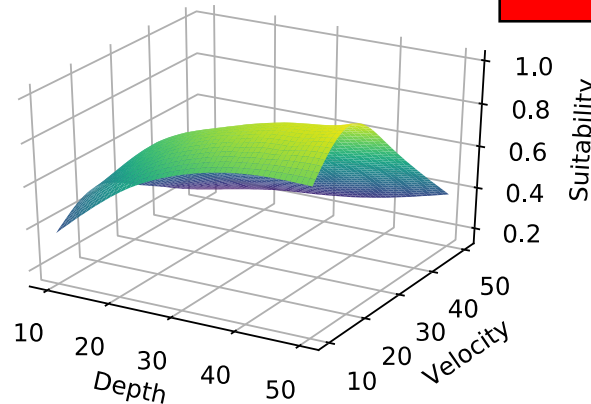
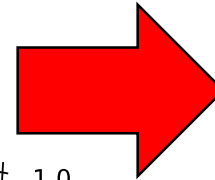
Focal point
depth and velocity



Habitat suitability
model predictions

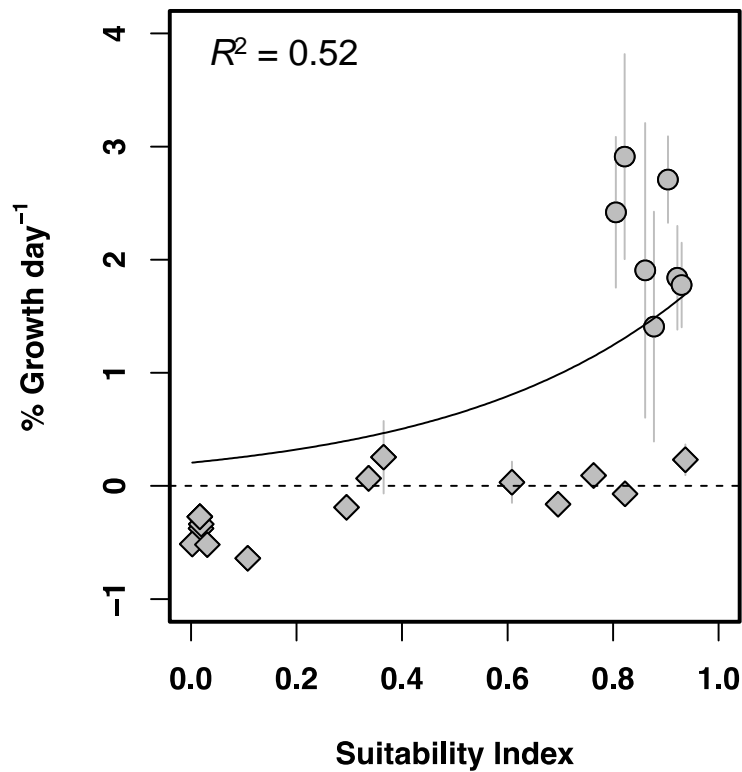


Test if suitability
predicts growth

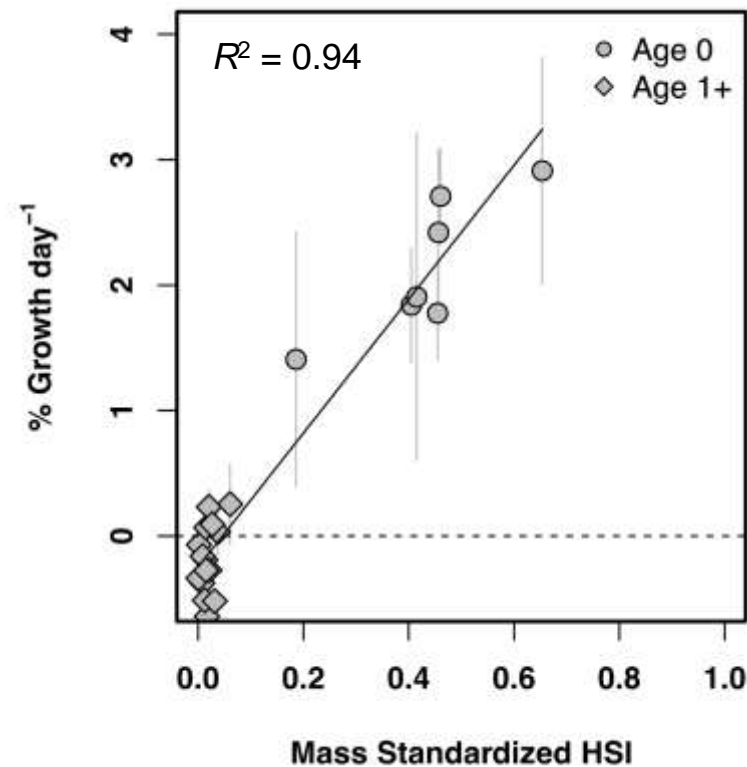


Results – Model performance predicting growth

Correlative model

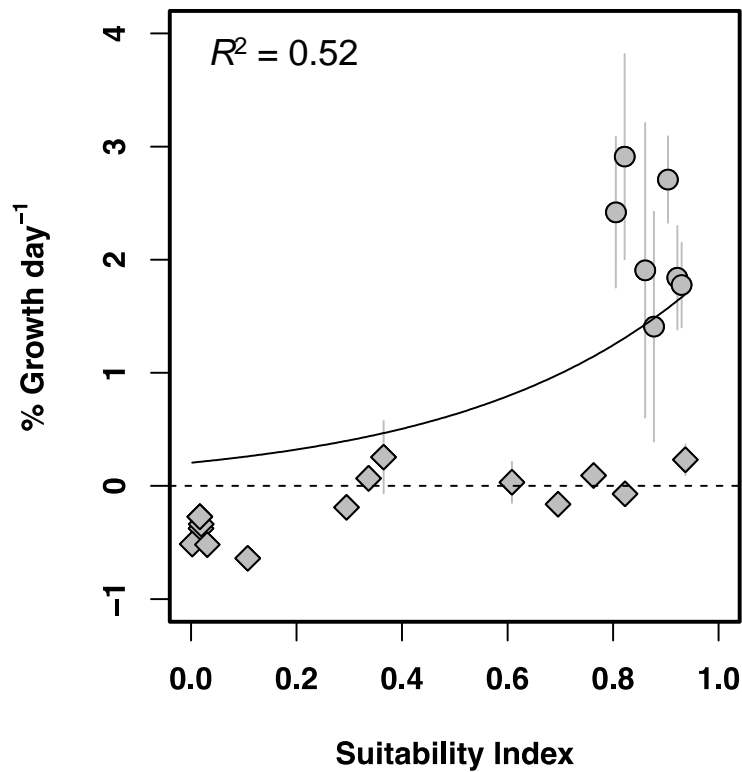


Bioenergetic model

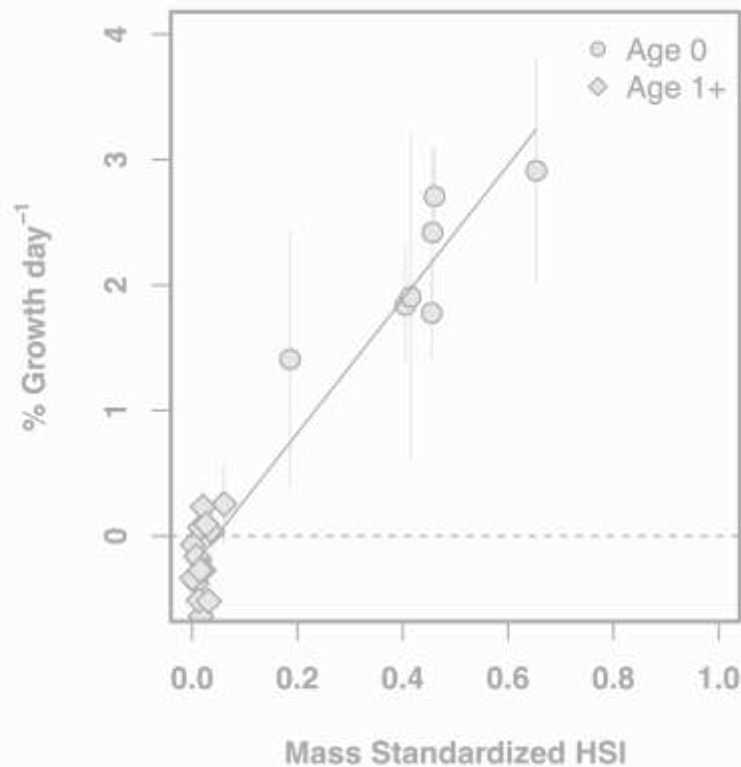


Results – Model performance predicting growth

Correlative model

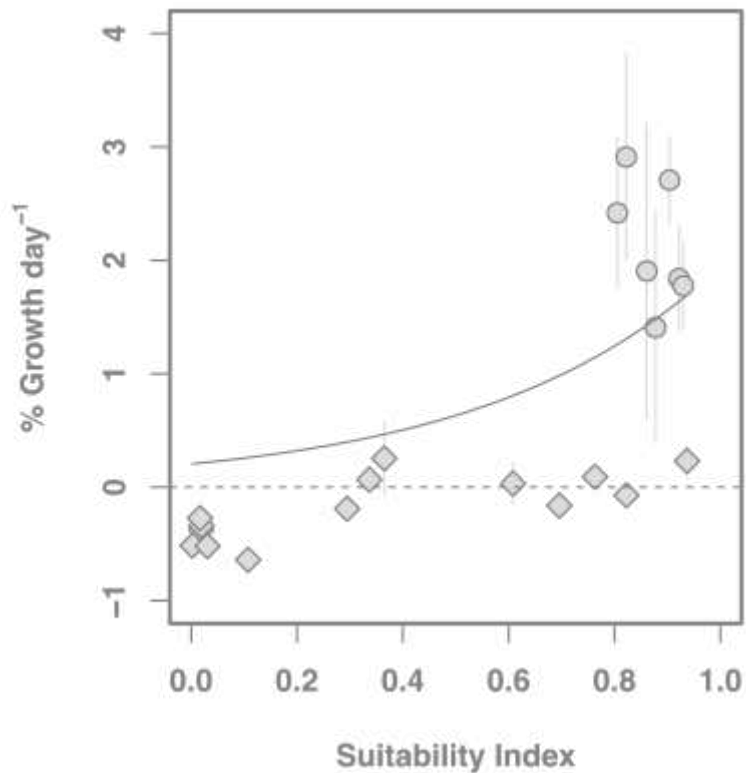


Bioenergetic model

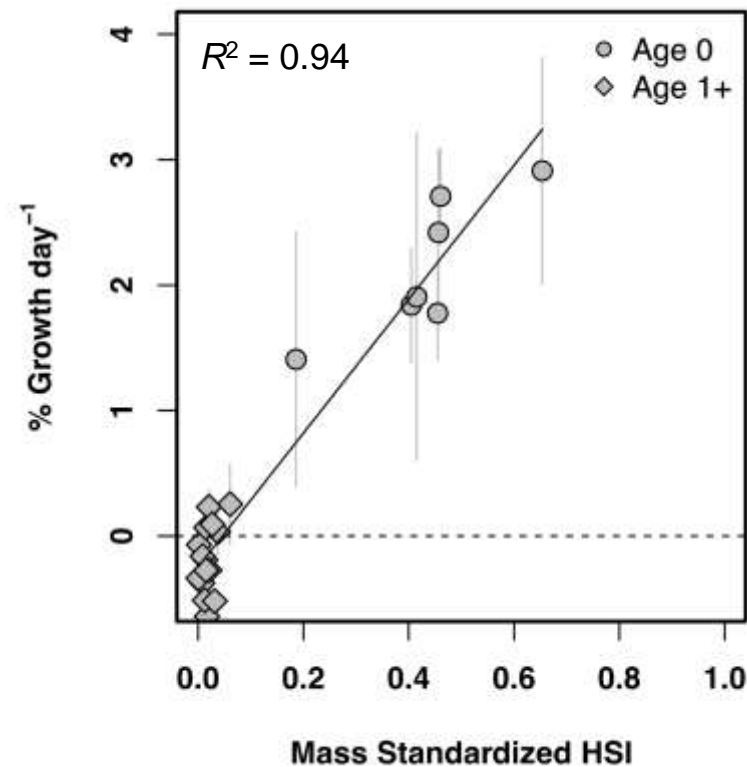


Results – Model performance predicting growth

Correlative model



Bioenergetic model



Key messages

- Correlative and mechanistic models make different predictions of habitat suitability

Key messages

- Correlative and mechanistic models make different predictions of habitat suitability
- Improved performance using mechanistic bioenergetic habitat suitability models

User-friendly software for bioenergetic habitat suitability criteria

MainWindow

Model Settings Results Batch Process

/Users/Sean/Documents/Rprojects/HSC_validation/Raw_data/phdrift_bulk_2018-5-8.csv Drift density file

Fish wet mass 4.0 g Fish fork length 7.0 cm Water temperature 12.0 °C

Fish focal point depth 0.5 as a fixed distance above the bottom (cm) Turbidity 0.0 NTUs

Swimming cost submodel Brett & Glass 1973 (Sockeye salmon)

Vertical velocity profile Logarithmic

Capture success method Logistic regression

Turbulence adjustment None

Assimilation method Constant factor = 0.6 (Tucker and Rasmussen 1999, Hewett and Johnson 1992)

Prey detection probability 1.0 Reaction distance multiplier 1.0

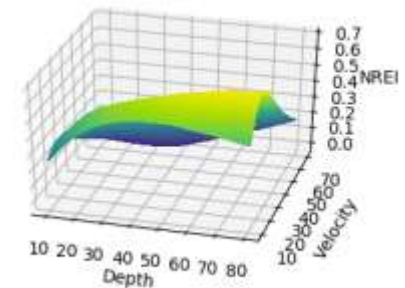
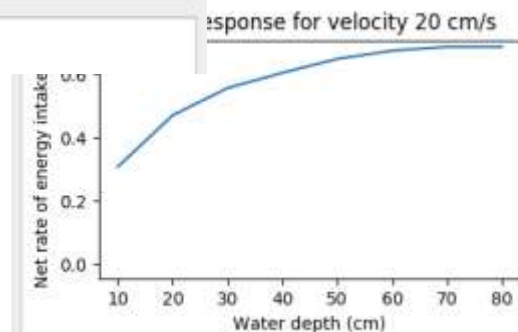
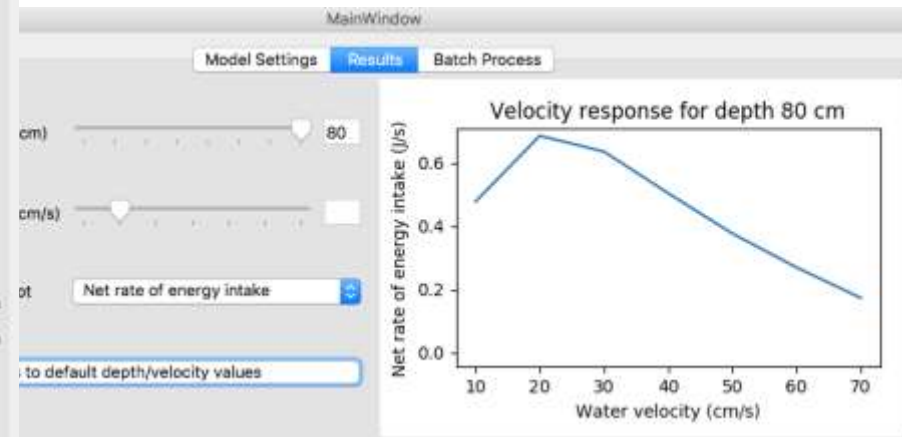
☒ Optimize diet by dropping energetically wasteful prey types

Maximum water velocity 100 cm/s Maximum depth 100 cm

Spatial grid resolution: 10 cm Velocity intervals: 10 cm/s Depth intervals: 10 cm

Run Model

Calculated NREI = -0.0624 J/s at depth = 10.00 cm and velocity = 100.00 cm/s.
Calculated NREI = -0.0485 J/s at depth = 20.00 cm and velocity = 100.00 cm/s.
Calculated NREI = -0.0369 J/s at depth = 30.00 cm and velocity = 100.00 cm/s.



Thanks!

- Funding - NSERC (Canada), BC Hydro, Freshwater Fisheries Society of BC, BC Ministry of Environment
- Field and lab assistance – Eva Jordison, Melanie Kuzyk, Angie Nicholas
- Logistics and advice – Kristin Gale, Josh Korman, Alexis Hall, BC Provincial Parks

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