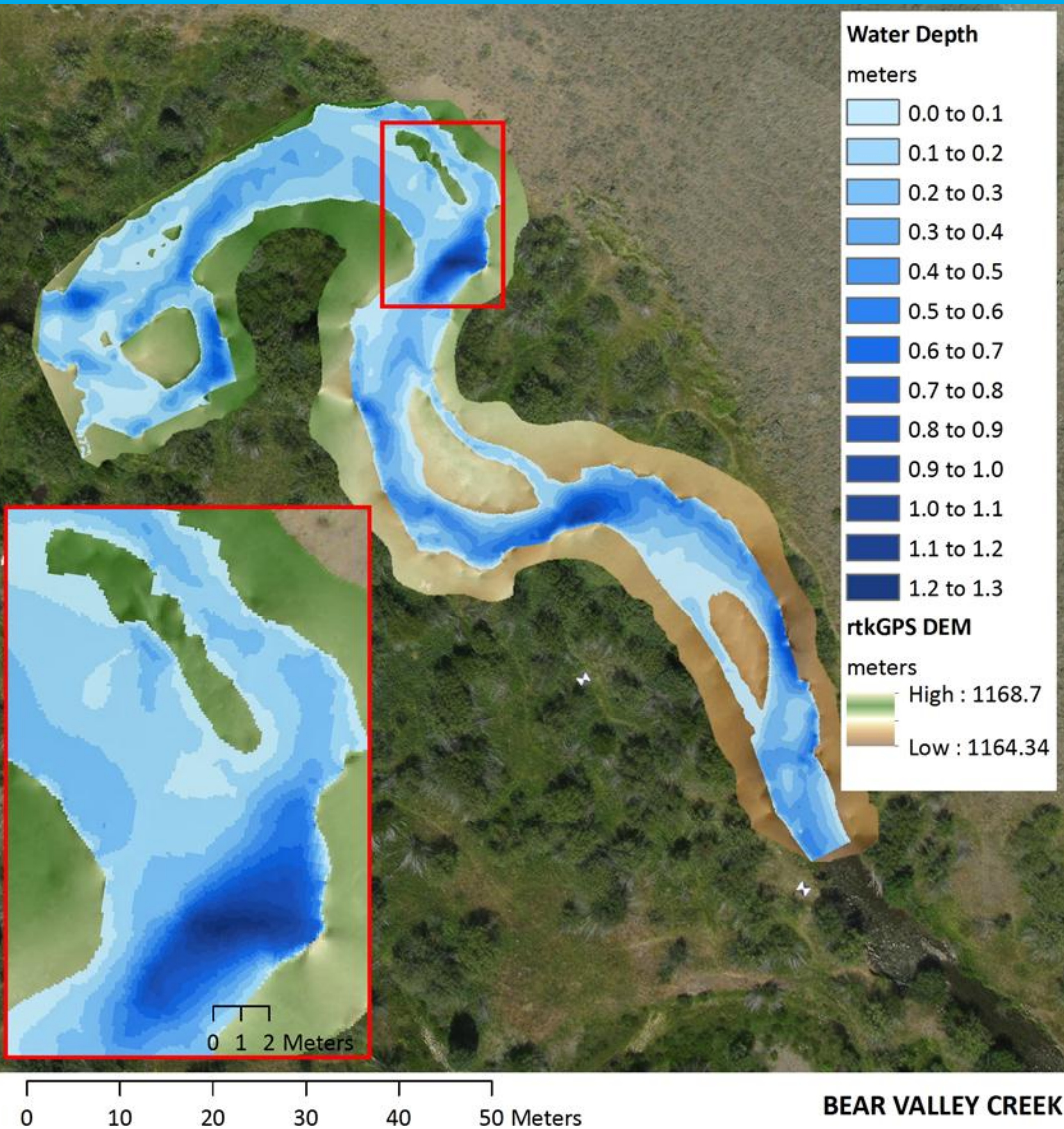
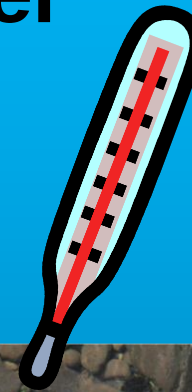
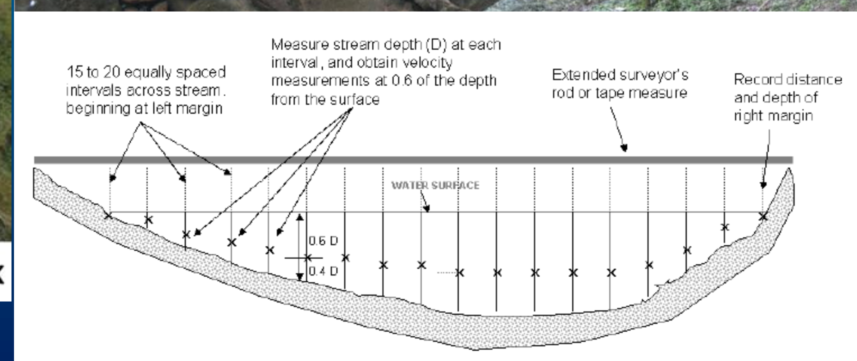
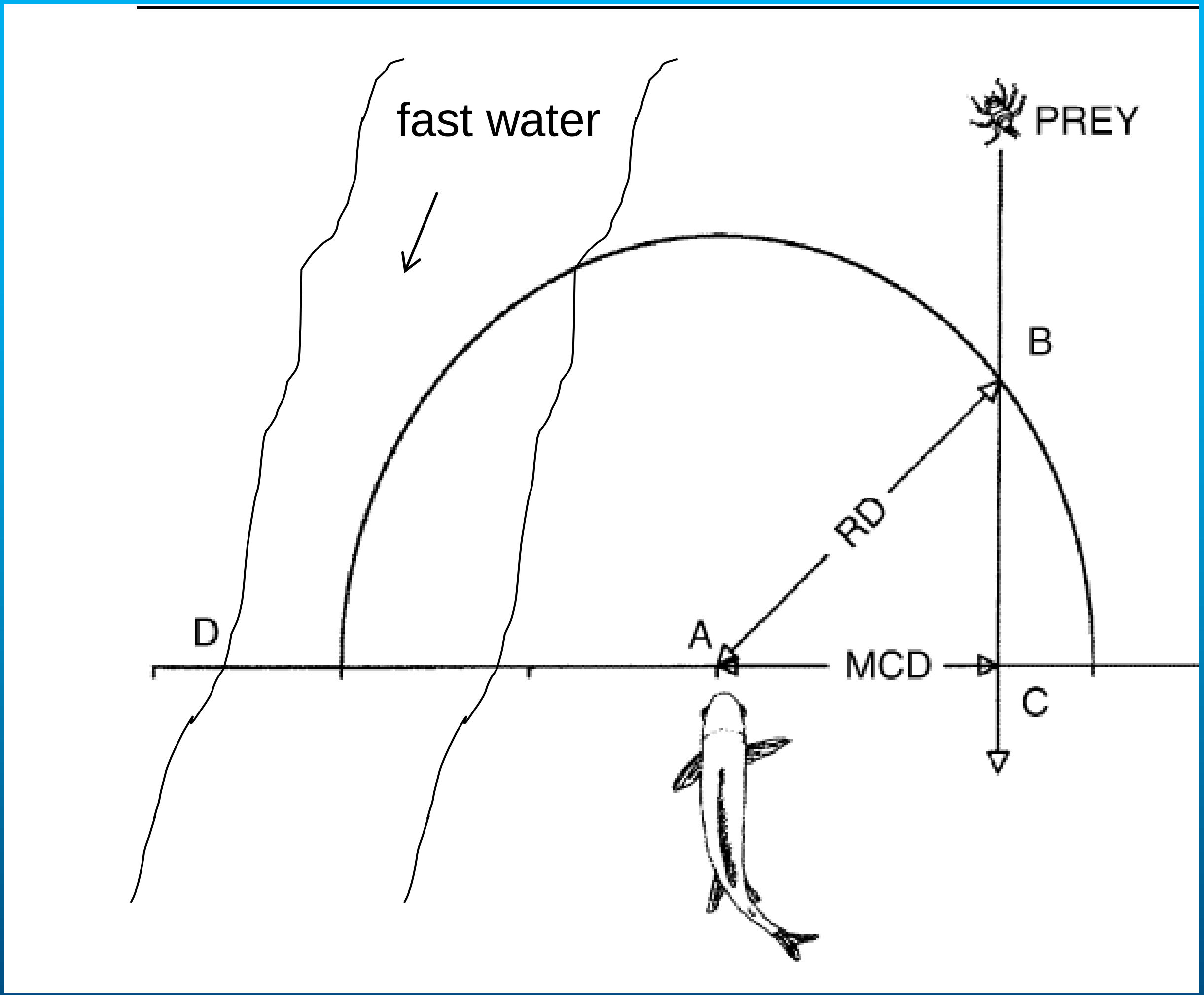
What does this mean to fish?
Putting the pieces together









Foraging Model

From Hayes et al. 2007

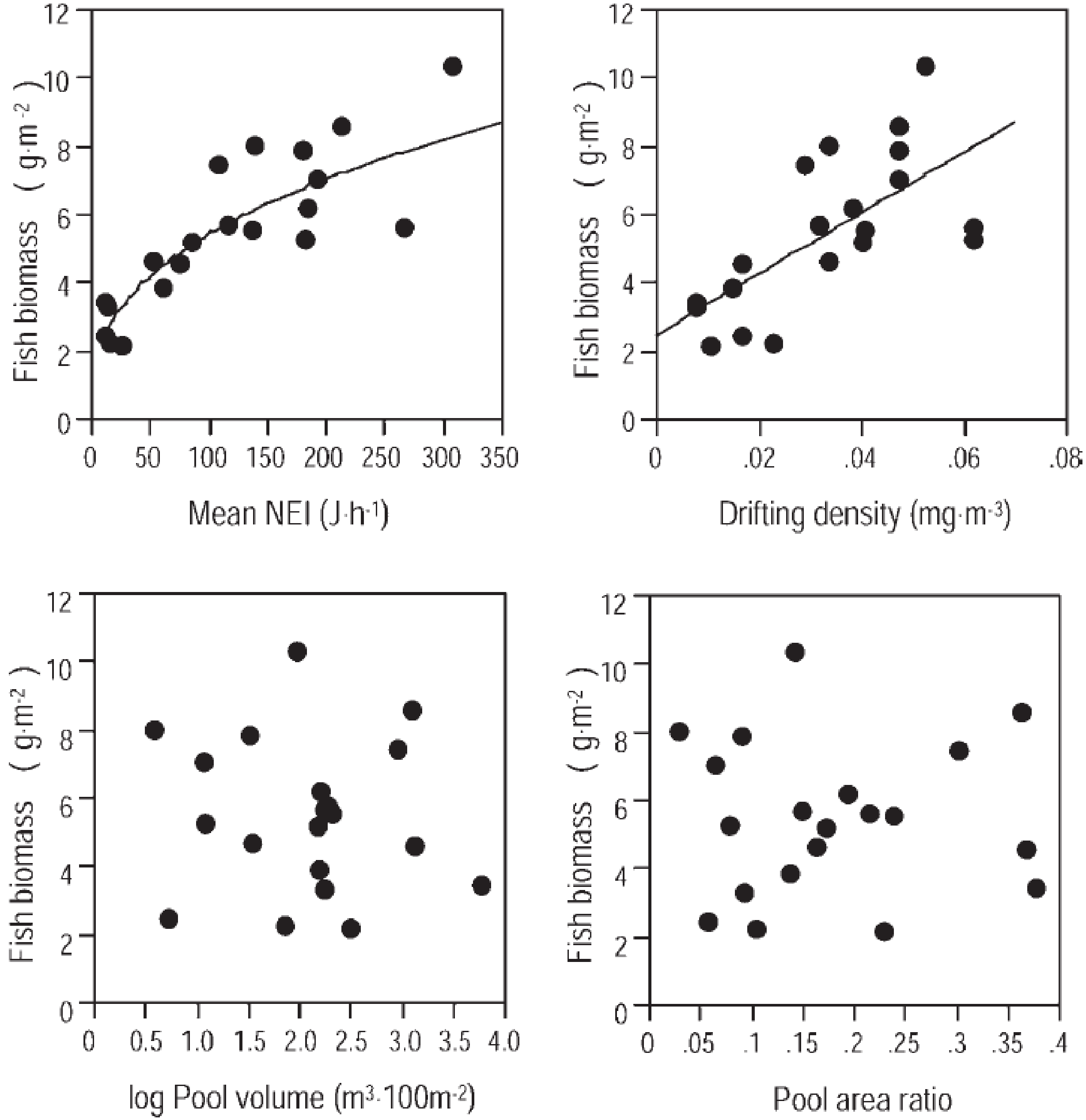
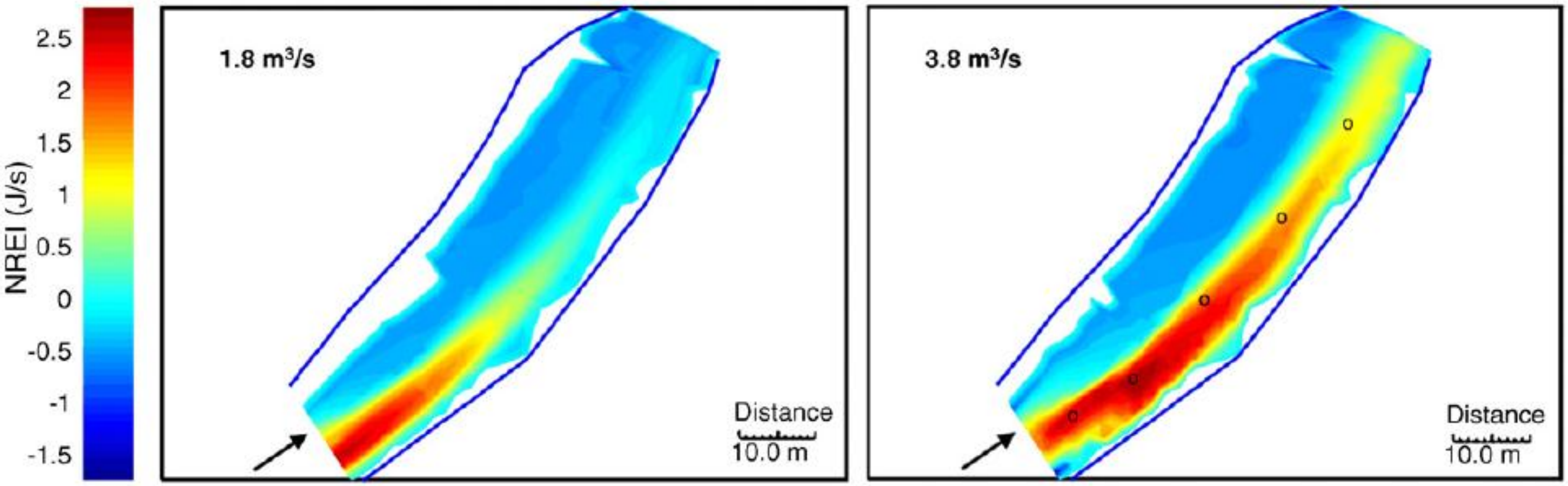


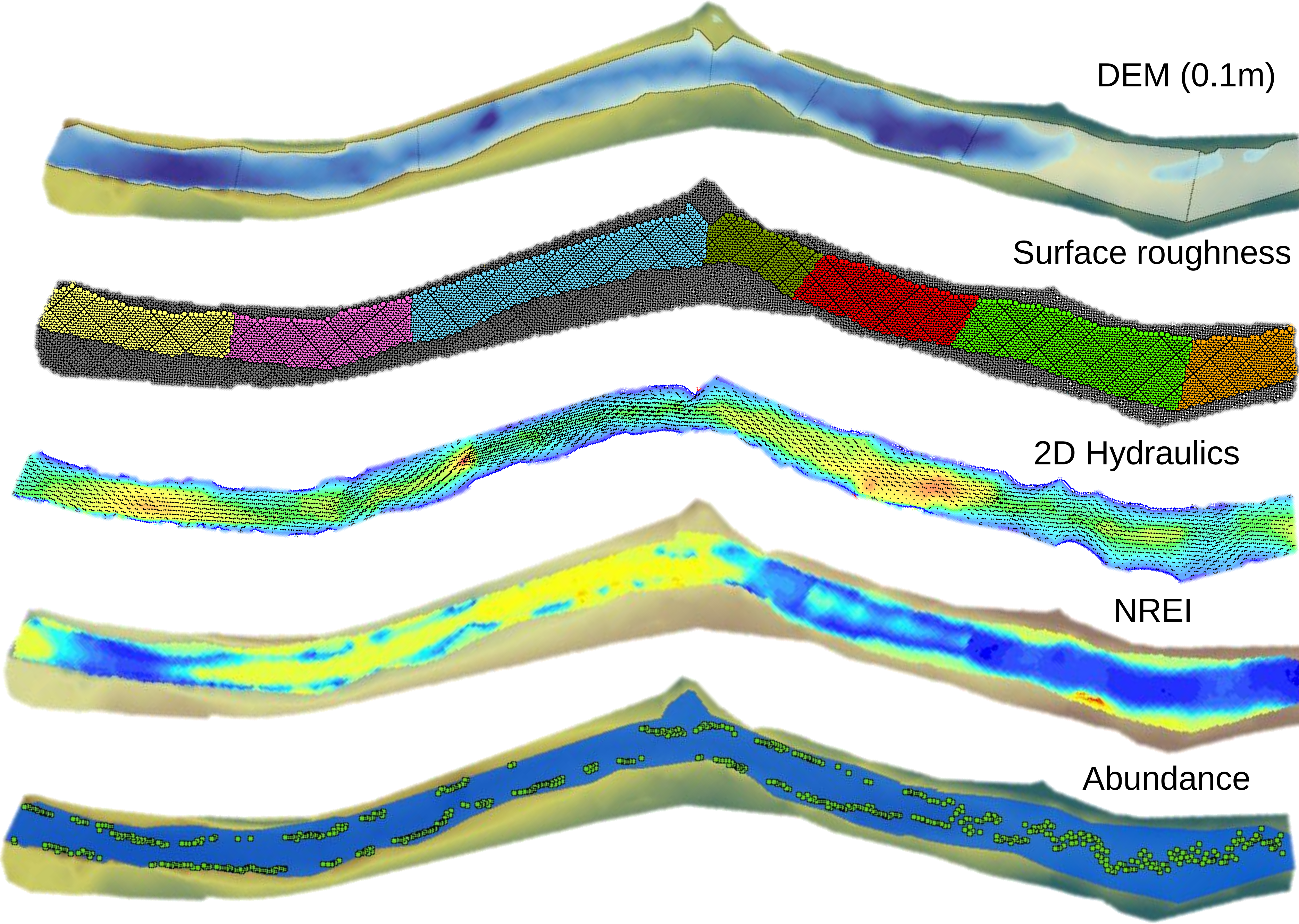
FIGURE 2.—Relationships between salmonid biomass and mean net energy intake (NEI), prey density, log-transformed pool volume, and pool area.

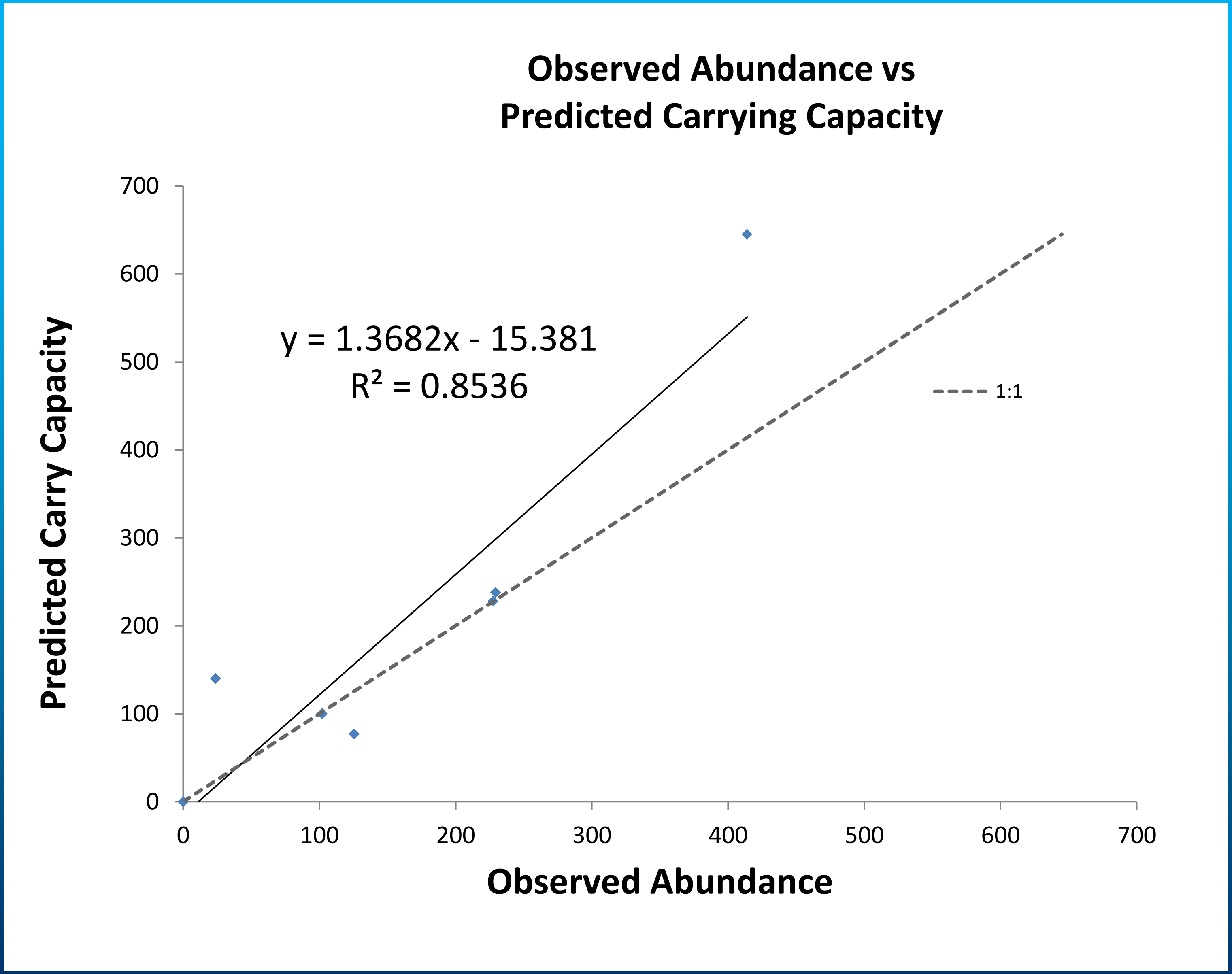
Urabe et al. 2010 TAFS

Net Rate of Energy Intake (NREI) and Carrying Capacity
Synthesis of drift, DEM and temperature

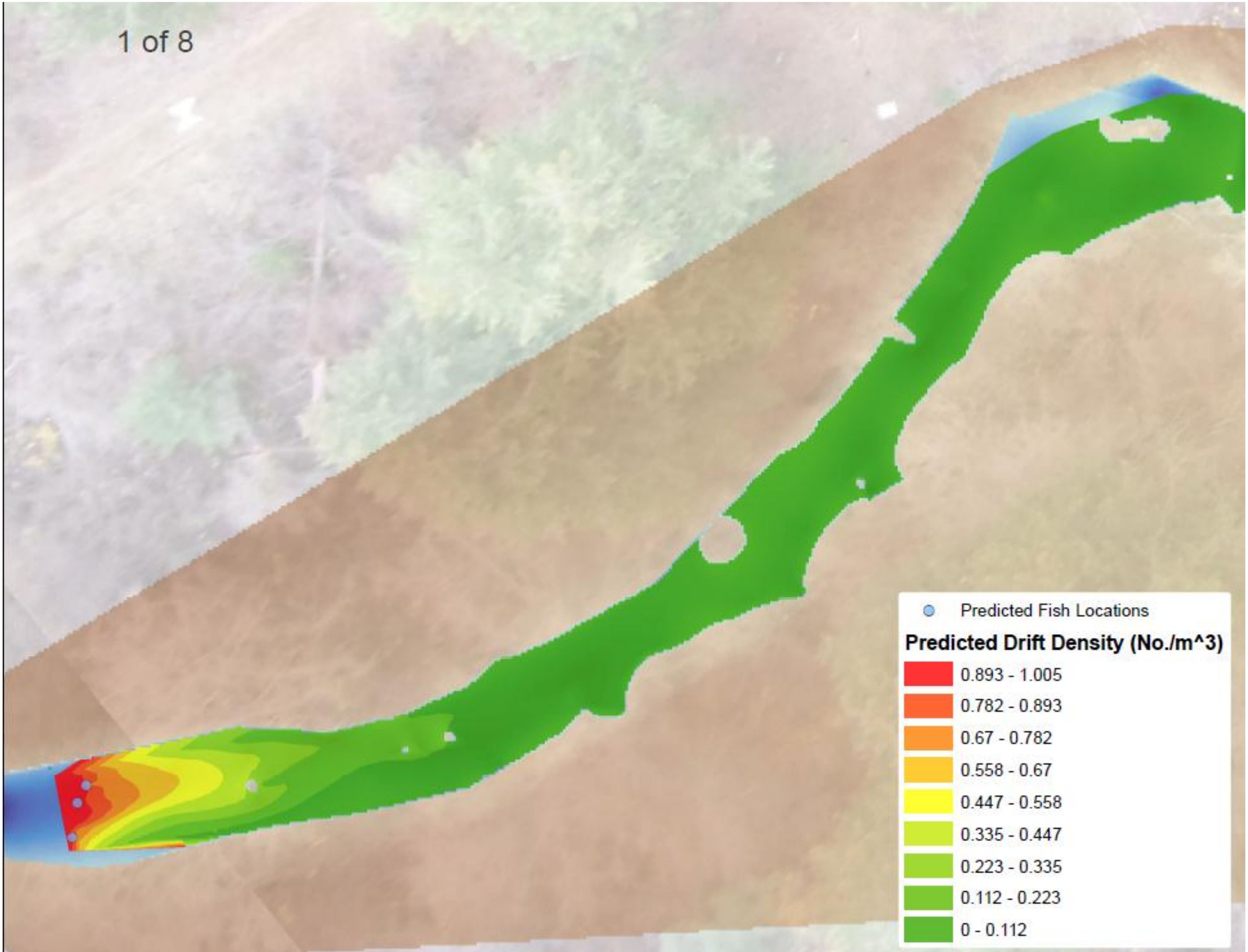


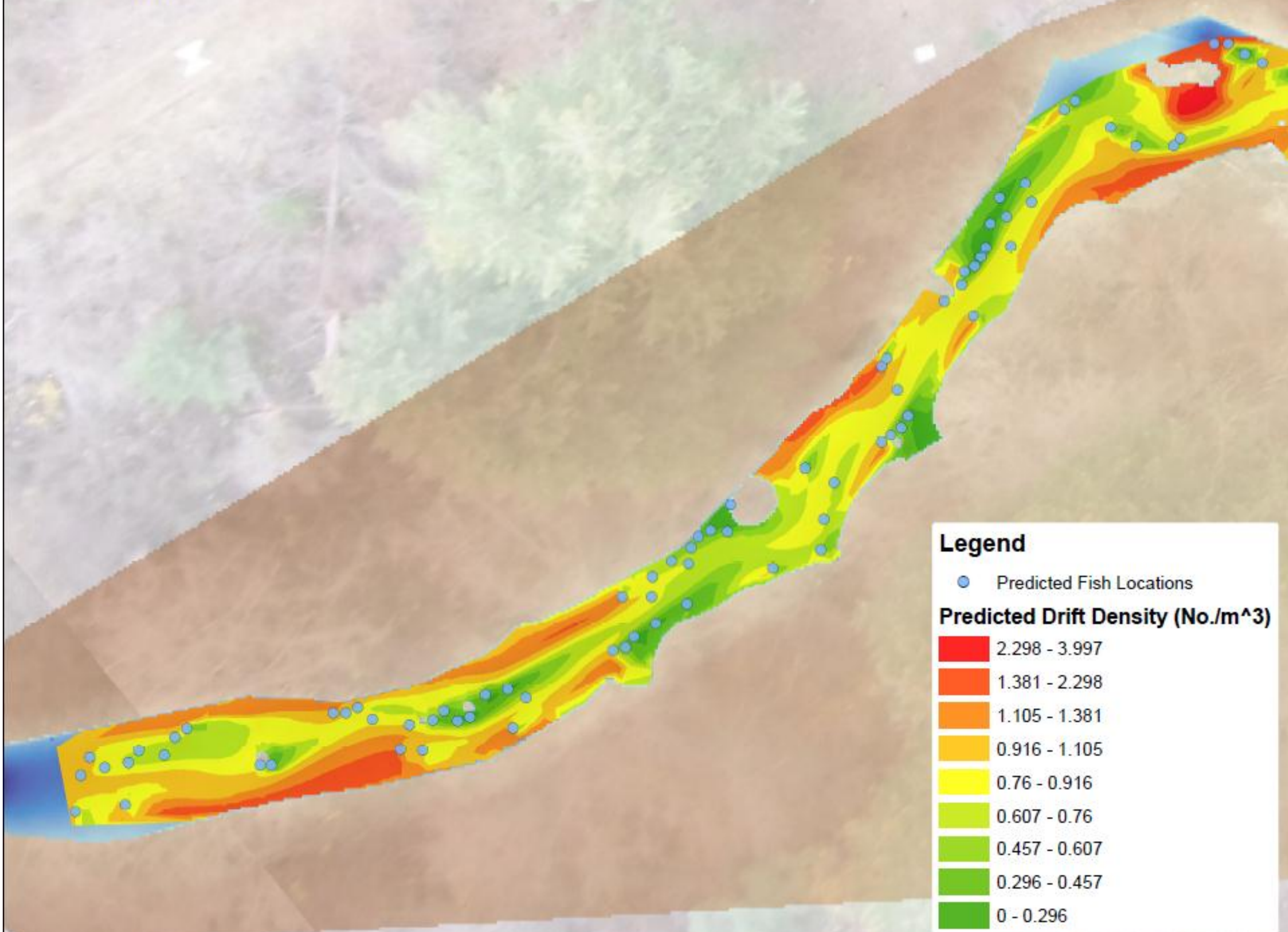
From Hayes et al. 2007

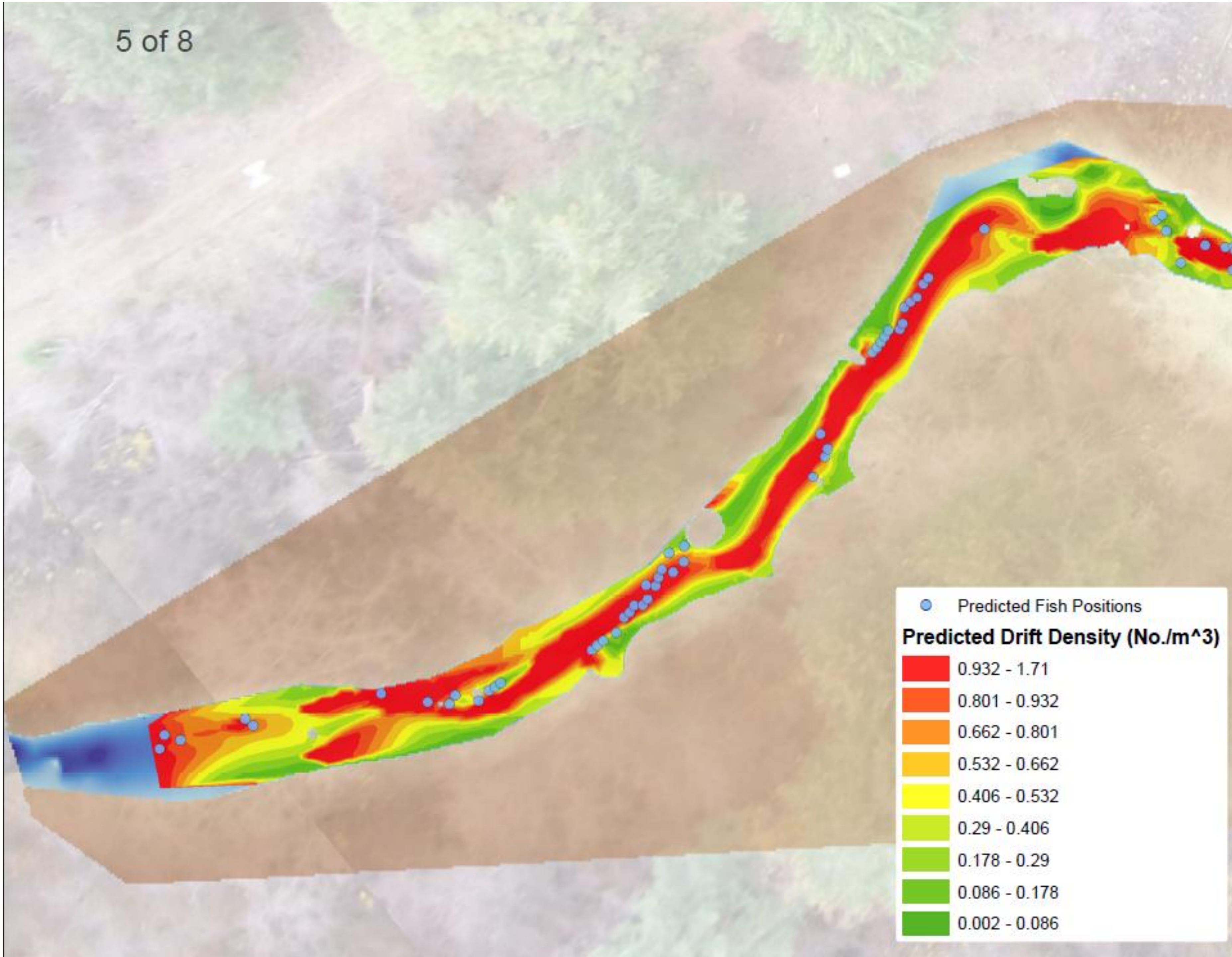

DEM (0.1m)
Surface roughness
2D Hydraulics
NREI
Abundance

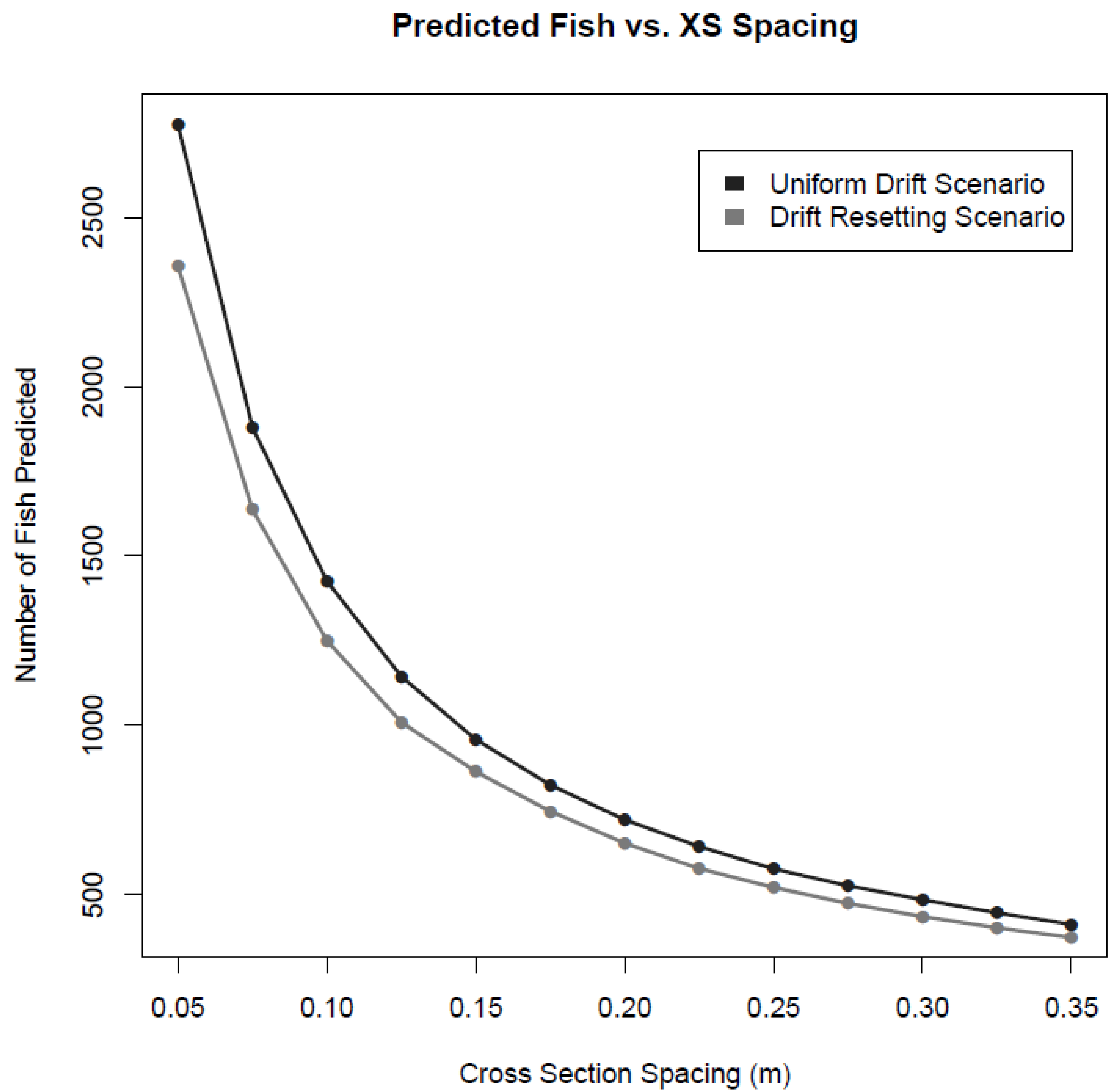


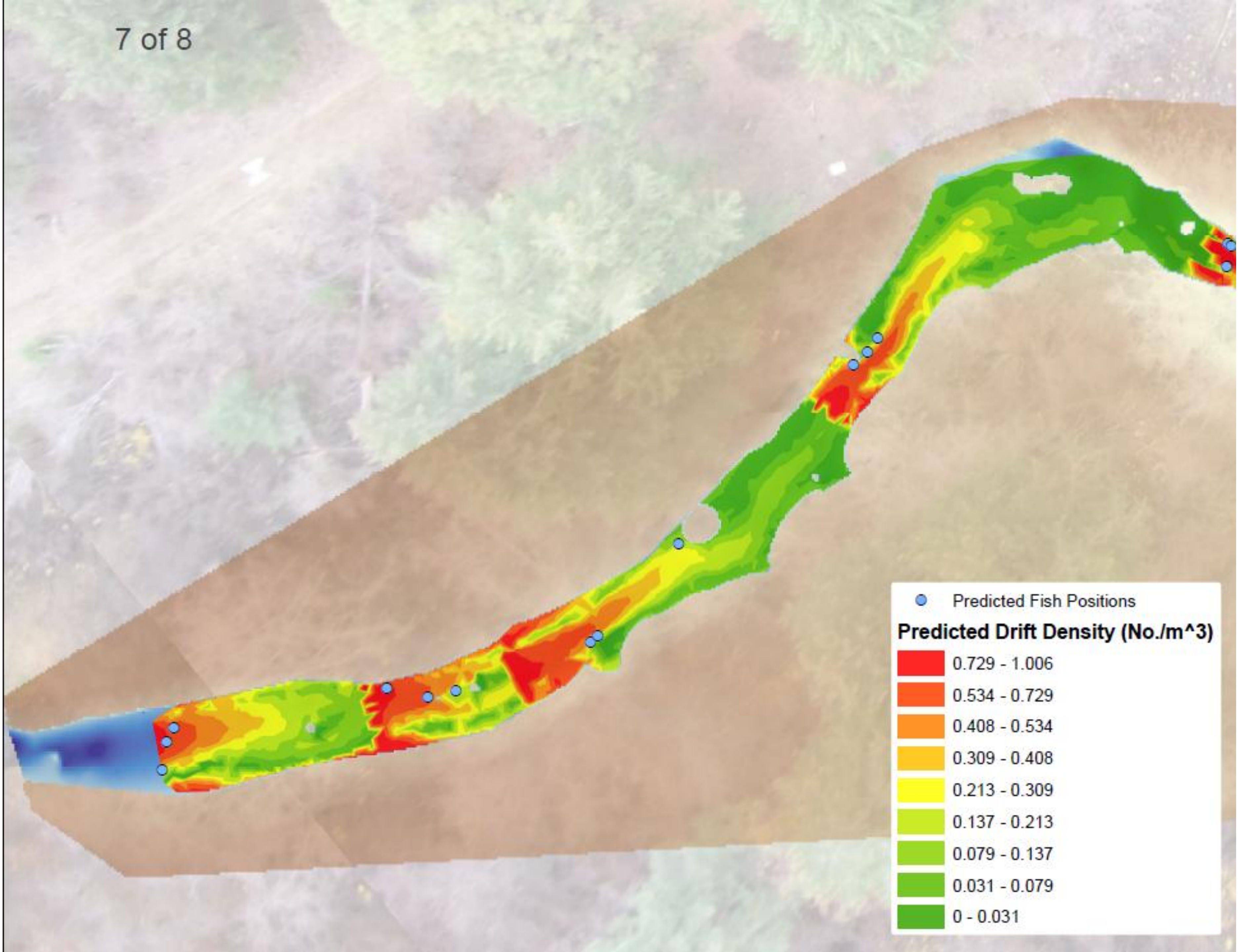
Observed Abundance vs
Predicted Carrying Capacity
y = 1.3682x - 15.381
R² = 0.8536
1:1
Predicted Carry Capacity
Observed Abundance
0
100
200
300
400
500
600
700


Predicted Fish Locations
Predicted Drift Density (No./m^3)
0.893 - 1.005
0.782 - 0.893
0.67 - 0.782
0.558 - 0.67
0.447 - 0.558
0.335 - 0.447
0.223 - 0.335
0.112 - 0.223
0 - 0.112

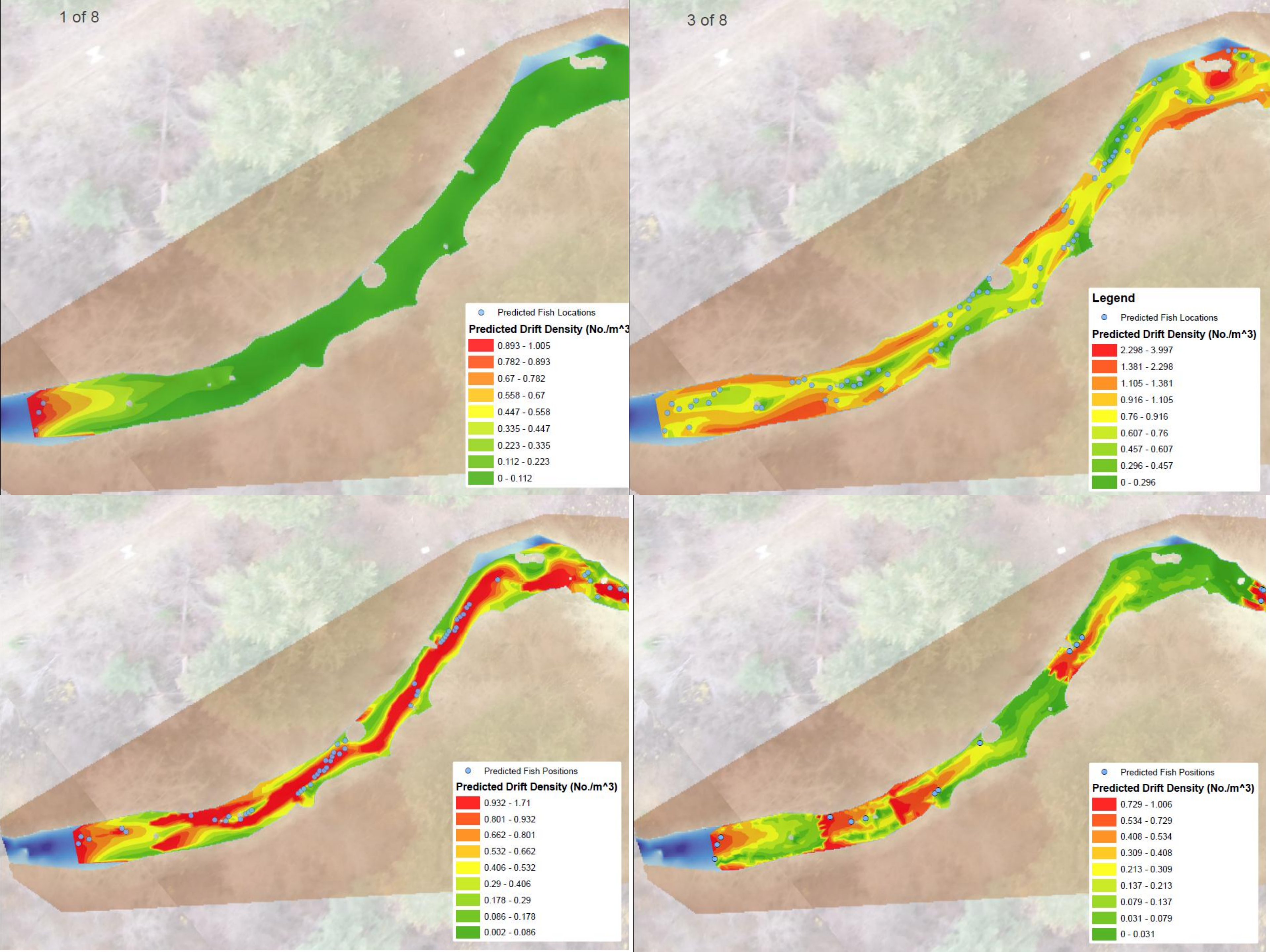

Legend
Predicted Fish Locations
Predicted Drift Density (No./m^3)
2.298 - 3.997
1.381 - 2.298
1.105 - 1.381
0.916 - 1.105
0.76 - 0.916
0.607 - 0.76
0.457 - 0.607
0.296 - 0.457
0 - 0.296

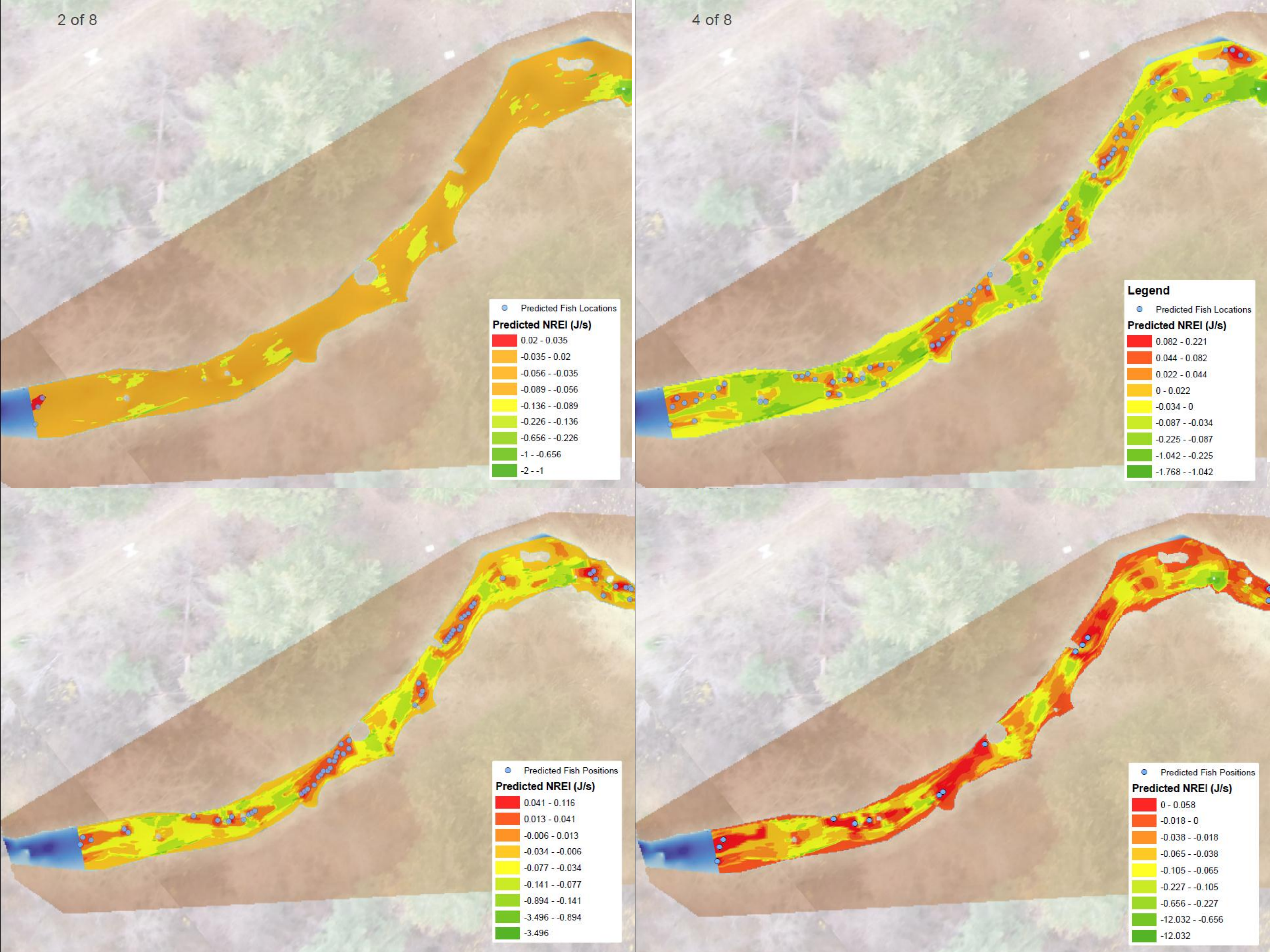

Predicted Fish Positions
Predicted Drift Density (No./m^3)
0.932 - 1.71
0.801 - 0.932
0.662 - 0.801
0.532 - 0.662
0.406 - 0.532
0.29 - 0.406
0.178 - 0.29
0.086 - 0.178
0.002 - 0.086


Predicted Fish vs. XS Spacing
Uniform Drift Scenario
Drift Resetting Scenario
Number of Fish Predicted
500
1000
1500
2000
2500
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Cross Section Spacing (m)



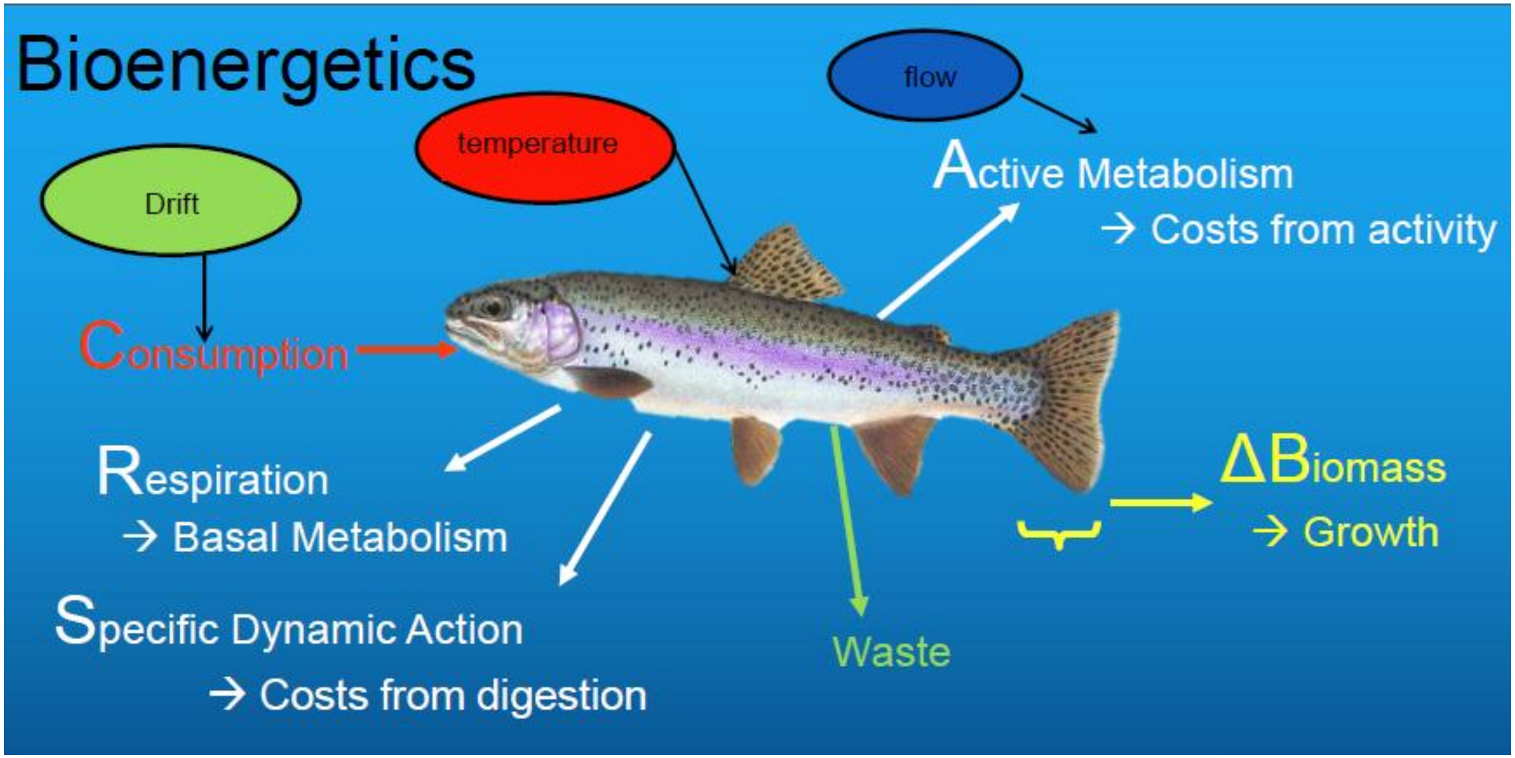
Predicted Fish Positions
Predicted Drift Density (No./m^3)
0.729 - 1.006
0.534 - 0.729
0.408 - 0.534
0.309 - 0.408
0.213 - 0.309
0.137 - 0.213
0.079 - 0.137
0.031 - 0.079
0 - 0.031

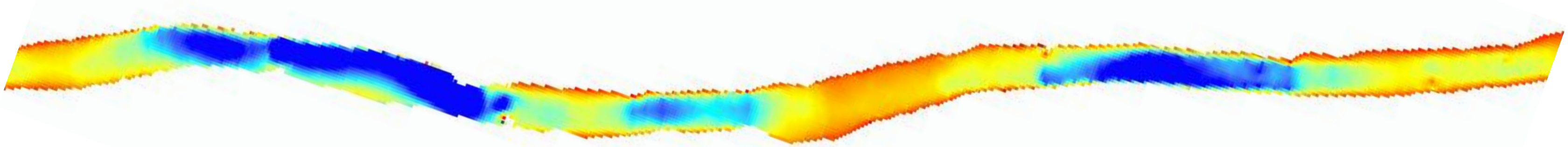

1 of 8
Predicted Fish Locations
Predicted Drift Density (No./m^3
0.893 - 1.005
0.782 - 0.893
0.67 - 0.782
0.558 - 0.67
0.447 - 0.558
0.335 - 0.447
0.223 - 0.335
0.112 - 0.223
0 - 0.112
3 of 8
Legend
Predicted Fish Locations
Predicted Drift Density (No./m^3)
2.298 - 3.997
1.381 - 2.298
1.105 - 1.381
0.916 - 1.105
0.76 - 0.916
0.607 - 0.76
0.457 - 0.607
0.296 - 0.457
0 - 0.296
Predicted Fish Positions
Predicted Drift Density (No./m^3)
0.932 - 1.71
0.801 - 0.932
0.662 - 0.801
0.532 - 0.662
0.406 - 0.532
0.29 - 0.406
0.178 - 0.29
0.086 - 0.178
0.002 - 0.086
Predicted Fish Positions
Predicted Drift Density (No./m^3)
0.729 - 1.006
0.534 - 0.729
0.408 - 0.534
0.309 - 0.408
0.213 - 0.309
0.137 - 0.213
0.079 - 0.137
0.031 - 0.079
0 - 0.031



2 of 8
Predicted Fish Locations
Predicted NREI (J/s)
0.02 - 0.035
-0.035 - 0.02
-0.056 - -0.035
-0.089 - -0.056
-0.136 - -0.089
-0.226 - -0.136
-0.656 - -0.226
-1 - -0.656
-2 - -1
4 of 8
Legend
Predicted Fish Locations
Predicted NREI (J/s)
0.082 - 0.221
0.044 - 0.082
0.022 - 0.044
0 - 0.022
-0.034 - 0
-0.087 - -0.034
-0.225 - -0.087
-1.042 - -0.225
-1.768 - -1.042
Predicted Fish Positions
Predicted NREI (J/s)
0.041 - 0.116
0.013 - 0.041
-0.006 - 0.013
-0.034 - -0.006
-0.077 - -0.034
-0.141 - -0.077
-0.894 - -0.141
-3.496 - -0.894
-3.496
Predicted Fish Positions
Predicted NREI (J/s)
0 - 0.058
-0.018 - 0
-0.038 - -0.018
-0.065 - -0.038
-0.105 - -0.065
-0.227 - -0.105
-0.656 - -0.227
-12.032 - -0.656
-12.032

An Alternative to NREI Modeling



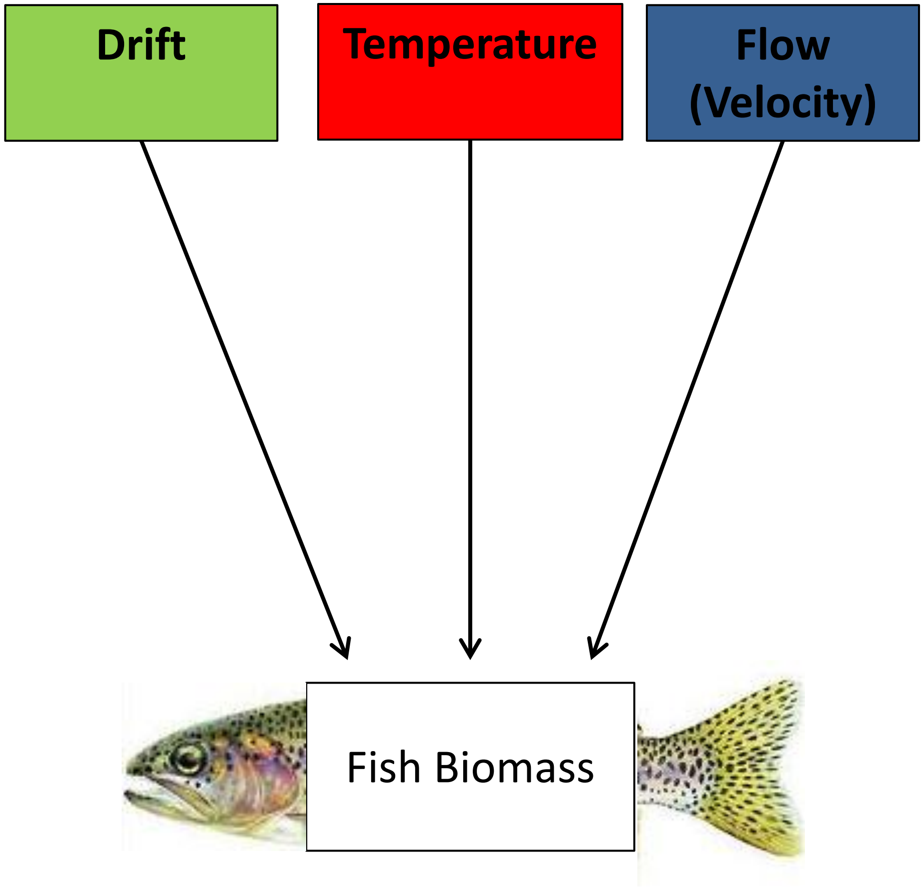


Net Rate Energy Intake

Low High

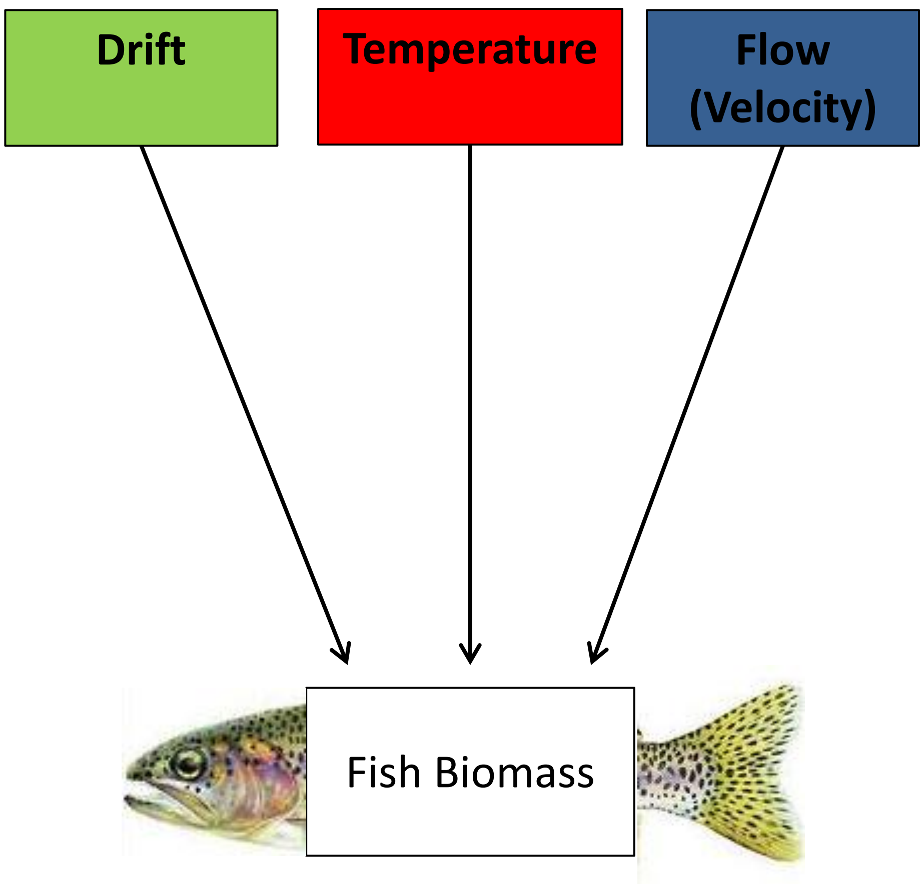
An Alternative to NREI Modeling

Multiple Regression

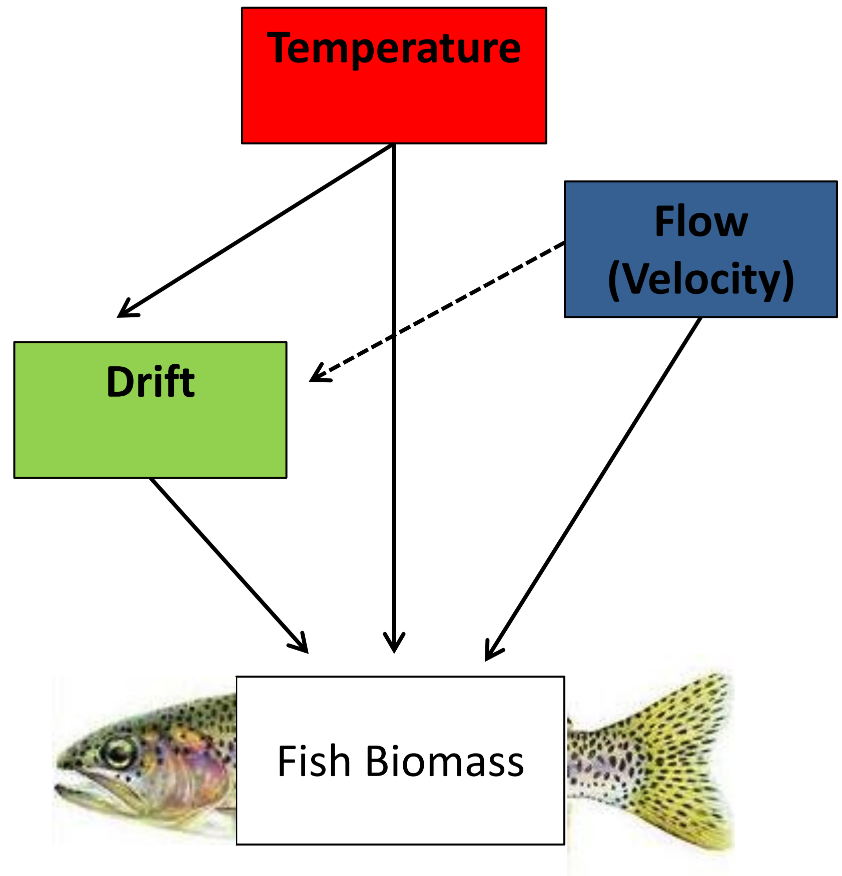


An Alternative to NREI Modeling

Multiple Regression



Structural Equation Models



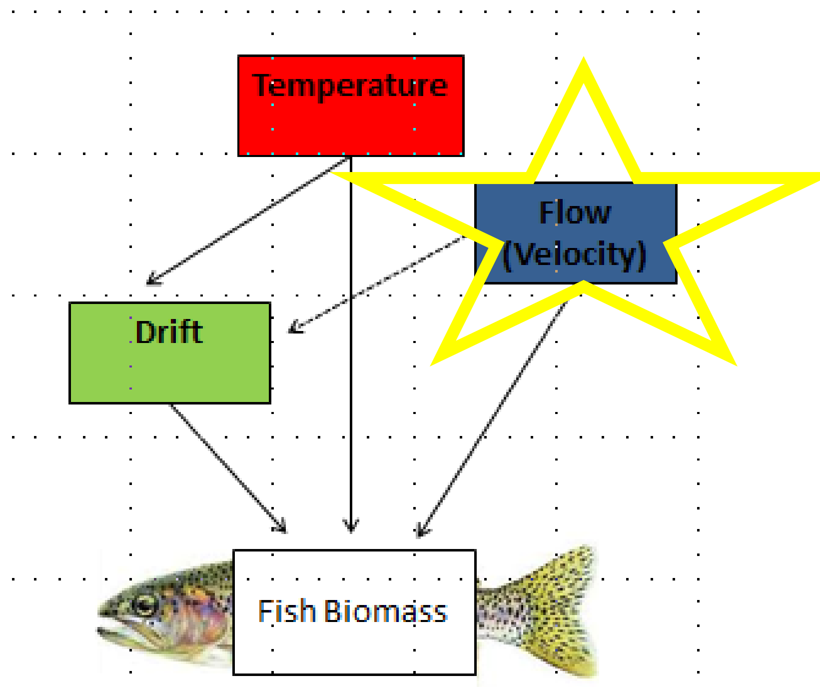
Utilizing CHaMP Data To Examine Hydraulic Patterns and Identify Preferable Habitats

Flow Patterns = Longitudinal and lateral changes in velocity

Why? – Help to identify where we might expect to find fish

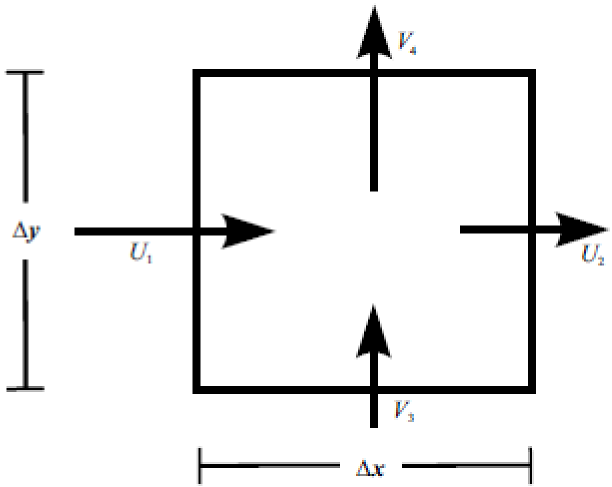
- Quantify preferable habitat availability based on:

Food Delivery
&
Energy Expenditure

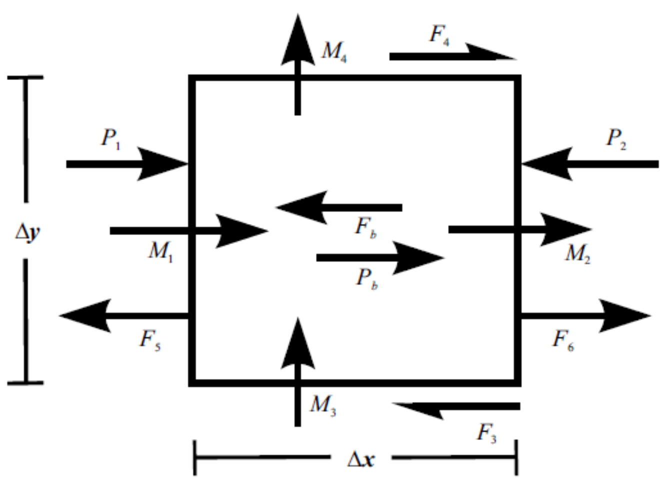


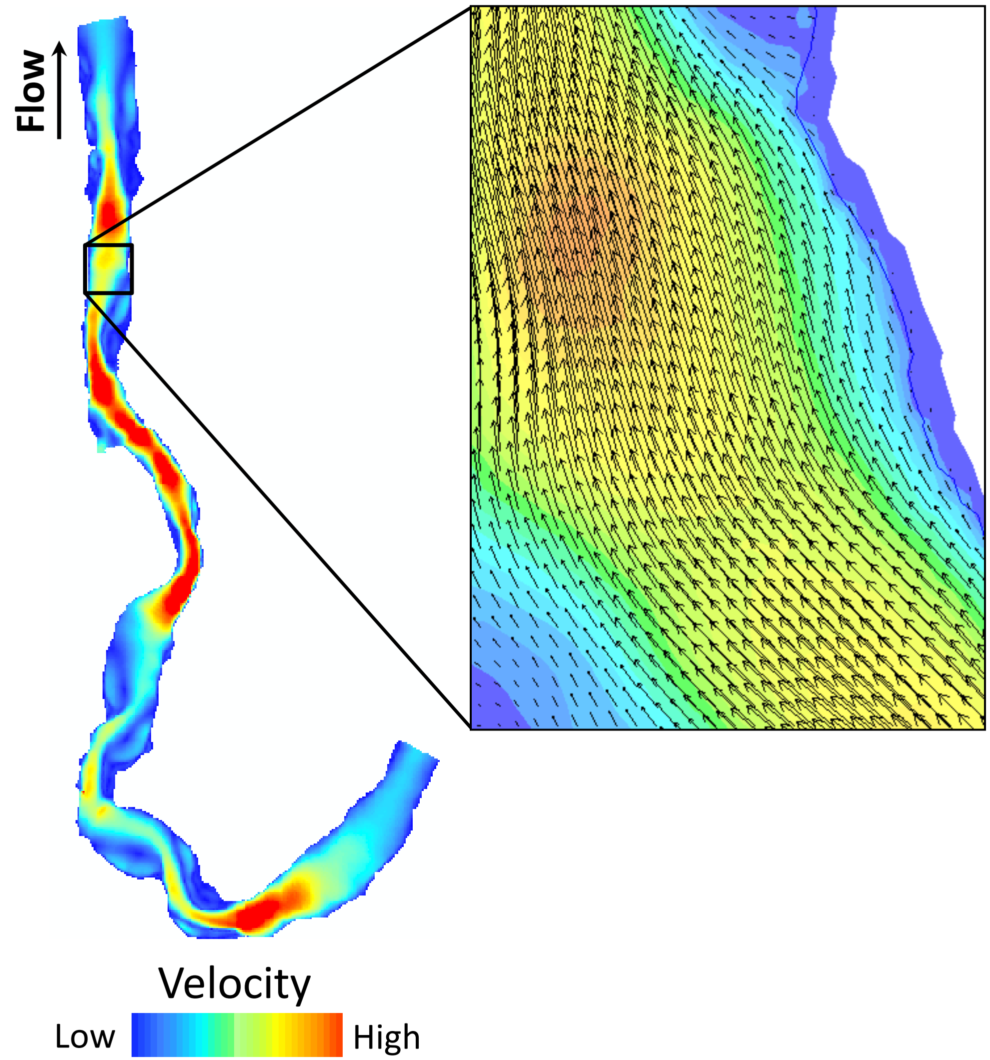
Flow Models

Conservation of Mass

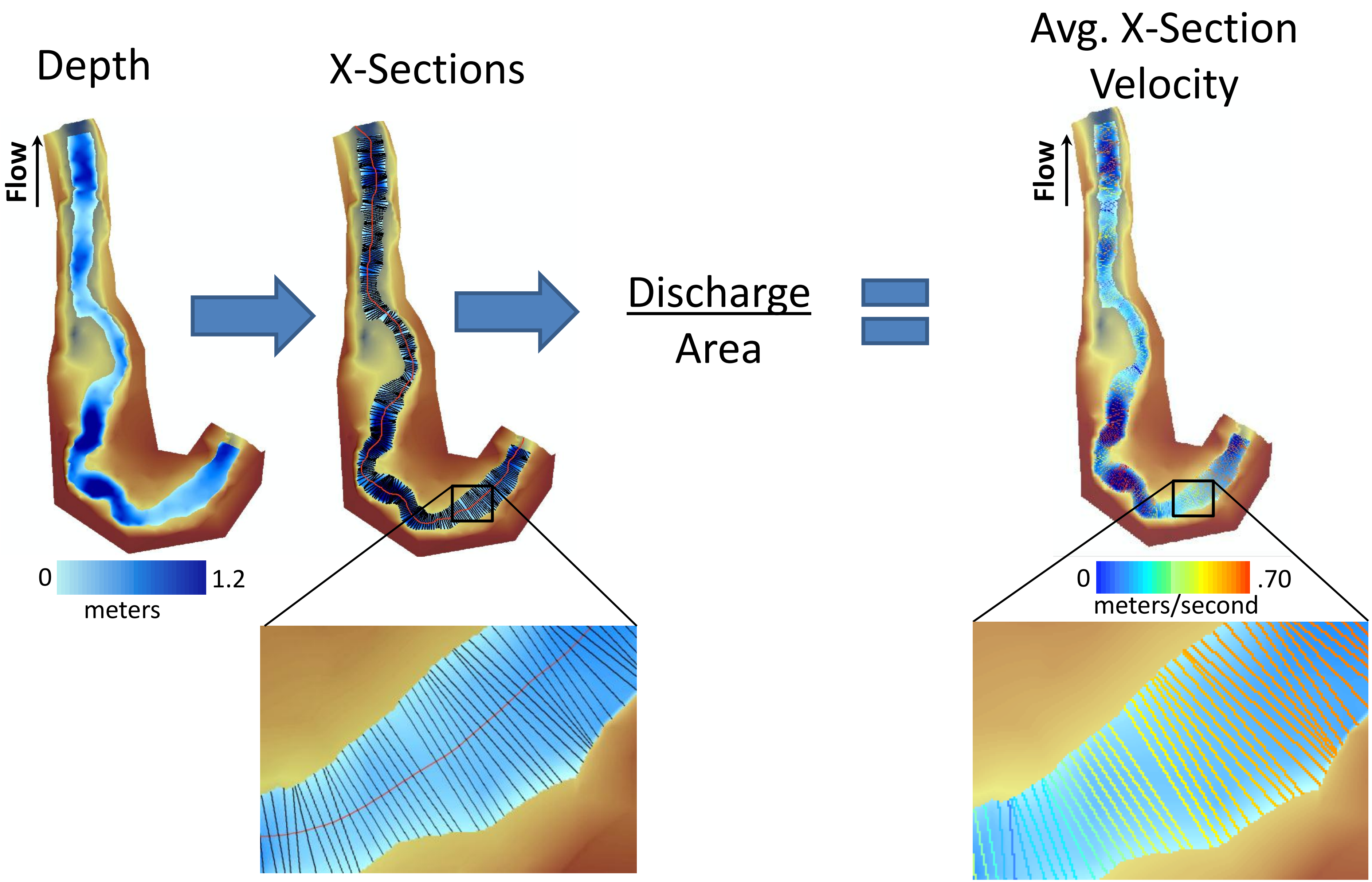


Conservation of Momentum





Using CHaMP Data To Examine Hydraulic Patterns



Longitudinal Flow Patterns

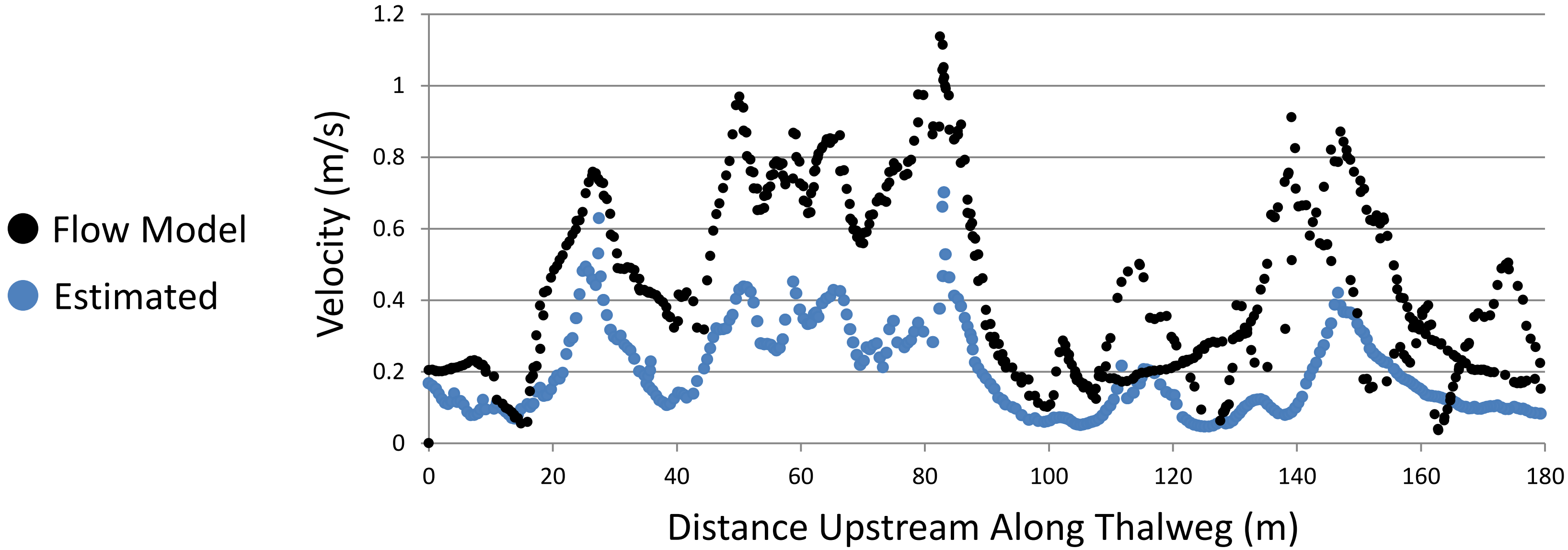
Flow model (truth) vs. estimated x-section velocity at defined intervals (0.5m) along the thalweg

<u>M.F. John Day River</u>

Width = 7.0 m

Gradient = 0.45 %

Q = 0.37 m^3/s



Longitudinal Flow Patterns

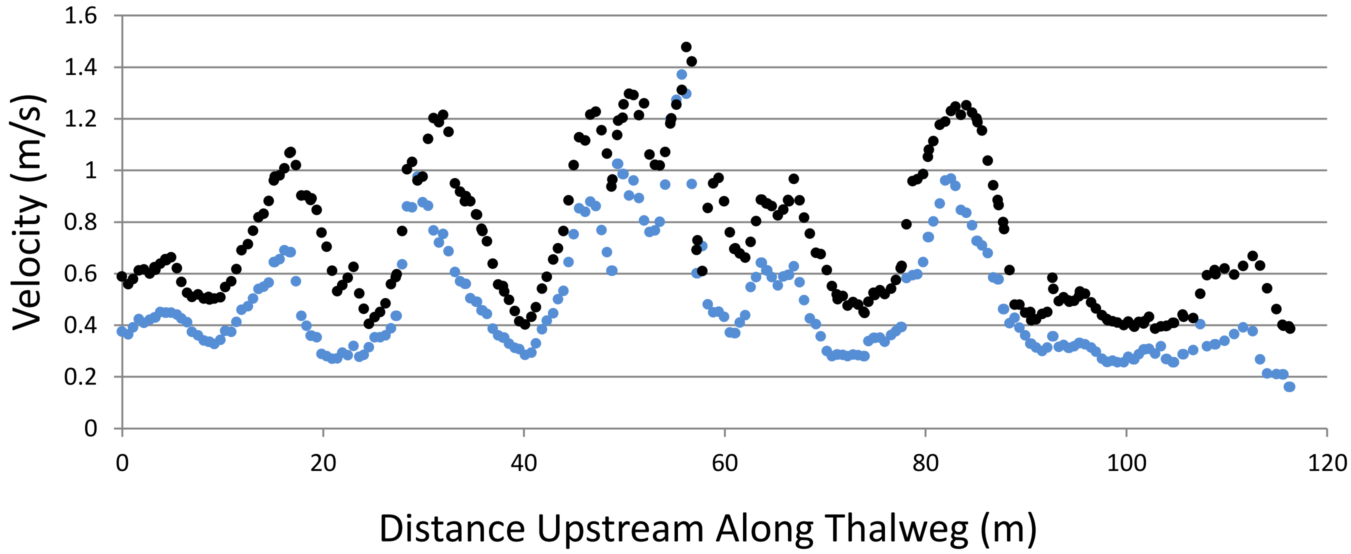
Flow model (truth) vs. estimated x-section velocity

<u>Service Creek</u>

Width = 1.8 m

Gradient = 1.2 %

Q = 0.183 m^3/s



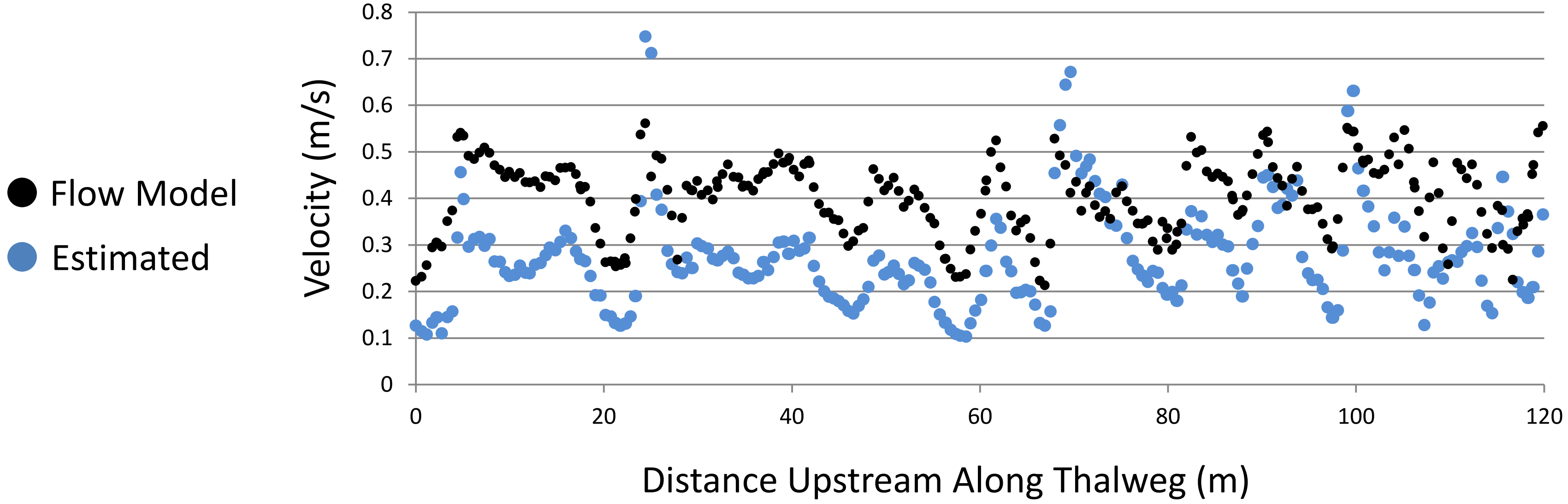
● Flow Model

● Estimated

Longitudinal Flow Patterns

Flow model (truth) vs. estimated x-section velocity

Cummings Creek
Width = 1.8 m
Gradient = 2.1 %
Q = 0.033 m^3/s



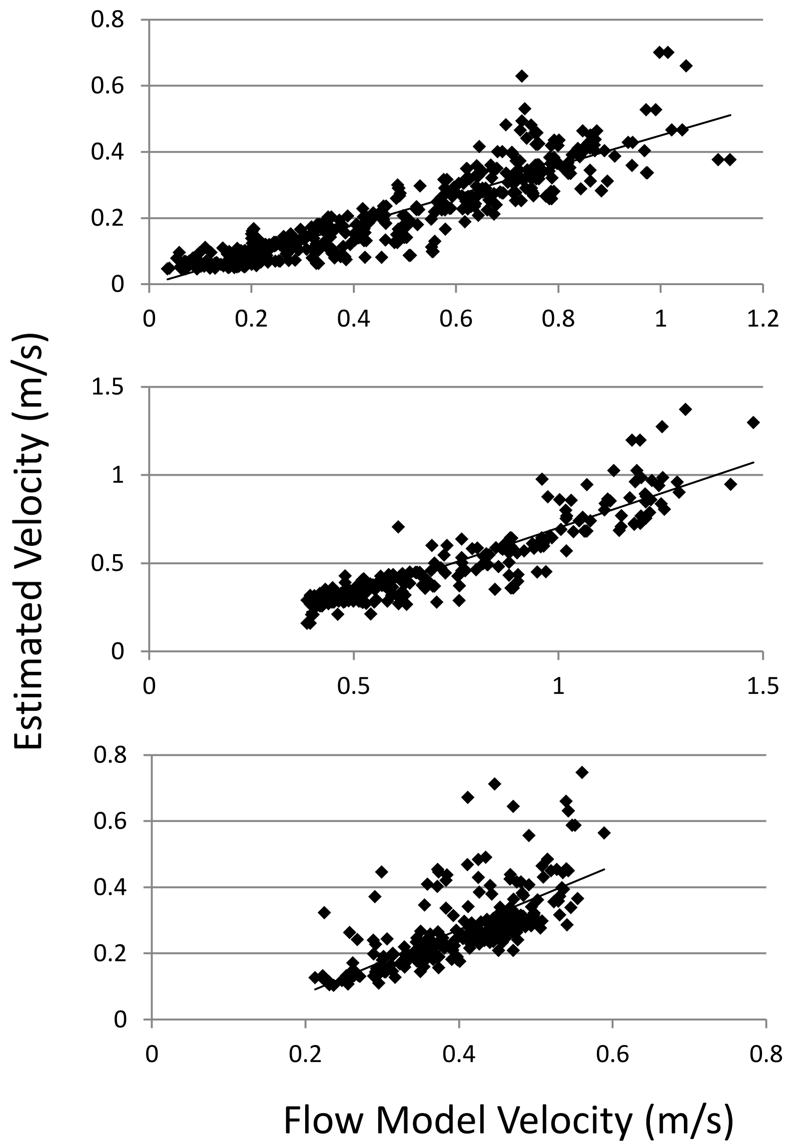
Longitudinal Flow Patterns

Flow model (truth) vs. estimated x-section velocity

M.F. John Day

Service Creek

Cummings Creek

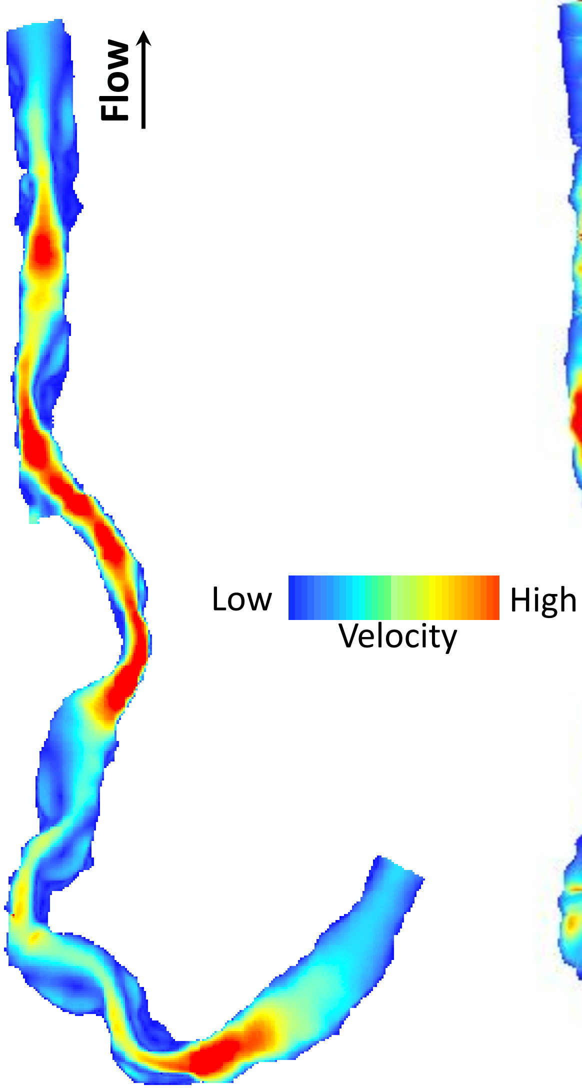


$R^2 = 0.83$

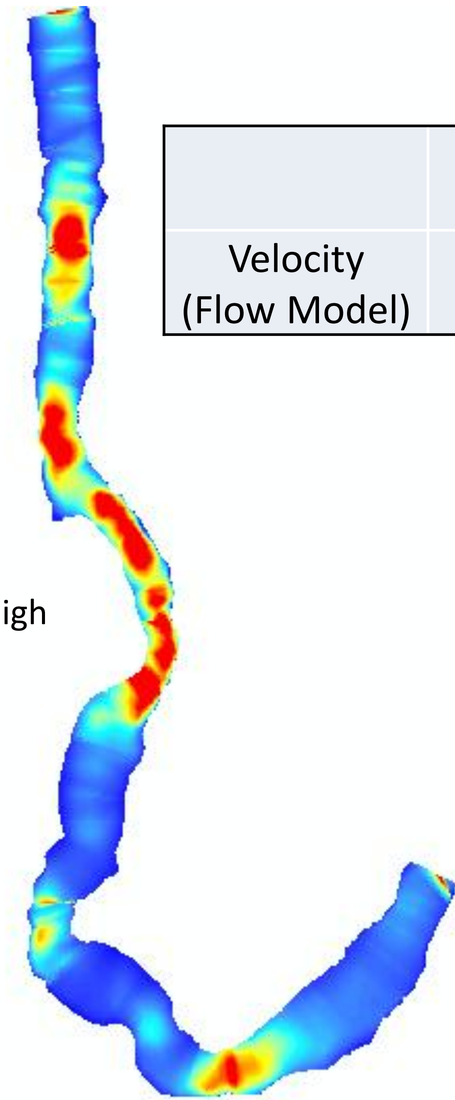
$R^2 = 0.83$

$R^2 = 0.47$

Extending Longitudinal to Lateral Variations in Flow



Flow Model Velocity

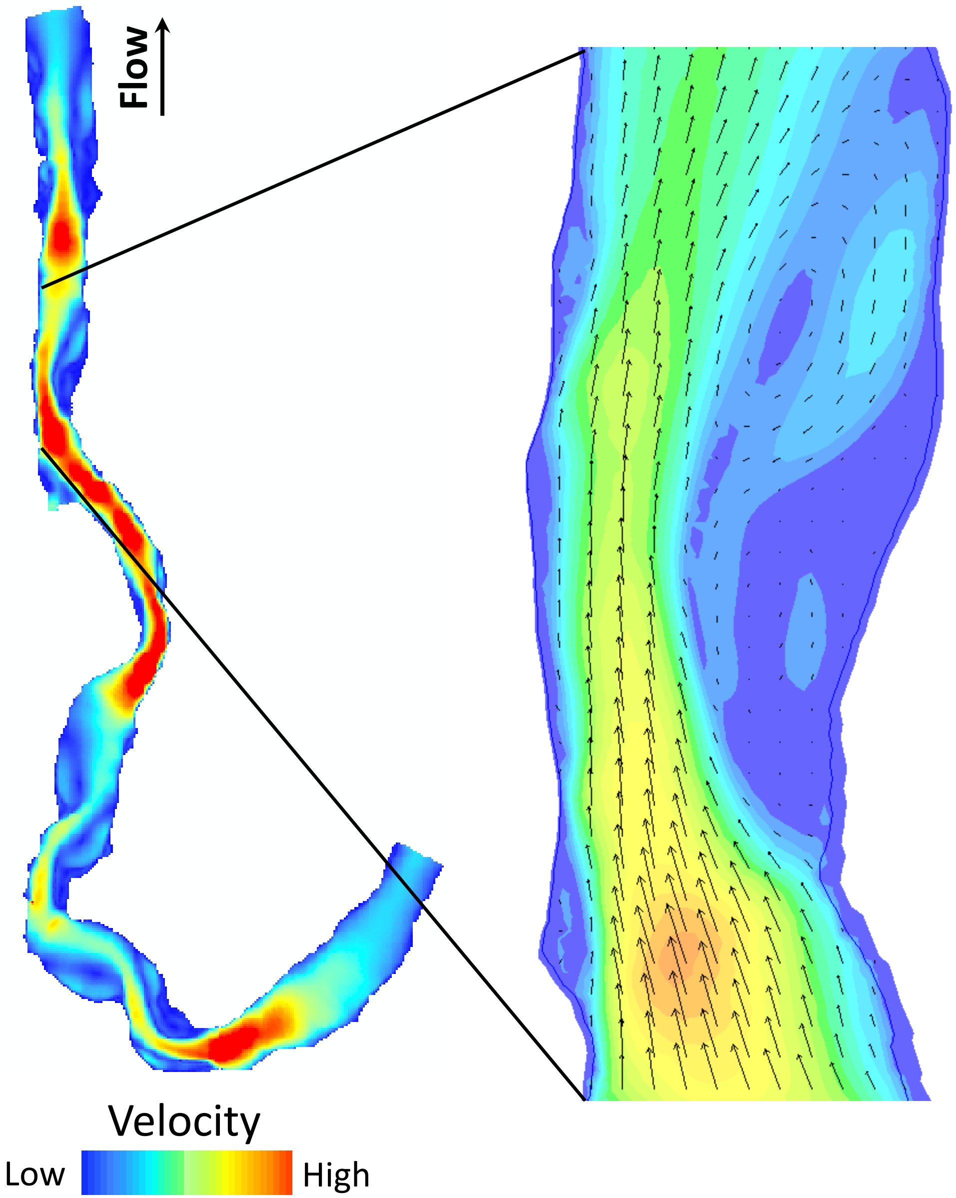


Interpolated Velocity
From X-Sections

Correlations

	Estimated MFJD	Estimated Service Cr.	Estimated Cummings Cr.
Velocity (Flow Model)	0.759	0.775	0.623

How Do We Identify Shear Zones?

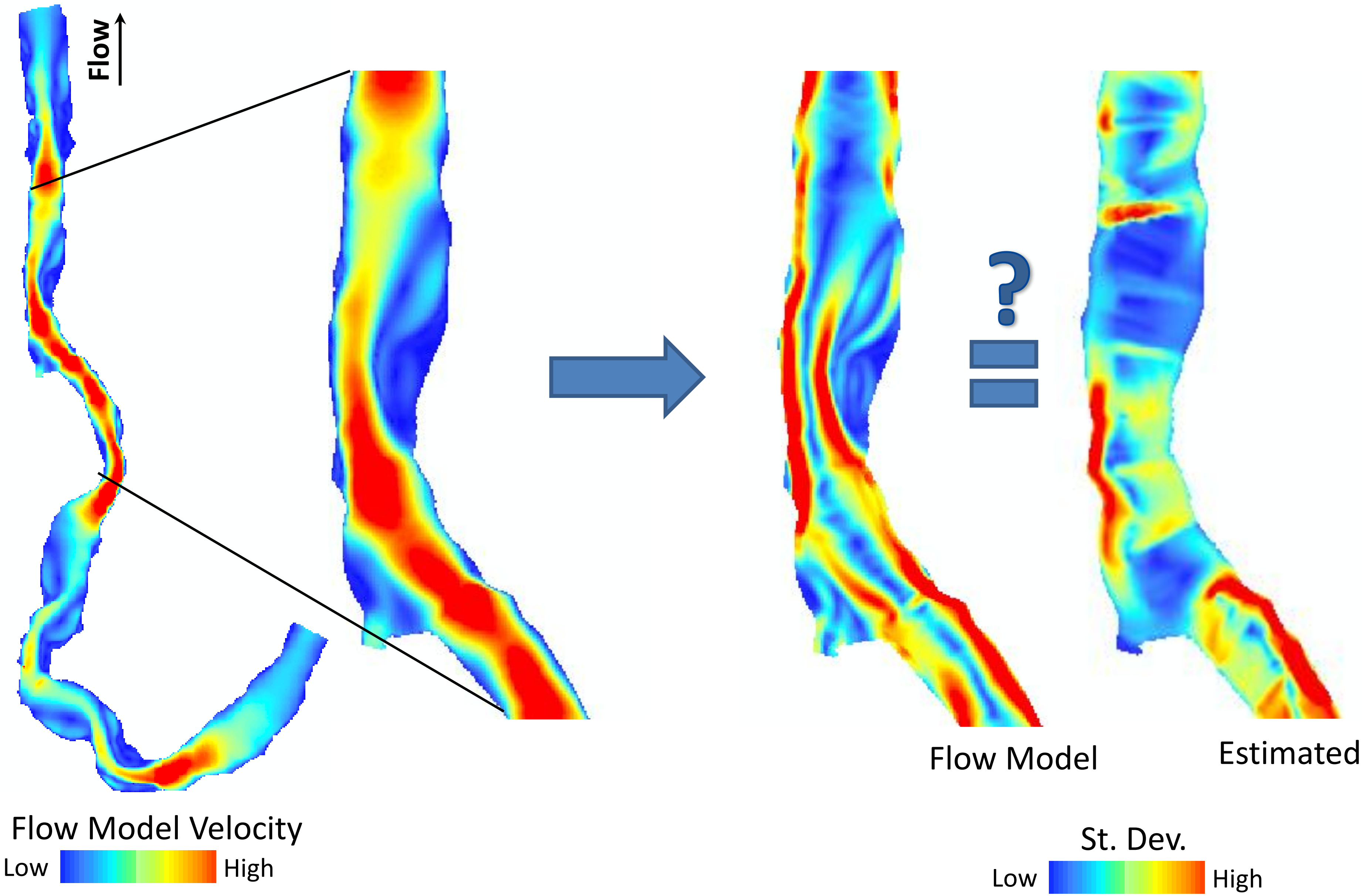


Shear Zones: Interfaces between slower and faster water.

Fast Water: ↑ Food Delivery

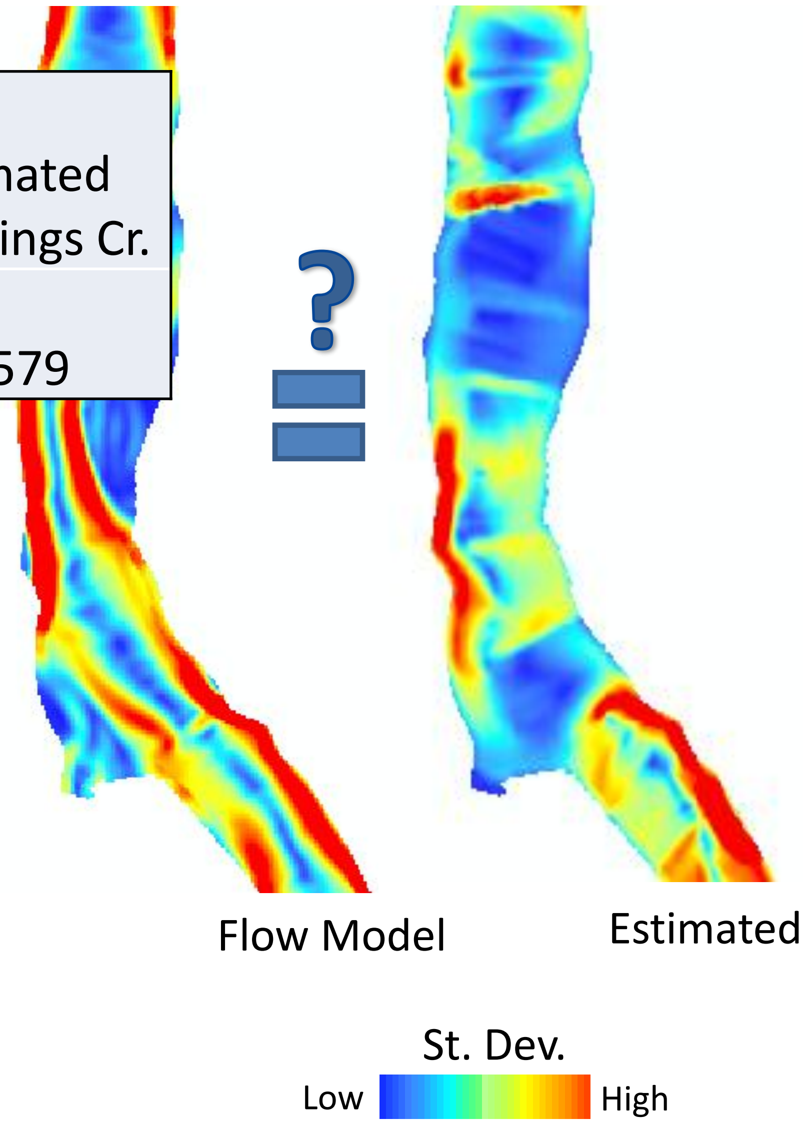
Slow Water: ↓ Energy Expenditure

Locating Shear Zones



Locating Shear Zones

	Estimated MFJD	Estimated Service Cr.	Estimated Cummings Cr.
Velocity St. Dev. (Flow Model)	0.476	0.782	0.579



Locating Shear Zones

Moving Forward:

Do not need to precisely estimate velocity on a cell by cell basis, but only where zones are likely to occur

Channel geometry to identify locations (width expansion/contraction, bank irregularities) of flow divergence

Use multiple lines of evidence to identify where shear zones will occur