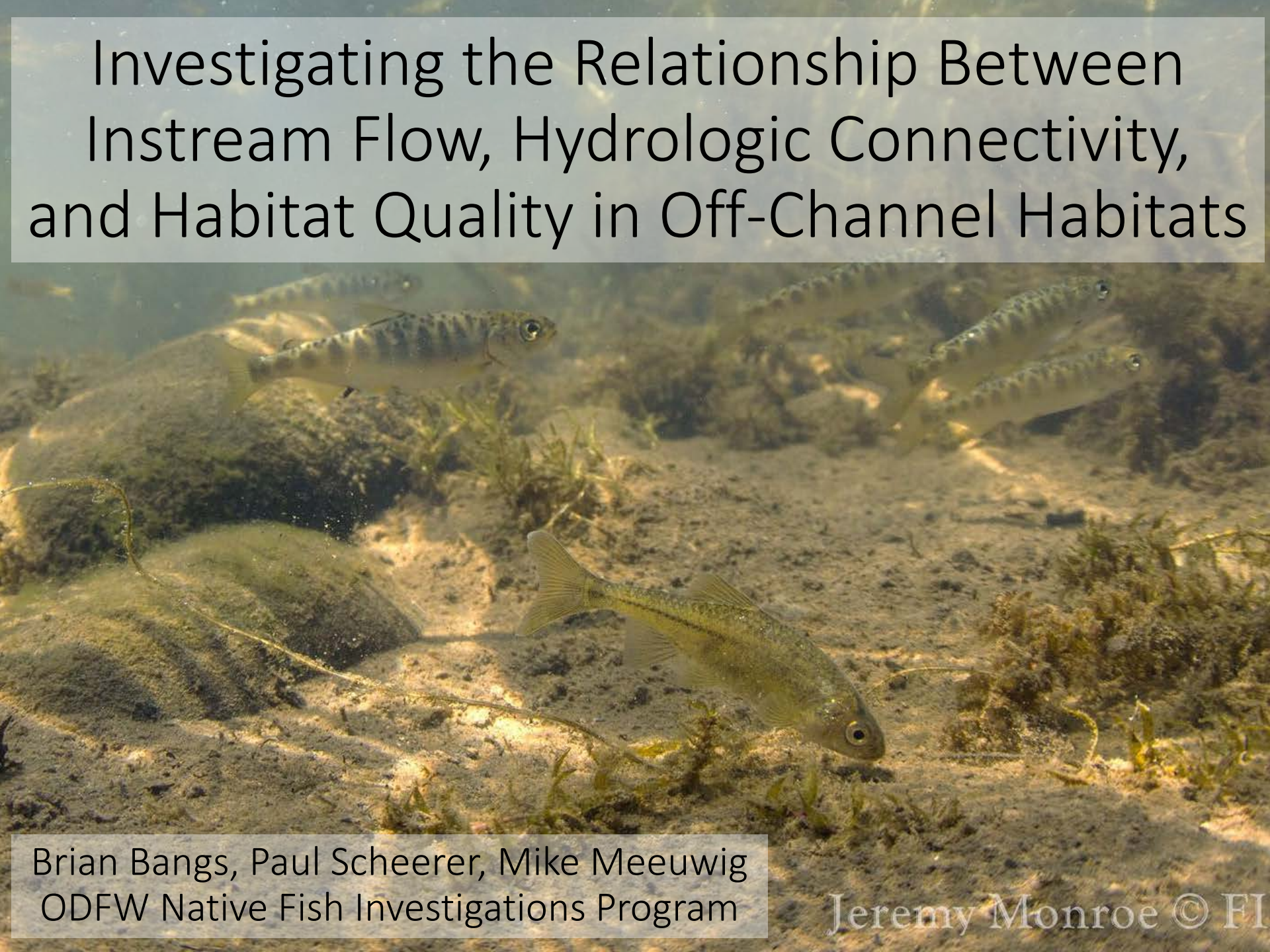
Investigating the Relationship Between Instream Flow, Hydrologic Connectivity, and Habitat Quality in Off-Channel Habitats



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ODFW Native Fish Investigations Program

Background

- Initiated in 2009; ACOE BiOp
- Coincided with Oregon chub downlisting

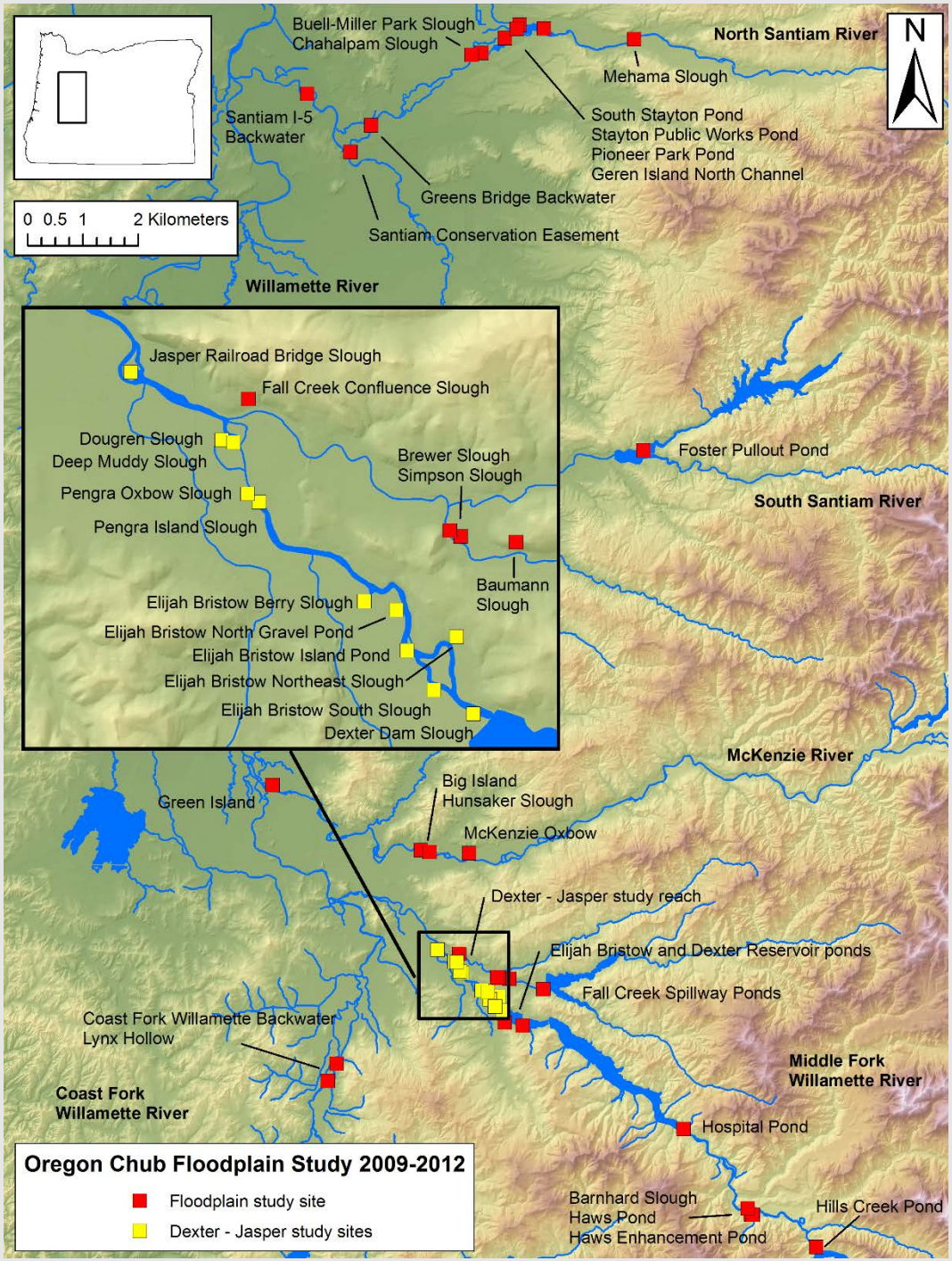
Goal

Describe relationships between

- River flows,
- Habitat characteristics,
- Temperature regimes,
- Timing, frequency, duration, magnitude of connection, **and**
- Fish assemblage structure in off-channel habitats

Approach

1. Monitor water levels
2. Monitor temperatures
3. Mapping bathymetry
   A. Relationships: water level, habitat availability, suitability
   B. Connectivity
   C. Changes in bathymetry
4. Describe fish assemblages

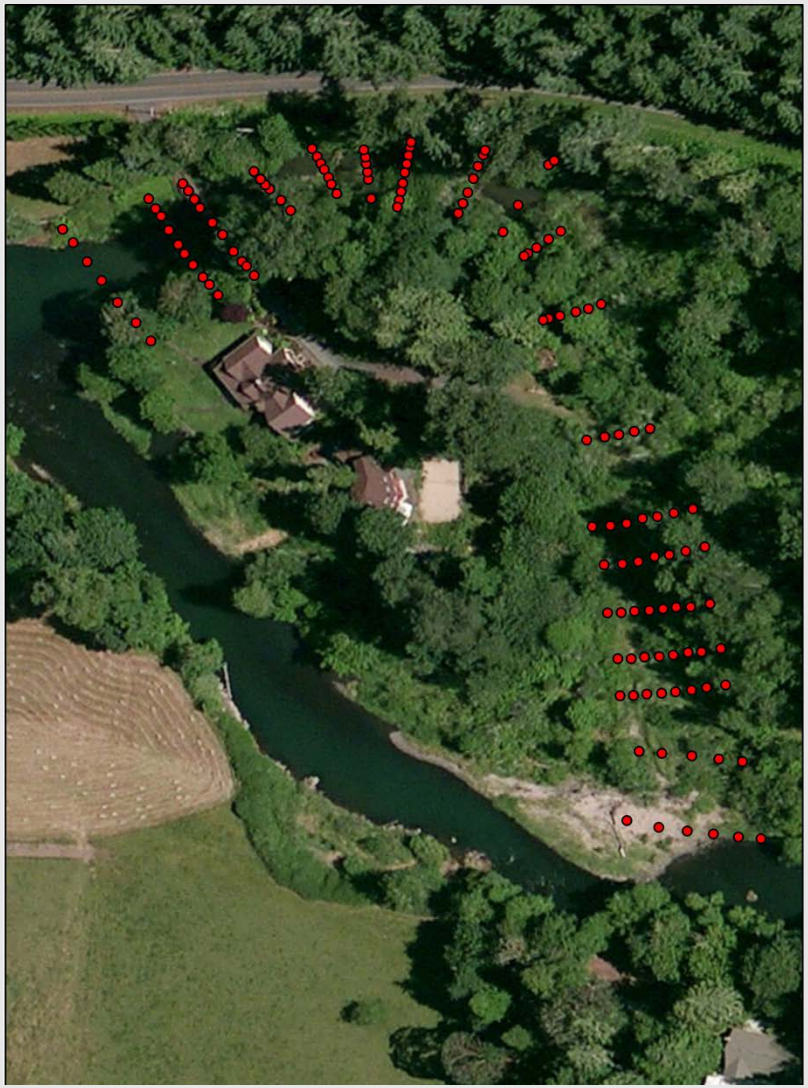


Study Locations

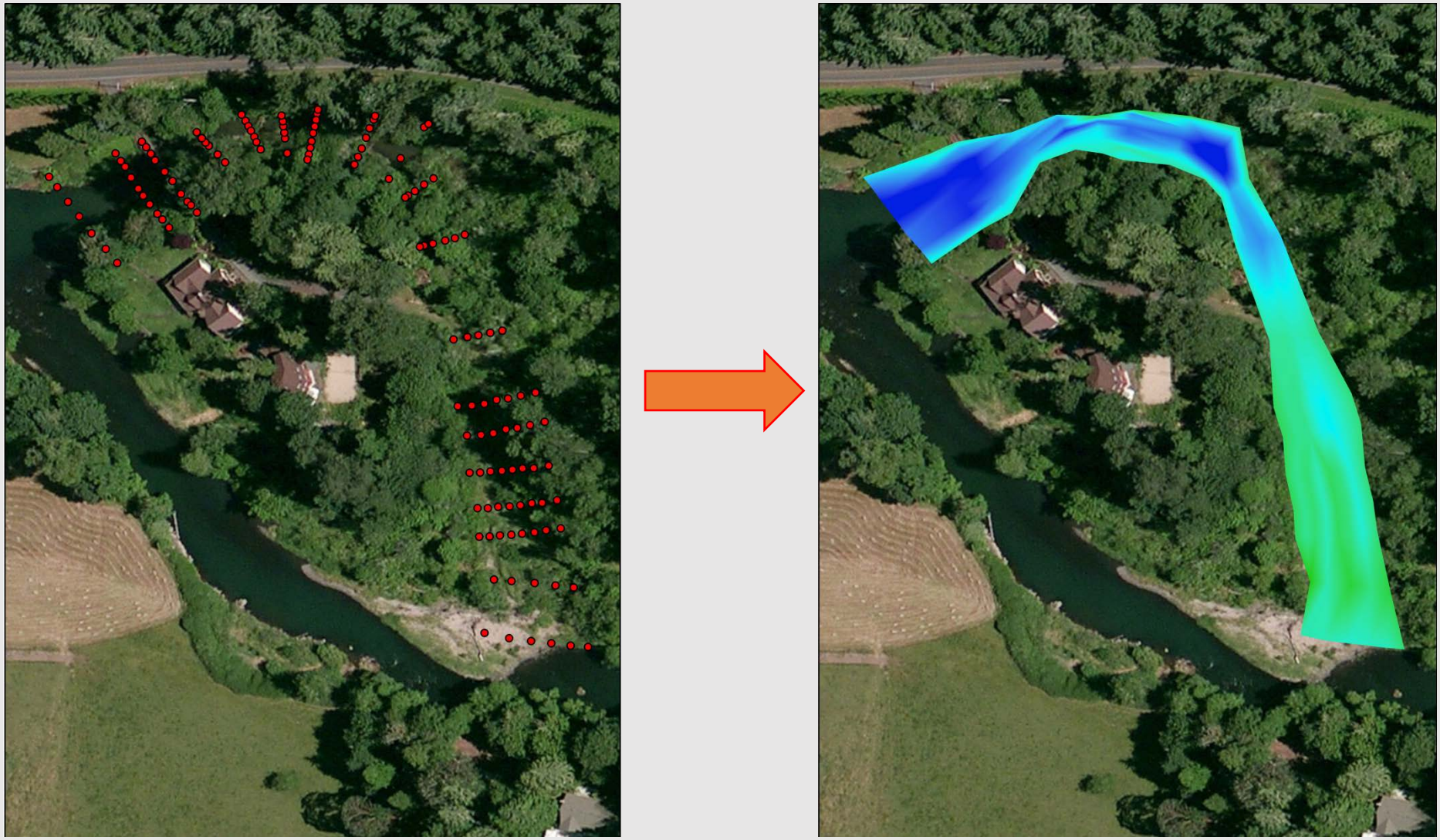
- 2016:
  39 sites located on Army Corps of Engineer land, or potentially influenced by Willamette Project Dams
  - 22 in the Middle Fork
  - 11 in the Santiam
  - 4 in the McKenzie
  - 2 Coast Fork Willamette

Bathymetry Mapping

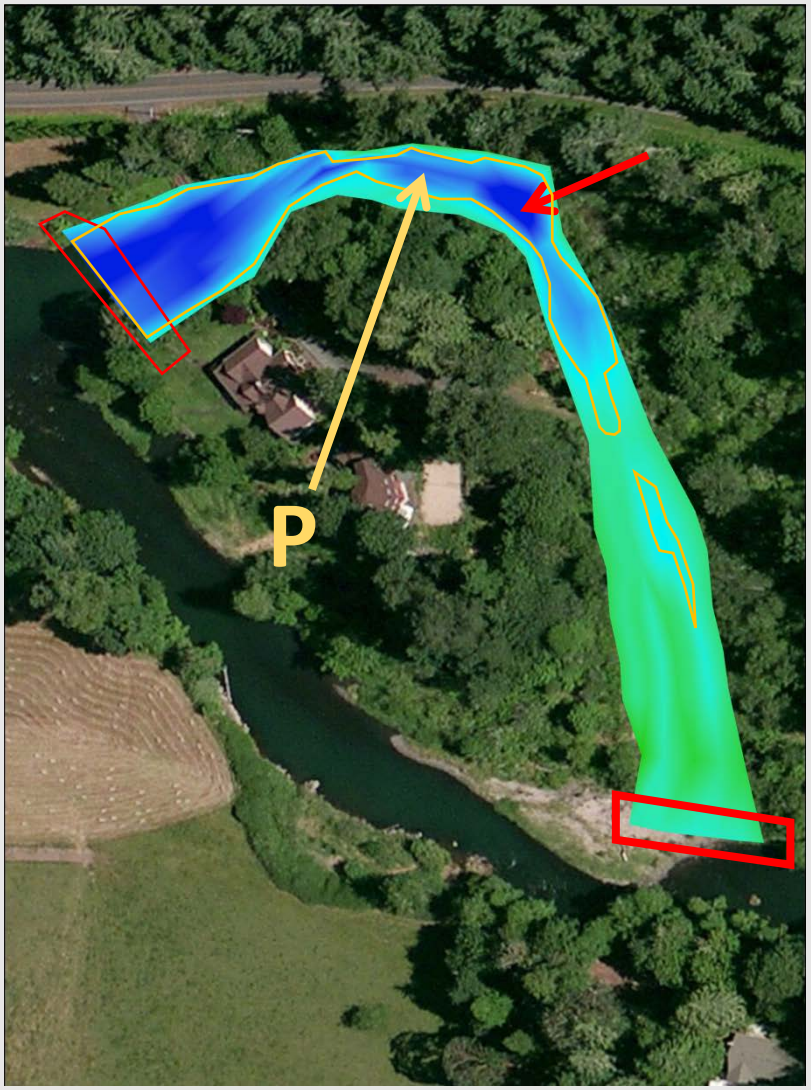
Bathymetry mapping

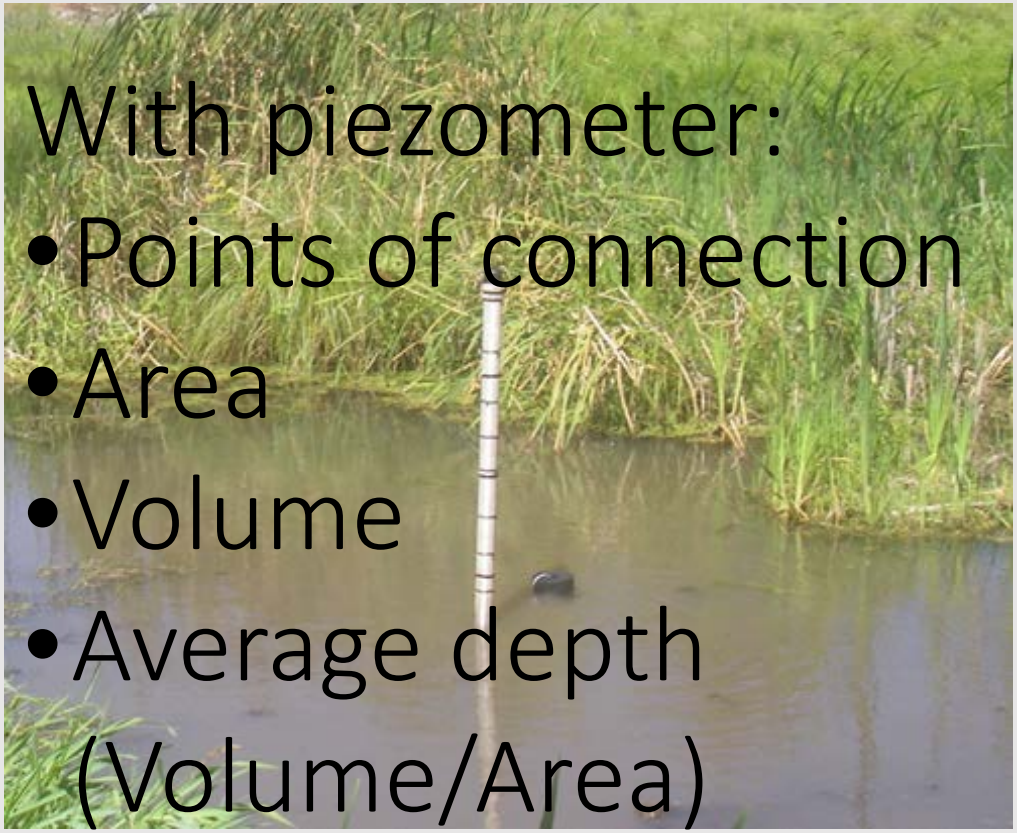


Bathymetry mapping



What is it good for?





With piezometer:

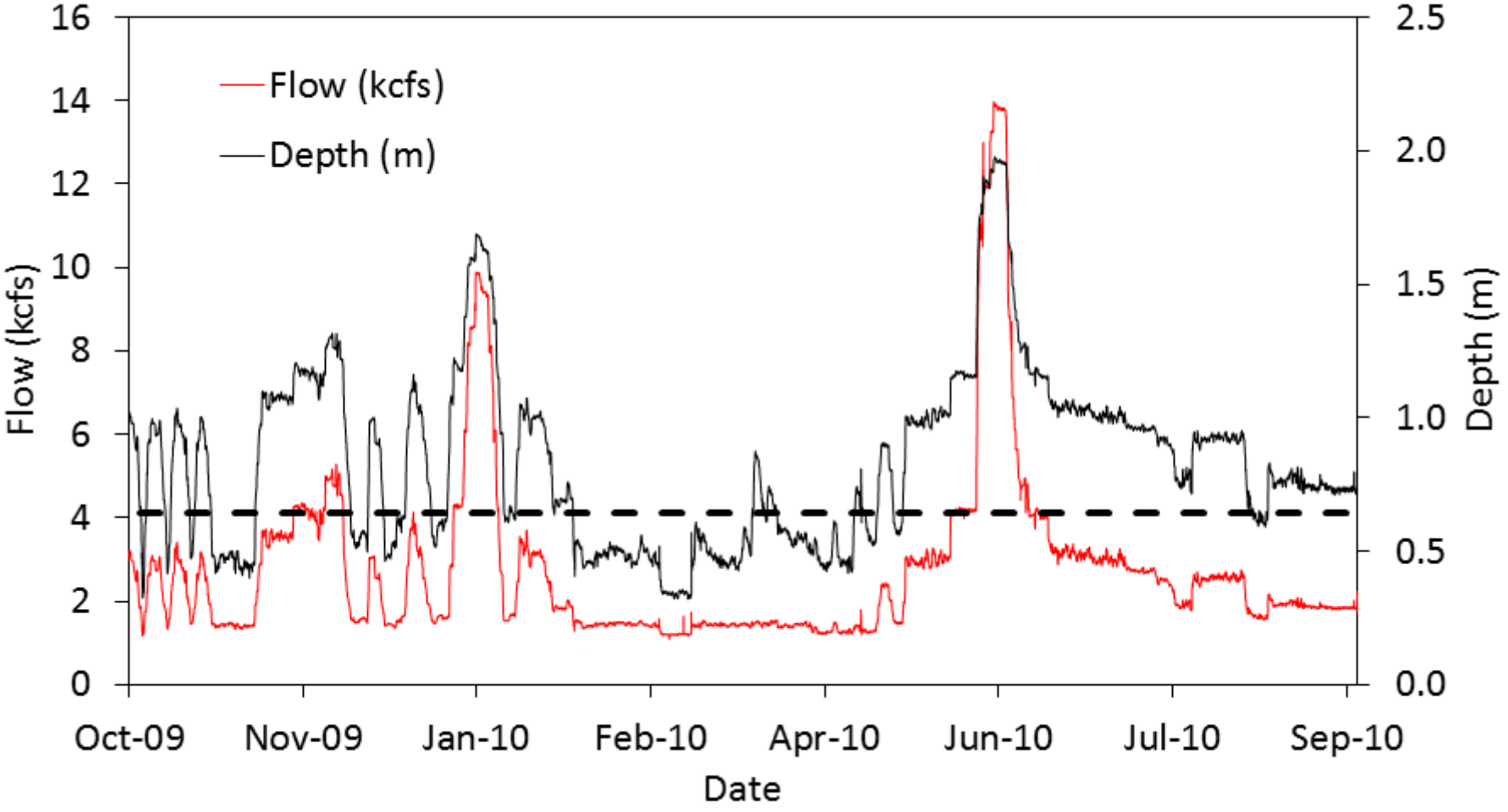
- Points of connection
- Area
- Volume
- Average depth (Volume/Area)
- Max. depth

Connectivity

What do we mean?

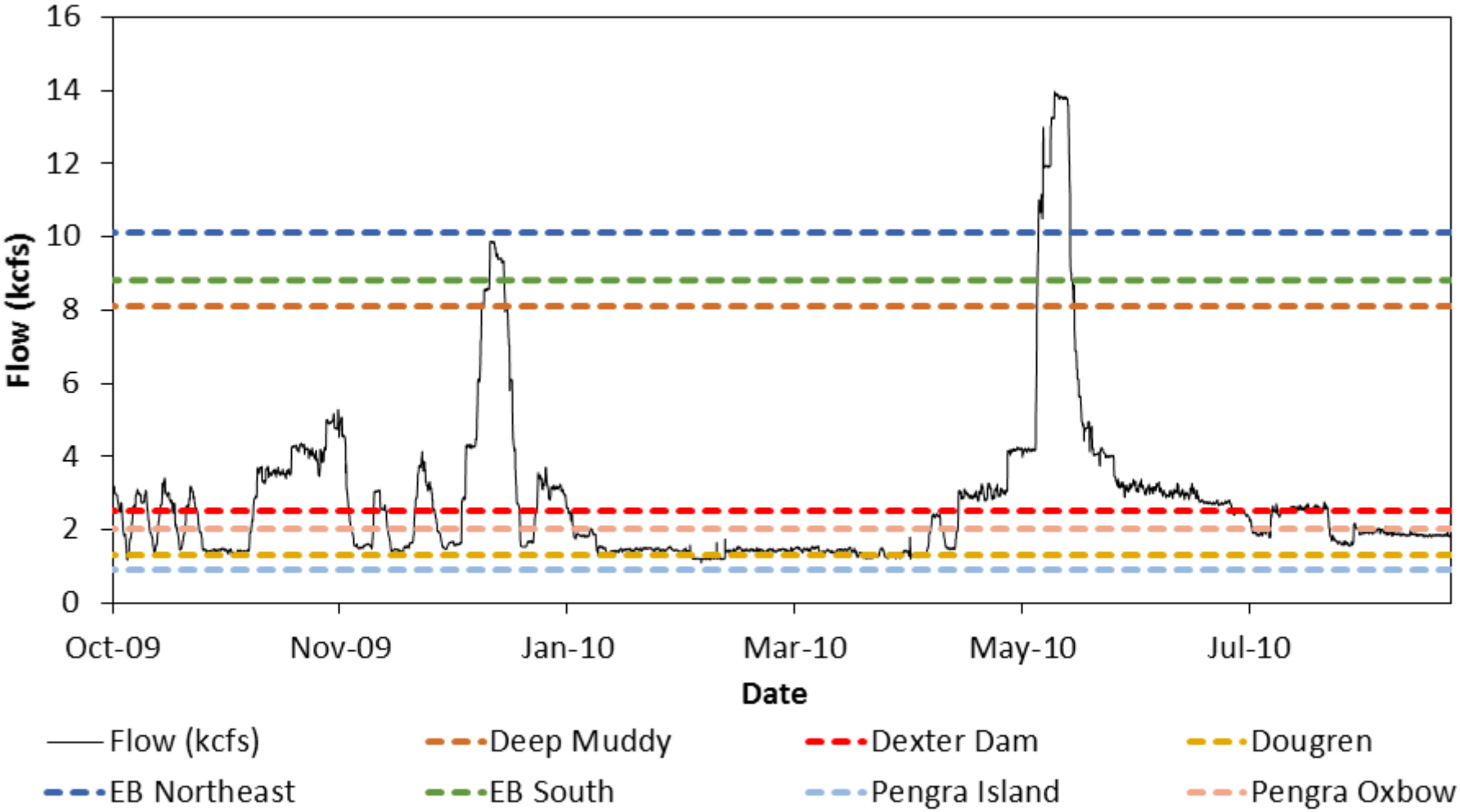
- Open water, direct connection to surrounding waterbodies

Connectivity and flow



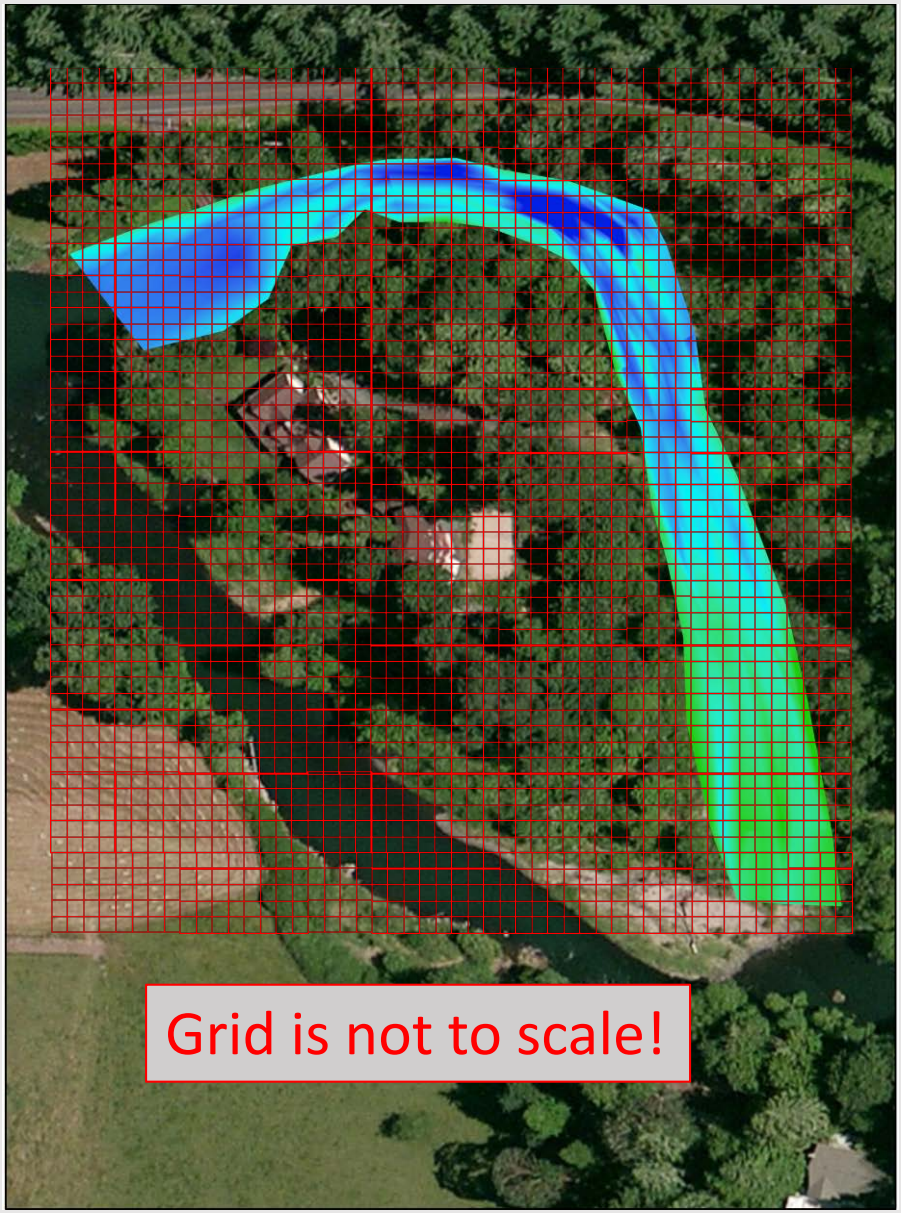
- Dashed line: depth required to connect site, based on bathymetry map
- Strong relationship between flow and depth at most sites

Connectivity and flow



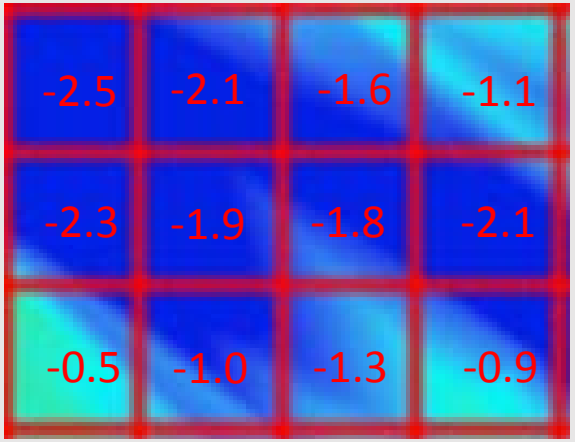
- Flows required to connect sloughs – Middle Fork Willamette
- Variable, but we can determine when sites connect

Back to bathymetry

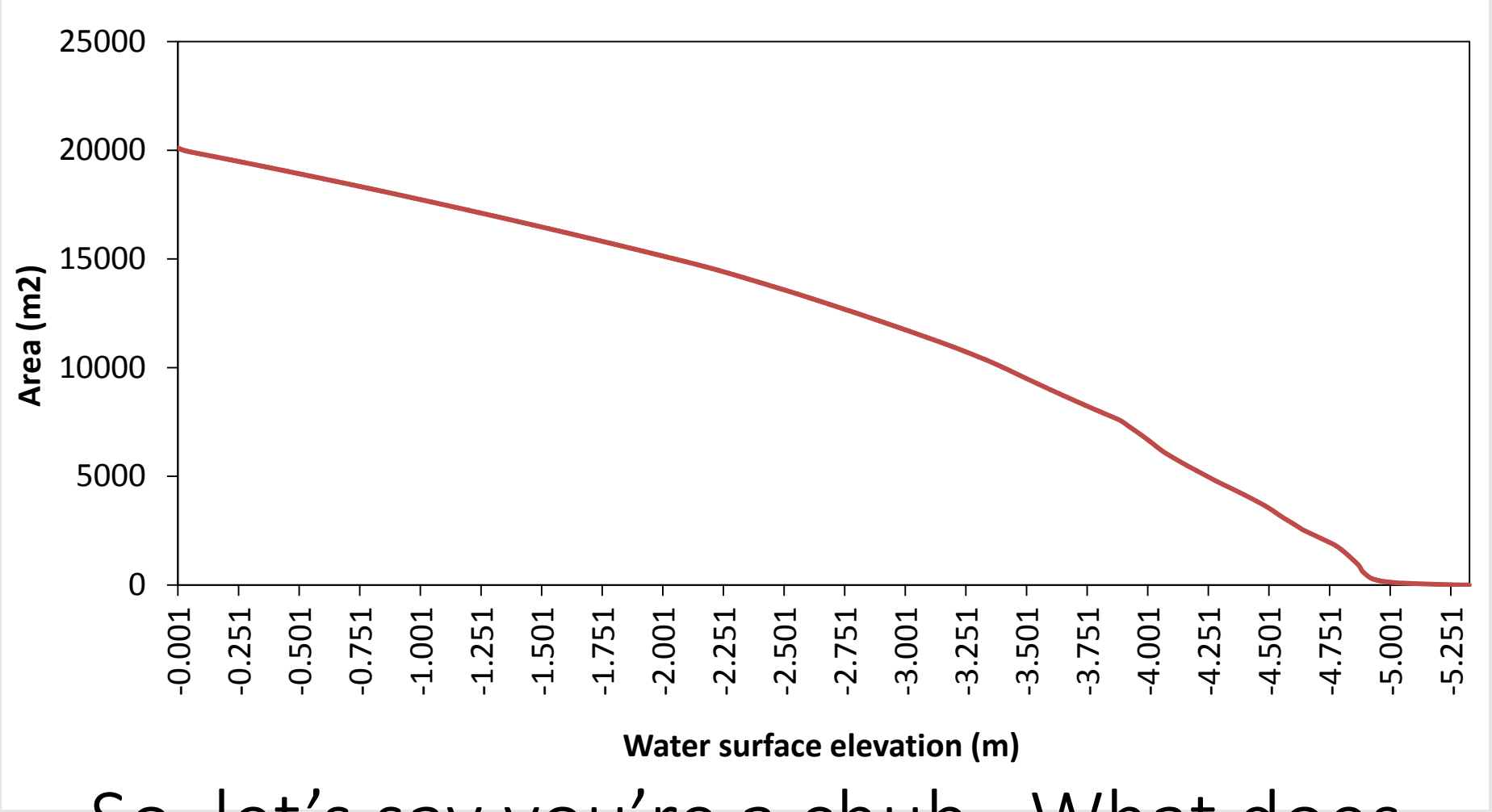


Convert TIN map to raster grid

Each cell 0.1 m^2, and contains elevation data



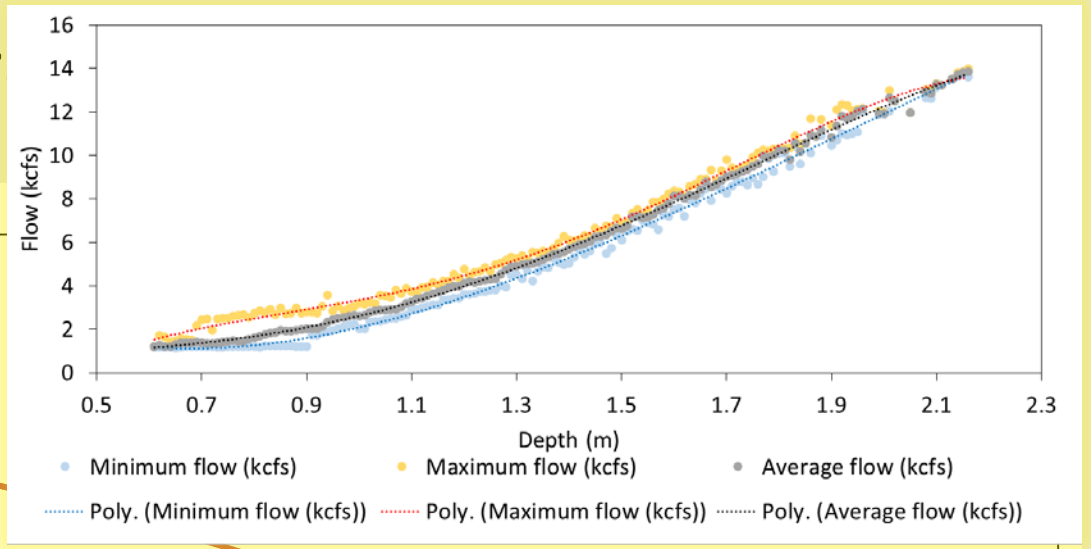
Habitat availability vs Depth



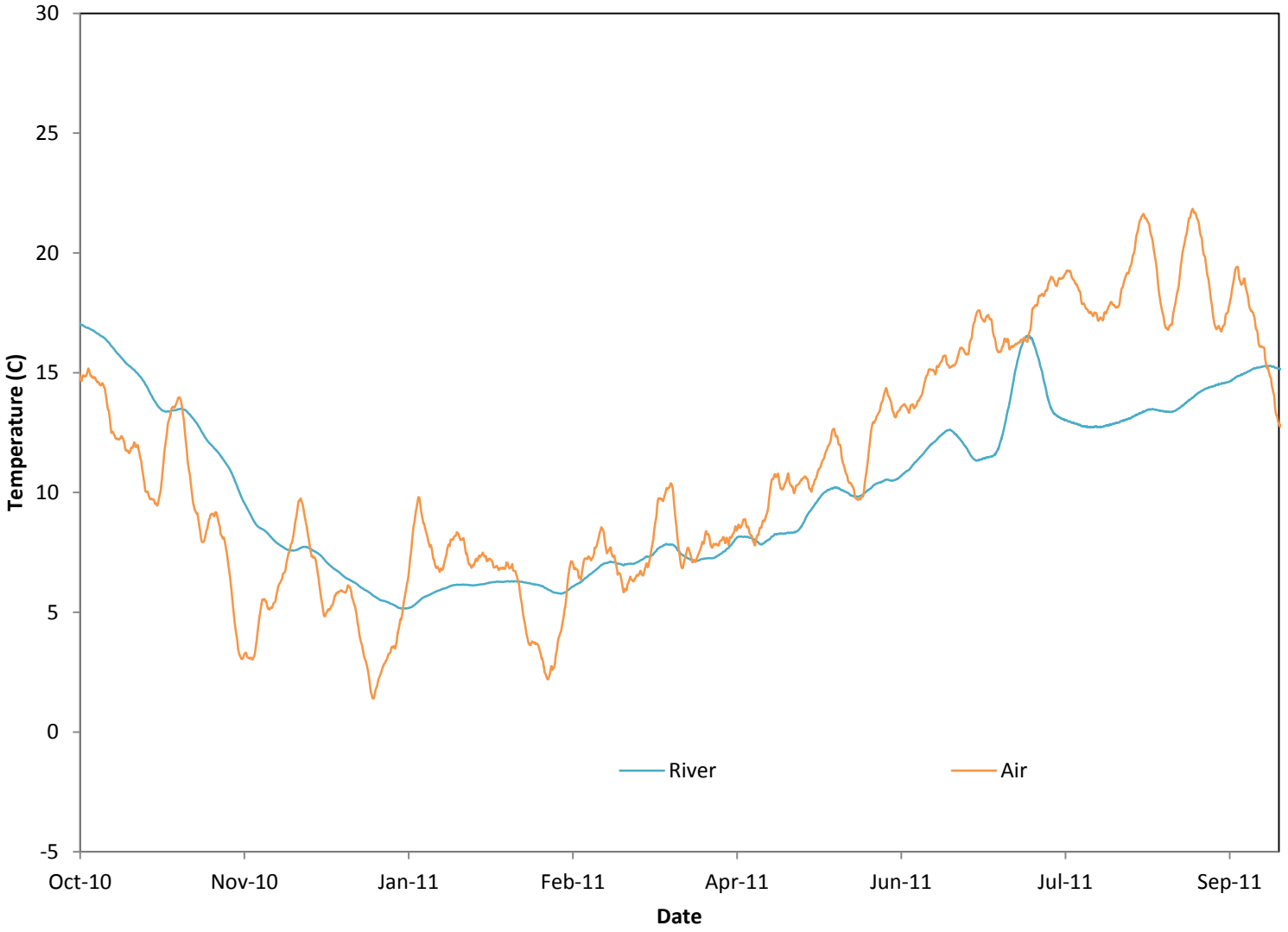
So, let's say you're a chub. What does this mean to you?

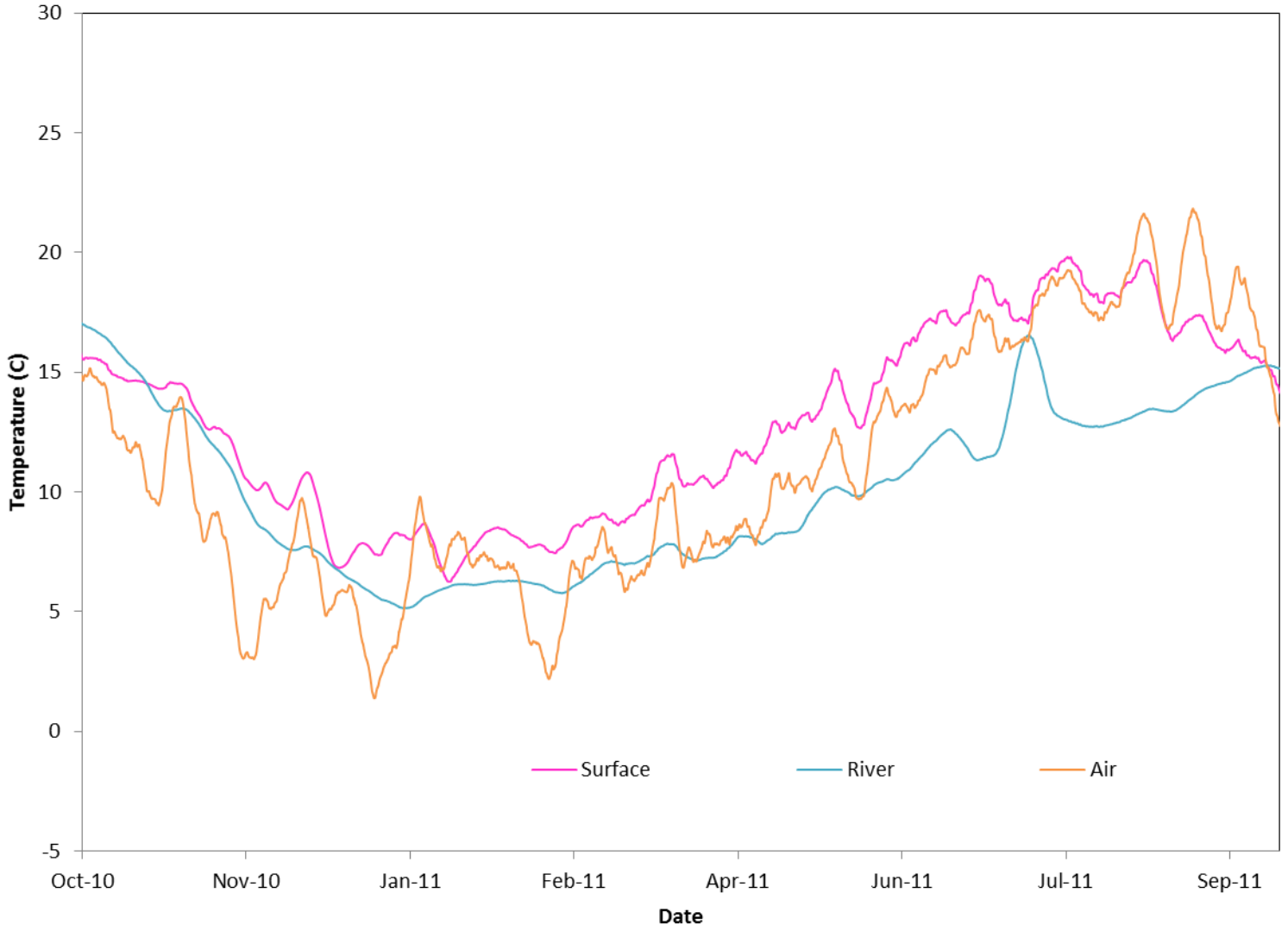

= Oregon chub
Prefers depths 0.1 - 1.0m
Bench inundated = add 1.0m
Depth = 0.5m
Depth of blue area = now 1.5m

Wetted ar


Flow (kcfs)
16
14
12
10
8
6
4
2
0
0.5
0.7
0.9
1.1
1.3
1.5
1.7
1.9
2.1
2.3
Depth (m)
Minimum flow (kcfs)
Maximum flow (kcfs)
Average flow (kcfs)
Poly. (Minimum flow (kcfs))
Poly. (Maximum flow (kcfs))
Poly. (Average flow (kcfs))

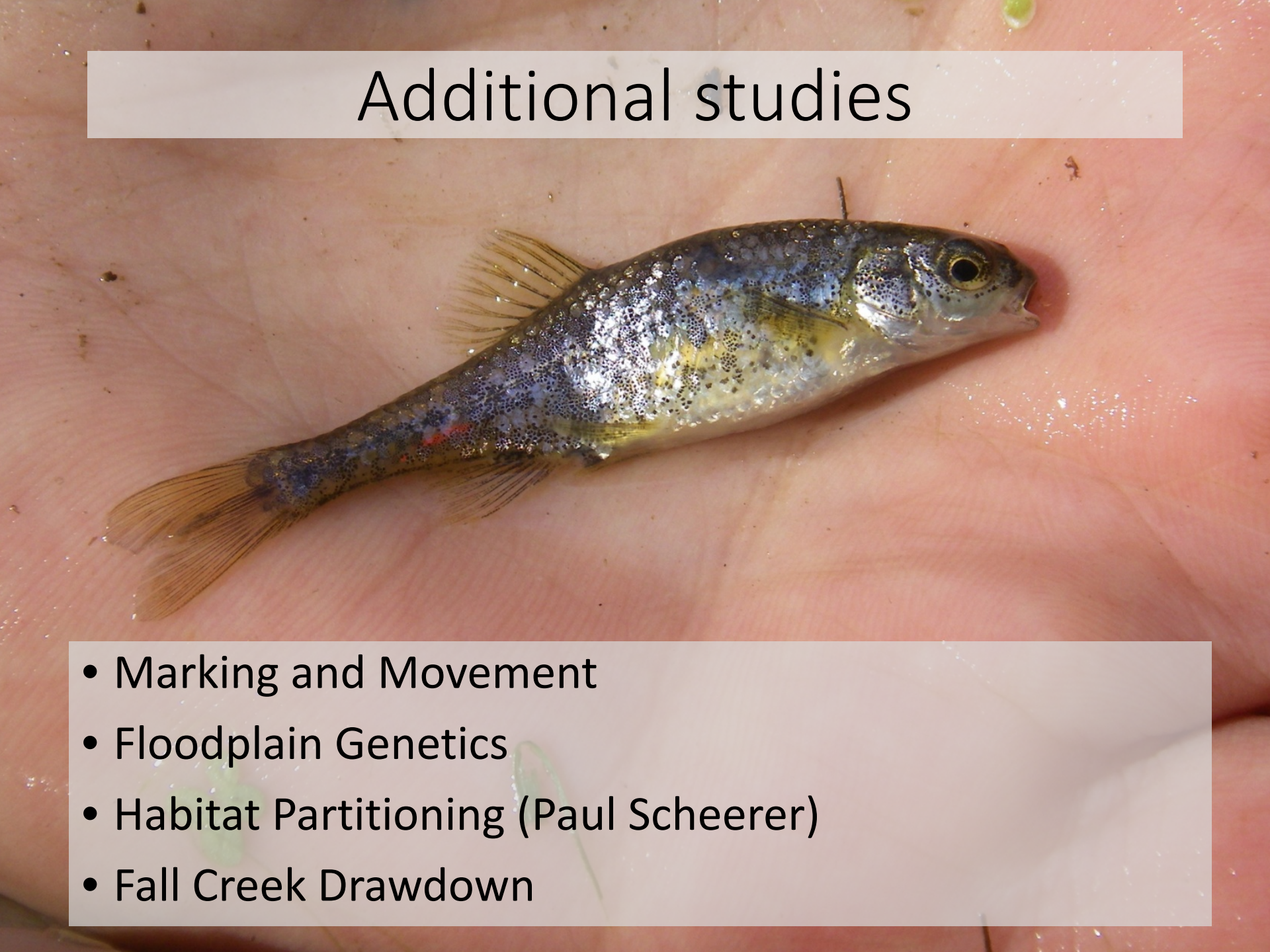
Area (m2)
25000
20000
15000
10000
5000
0
10 kfcs
6 kfcs
3 kfcs
1.5 kfcs
-0.001
-0.251
-0.501
-0.751
-1.001
-1.251
-1.501
-1.751
-2.001
-2.251
-2.501
-2.751
-3.001
-3.251
-3.501
-3.751
-4.001
-4.251
-4.501
-4.751
-5.001
-5.251
Water surface elevation (m)


30
25
20
15
10
5
0
-5
Temperature (C)
Oct-10
Nov-10
Jan-11
Feb-11
Apr-11
Jun-11
Jul-11
Sep-11
Date
River
Air


30
25
20
15
10
5
0
-5
Temperature (C)
Surface
River
Air
Oct-10
Nov-10
Jan-11
Feb-11
Apr-11
Jun-11
Jul-11
Sep-11
Date


30
25
20
15
10
5
0
-5
Temperature (C)
Oct-10
Nov-10
Jan-11
Feb-11
Apr-11
Jun-11
Jul-11
Sep-11
Date
Substrate
Surface
River
Air

Additional studies



- Marking and Movement
- Floodplain Genetics
- Habitat Partitioning (Paul Scheerer)
- Fall Creek Drawdown

Additional studies: Movement

Hatch Side Channels

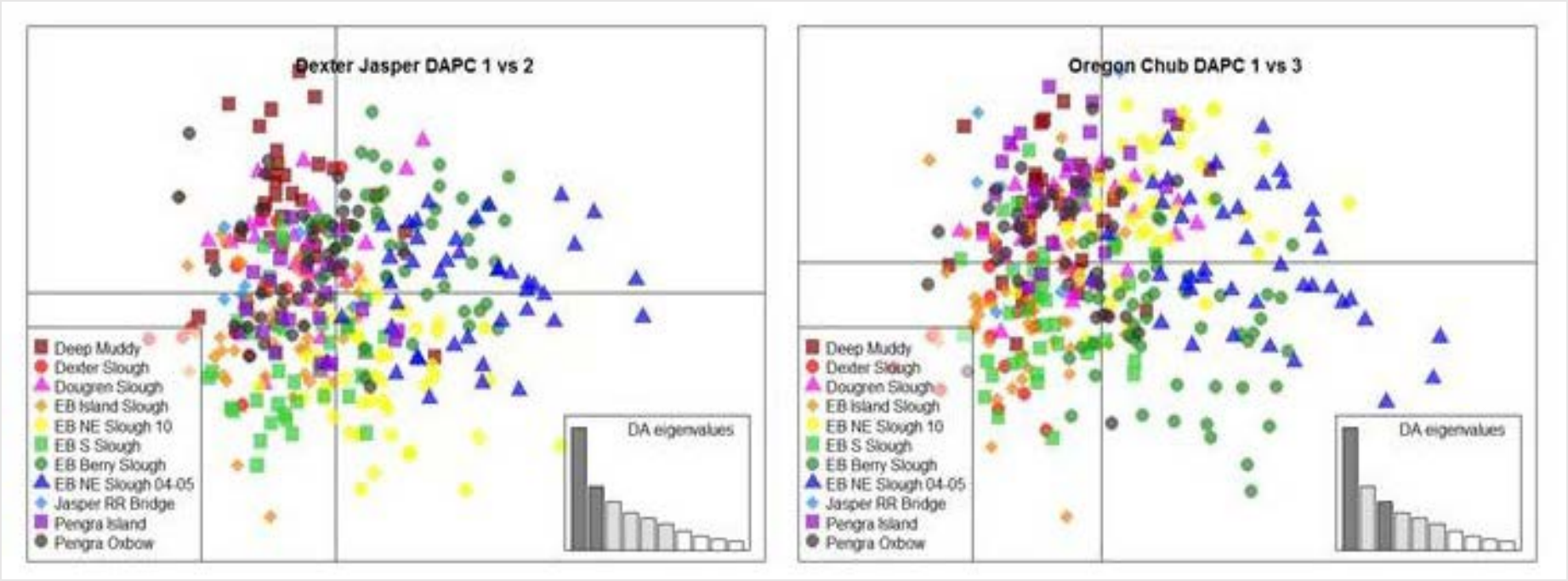
Buell-Miller Slough

Koenig Slough

- Fish marked in 2013
- Recaptured in 2015
- 6.5 km (4.1 miles)
- N. Santiam, McKenzie, Middle Fork

Additional studies: Movement

- Middle Fork Willamette: confirmed through genetic analysis (Pat DeHaan, USFWS Abernathy FTC)
- Dexter-Jasper reach represent a single population with high levels of genetic exchange among sites



Additional studies: Habitat Partitioning

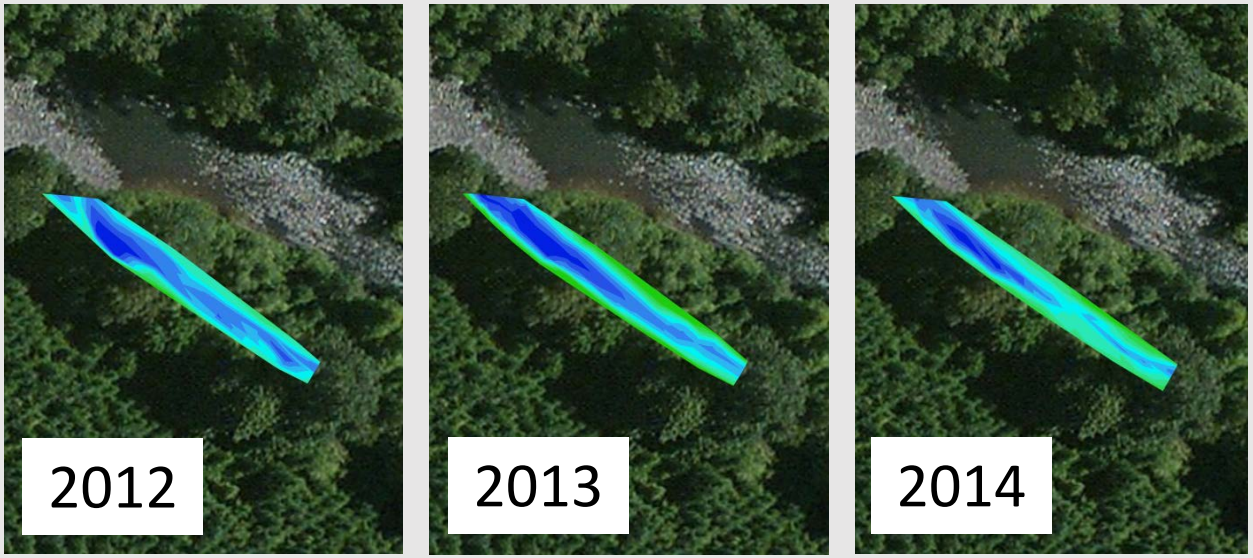
Paul Scheerer's study

Objective: Describe bluegill and Oregon chub habitat use in an off-channel location

Findings:

- Significant interaction between depth and temperature on bluegill habitat use
- Although some overlap, Oregon chub and bluegill use different habitats

Additional studies: Fall Creek Drawdown

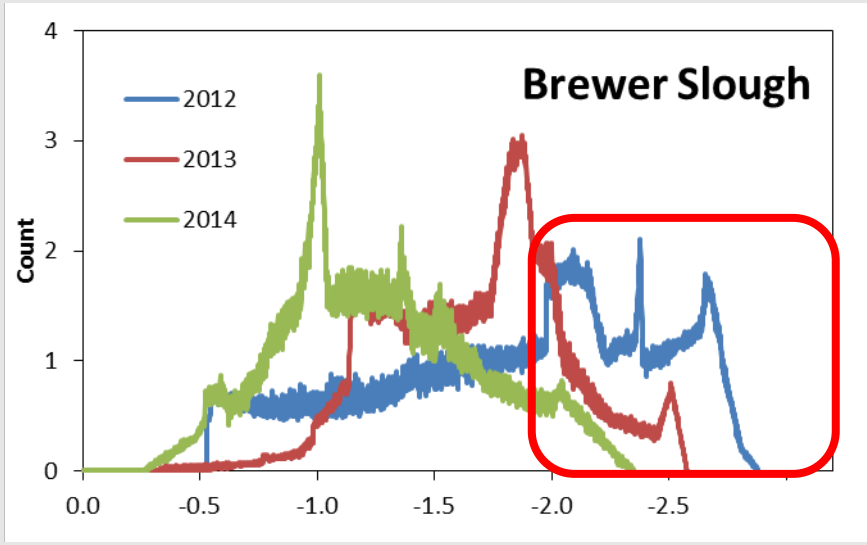


Objective: Determine the impact of complete reservoir drawdown on off-channel habitats

Initially: Sedimentation severely reduced off-channel habitat

Recently: Some sites have partially recovered

Managed flows may not have energy necessary to move sediment from off-channel locations



Initial Findings

- Supported the delisting (2015)
  - Many new populations
  - Metapopulations, movement
  - Co-occurring with nonnative fish
- Initial analyses
  - Positive relationship between flow and abundance
  - Strong relationship between flow and water depth, habitat quality
  - Temperature varied

Future work, conclusions

- Upcoming report:
  - Include a tool (Excel?) to assist managers to determine flow levels to connect habitats, provide quality habitat levels
- Floodplain study
  - Preliminary data
  - Eventually build models to help determine characteristics that benefit native fish (and chub) over nonnative fish in floodplain habitats

Questions?

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