Cold Water Refuges in the Willamette River

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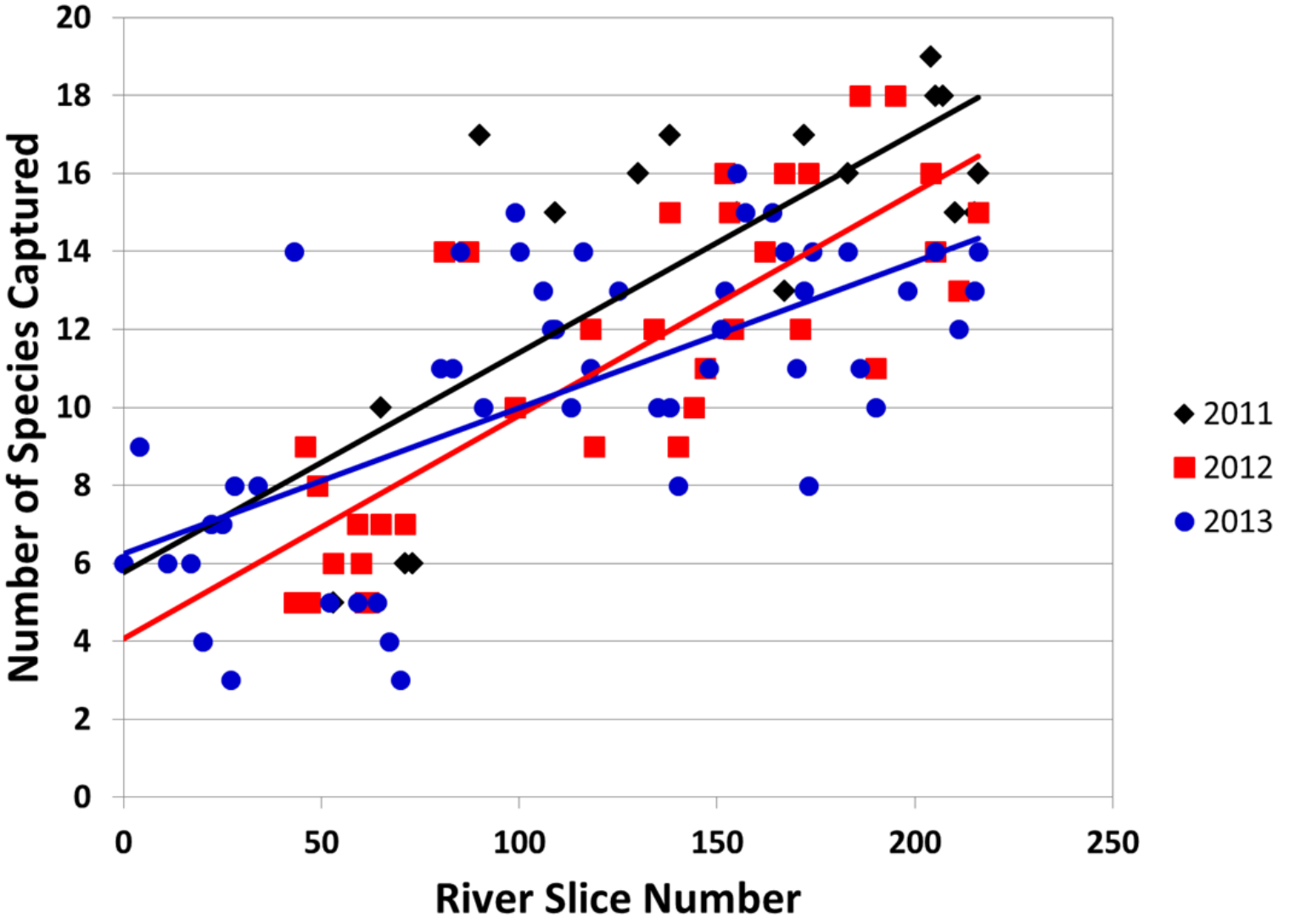
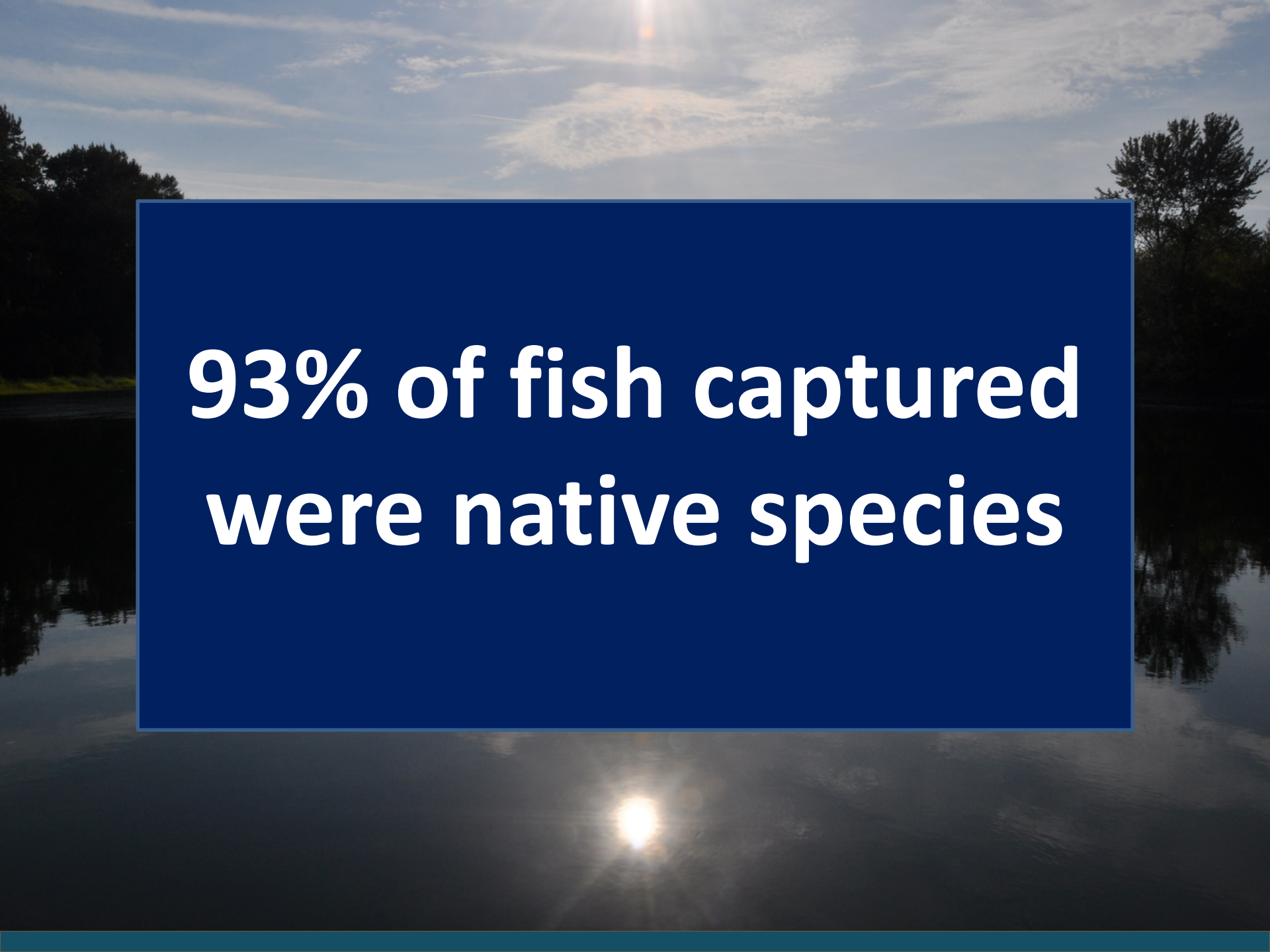
University of Oregon

Presentation to Willamette Fisheries Science Review **Feb. 8, 2016**

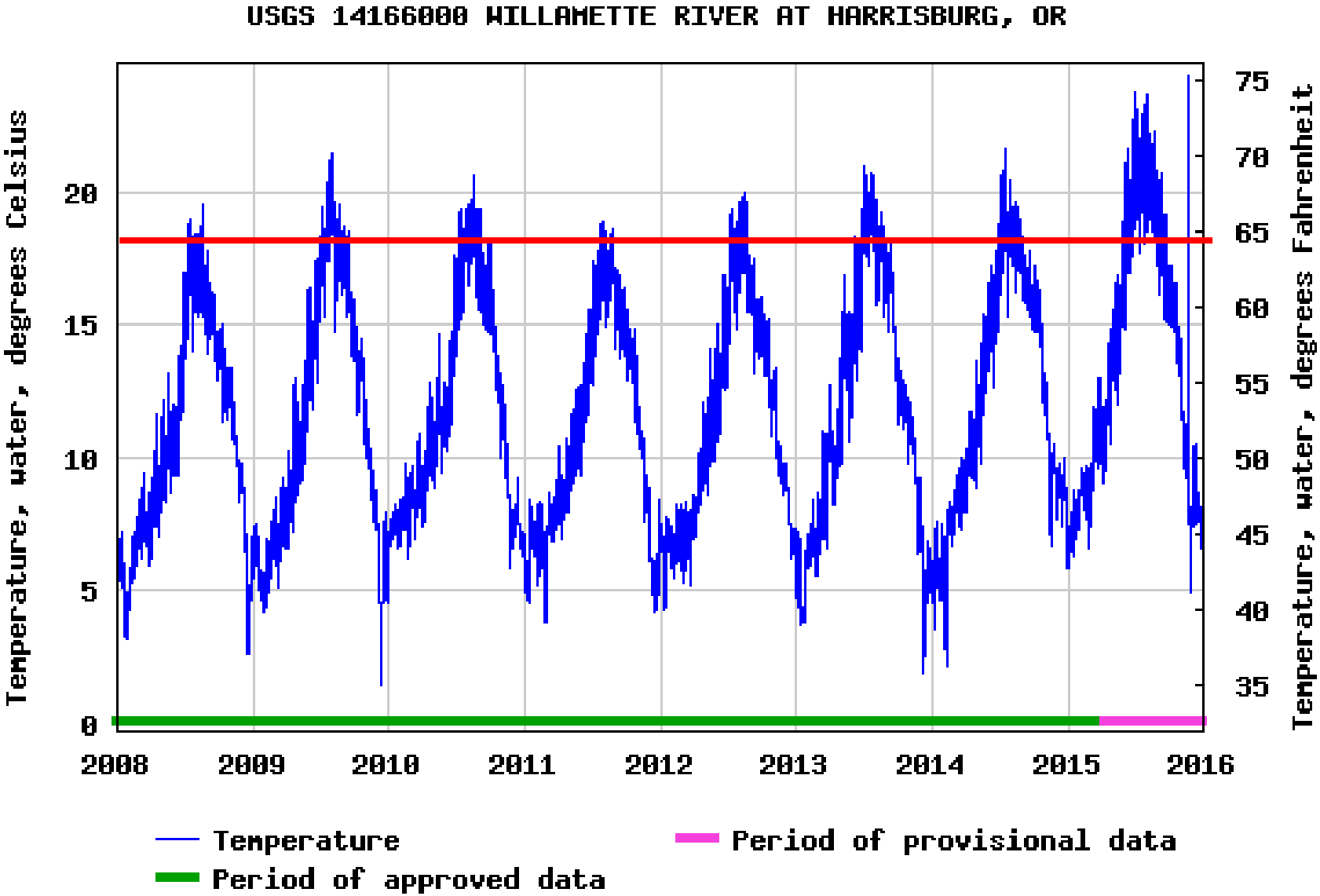
Number of Species




93% of fish captured were native species

Willamette River Thermal Regime

2008 to 2015



Cold Water Refuges

- **Those portions of a water body where, or times during the day when, the water temperature is at least 2 degrees Celsius colder than the daily maximum temperature of the adjacent well-mixed flow of the water body.**

OAR 340-041-0002(10)

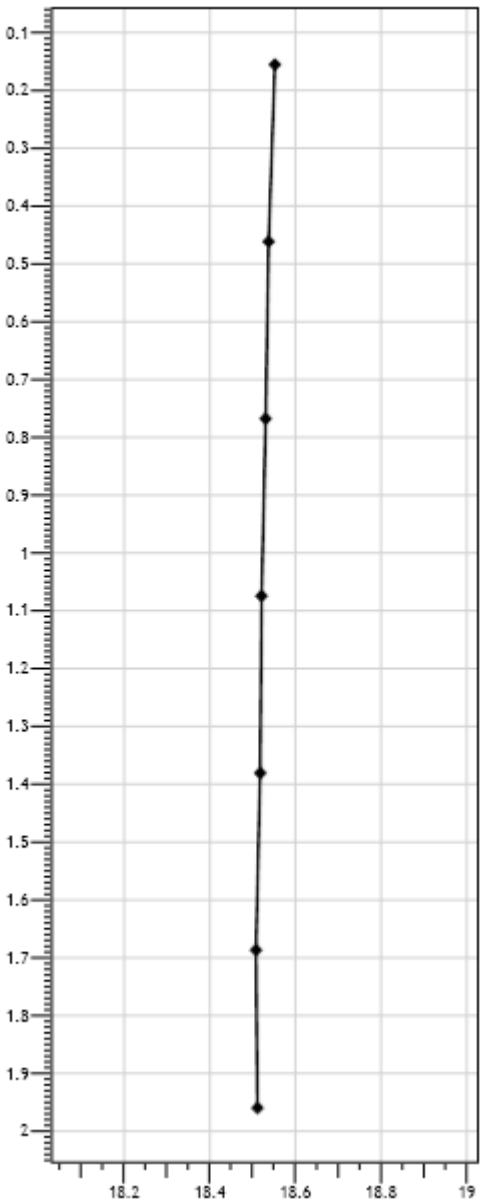
EPA 910-C-12-001

United States Environmental Protection Agency	Region 10 1200 Sixth Ave. Seattle, WA 98101	Alaska Idaho Oregon Washington
Water Division	Office of Water and Watersheds	February 2012

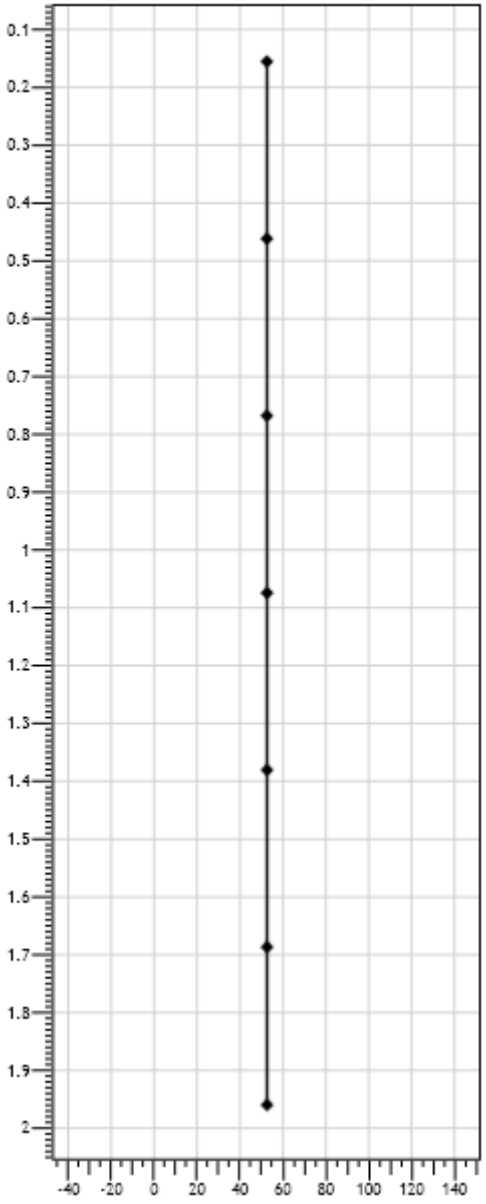
Primer for Identifying Cold-Water Refuges to Protect and Restore Thermal Diversity in Riverine Landscapes

Beginning in 2010, the Meyer Memorial Trust and OWEB supported a study of thermal patterns of 200 miles of the mainstem Willamette River and more than 100 sloughs, side channels, and tributary mouths.

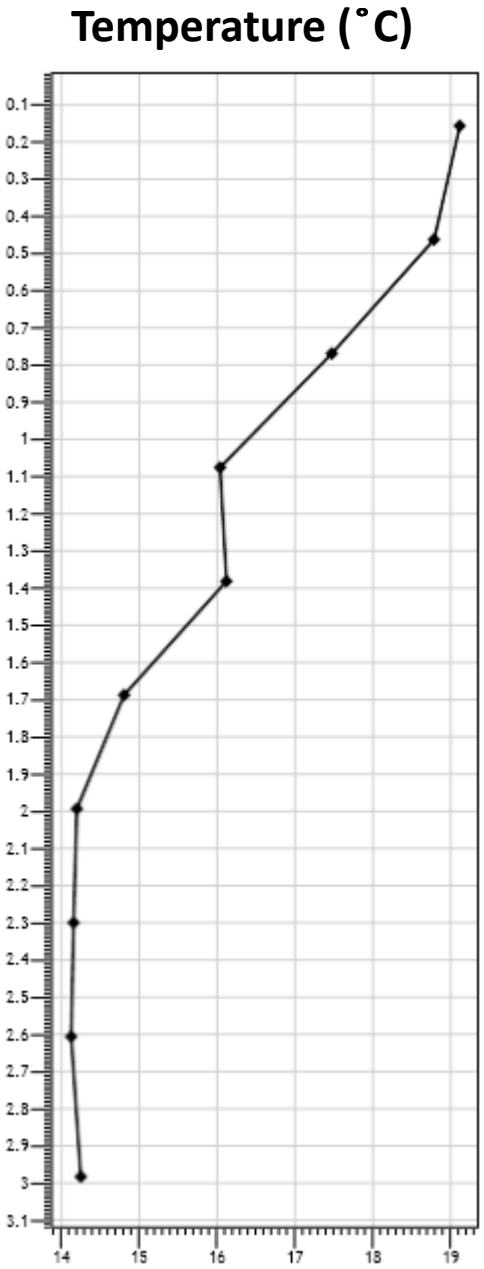
Temperature (˚C)

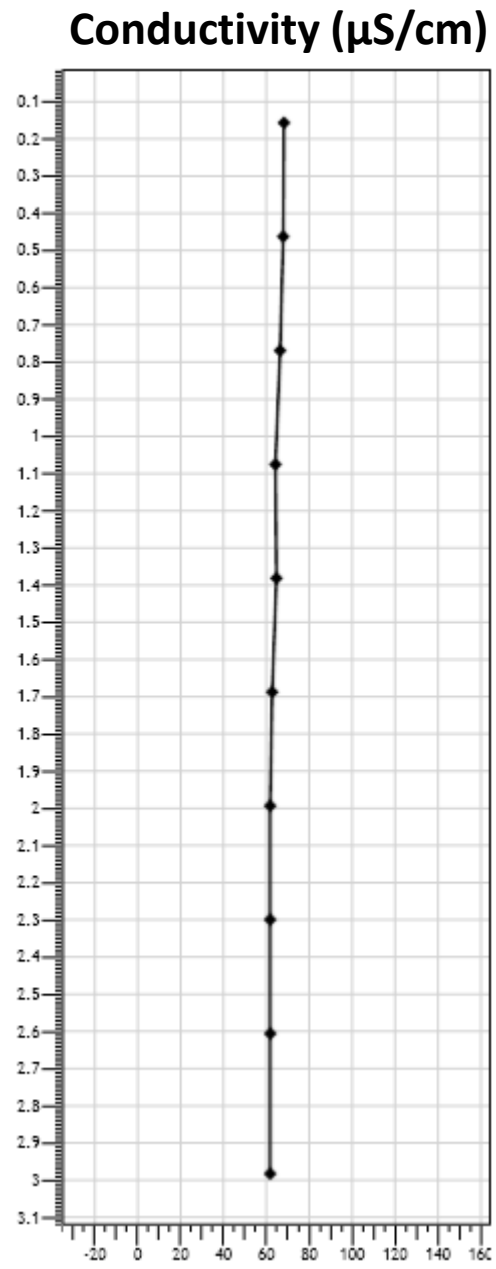


Conductivity (µS/cm)



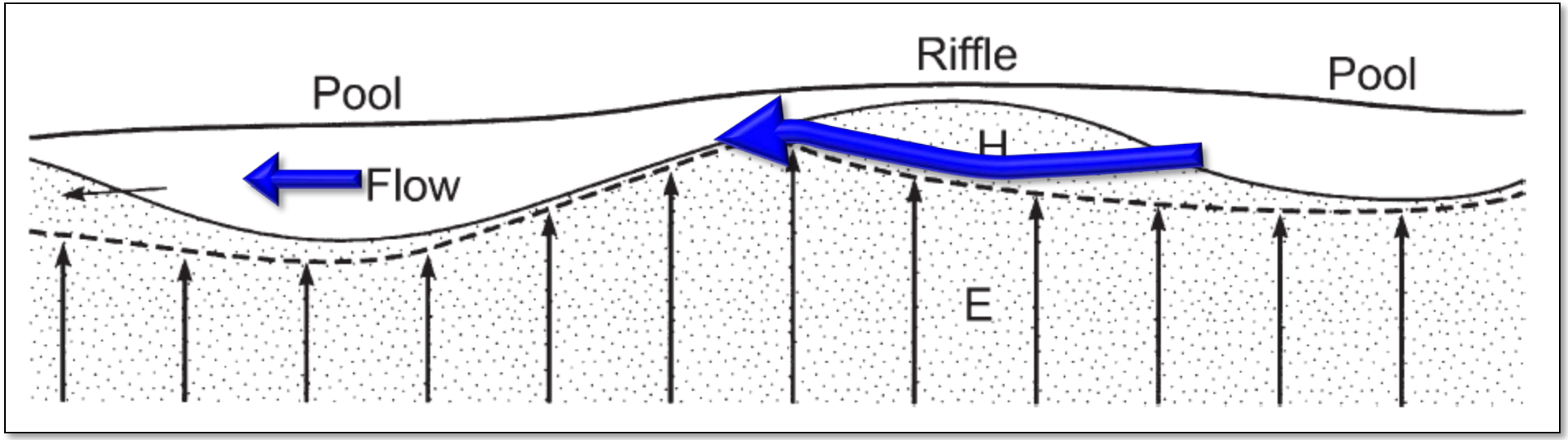
Green Island Mainstem- data shown are depth profiles

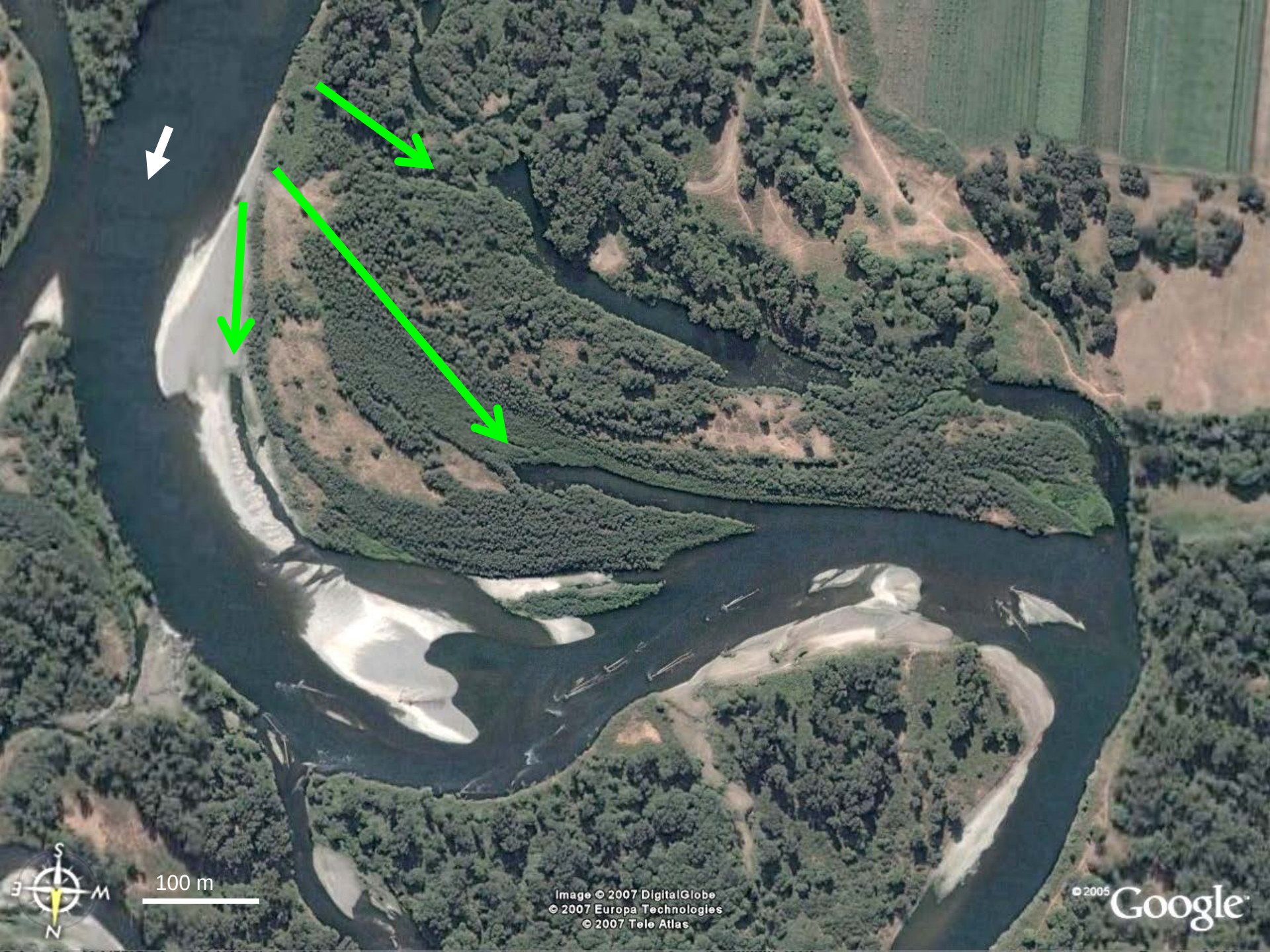


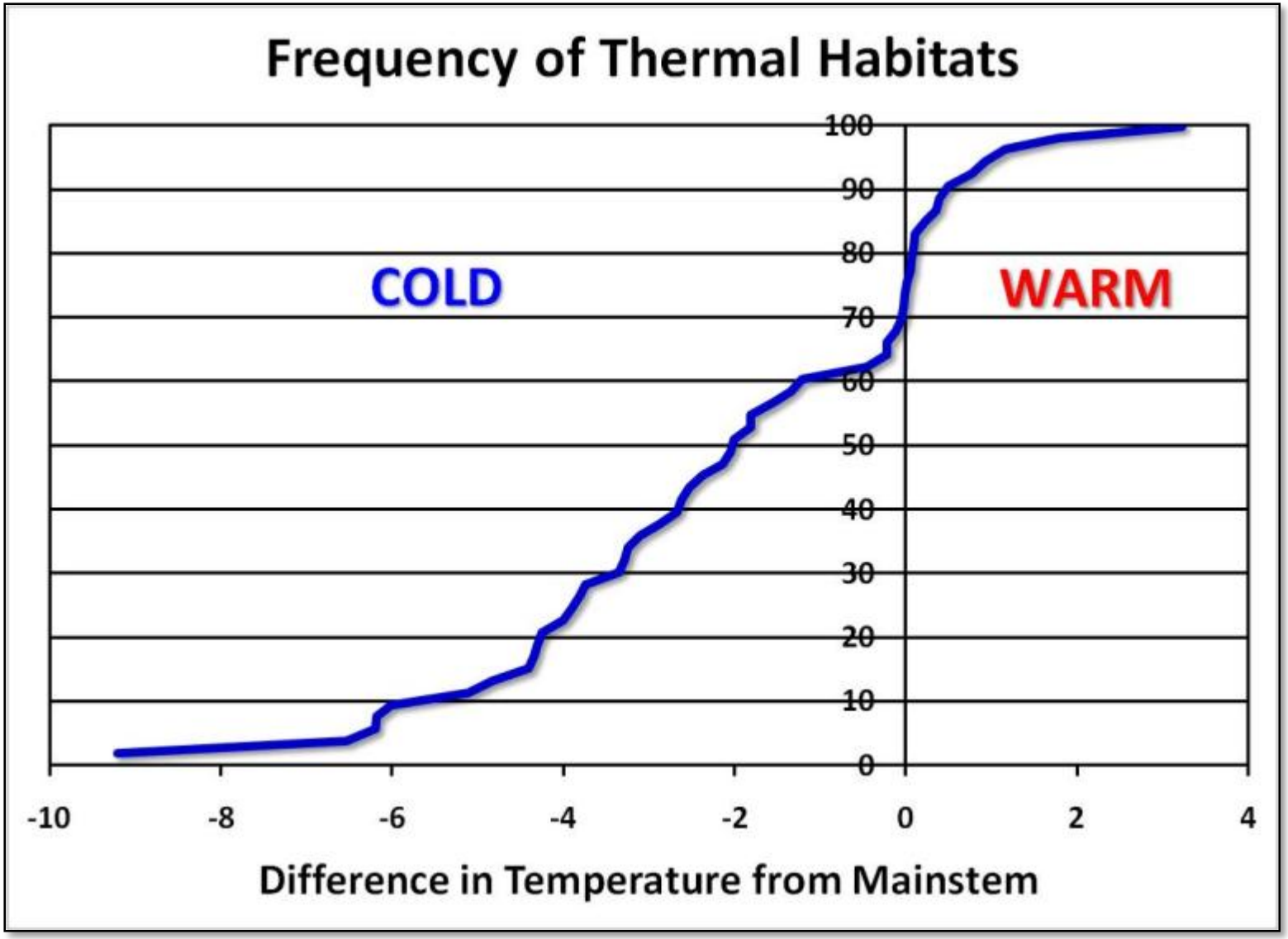


Green Island Alcove- data shown are depth profiles

Hyporheic Flow- side view



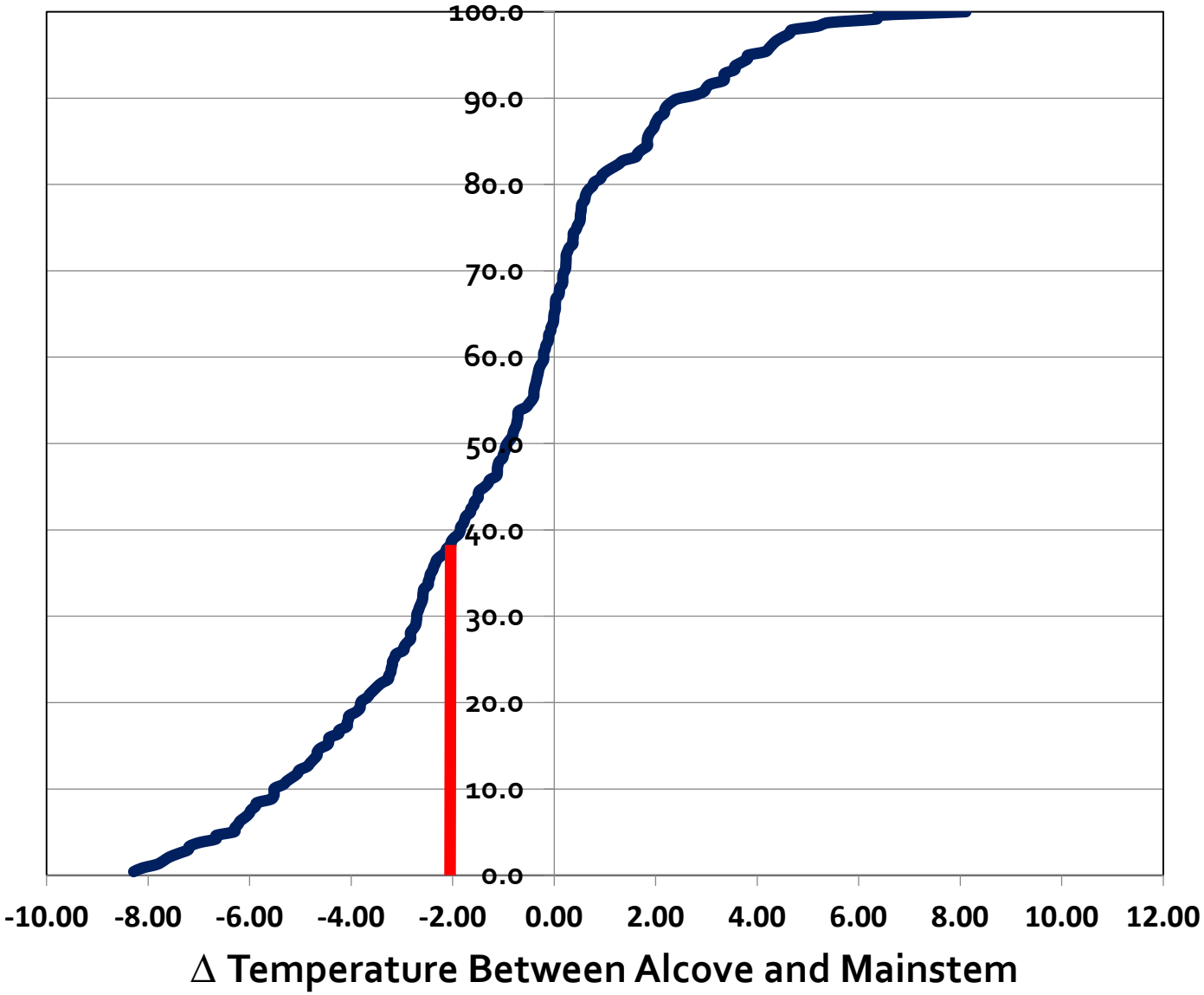

100 m
Image © 2007 DigitalGlobe
© 2007 Europa Technologies
© 2007 Tele Atlas
© 2005 Google


Frequency of Thermal Habitats
COLD
WARM
100
90
80
70
60
50
40
30
20
10
0
-10
-8
-6
-4
-2
0
2
4
Difference in Temperature from Mainstem

Floodplain Alcoves

65% of sites colder than mainstem

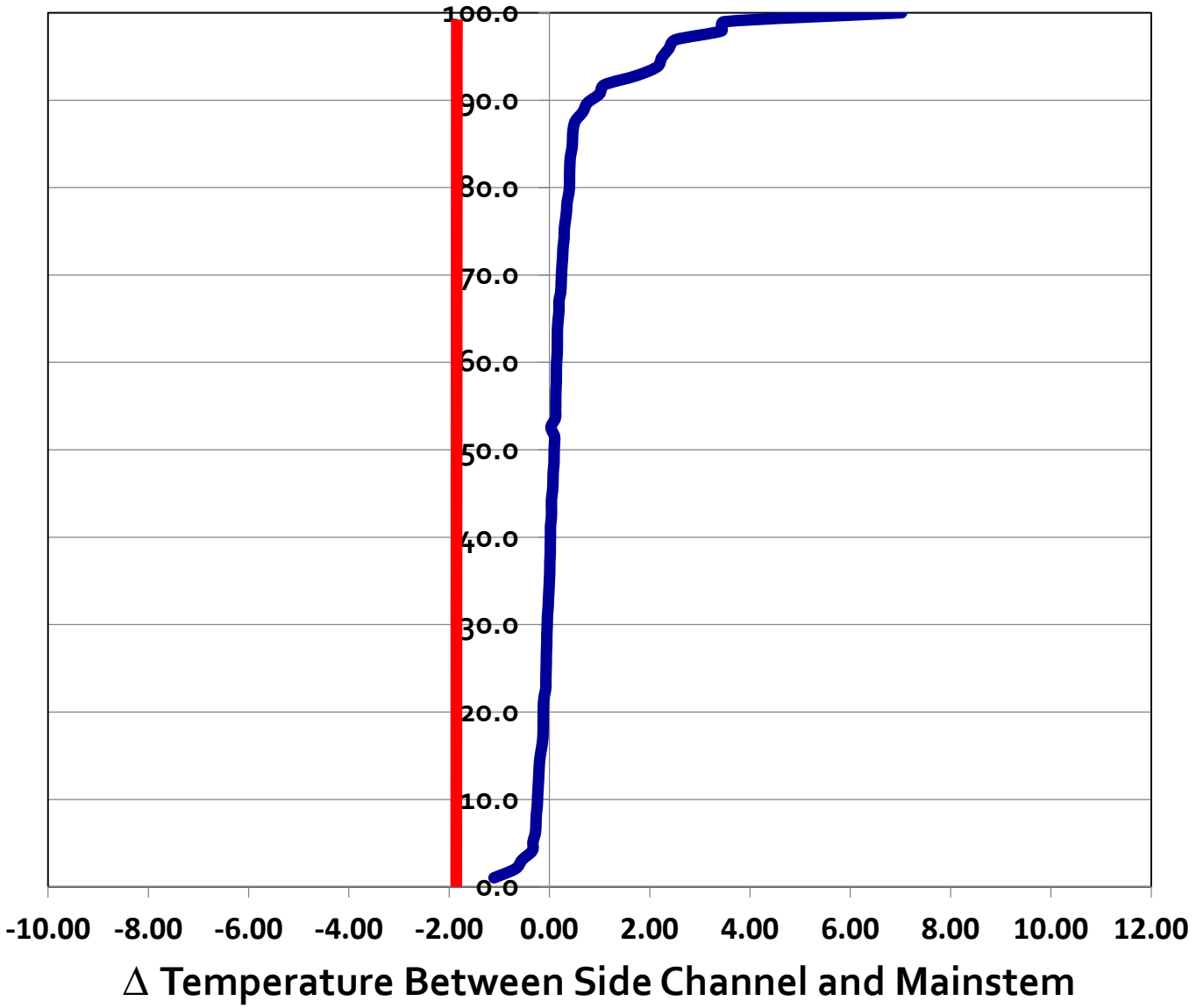
39% more than 2ºC colder than mainstem



Side Channels

25% of side channel sites were colder than mainstem

None of the side channels were >2ºC colder than mainstem



2011 -2015

- **72% of 81 separate floodplain sloughs in the Willamette River were colder than the mainstem maximum temperature**

- **40% of these sloughs were more than 2^{o}C colder than the maximum mainstream temperature.**

2011 -2015

- **Dissolved oxygen concentrations can be low in some sloughs.**

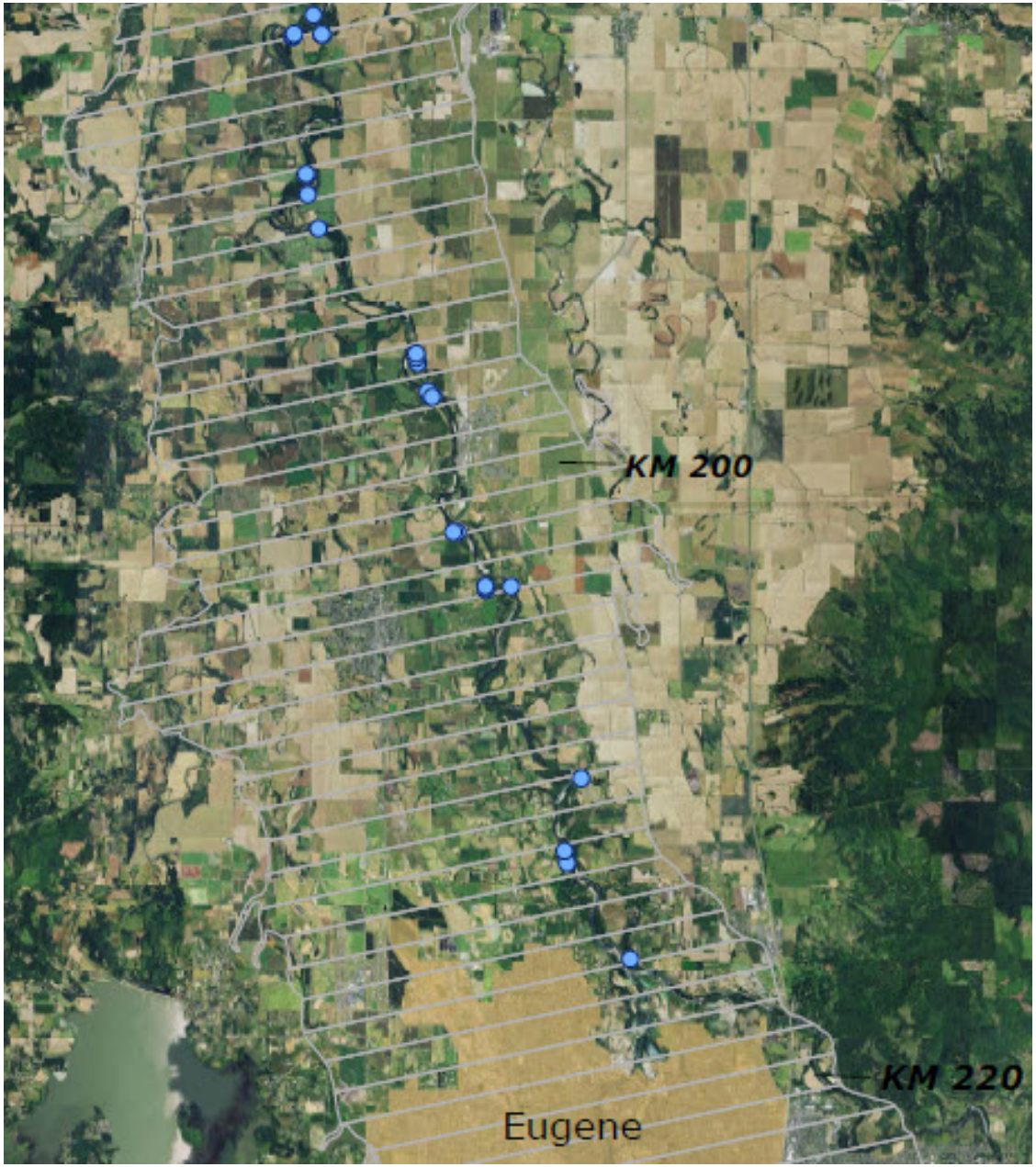
- **80% of the sloughs that were more than 2^{o}C colder than the mainstream contained adequate dissolved oxygen to support native fish where cold water was detected.**


It’s not just about
temperature!

2011 -2015

- **One-third of the sloughs in the Willamette River meet the definition of cold water refuge and have adequate oxygen for native fish.**

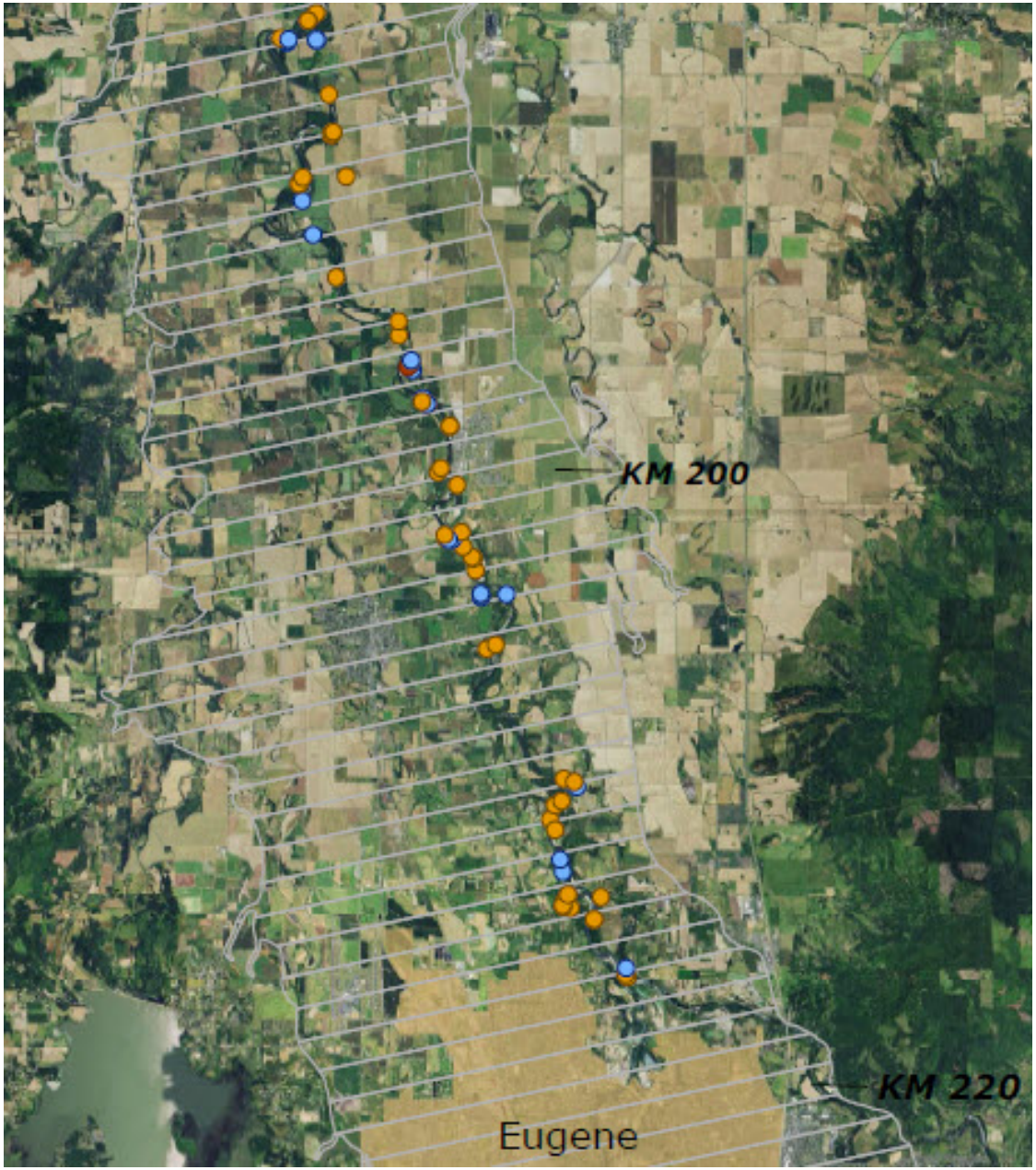
Cold Water Refuges 2011-2015



Cold Water Refuge

1 Km Slice

Cold Water Refuges 2011-2015

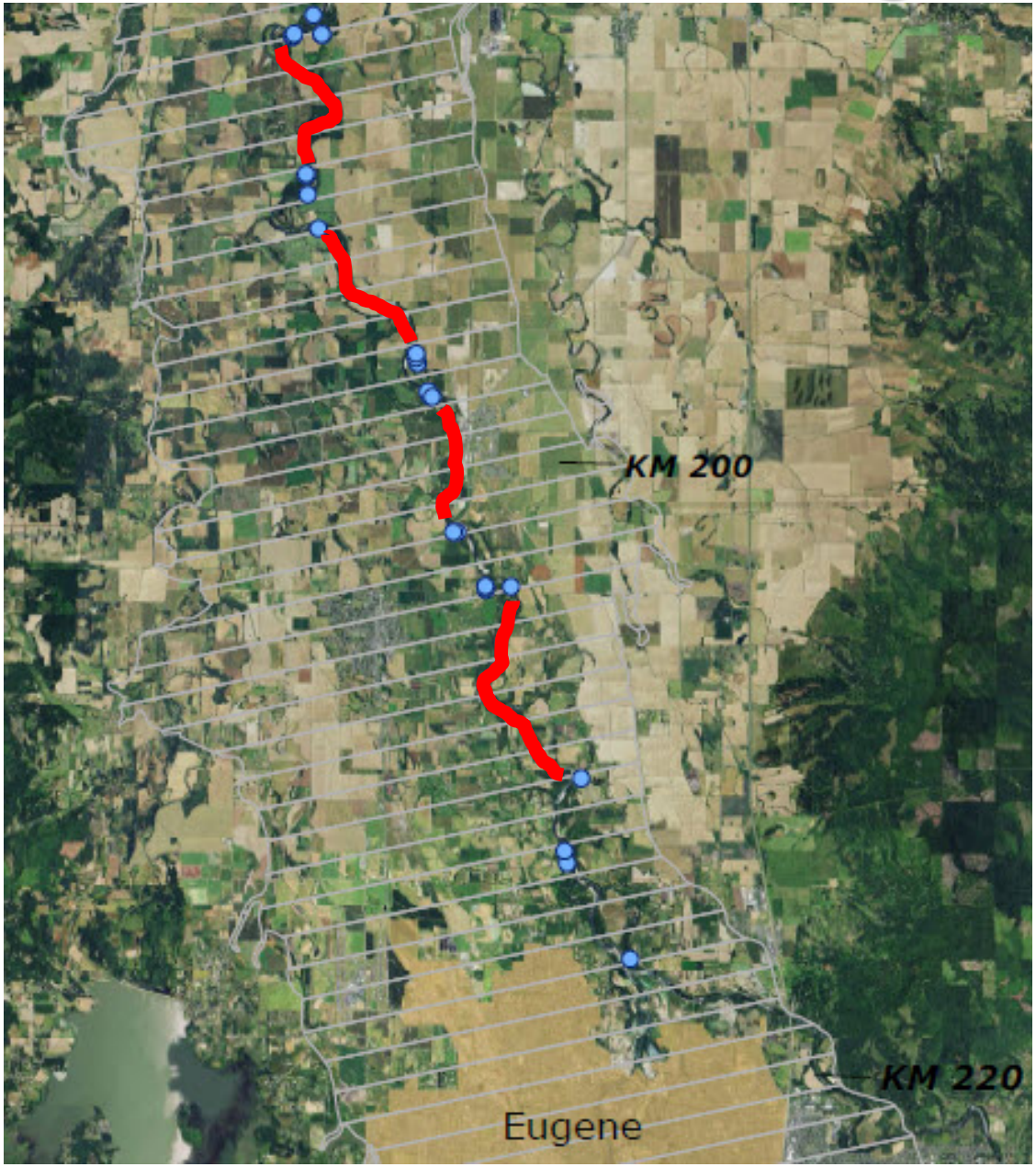


Cold Water Refuge

Not Cold Water Refuge

1 Km Slice

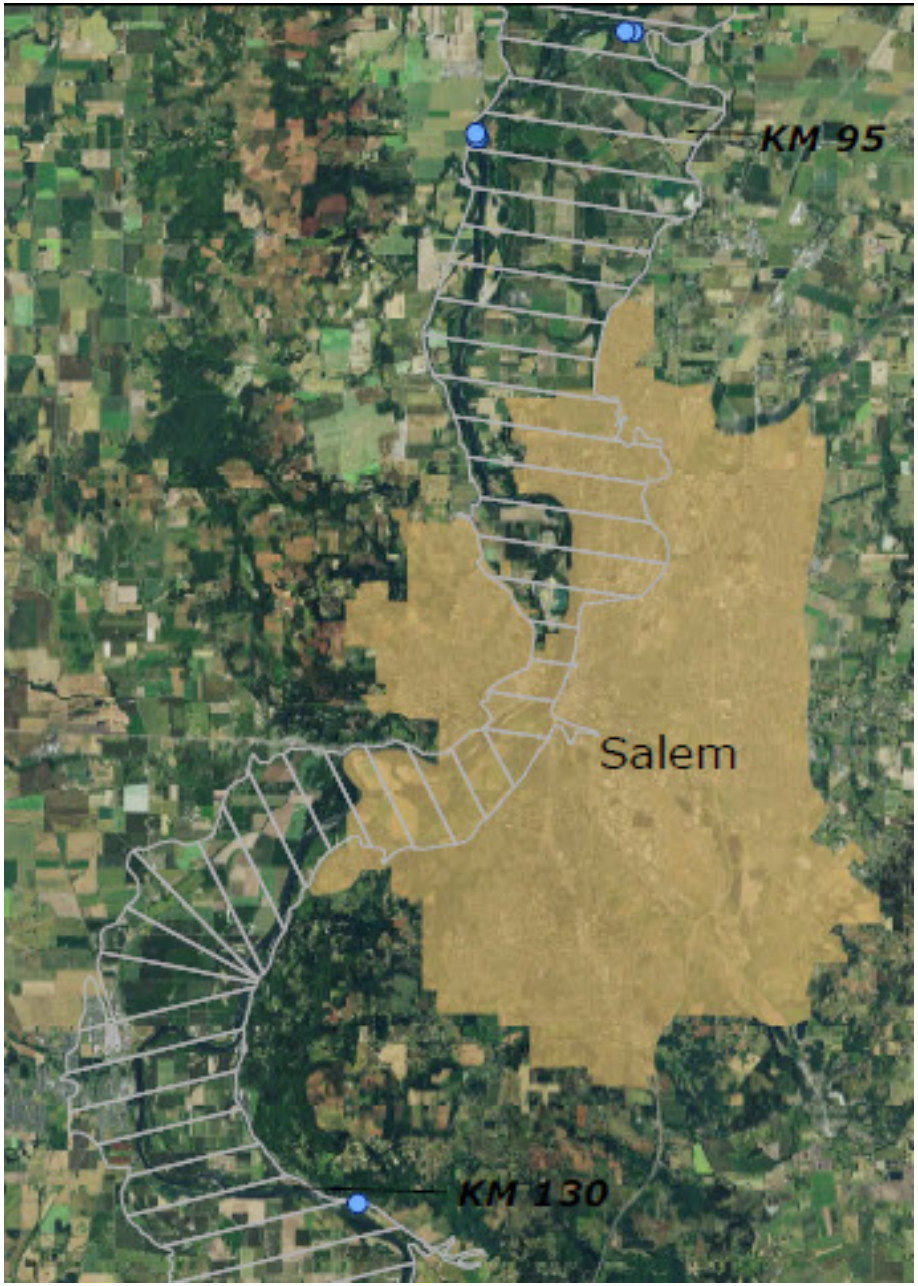
Cold Water Refuges 2011-2015



Cold Water Refuge

1 Km Slice

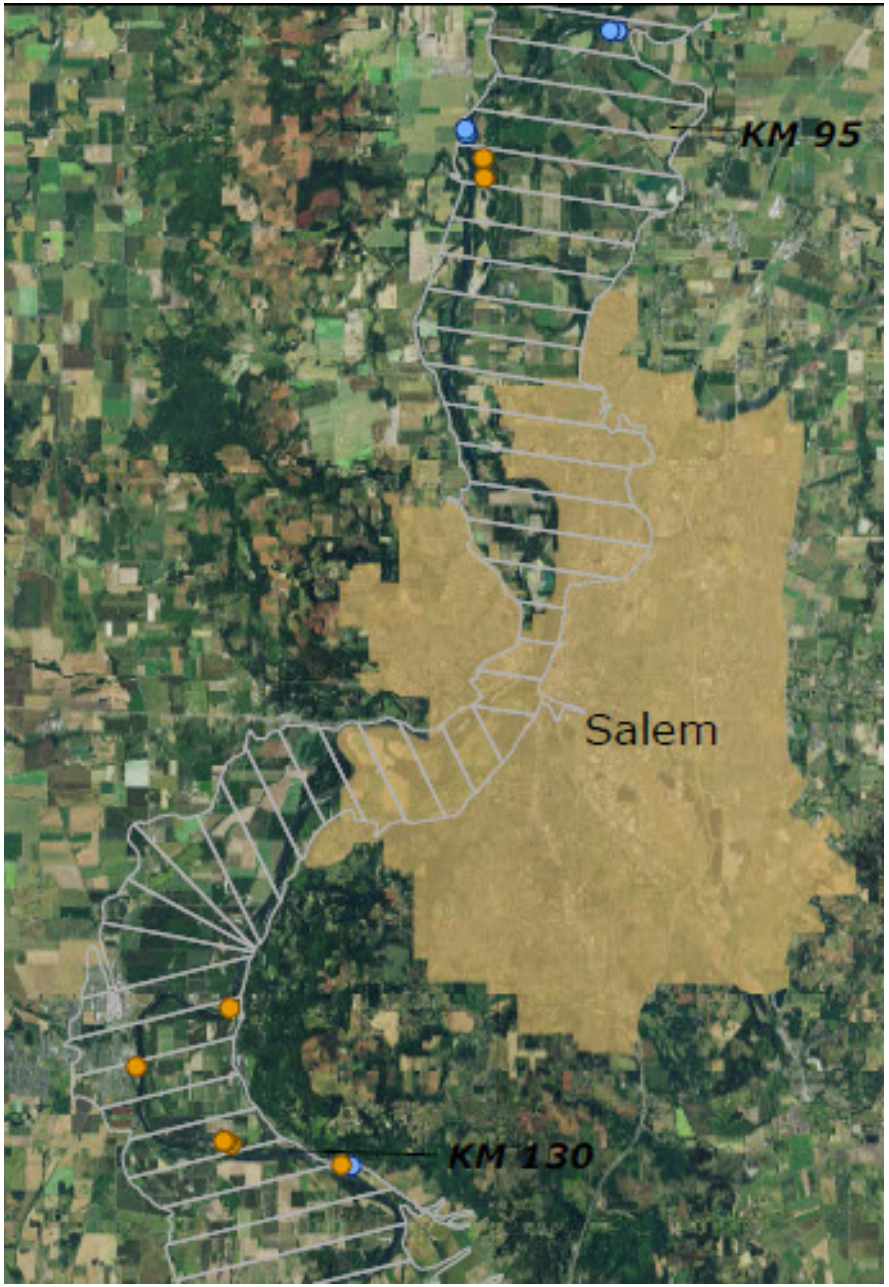
Cold Water Refuges 2011-2015



Cold Water Refuge

1 Km Slice

Cold Water Refuges 2011-2015

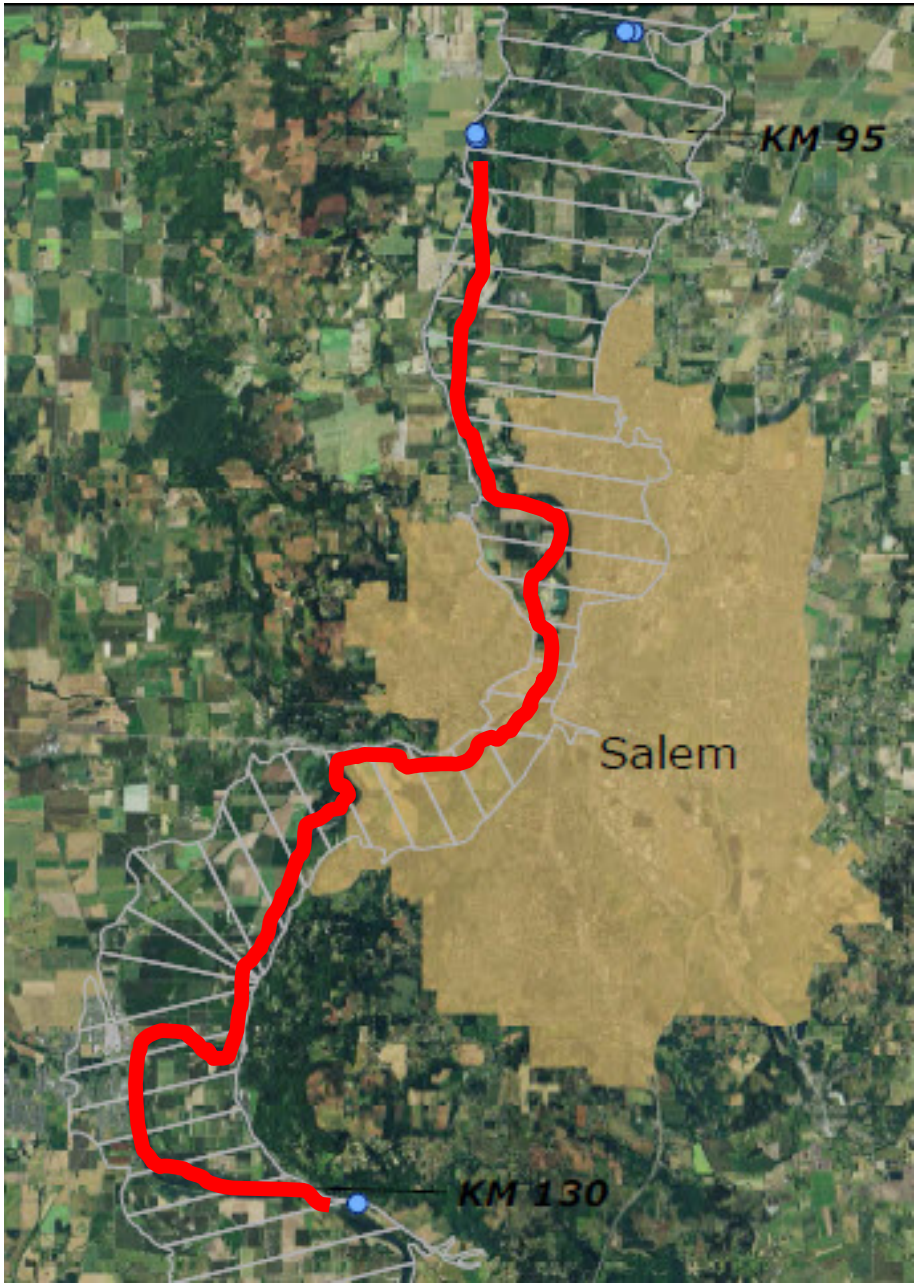


Cold Water Refuge

Not Cold Water Refuge

1 Km Slice

Cold Water Refuges 2011-2015



Cold Water Refuge

1 Km Slice

Fish Communities

- **Abundance and number of native fish species were greater than non-native species in cold water habitats**

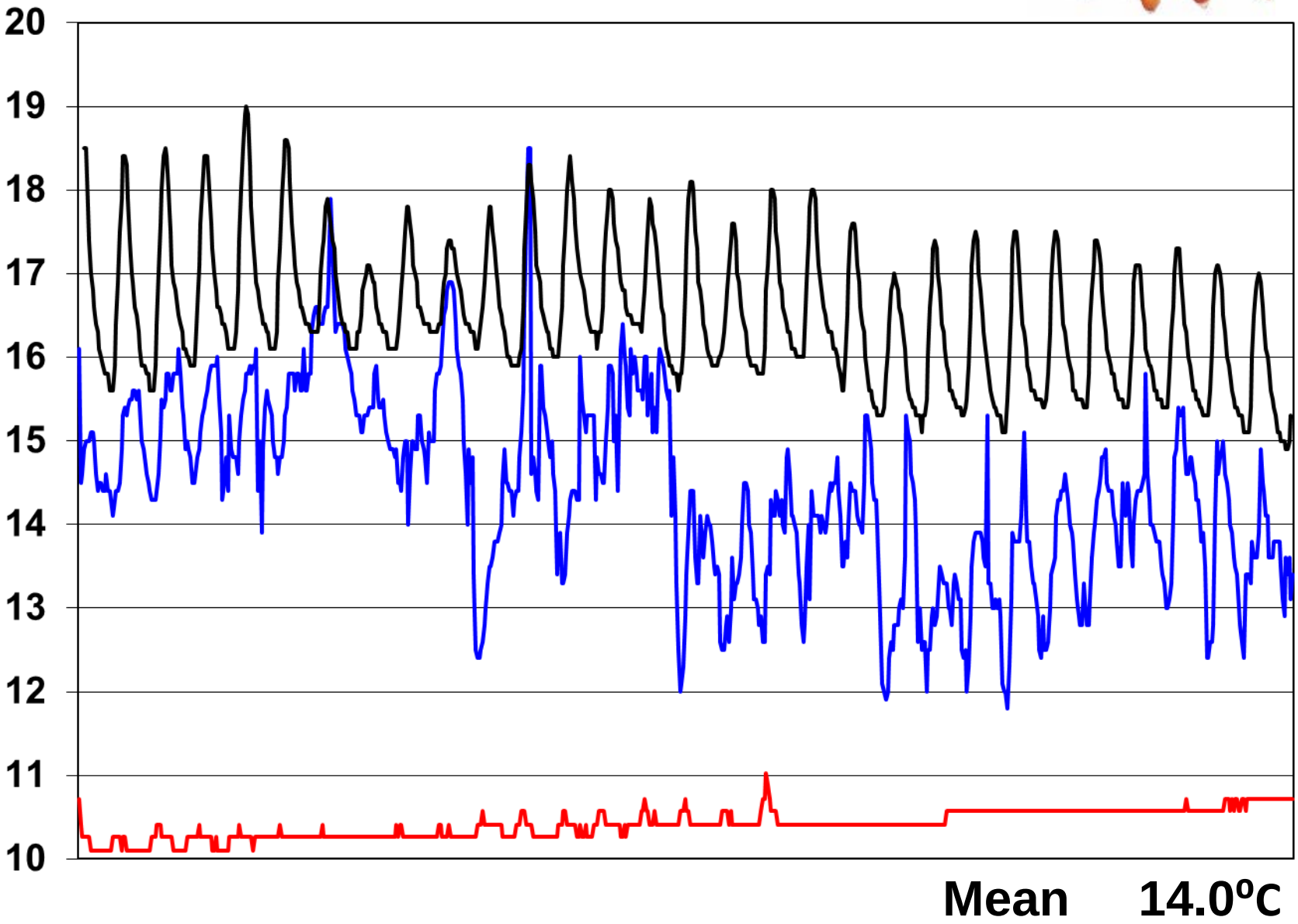
- **Native fish made up more than 60% of the individuals captured in cold water sloughs**

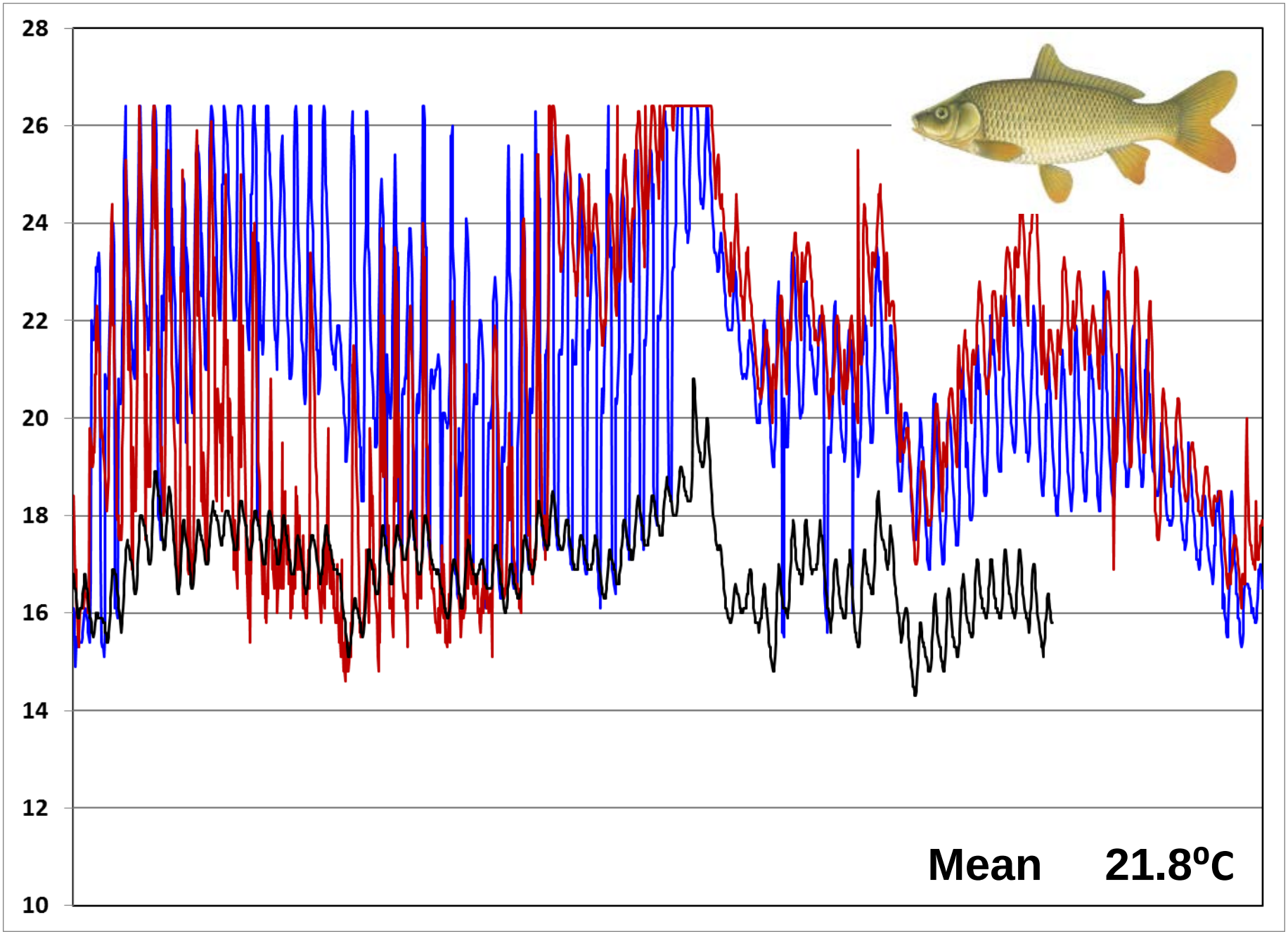
- **Non-native fish comprised more than 85% of the fish captured in warm water sloughs.**

Fish Communities

- **Salmonids were 10 times more abundant in cold water sloughs than in warm water sloughs.**

- **Chinook juveniles were found in two of the ten cold water sloughs and were not observed in warm water sloughs.**

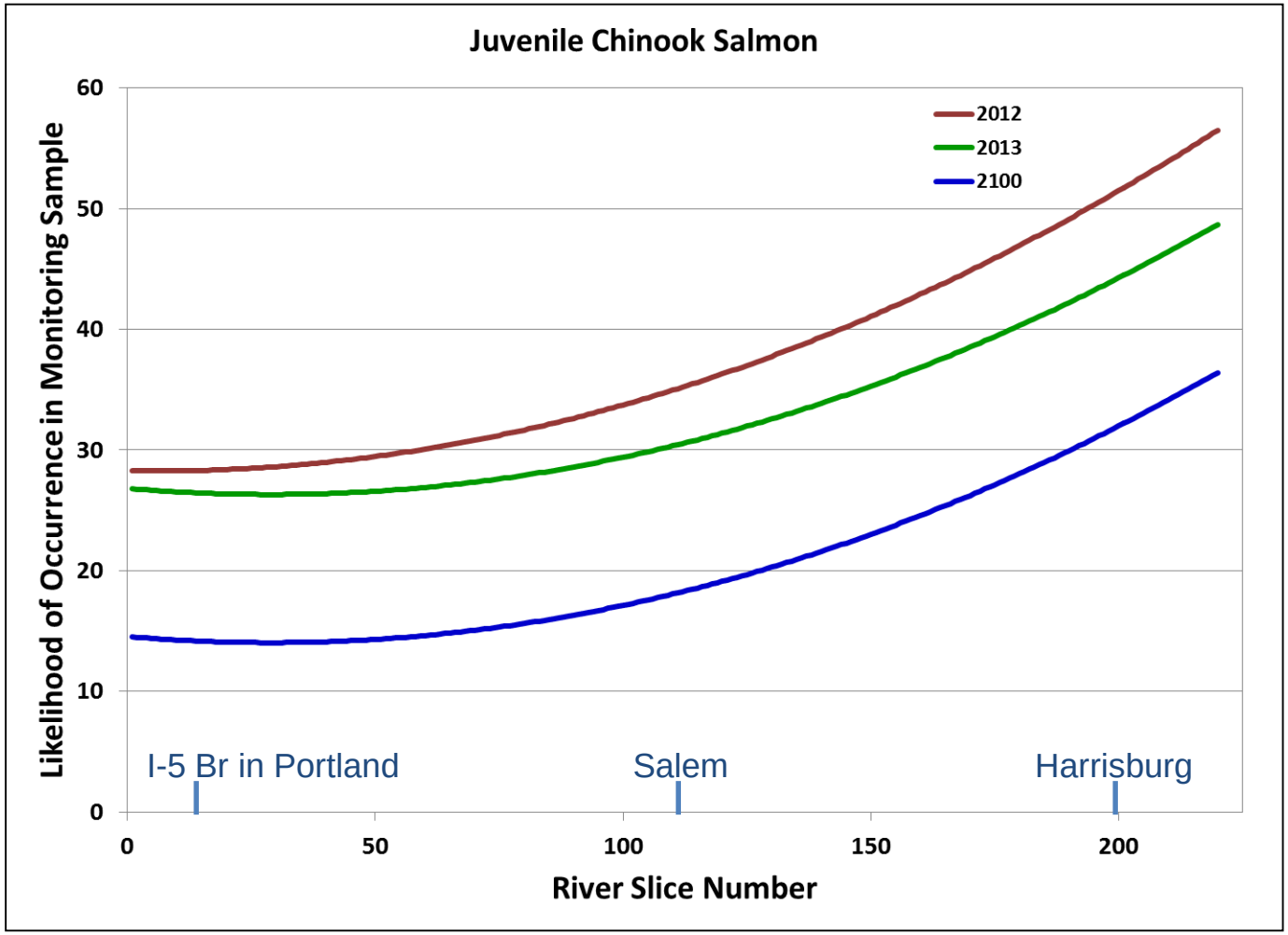

20
19
18
17
16
15
14
13
12
11
10
Mean 14.0°C


28
26
24
22
20
18
16
14
12
10
Mean 21.8ºC

High Confidence Future Projections

- **The likelihood of occurrence for cold-water species along the river is likely to decrease as river temperatures warm in the future.**

- **Cold water habitats associated with the floodplain and active gravel bars provide potential refuges for native fish during periods of high water temperature.**


Juvenile Chinook Salmon
Likelihood of Occurrence in Monitoring Sample
60
50
40
30
20
10
0
2012
2013
2100
I-5 Br in Portland
Salem
Harrisburg
0
50
100
150
200
River Slice Number

High Confidence Future Projections

- **The river is changing because of human caused changes in hydrology and sediment supply.**

- **A new river is forming and the occurrence of cold water habitats will depend on the dynamics of the channel and floodplain.**

SLICES Framework

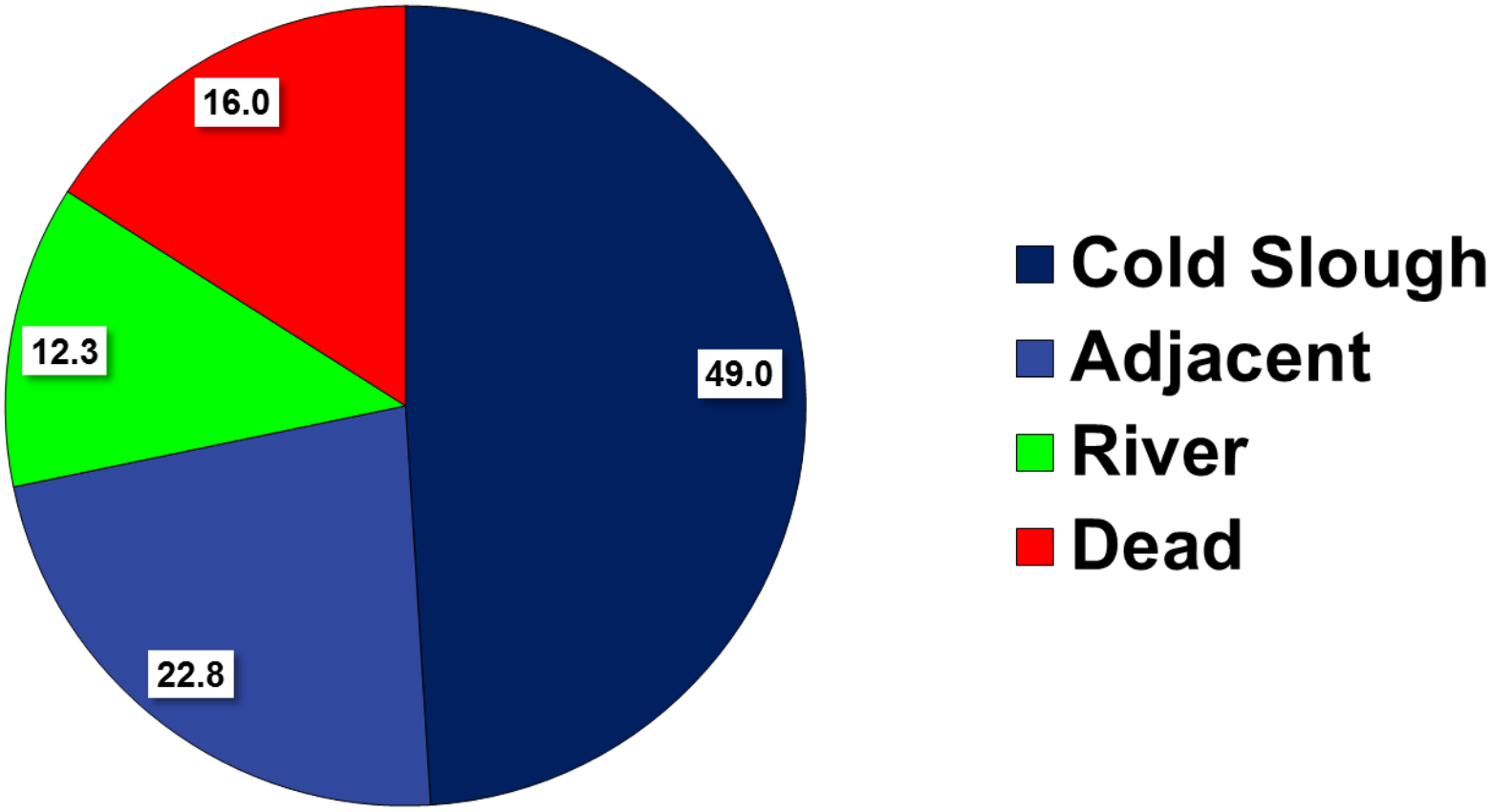
- David Hulse and his research team at the University of Oregon are integrating the cold water refuge information into the SLICES framework, a spatially explicit floodplain framework for the Willamette River.
- The SLICES database provides a context to identify cold water refuges as a basis for designing floodplain and river restoration actions to create cold water habitats (http://ise.uoregon.edu/slices/Main.html).

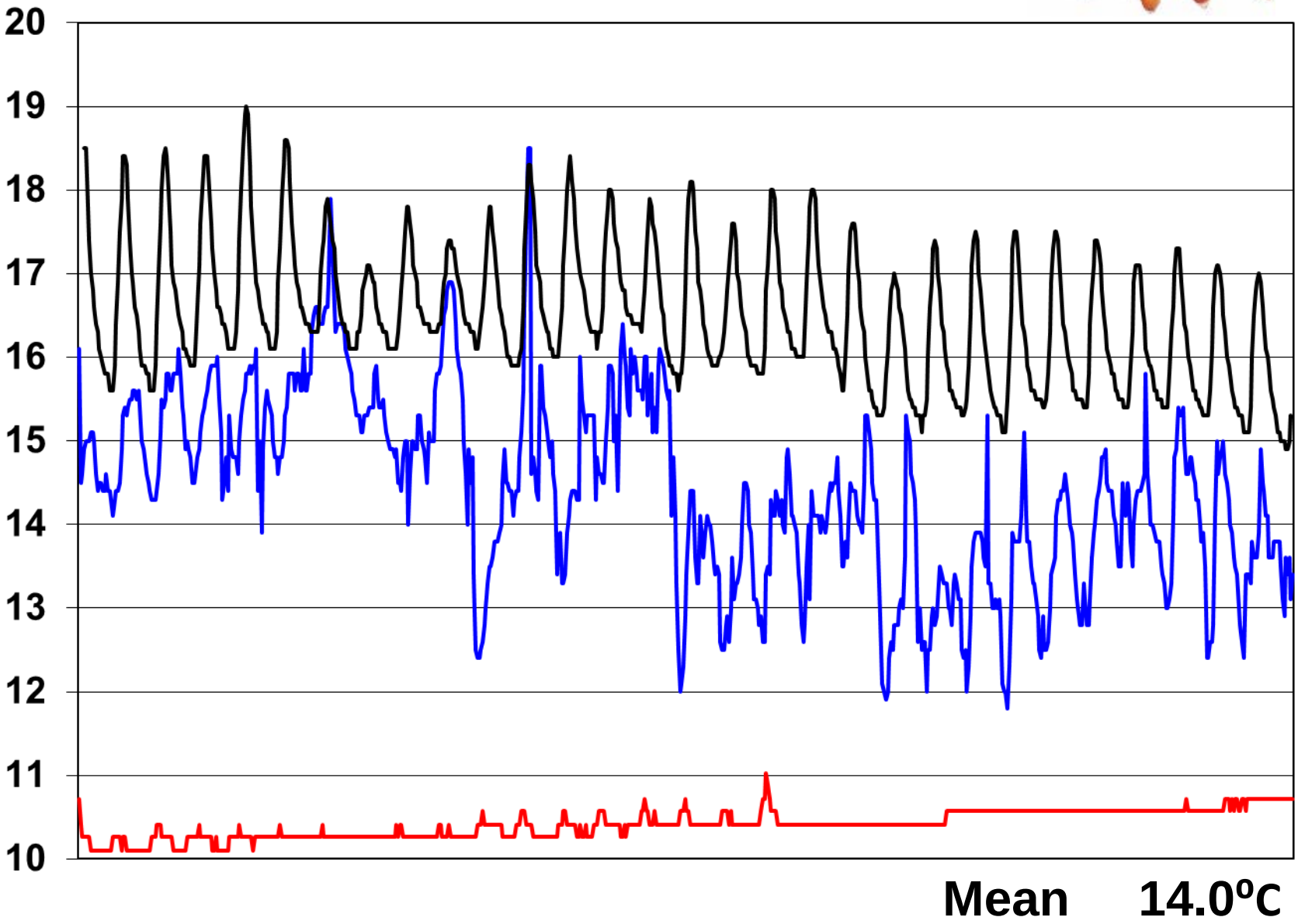
- THE END

- EXTRA SLIDES IF QUESTIONS


BITE ME

Trout Movement — 2008 and 2009




20
19
18
17
16
15
14
13
12
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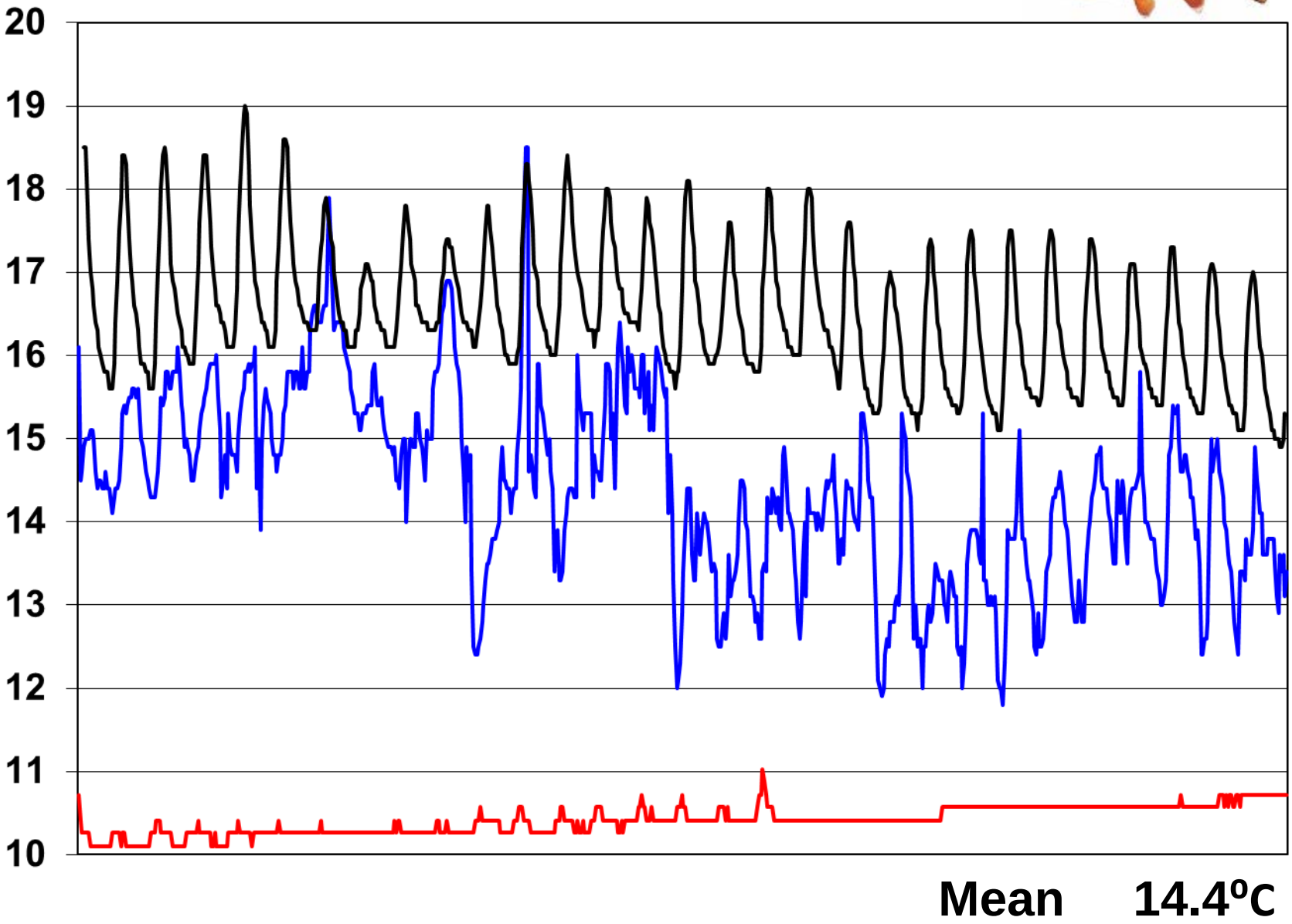
10
Mean 14.0°C

20
19
18
17
16
15
14
13
12
11
10

Mean 13.8ºC


20
19
18
17
16
15
14
13
12
11
10
Mean 14.4ºC


Slice 155
(1 km slices)
Slice 15501
Slice 15505
Slice 15508

SLICES Framework

- **The SLICES framework has been used to identify critical reaches for conservation and restoration projects, including identification of potential cold water refuges.**
- **OWEB and Meyer Memorial Trust have used data from this project to develop the anchor habitats framework for Willamette Partnership.**
- **SLICES information is used in Willamette proposals and the new OWEB Focused Investment Partnership program.**