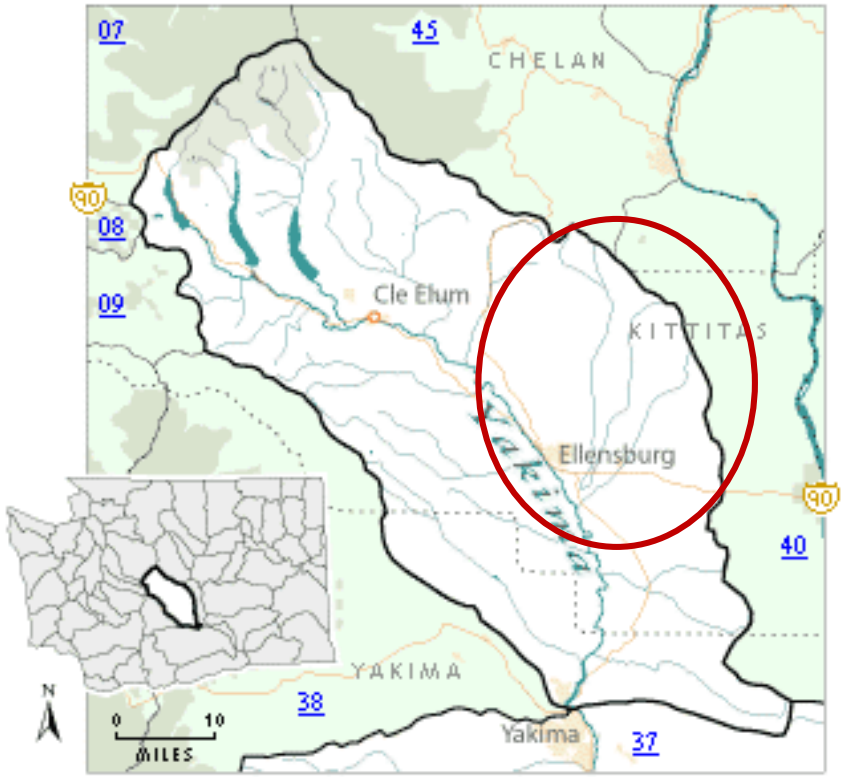
Salmonids in an Urban Stream: Movement, Potential Barriers and Fragmented Habitat

Connor Parrish
Central Washington University

Salmonids in the Upper Yakima River Basin

- Species of Concern
  - Steelhead trout, spring chinook, coho and sockeye salmon
- Other Potential Recovery Opportunities?
  - Urban Streams



Urban vs Natural Stream

Urban vs Natural Stream

- Impervious Surfaces

Urban vs Natural Stream

- Impervious Surfaces
- Flashy Hydrograph

Urban vs Natural Stream

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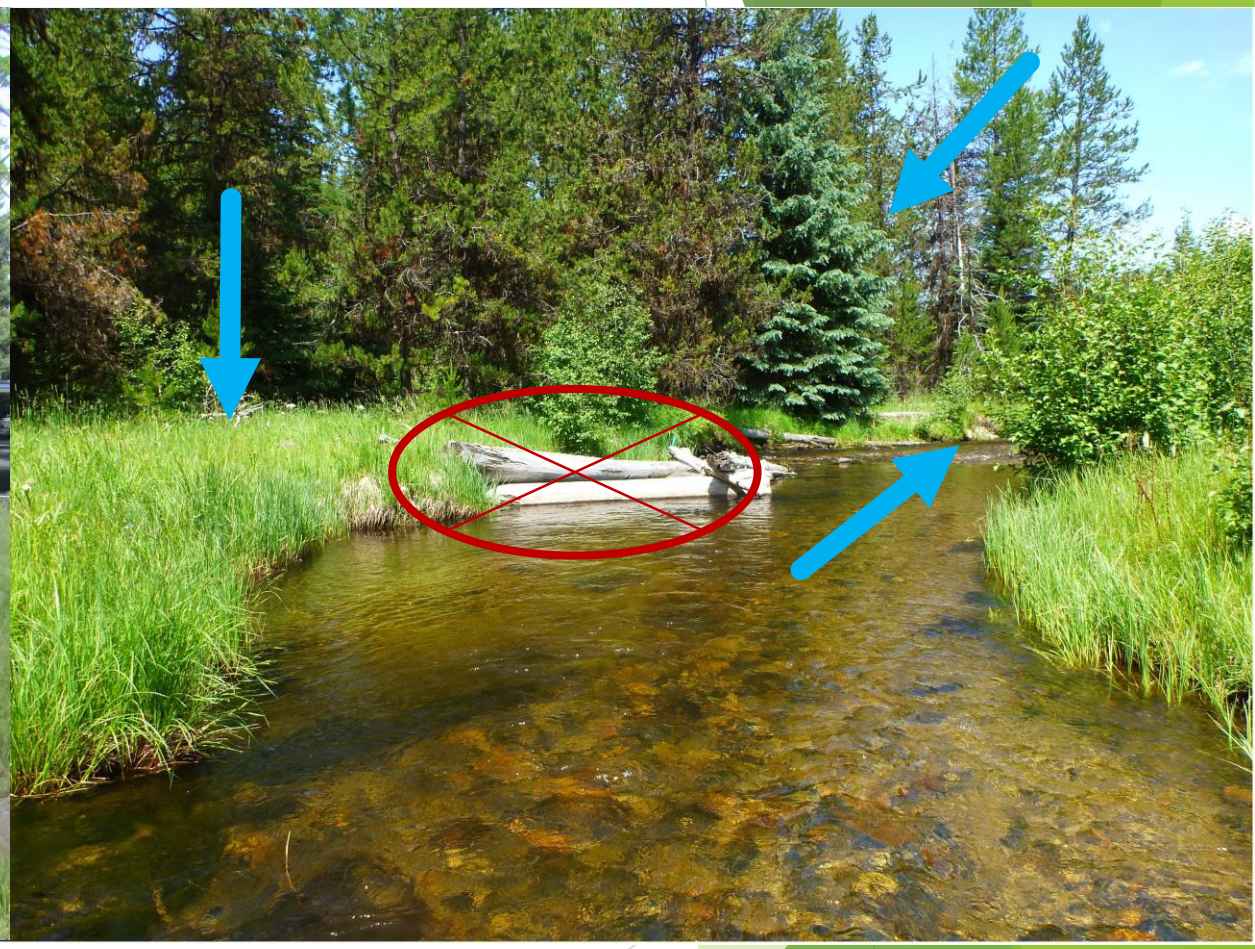
- Flashy Hydrograph

Urban vs Natural Stream

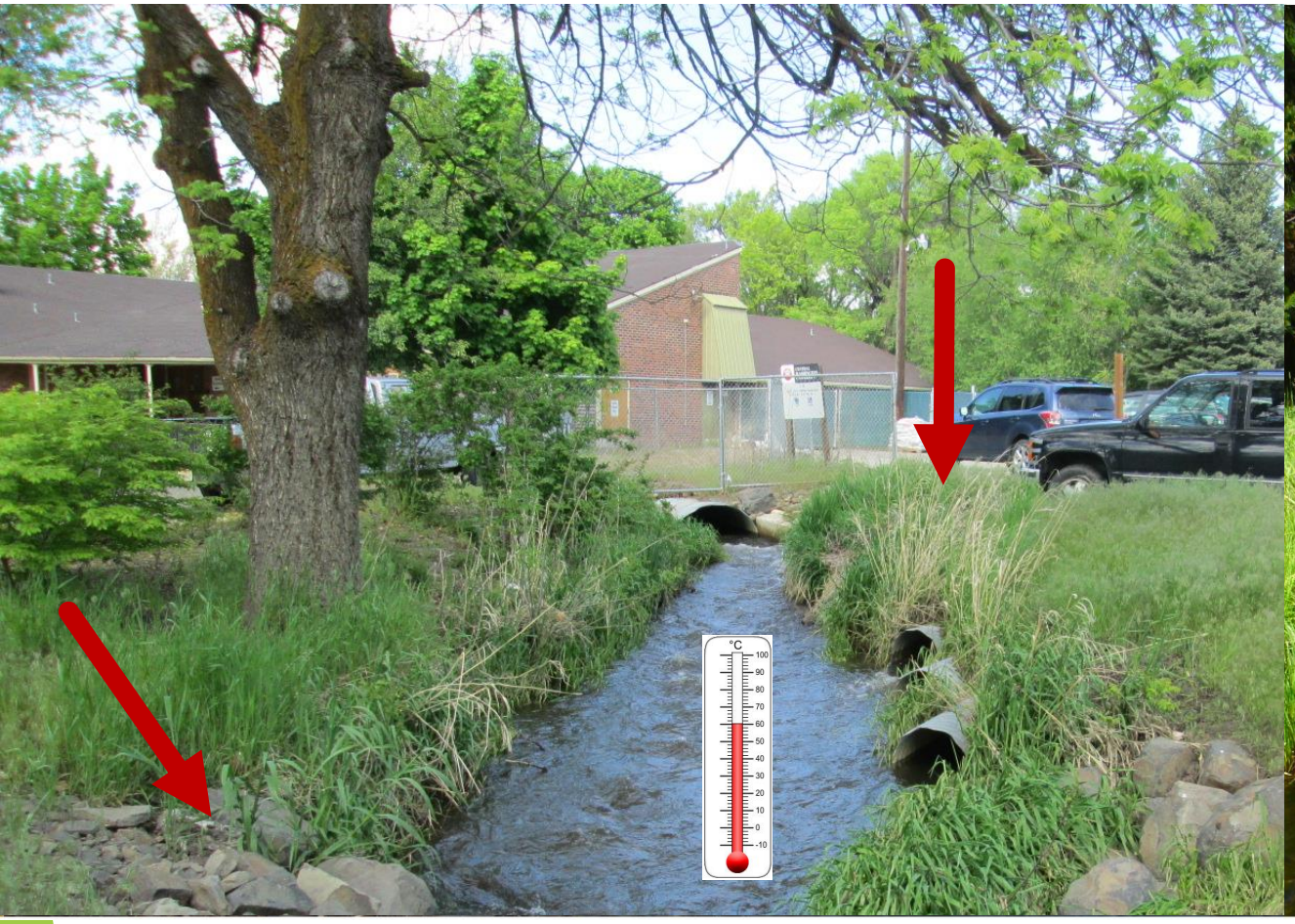
- Impervious Surfaces
- Flashy Hydrograph
- Increased Nutrients/Toxicants

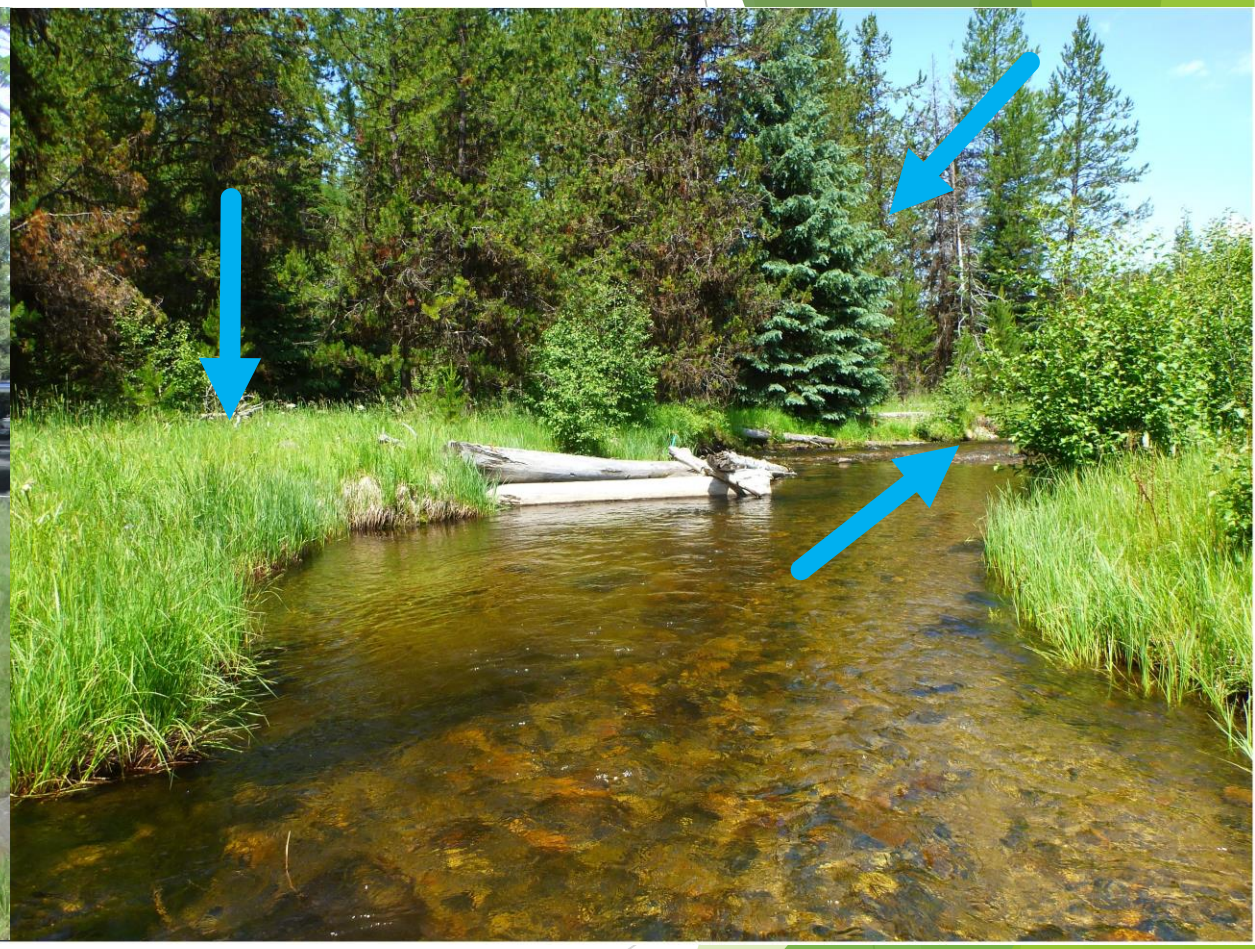
Urban vs Natural Stream



- Impervious Surfaces
- Flashy Hydrograph
- Increased Nutrients/Toxicants
- Degraded Riparian Area

Urban vs Natural Stream





- Impervious Surfaces
- Flashy Hydrograph
- Increased Nutrients/Toxicants
- Degraded Riparian Area
- Increased Stream Temp

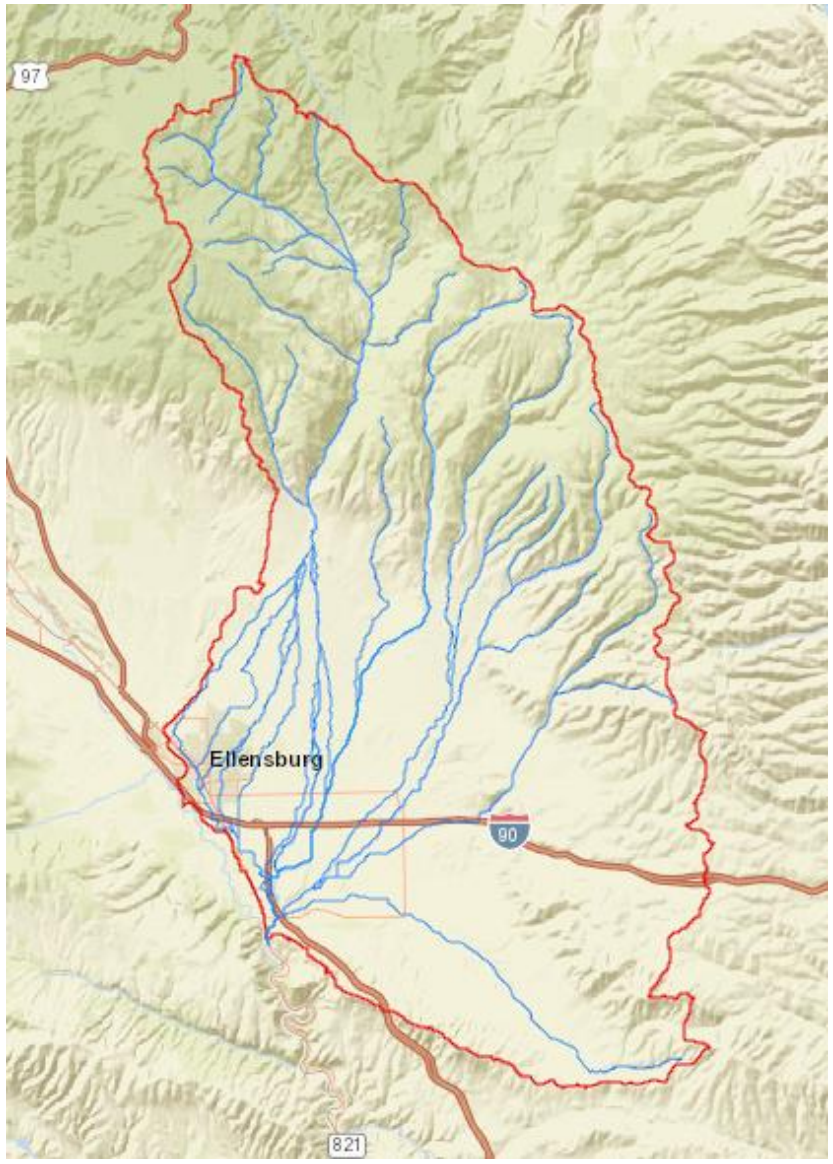
Urban vs Natural Stream

- Impervious Surfaces
- Flashy Hydrograph
- Increased Nutrients/Toxicants
- Degraded Riparian Area
- Increased Stream Temp
- Decreased Stream Complexity

Urban vs Natural Stream

- Impervious Surfaces
- Flashy Hydrograph
- Increased Nutrients/Toxicants
- Degraded Riparian Area
- Increased Stream Temp
- Decreased Stream Complexity
- Habitat Fragmentation and Possible Movement Barriers

Opportunity for Recovery: Urban Streams



- **Can Urban Streams be Utilized?**
  - Degraded/Fragmented Habitat
  - Many Potential Movement Barriers
- **Multiple Local Urban Streams**
  - Coho Salmon
  - Steelhead Trout
- **Limited Data**

Previous Urban Stream Research on Salmonids

- James et al. 2014: Yakama Nation Juvenile Coho Salmon
  - Documented successful downstream movement
  - ~6% detected at downstream structures
- Questions Remaining
  - Upstream movement?
  - Are most buried sections barriers?

Movement Objectives

- **Movement of Salmonids in an Urban Stream**
  - Range
  - Directionality
  - Seasonal Activity
  - Potential Barriers
  - Age Class

Habitat Objectives

- Characterize urban stream habitat
- Evaluate restoration project
- Stream temperature
  - Growth

Study Area: Wilson Creek

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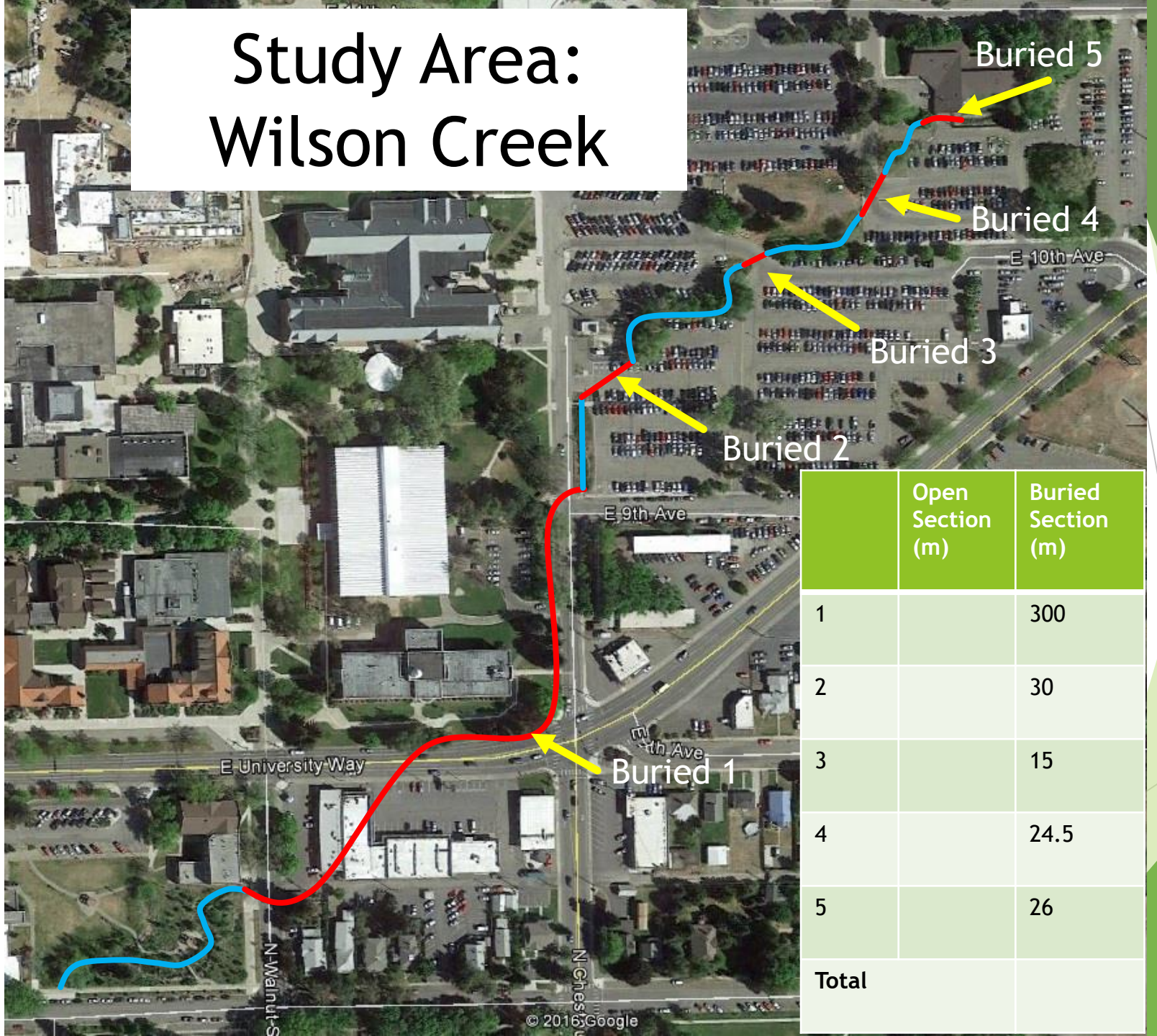
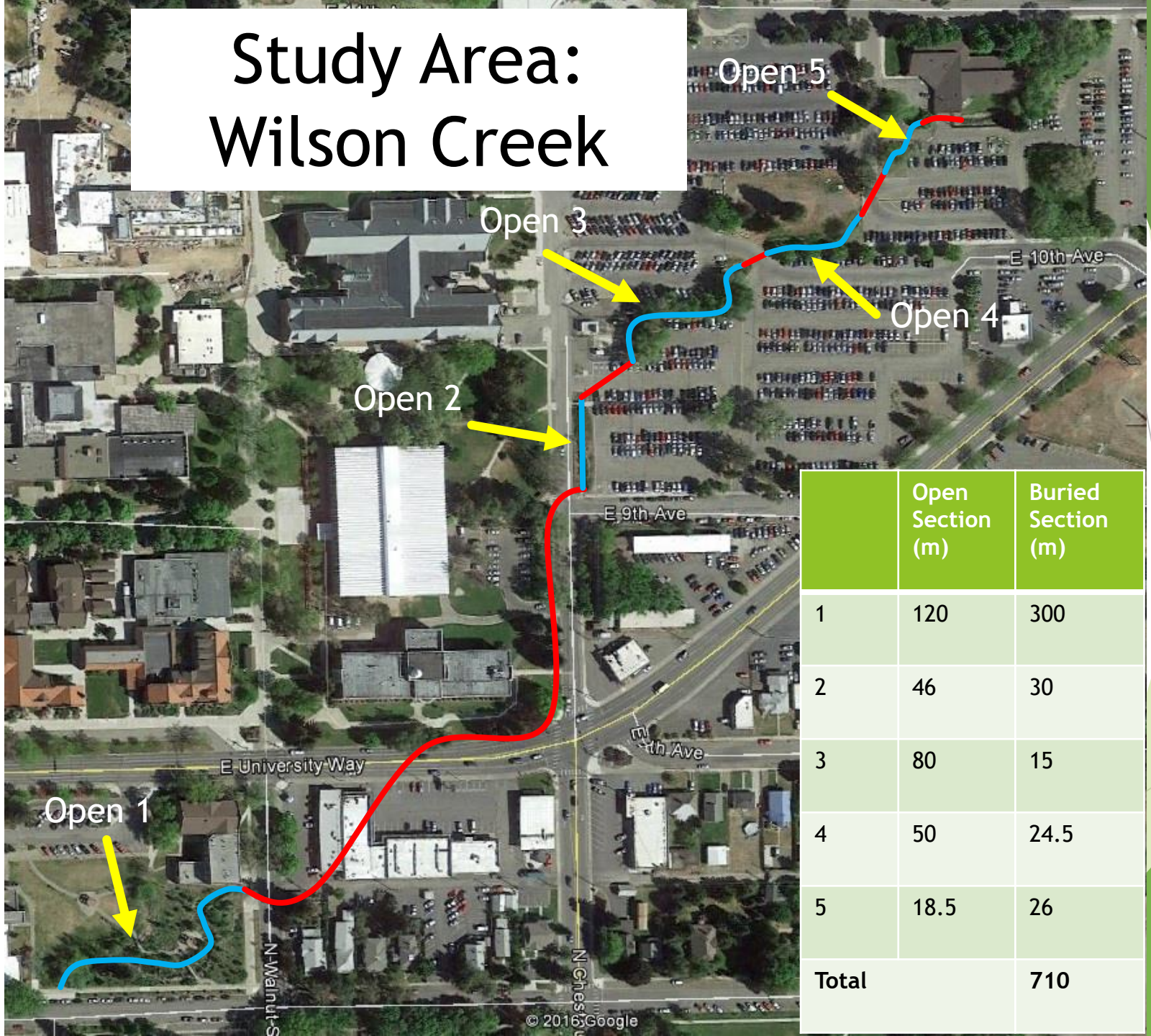


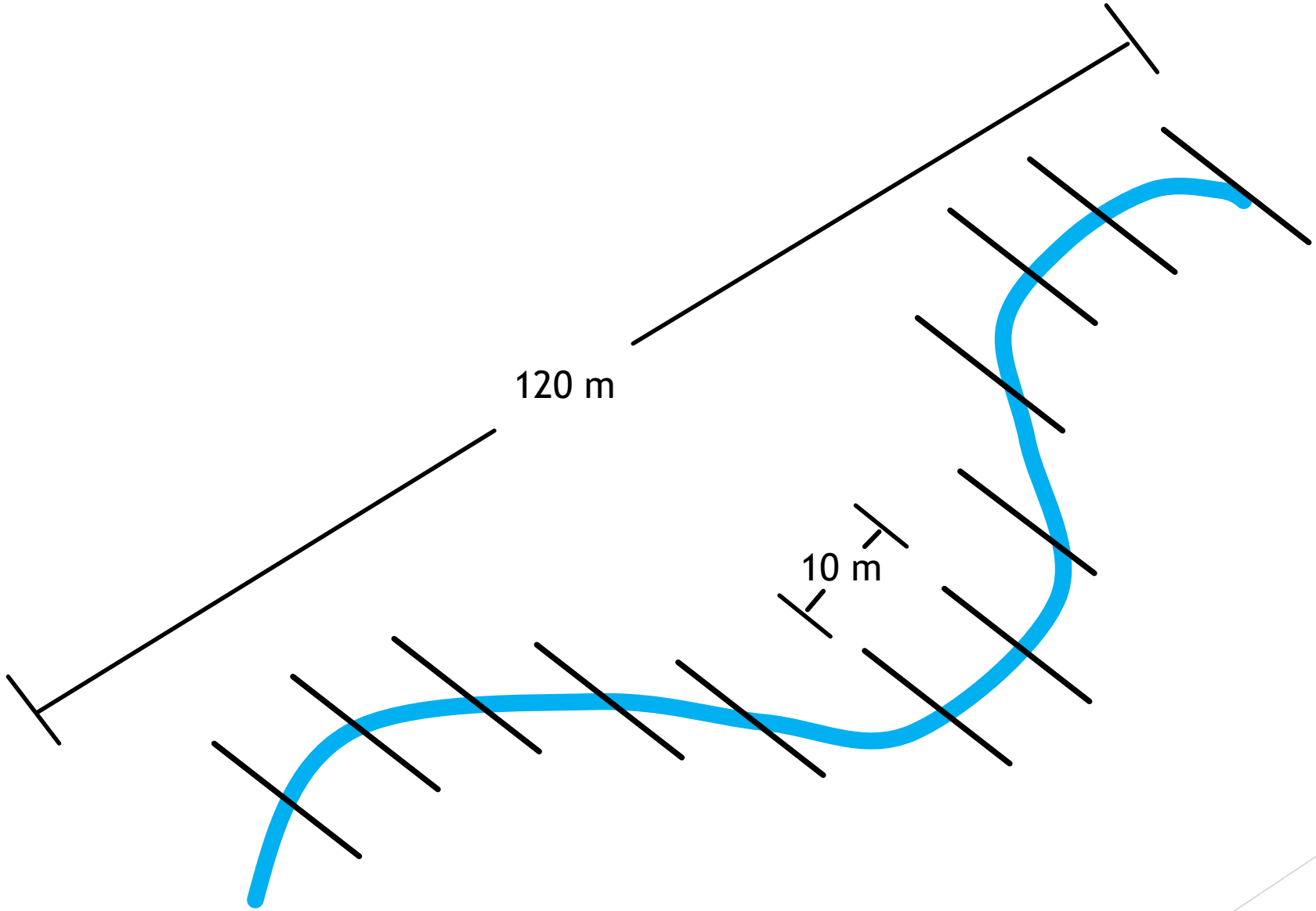
	Open Section (m)	Buried Section (m)
1		300
2		30
3		15
4		24.5
5		26
Total		

Study Area: Wilson Creek



	Open Section (m)	Buried Section (m)
1	120	300
2	46	30
3	80	15
4	50	24.5
5	18.5	26
Total		**710**

Example: Section 1



Fish Capture

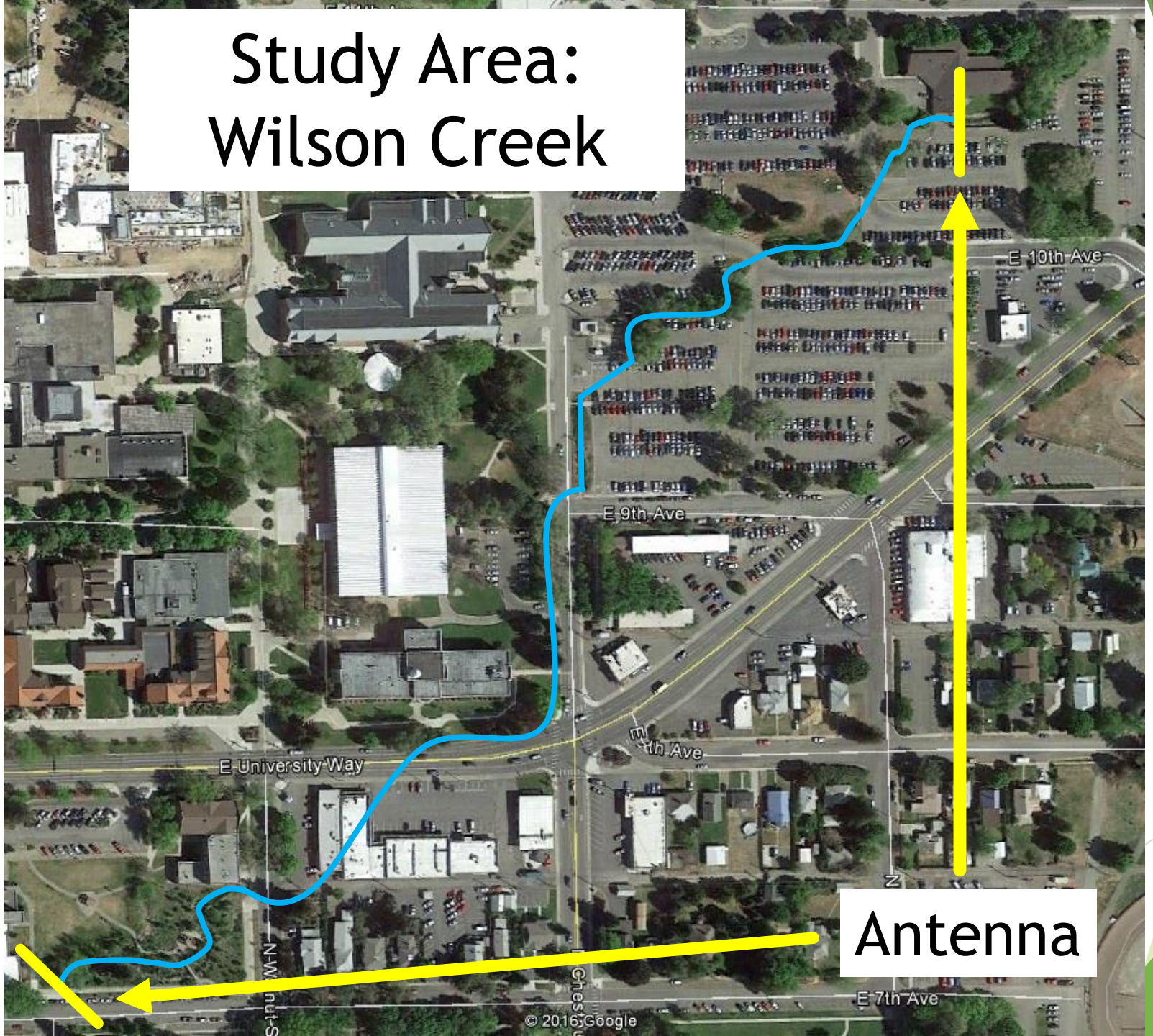
- **Electro-fisher**
  - 2 capture events
    - June & July
  - Collected all species of fish
  - 1 bucket per segment

Fish Processing

- **All fish**
  - Identified
  - Assigned to segment of origin
- **Salmonids**
  - Measured
  - >70 mm PIT tagged
- **Released**
  - Original segment

Pit Tag Antennas

Study Area: Wilson Creek



Tracking Salmonids

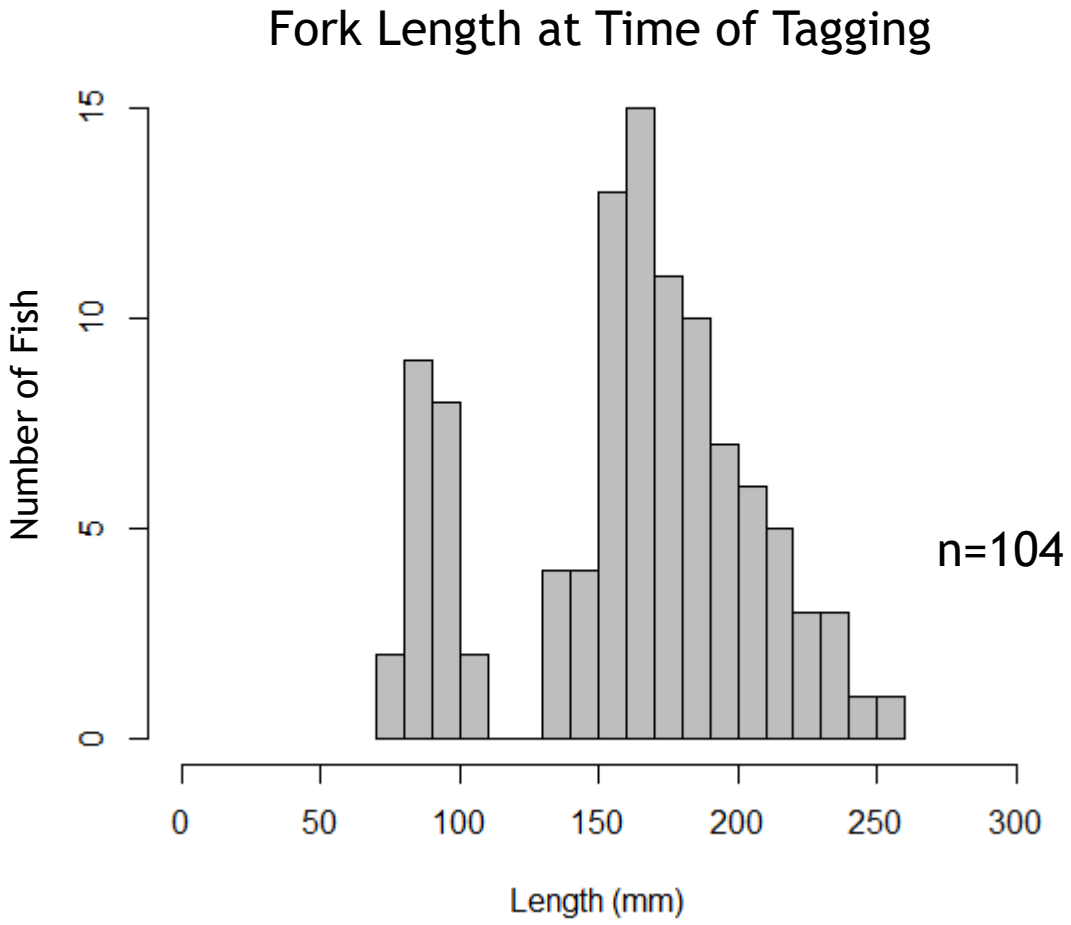
- Handheld BioMark PIT tag antenna
  - Small read range 3-5 inches
  - June-January
  - Weekly surveys
    - day and night
- Final Fish Capture
  - January 23rd
    - Growth data
    - Final location

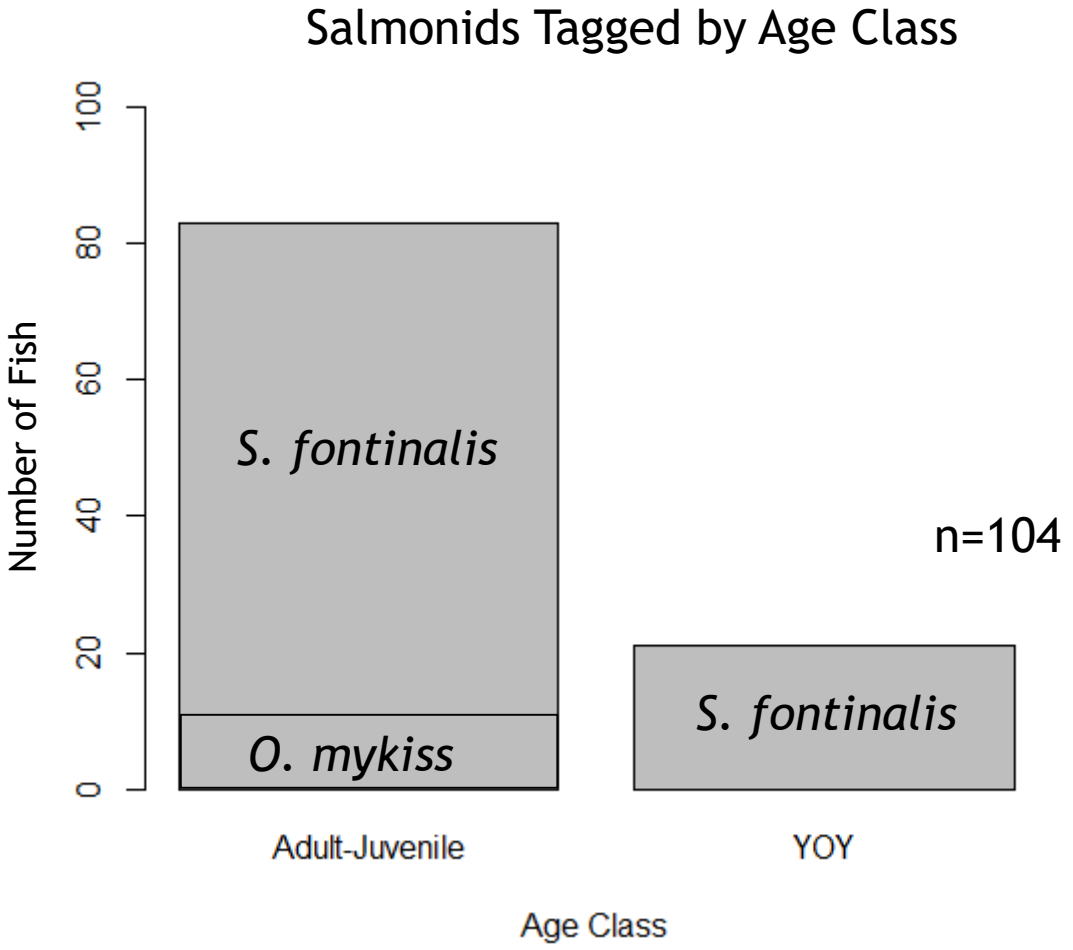
Salmonids in Wilson Creek

Species	Optimal Temperature Range	Growth Cutoff (approximately)
Brook Trout	11 – 16 ˚C	20 ˚C
O. mykiss	11 – 18 ˚C	23 ˚C
Coho Salmon*	10 – 15 ˚C	20 ˚C

- Coho **NOT** found in study area*

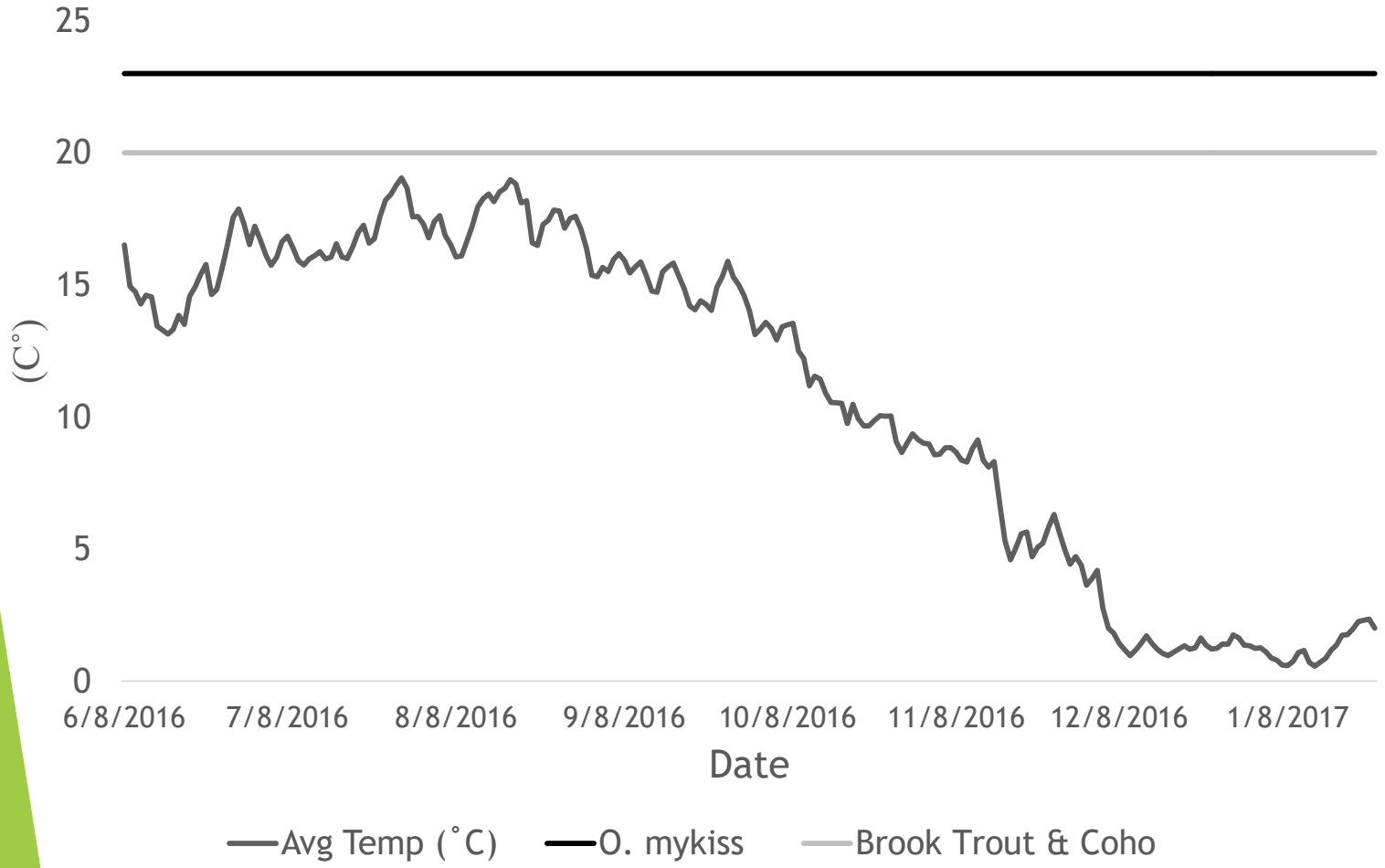
Fish Capture Summary





Habitat

Temperature and Growth



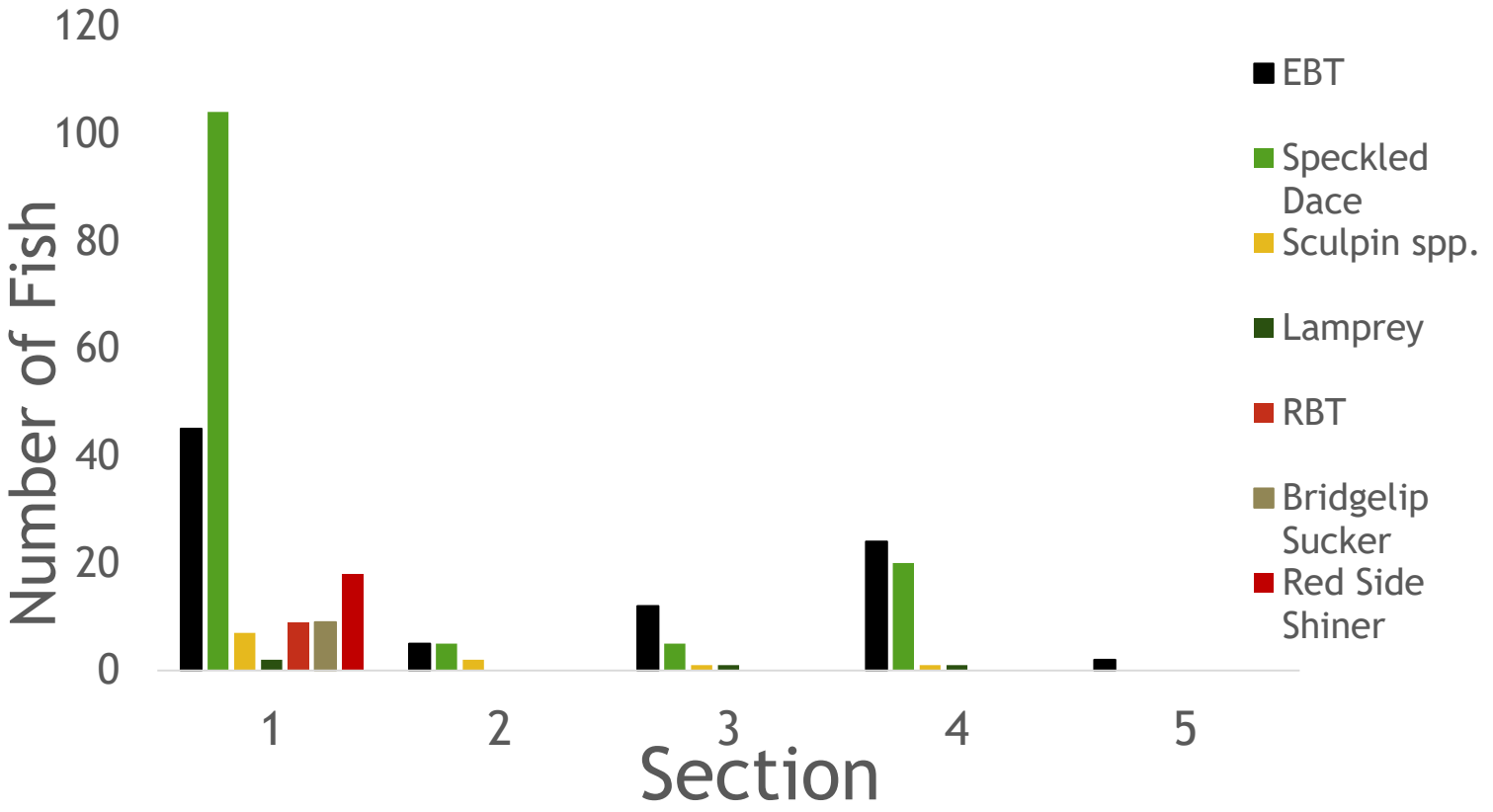
Date	YOY Average Length
June 10th	62.9 mm
January 23rd	125.9 mm

- **Average YOY Growth: 63 mm**

Descriptive Habitat Rating

Variable	Section 1	Section 2	Section 3	Section 4	Section 5
LWD	5	1	2	3	1
Fish Cover	4	5	1	2	4
Canopy Cover	3	1	5	2	4
Sinuosity	4	2	5	3	1
Section Length	5	2	4	3	1
Pool %	5	3	4	1	1
Average	**4.3**	2.3	3.5	2.3	2.0

Diversity and Density



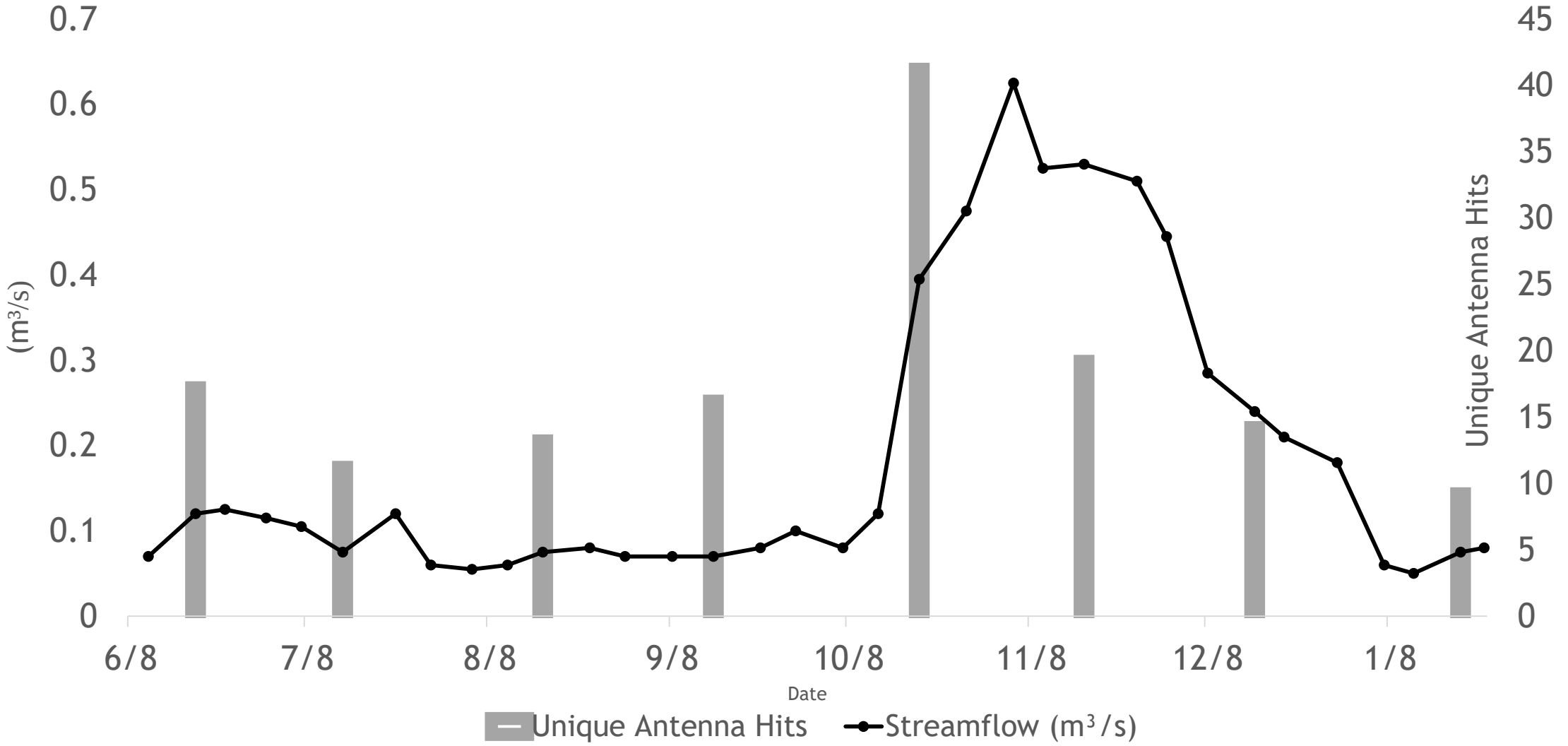
Section	Shannon Diversity Index	Salmonid Density
1	1.35	0.45
2	1.03	0.11
3	0.95	0.15
4	0.87	0.48
5	0	0.11

Movement

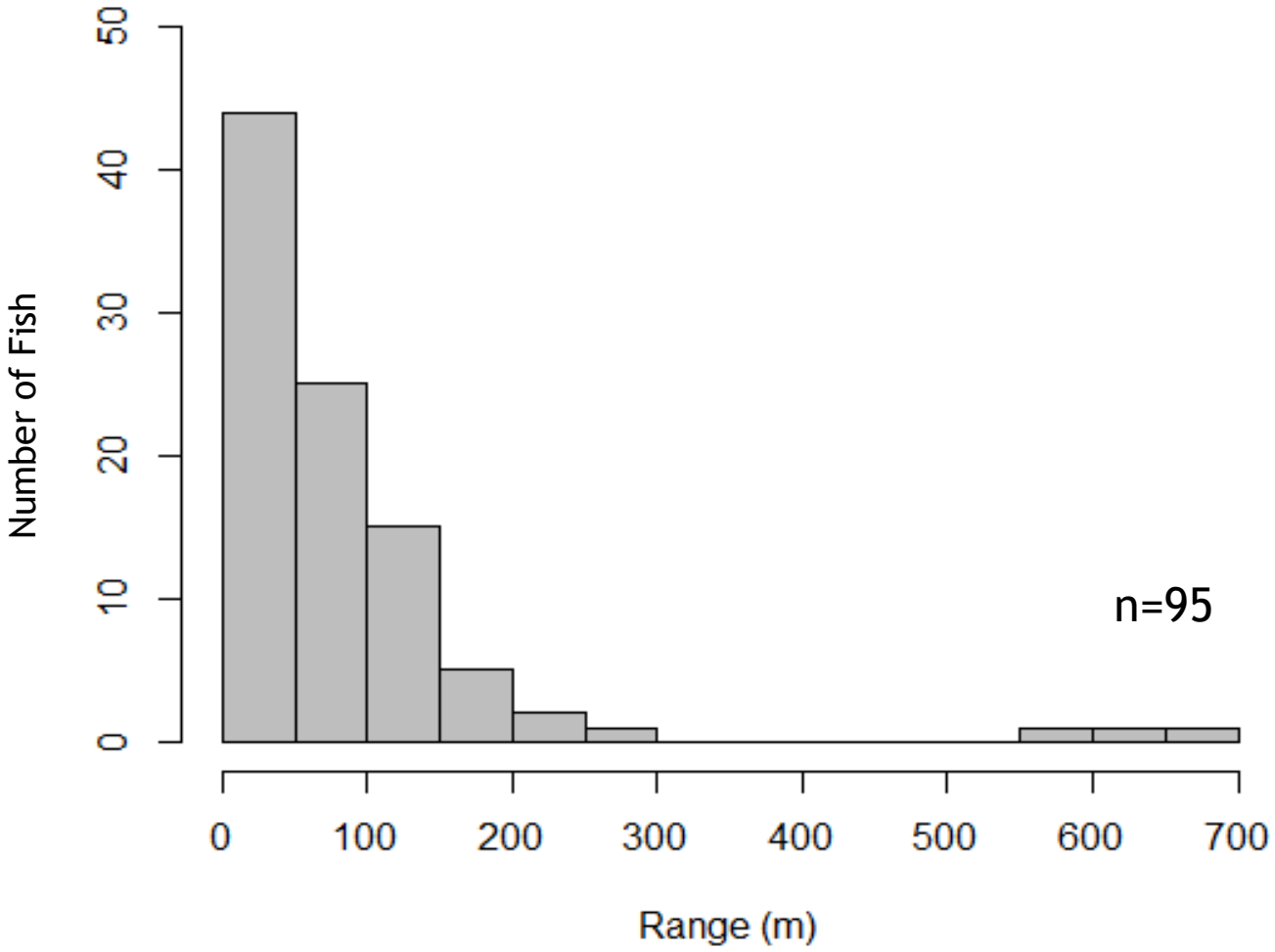
Recapture STATS

- 102 of 104 (98%) PIT tags were recovered
- 583 mobile antenna recaps
- >11,000 stationary antenna recaps

Monthly Antenna Hits and Streamflow

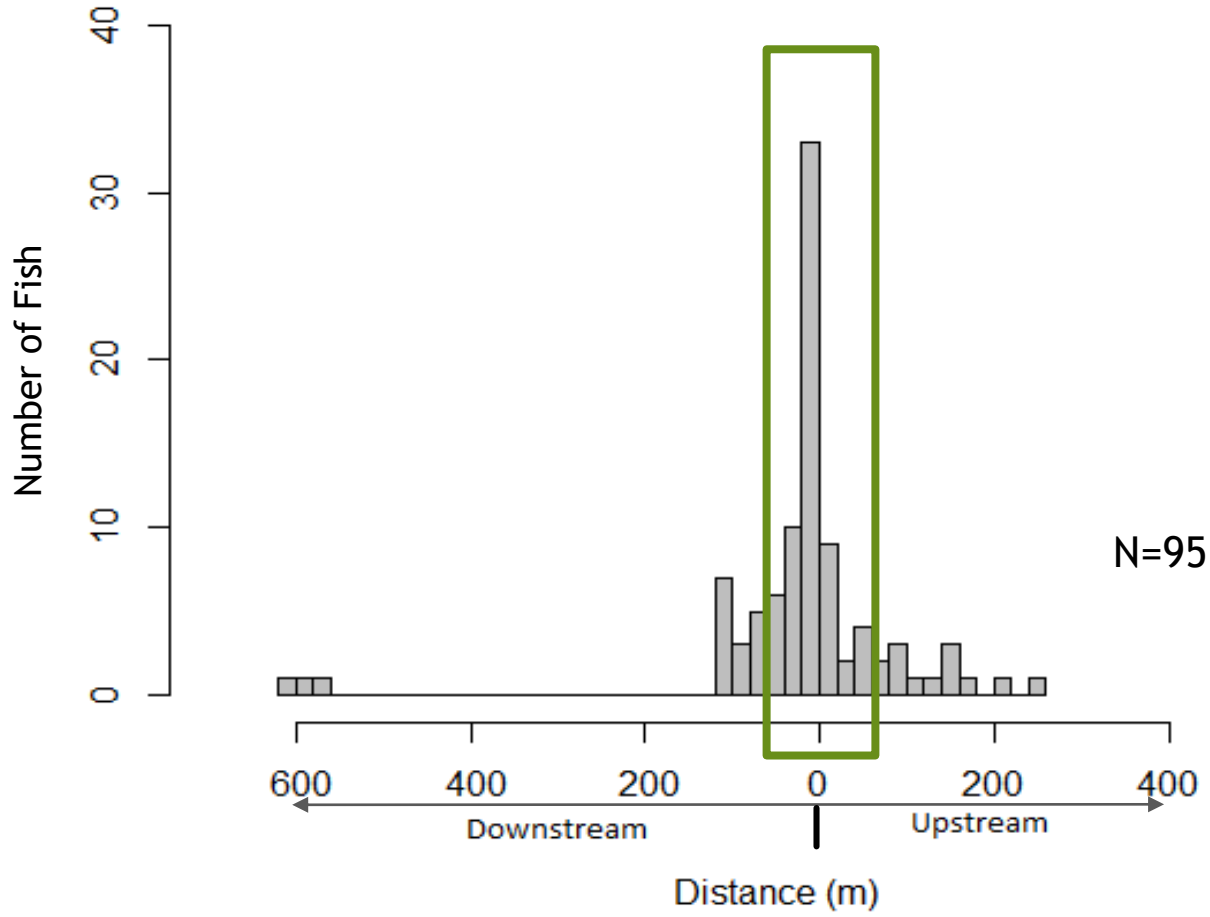


Range of Movement



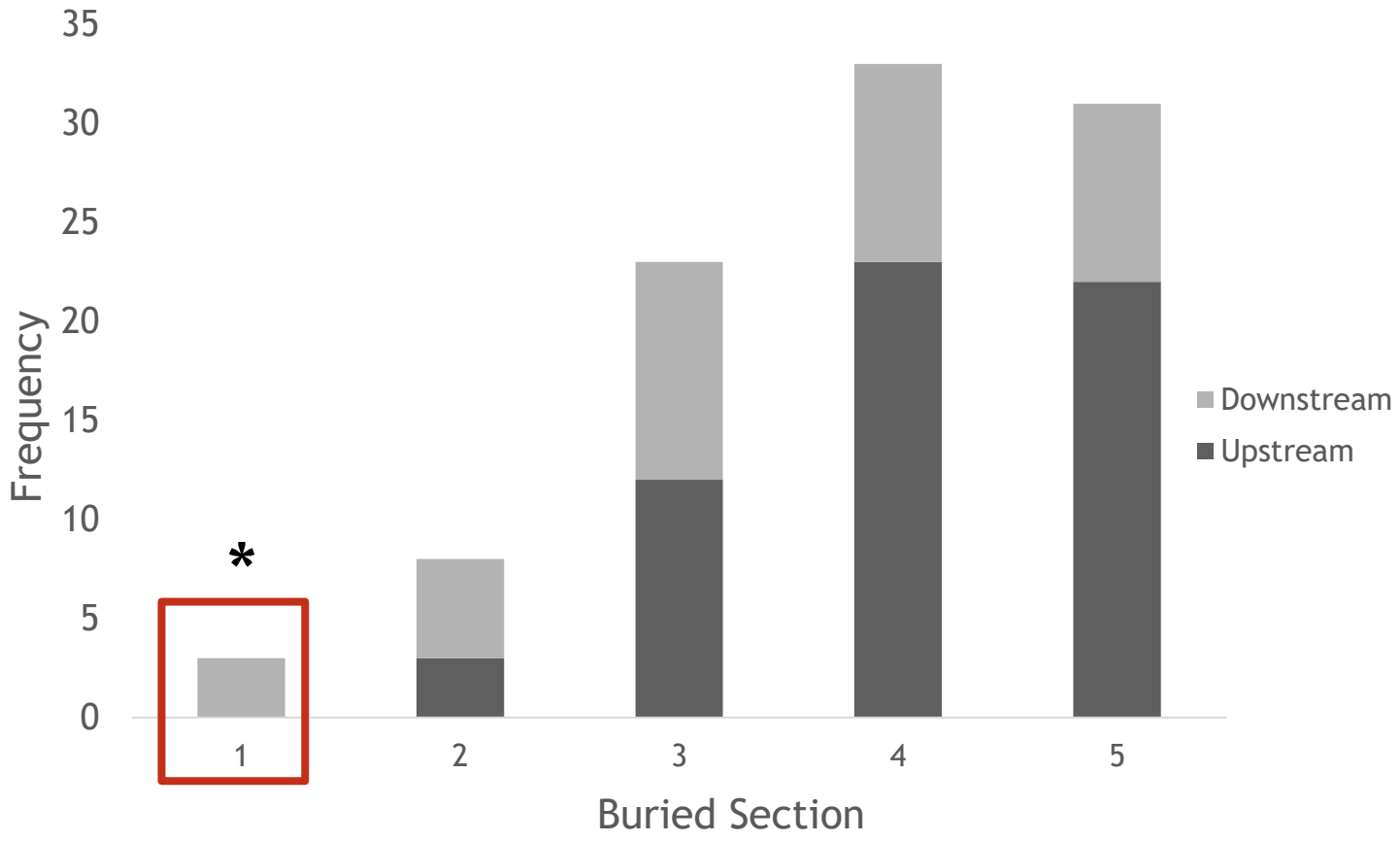
Min	Median	Mean	Max
0	65 m	86.9 m	700 m

Distance Between First and Last Recapture



Downstream Max	Upstream
601 m	244 m

Movement Barrier?



* No YOY movement through buried section

Wilson Creek

800 m Buried Section Downstream

Anadromous Fish in Wilson Creek?

- Unknown PIT Tag Recorded on BOS antenna in November 2016
- 133 mm juvenile steelhead from the Teanaway River
  - Tagged in August 2016 by WDFW Tag
- How did it get there?
- Path to reach the antenna
  - ~14 km of urban Wilson Creek
  - Successfully navigated 800 m buried section under downtown Ellensburg

Anadromous Fish in Wilson Creek?

Date	Event Type	Site Code	Site Name	Event Site Type	Event Site RKM
05/20/2017	Observation	PRO	Prosser Diversion Dam Combined	Combined Dam Location; separate detections of upstream and downstream migrants.	539.076

Discussion

- **Habitat Restoration Works**
  - High density of salmonids
  - High diversity
- **Wilson Creek can Sustain Salmonid Population**
  - High growth rate
  - Movement
- **Buried Section 1- Barrier to Movement**


2097 m
NANUM CANYON
WENATCHEE MOUNTAI
KITTITAS VALLEY
BOWERS FLD
Study Area
Ellensburg
90
ASH RIDGE
BOYLSTON MOUNTAINS
SADDLE
0 5 10km

Acknowledgments

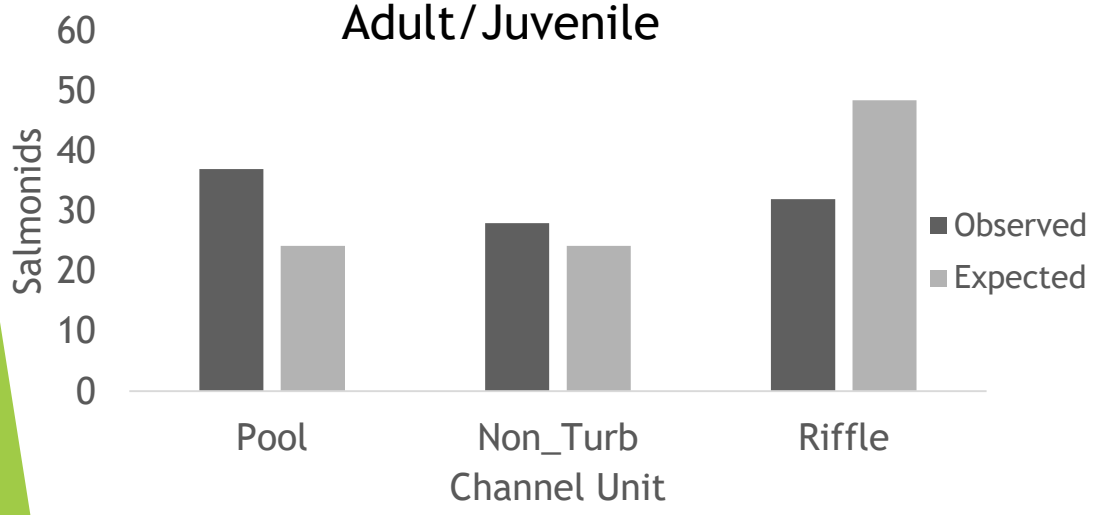
- Committee
- CWU Biology Department and School of Graduate Studies
- WDFW and Yakama Nation
- Fellow Graduate Students

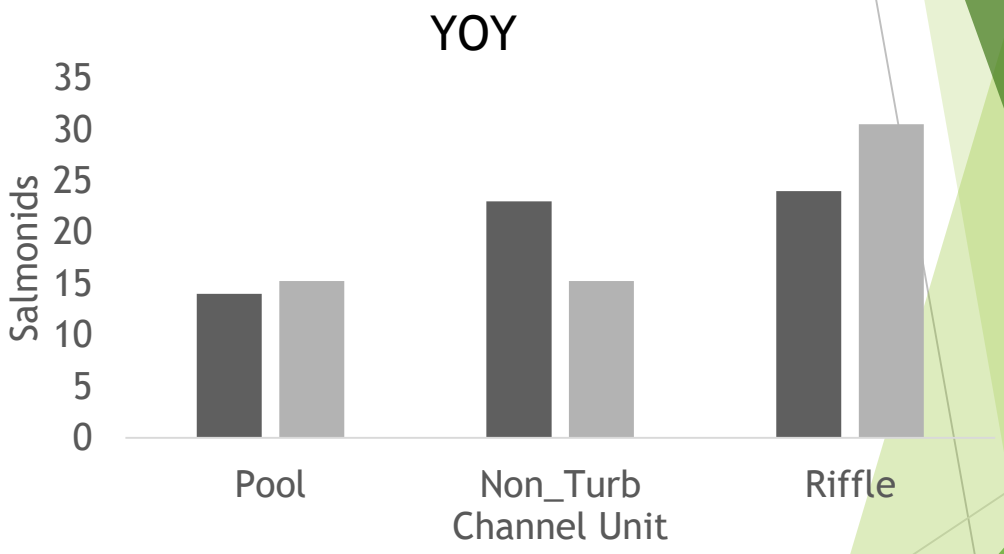

Questions??

Wilson Creek Open Sections

	Open Section (m)
1	120
2	46
3	80
4	50
5	18.5
Total	**710**

Habitat Association: Used vs Available





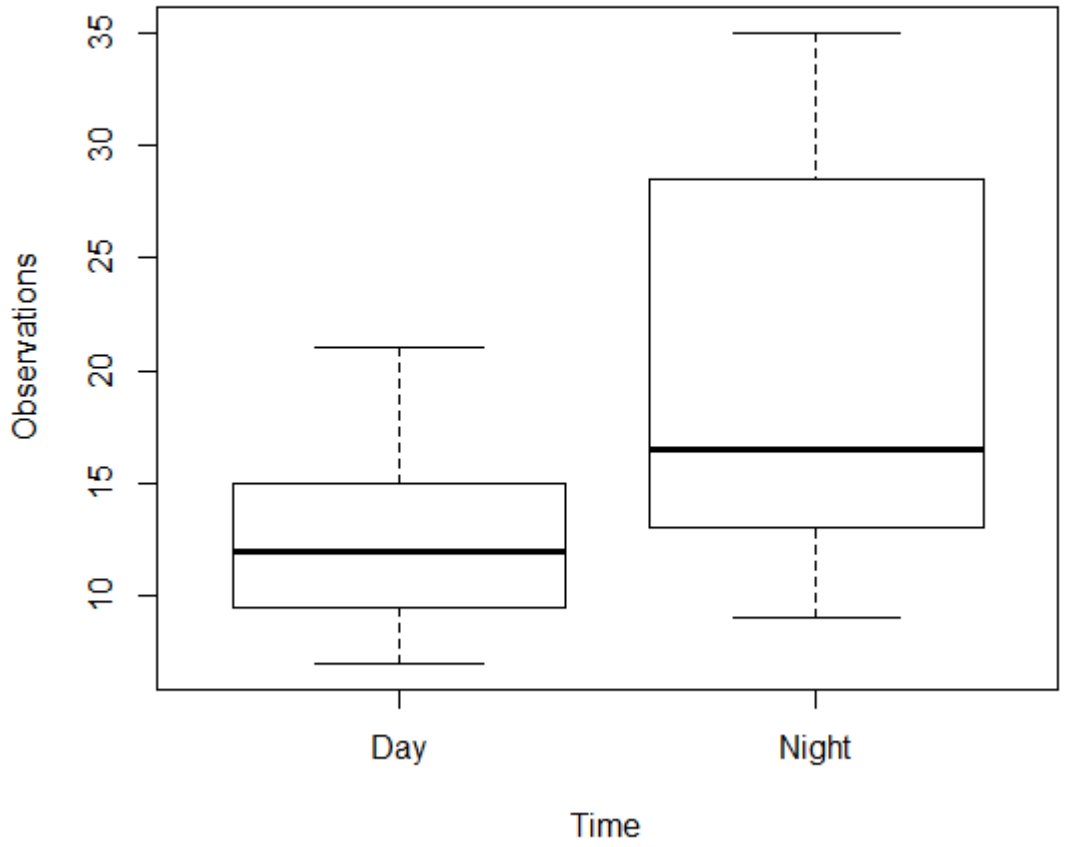
Habitat Association: Used vs Available

Chi-square Goodness of Fit		
Age Class	**Adult/Juvenile**	**YOY**
Degrees of Freedom	2	2
Chi Square	12.09	5.51
p-value	0.002365*	0.063

Wilson Creek vs Natural System

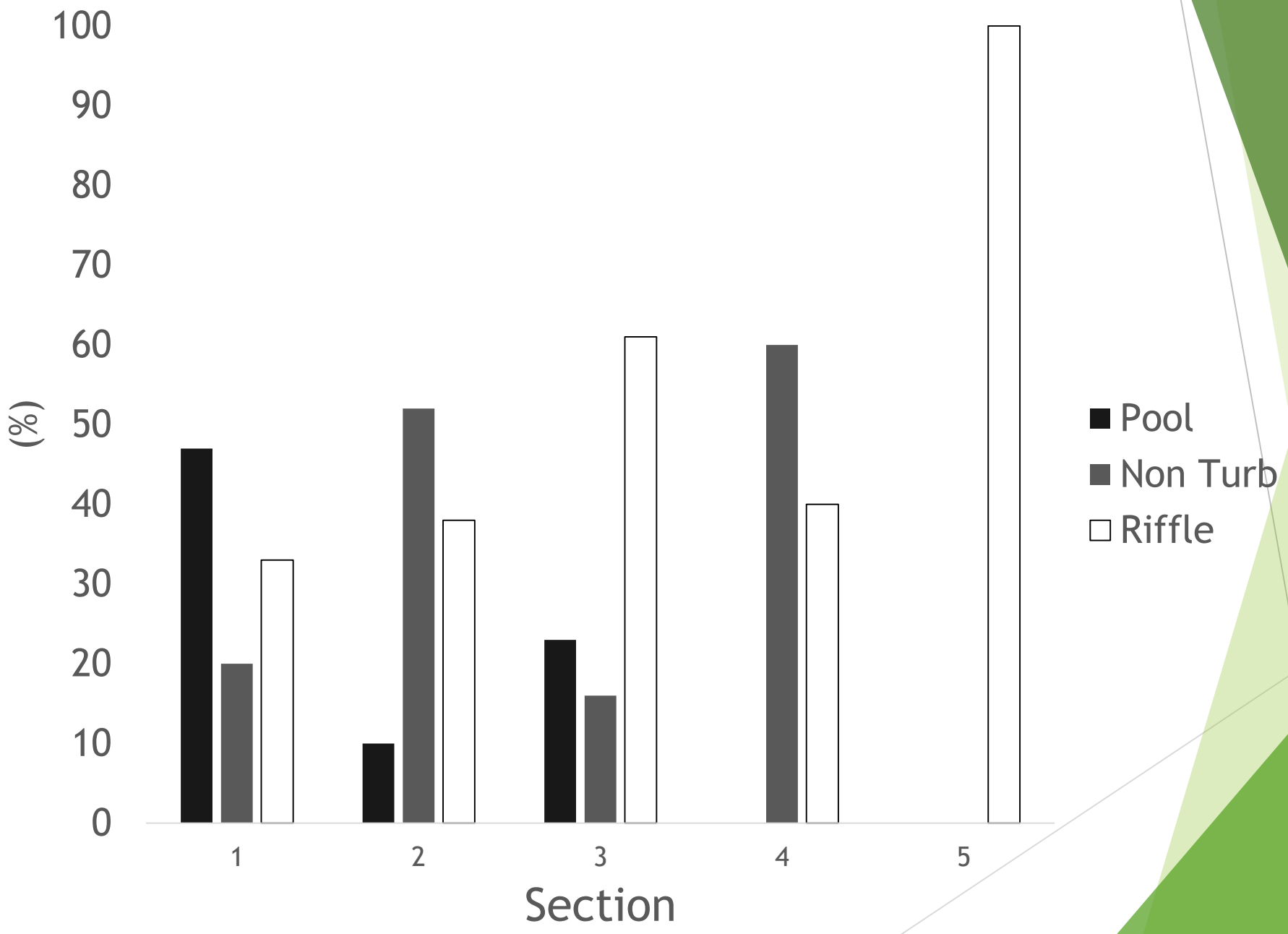
	Wilson Creek	Tributary to Connecticut River (Kanno et al)
Stream Order	3rd	3rd
Study Area Length	710 m	1000 m
Peak Activity	October	October/November
Maximum Observed Movement	700 m	820 m
Salmonid Movement <40 m	60%	62%

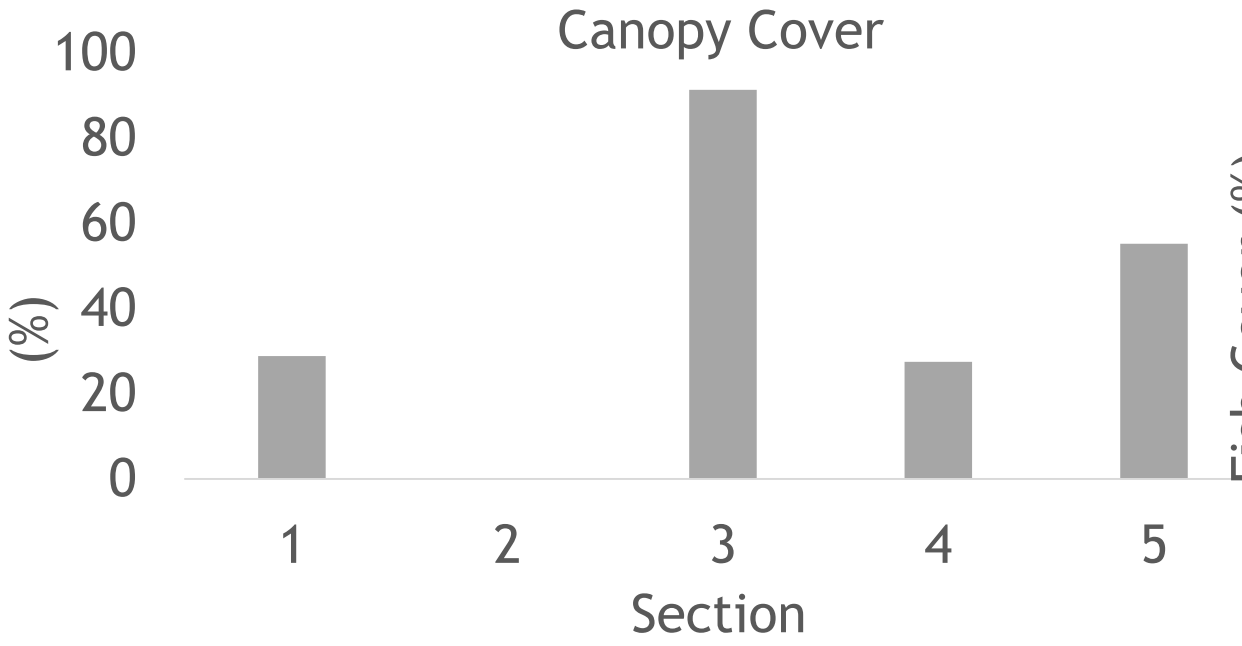
Handheld Antenna Recaptures

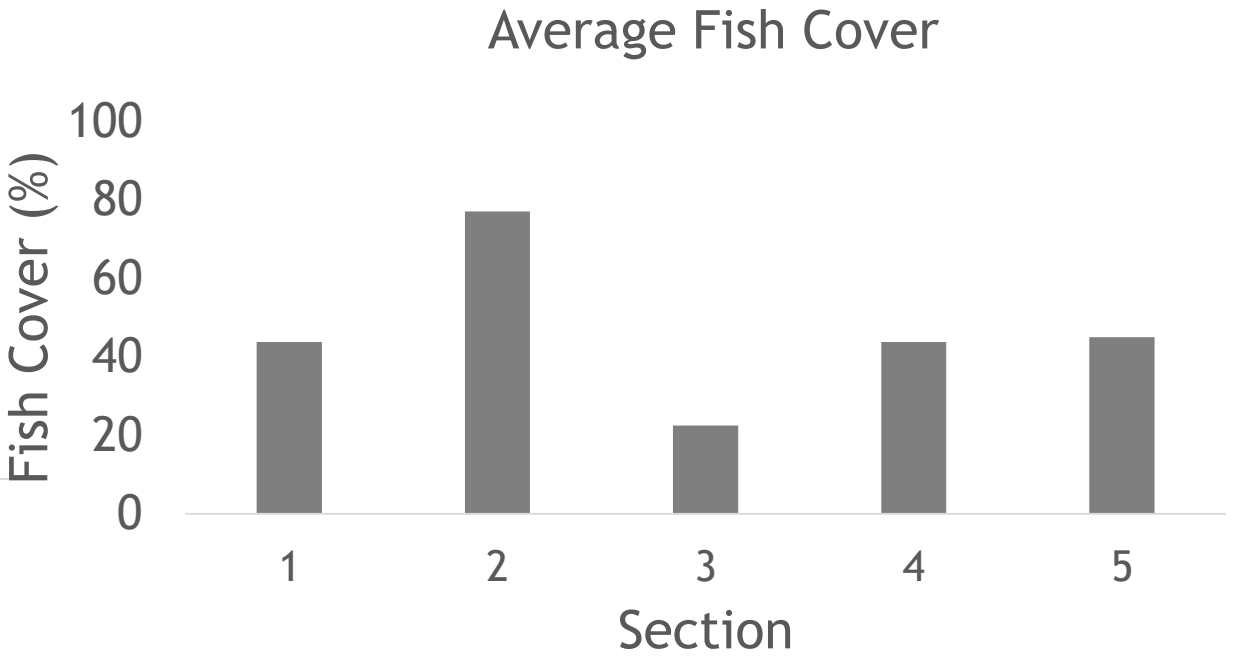


T-test: night survey recapture rates higher than day surveys (p-value=0.0043993).

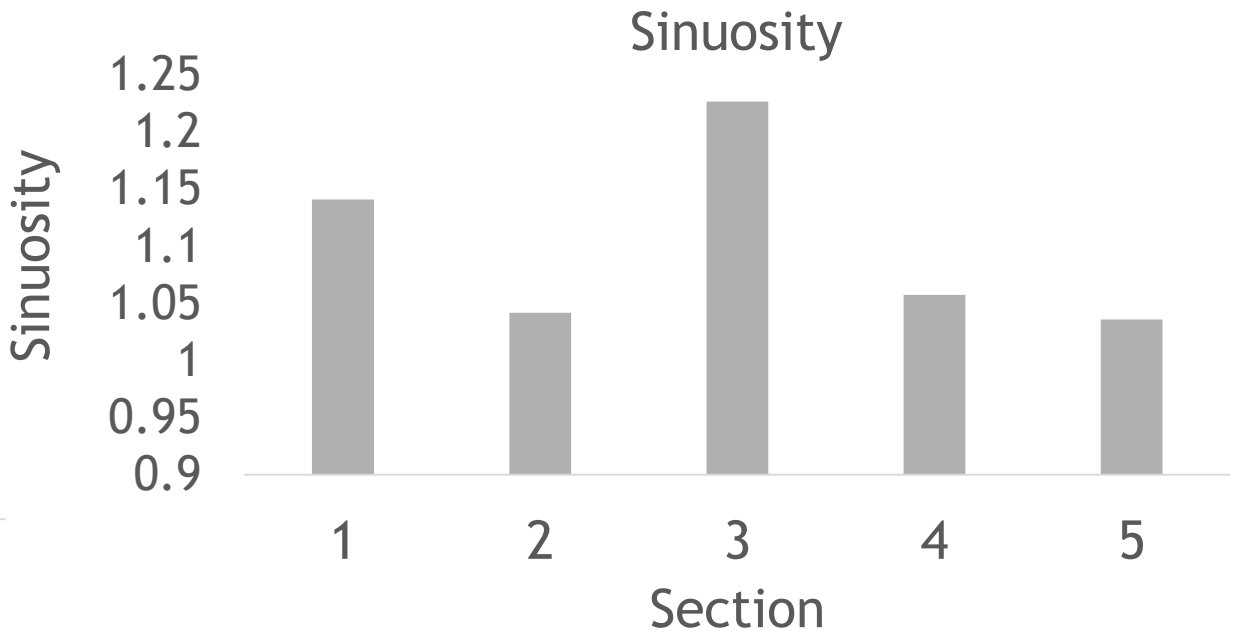
Percent Habitat Unit per Section




Canopy Cover
100
80
60
40
20
0
(%)
1
2
3
4
5
Section


Average Fish Cover
100
80
60
40
20
0
Fish Cover (%)
1
2
3
4
5
Section


Large Woody Debris
25
20
15
10
5
0
LWD Frequency
1
2
3
4
5
Section


Sinuosity
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
Sinuosity
1
2
3
4
5
Section

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Japanese Garden
Science II
Center (SURC)
and Counseling
CWU Lot I15
Open 5
Buried 5
CWU Lot I19
Open 4
Buried 4
H18
East 10th Ave
Open 3
Buried 3
Black Hall
Mary Gruppe Conference Center
Samuelson Hall
Walnut Mall
Starbucks
CWU Lot G16
Buried 2
CWU Lot G15
Open 2
Boullion Hall
CWU Lot E-13
East 9th Avenue
Kamola Residence Hall
Tunstall Commons
Sue-Lombard Residence Hall
Lind Hall
East University
North Poplar Street
East University Way
Munson Conference Center
Bleachers
Buried 1
CWU Lot C9
Open 1
The Armory
East 7th Avenue
North Chestnut Street
0
50
100m
Buried
Open
Chestnut
Ellensburg Memorial