Lewis River Bull Trout Habitat Restoration Project Identification Assessment

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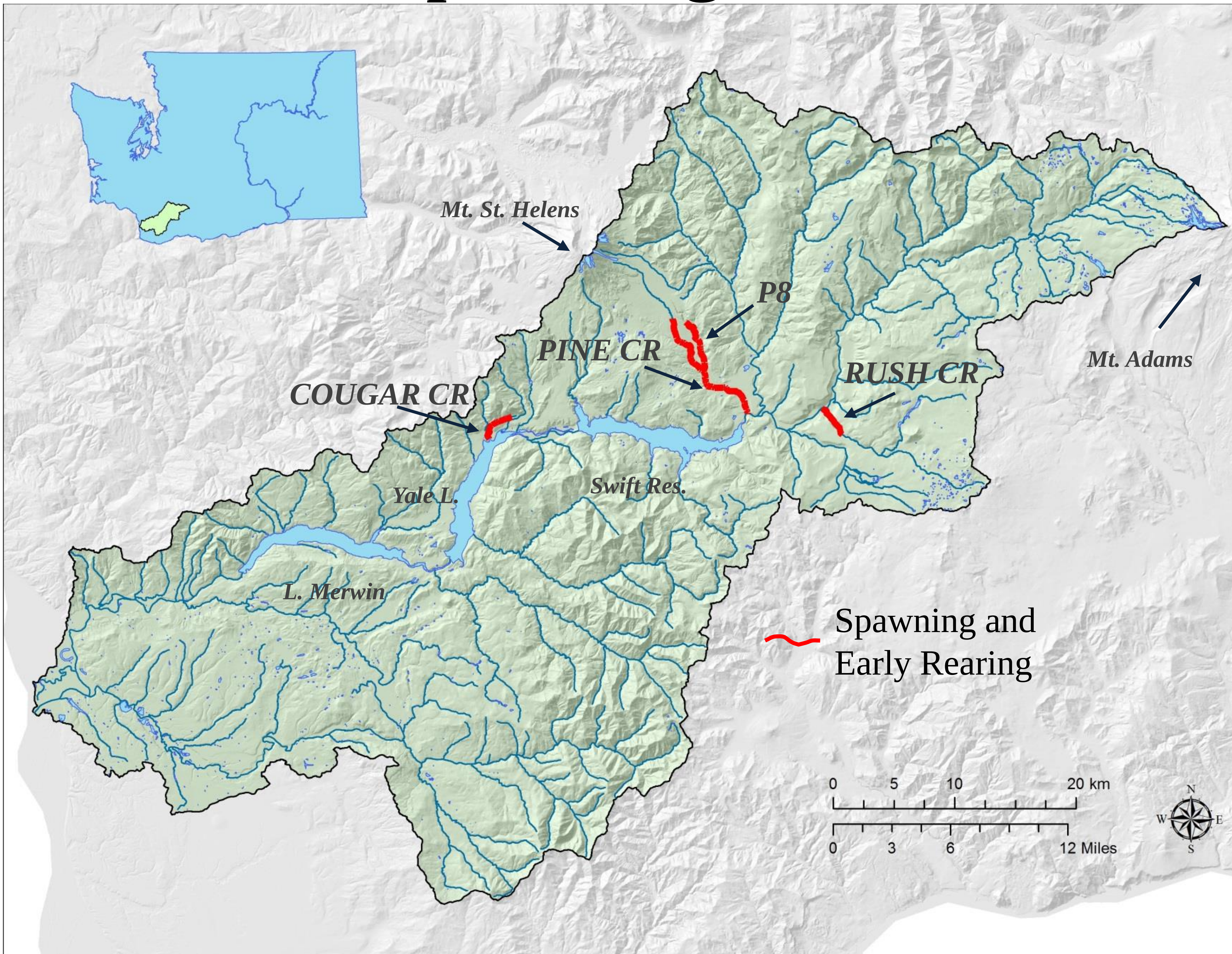
ACC Meeting, December 14, 2017

Limited Spawning Distribution



Study Area

Spawning and
Early Rearing
0 5 10 20 km
0 3 6 12 Miles
N
W
E
S
WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
MOUNT ST. HELENS INSTITUTE
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
PACIFICORP
U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR
COWLITZ INDIAN TRIBE
LOWER COLUMBIA FISH RECOVERY BOARD
CELEBRATING 15 YEARS OF FISH RECOVERY
1998 - 2013

Project Objective

Develop a list of project conceptual scoping designs that could be implemented to increase the quantity and quality of bull trout spawning and rearing habitat

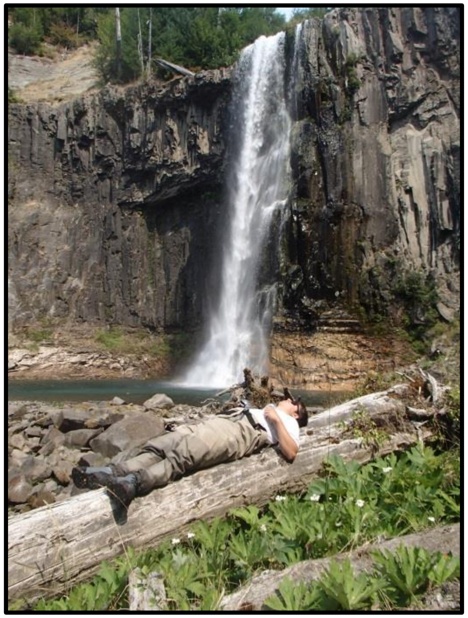
Approach

- Model bull trout redd occurrence (presence-absence) as a function of habitat in known spawning tributaries (logistic regression).
- Use model results to assess the habitat in the rest of the basin and to direct recommendations for project designs

What streams should we assess outside of known spawning tributaries?

1) Habitat Accessibility

Below migration barriers



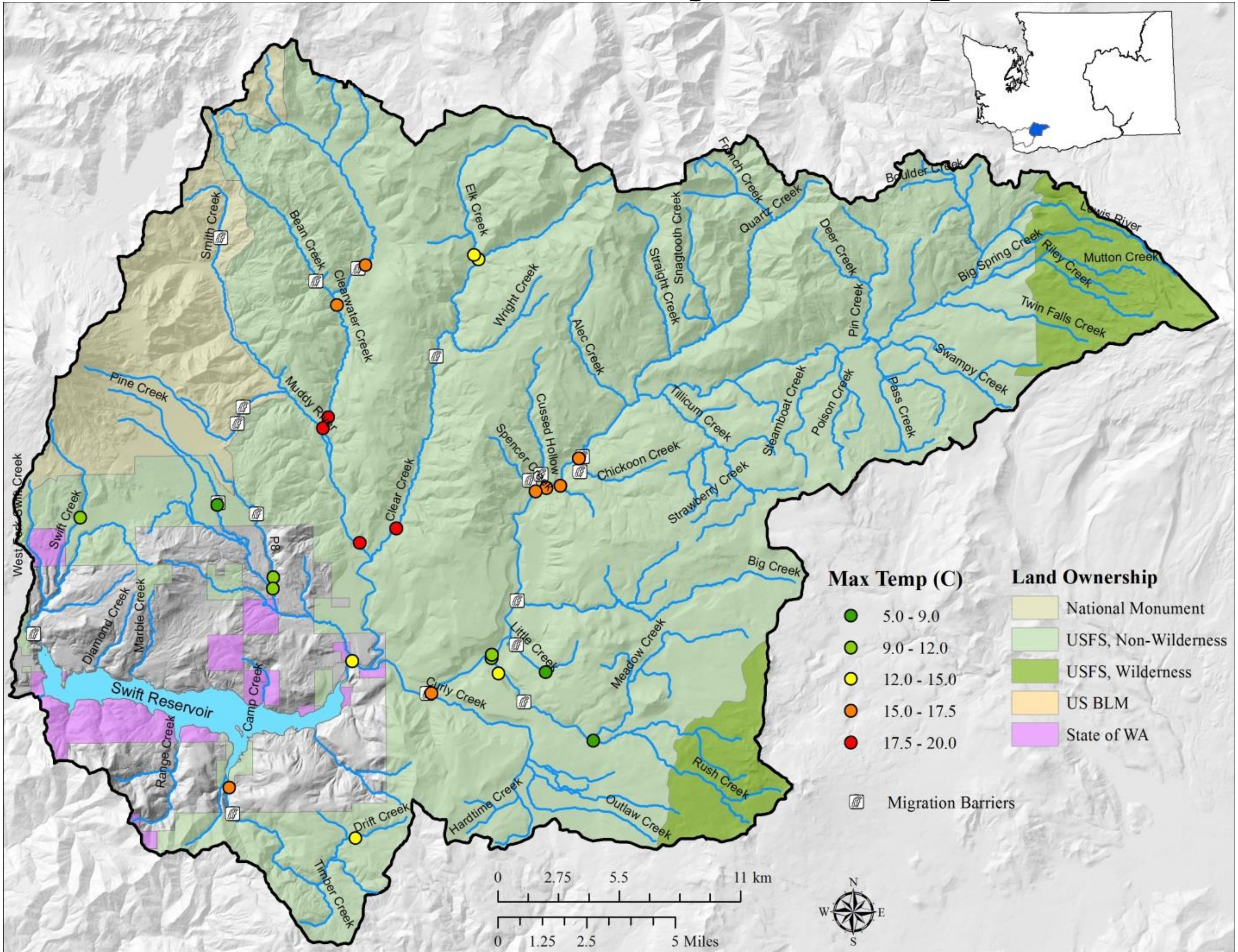
2) Restoration Potential

Outside of Mt. St. Helens National Monument

Outside of existing/planned project areas

3) Thermal Suitability

Thermal Suitability is Important



Thermal Suitability is Important

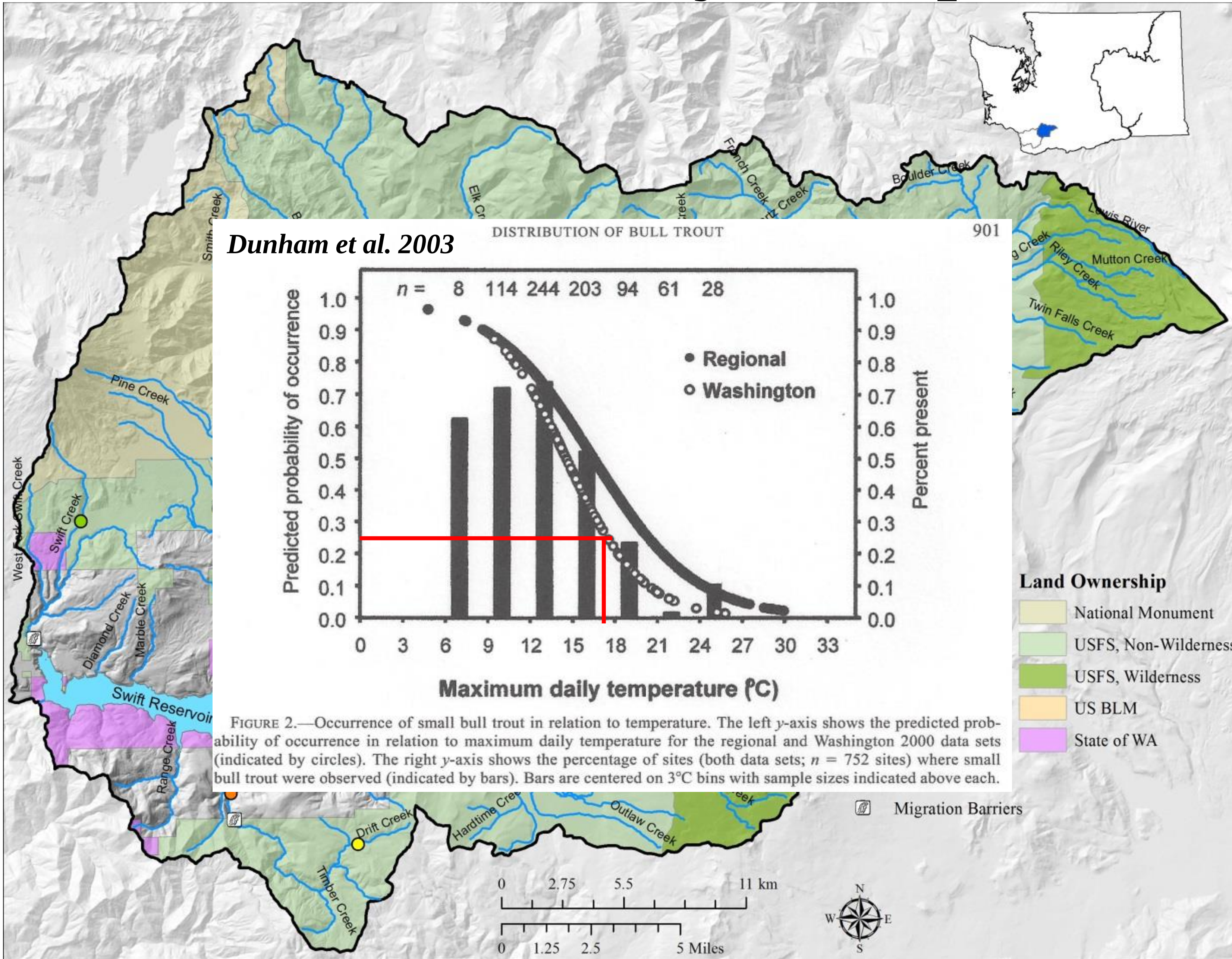
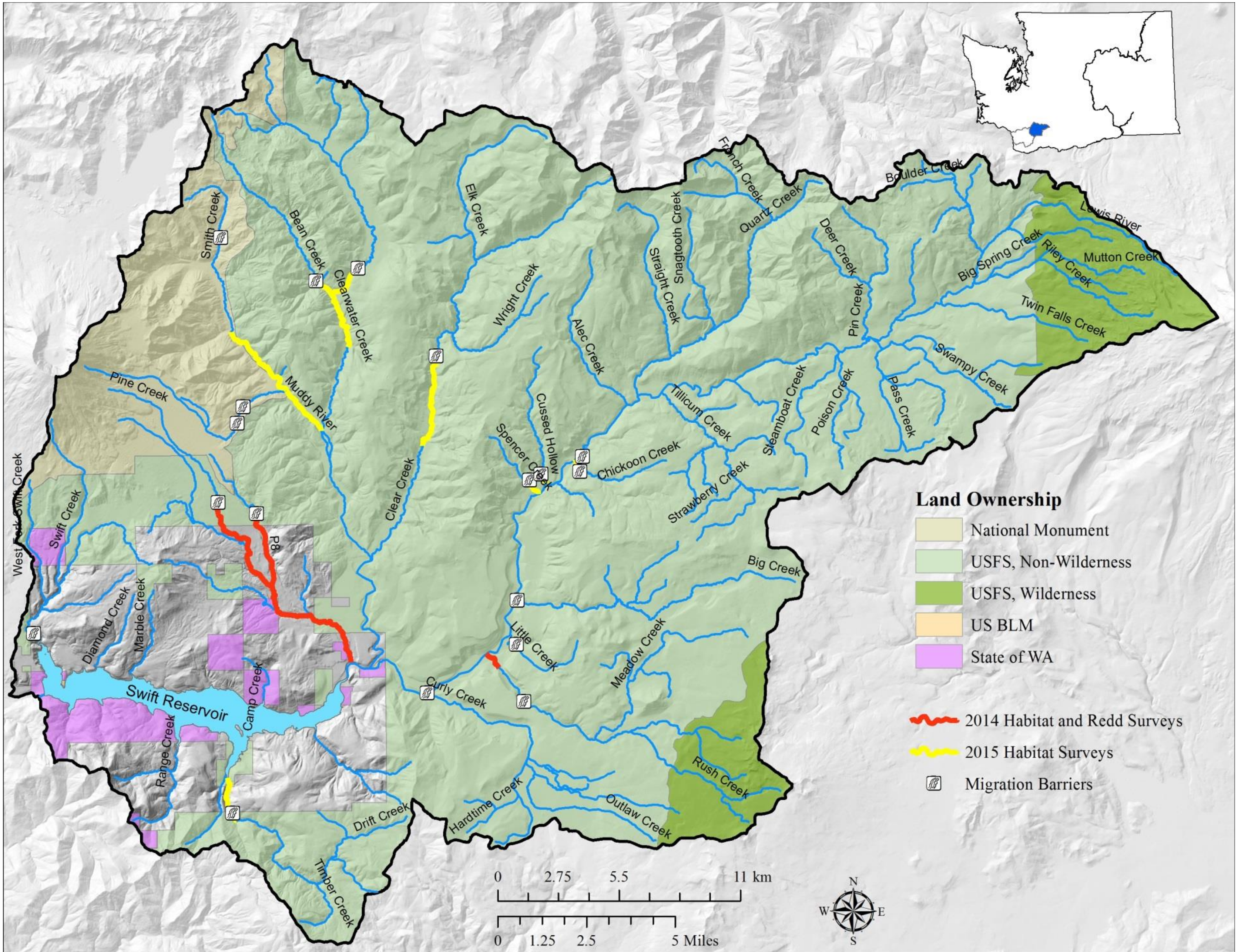


FIGURE 2.—Occurrence of small bull trout in relation to temperature. The left *y*-axis shows the predicted probability of occurrence in relation to maximum daily temperature for the regional and Washington 2000 data sets (indicated by circles). The right *y*-axis shows the percentage of sites (both data sets; n = 752 sites) where small bull trout were observed (indicated by bars). Bars are centered on 3°C bins with sample sizes indicated above each.

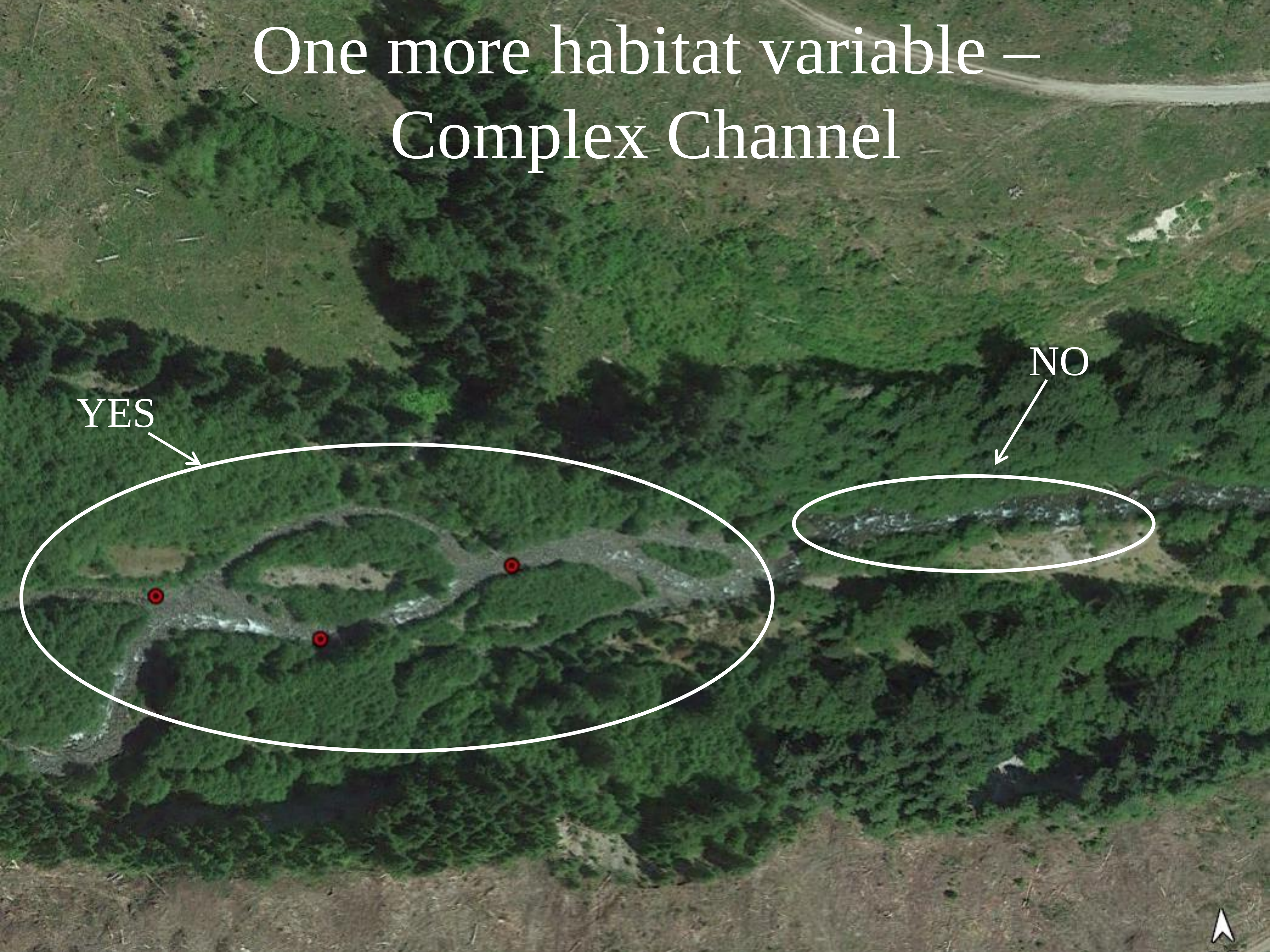
Stream Reaches Included for this Project



Habitat Variables

	Redd Present (n = 29)					Redd Absent (n = 134)				
Variable	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max
Depth (m)	**0.218**	**0.047**	**0.200**	**0.155**	**0.304**	**0.259**	**0.054**	**0.265**	**0.138**	**0.447**
Width (m)	**7.4**	**3.0**	**5.8**	**4.1**	**14.0**	**8.8**	**2.5**	**9.3**	**4.1**	**14.5**
W/D	36.1	9.9	33.6	22.5	61.8	37.2	8.9	37.0	18.3	69.8
CV depth (%)	96.1	5.1	95.6	90.3	115.3	97.1	5.1	96.8	88.5	110.7
CV width (%)	**19.3**	**6.9**	**18.2**	**10.1**	**35.9**	**22.2**	**7.7**	**22.5**	**6.2**	**47.6**
CV W/D (%)	35.0	12.1	34.4	9.4	61.4	40.2	14.1	38.2	9.3	79.5
Max Depth (m)	0.749	0.254	0.700	0.400	1.500	0.906	0.279	0.825	0.450	1.500
Cover (m^2)	3.8	6.6	1.4	0.0	31.5	3.0	5.1	1.5	0.0	40.7
PSP (m^2)	**4.3**	**4.7**	**2.1**	**0.0**	**15.0**	**2.5**	**3.6**	**1.5**	**0.0**	**26.3**
LWD (no./100m)	**5.7**	**4.6**	**5.6**	**0.2**	**14.3**	**4.0**	**4.1**	**3.0**	**0.0**	**19.0**
Pools (no./100m)	1.1	1.0	1.0	0.0	3.7	0.9	0.9	0.8	0.0	4.2
Pool (m^2)	**6.4**	**15.1**	**0.0**	**0.0**	**51.1**	**3.2**	**14.6**	**0.0**	**0.0**	**123.2**
Riffle (m^2)	737.0	301.9	569.3	388.4	1399.7	872.4	255.7	895.3	369.2	1457.2
Fines (m^2)	**14.5**	**31.4**	**0.0**	**0.0**	**125.3**	**7.4**	**35.7**	**0.0**	**0.0**	**267.2**
Gravel (m^2)	80.7	90.0	71.9	0.0	284.5	64.9	93.7	0.0	0.0	364.0
Cobble (m^2)	282.4	154.1	234.1	0.0	699.8	323.8	173.1	312.1	0.0	818.0
Boulder (m^2)	**138.3**	**154.6**	**61.3**	**0.0**	**439.9**	**182.5**	**139.5**	**197.3**	**0.0**	**495.6**
Bedrock (m^2)	0.0	0.0	0.0	0.0	0.0	34.4	114.2	0.0	0.0	666.2

One more habitat variable – Complex Channel

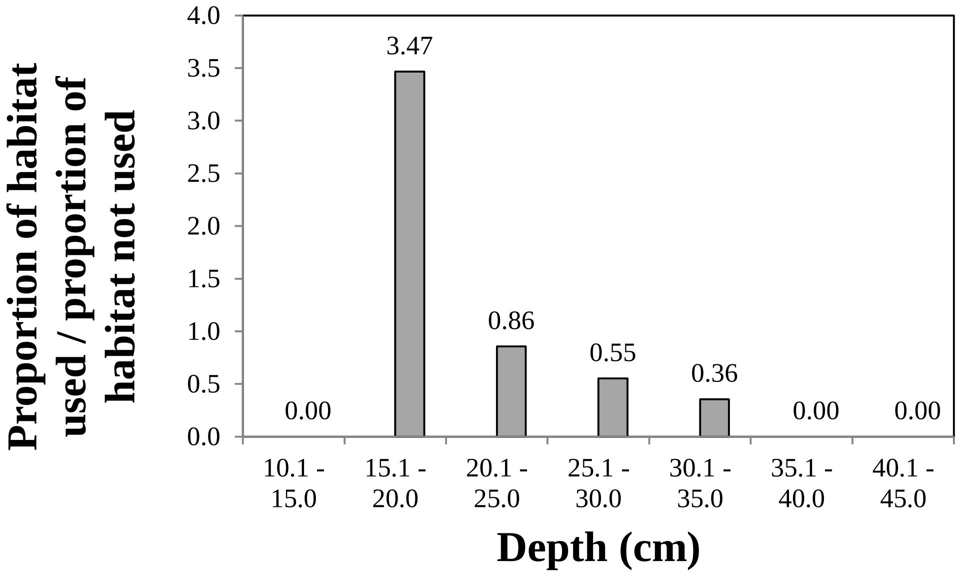


Model Selection

Model Variables	K	AIC_c	ΔAIC_c	AUC	max-rescaled R^2
Complex Channel, **Depth**	3	134.46	0.00	0.76	0.23
Complex Channel, **Depth**, CV Width	4	134.59	0.13	0.77	0.25
Complex Channel, **Depth**, Fines	4	135.93	1.47	0.78	0.23
Complex Channel, **Depth**, Boulder	4	136.00	1.54	0.76	0.23
Complex Channel, **Depth**, Boulder, CV Width	5	136.23	1.77	0.77	0.25
Complex Channel, **Depth**, LWD	4	136.24	1.78	0.76	0.23
Complex Channel, **Depth**, LWD, CV Width	5	136.34	1.89	0.78	0.25
Complex Channel, **Depth**, Width, CV Width	5	136.38	1.92	0.78	0.25
Complex Channel, **Depth**, Width	4	136.41	1.95	0.76	0.23
Complex Channel, **Depth**, Fines, CV Width	5	136.43	1.97	0.78	0.25
Complex Channel, **Depth**, PSP	4	136.45	1.99	0.76	0.23
GLOBAL (All variables included)	10	145.80	11.34	0.78	0.26
NULL (No variables)	1	156.66	20.20	0.50	0.00

Top Variables: Channel Complexity and Depth

Variable	Parameter Estimate	Standard Error	Scaling factor	**Scaled odds ratio**	95% CI for scaled odds ratio	*P*-value
Intercept	1.871	1.086				0.085
Complex Channel	1.378	0.453	1.00	**3.96**	1.63 - 9.64	0.002
Depth (m)	-16.830	4.739	0.05	**0.43**	0.27 - 0.69	< 0.001



Additional Support for Channel Complexity – Moderate Selection for Side Channel Habitat

Electivity Index, $D = (r – p) / (r + p) - 2rp$

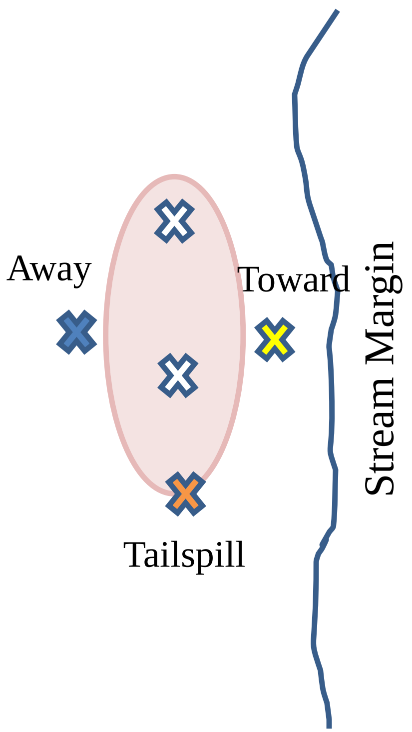
D Values:
-1.00 to -0.50 = strong avoidance
-0.49 to -0.26 = moderate avoidance
-0.25 to 0.25 = neutral selection
0.26 to 0.49 = moderate selection
0.50 to 1.00 = strong selection

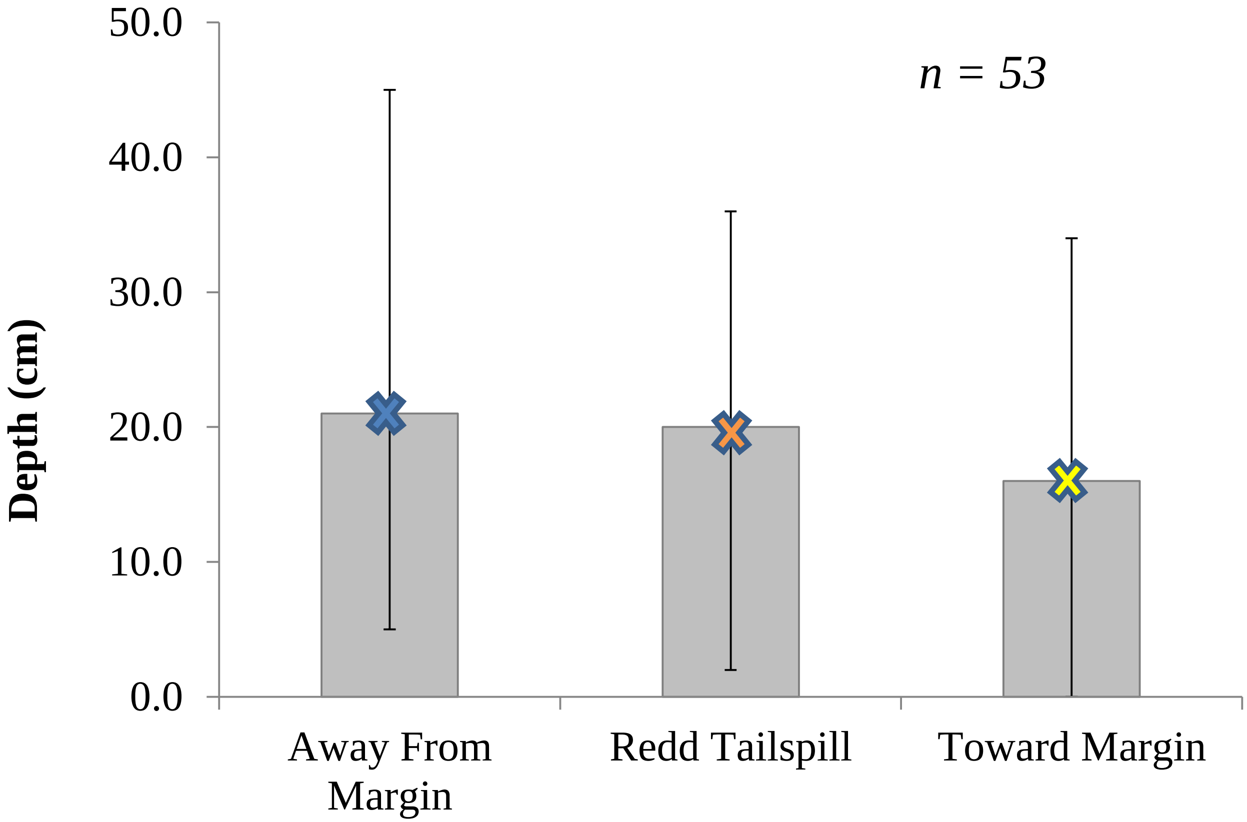
Stream	*D*	*r*	*p*
Pine Creek	0.467	0.300	0.094
P8	0.429	0.217	0.080
Pooled Data	***0.405***	***0.242***	***0.092***

These data are not associated with the modeling effort but provide additional information about habitat used by spawning bull trout.

Baltz (1990) and Mathews (1996)

Stream Depths Associated with Redds at the Microhabitat Scale (similar to reach scale depths)





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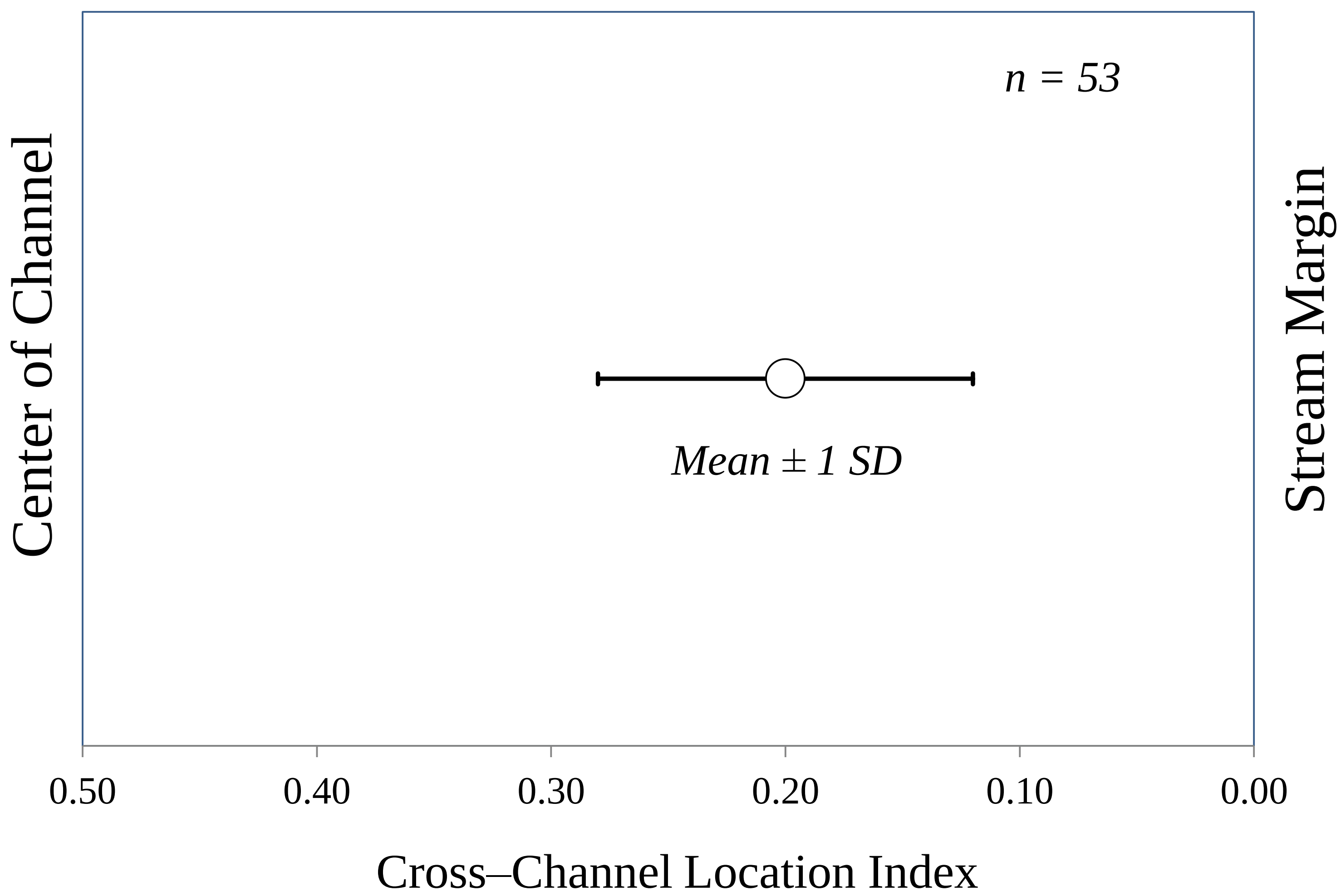
Bull Trout Redds were Constructed Near Stream Margins



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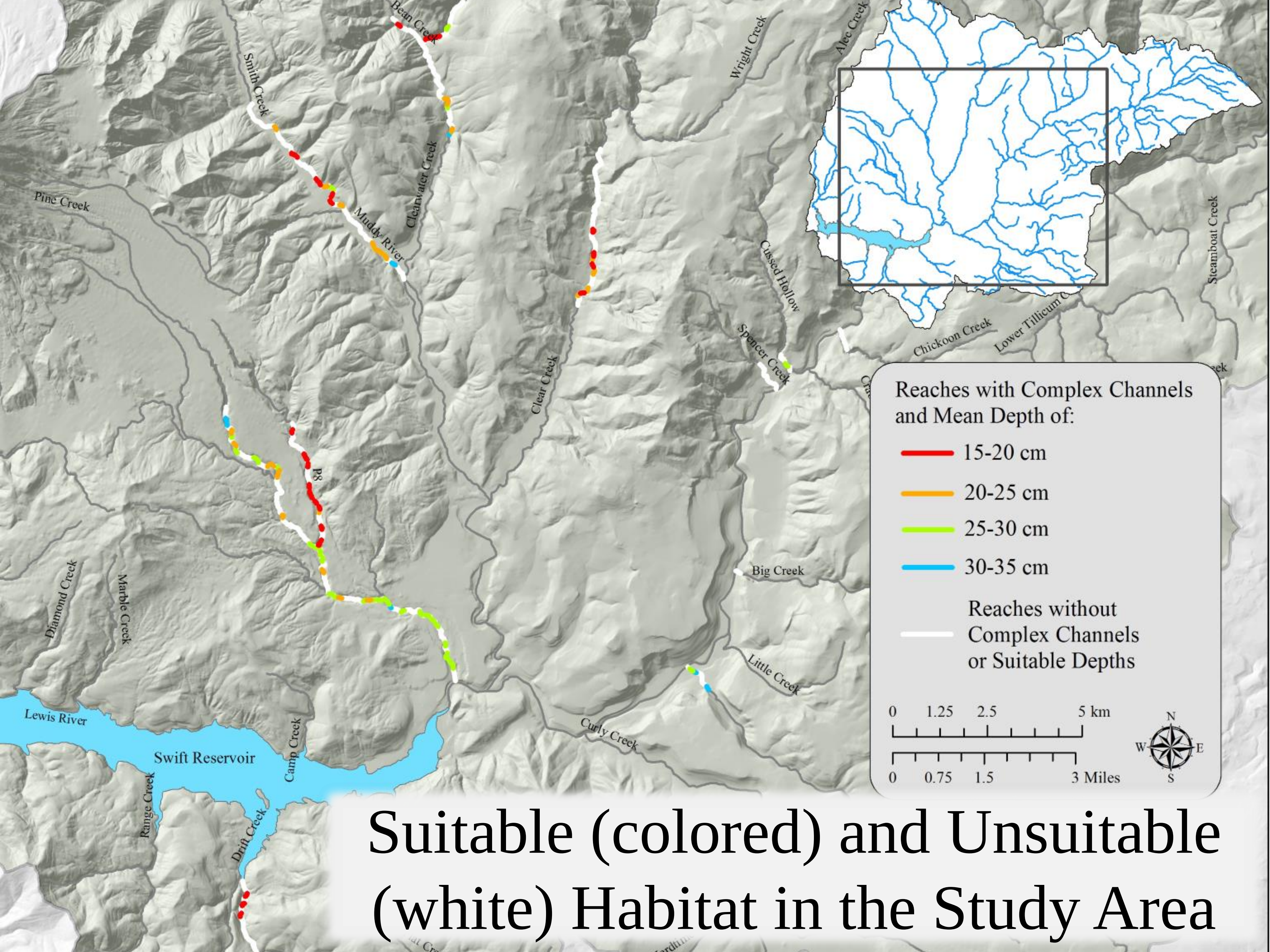
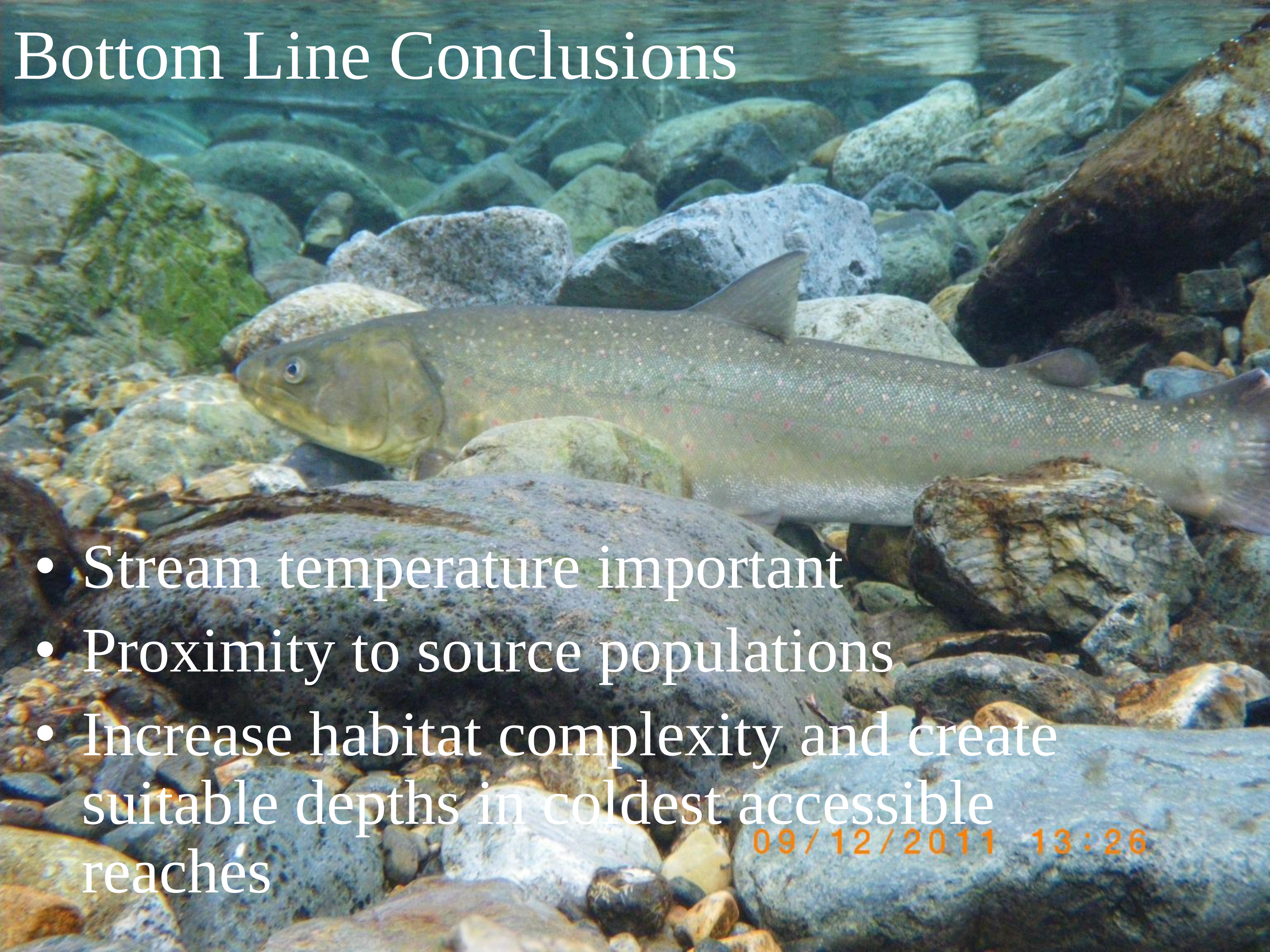


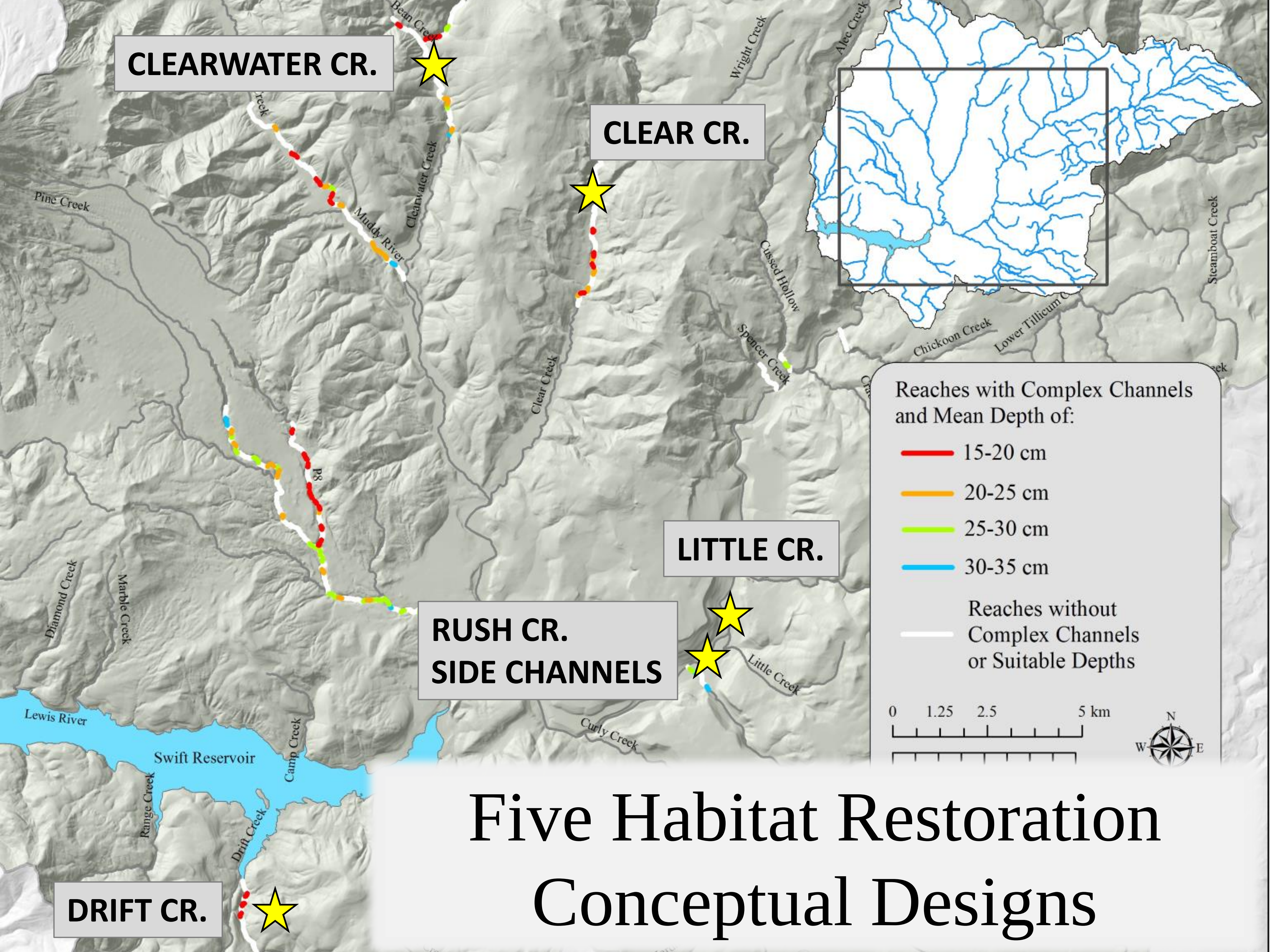
Suitable (colored) and Unsuitable (white) Habitat in the Study Area

Bottom Line Conclusions

- Stream temperature important
- Proximity to source populations
- Increase habitat complexity and create suitable depths in coldest accessible reaches



Five Habitat Restoration Conceptual Designs



Five Conceptual Designs

1) Little Creek

Temperature: Great (9 C)

Proximity: Great (~ 1 km)

Habitat: Functional

Recommendation: PIT array

Five Conceptual Designs

2) Rush Creek Side Channels

Temperature: Great (<12 C)

Proximity: Great (< 0.5 km)

Habitat: Evolving

Recommendation: Needs to stabilize

Five Conceptual Designs

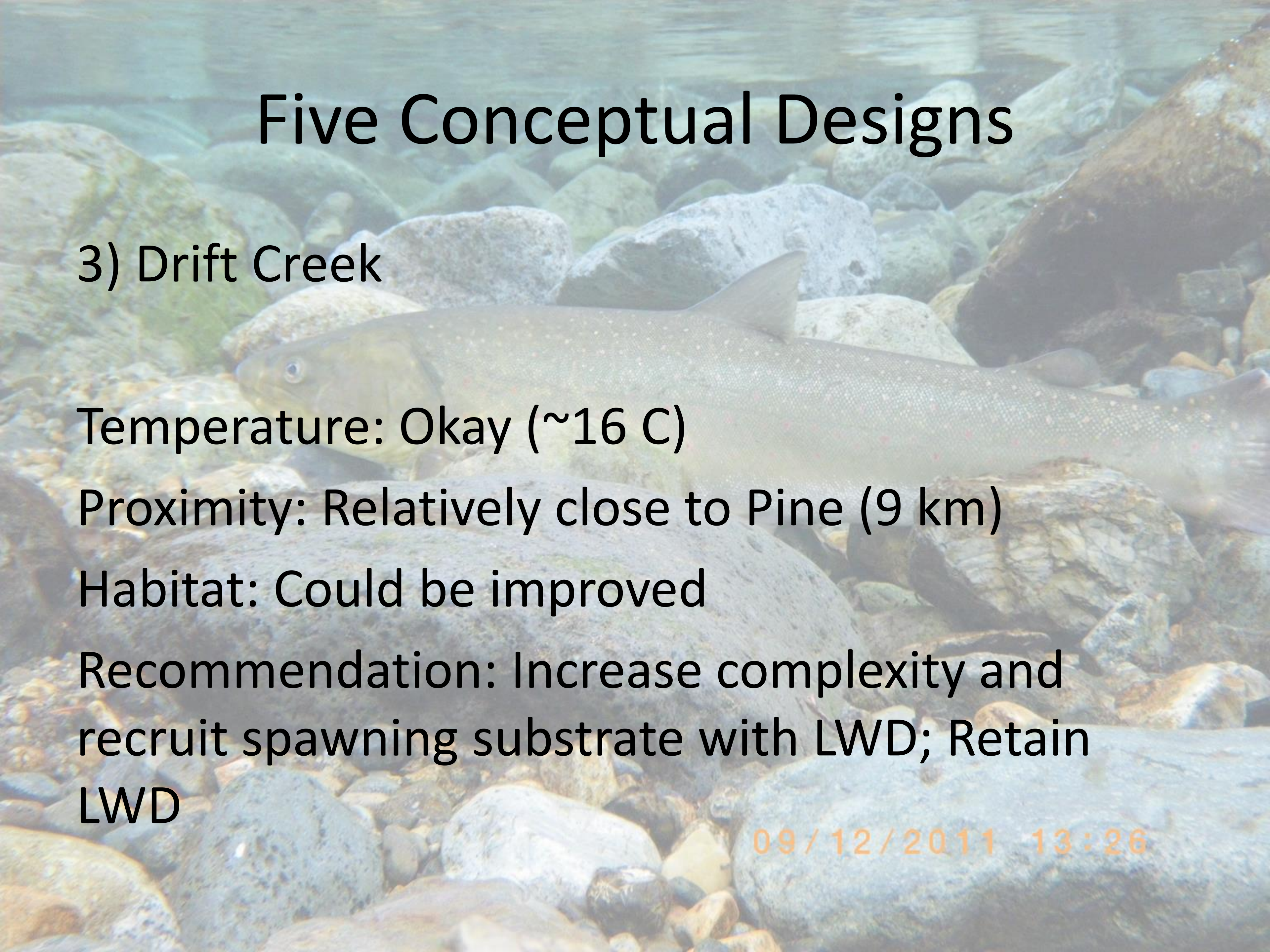
3) Drift Creek

Temperature: Okay (~16 C)

Proximity: Relatively close to Pine (9 km)

Habitat: Could be improved

Recommendation: Increase complexity and recruit spawning substrate with LWD; Retain LWD



Five Conceptual Designs

4) Clear Creek

Temperature: Okay (16 – 17.5 C)

Proximity: Not so close to Pine and Rush

Habitat: Could be improved

Recommendation: Decrease depth, increase complexity

Five Conceptual Designs

5) Clearwater Creek

Temperature: Okay (15 – 17.5 C)

Proximity: Furthest from Pine and Rush

Habitat: Could be improved

Recommendation: Increase suitable depths and complexity


THE END
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