

Habitat Use by Juvenile Bull Trout in Belt-Series Geology Watersheds of

Northern Idaho

Abstract

Bull trout (*Salvelinus confluentus*), a native char of the Pacific Northwest, has declined in abundance and distribution in recent years. Little is known about the habitat use by salmonids in streams with substrate characterized by Belt-Series geology. Such

information is needed by managers to evaluate potential effects of land use practices on the species, or to enhance or protect

Oreille (Figure 1; Table 1). Details of the study streams are presented in Saffel (1994). Eighteen stream reaches to be sampled were systematically placed within the stream distance available to adfluvial bull trout. Length of study reaches was 100 m in the case of the How

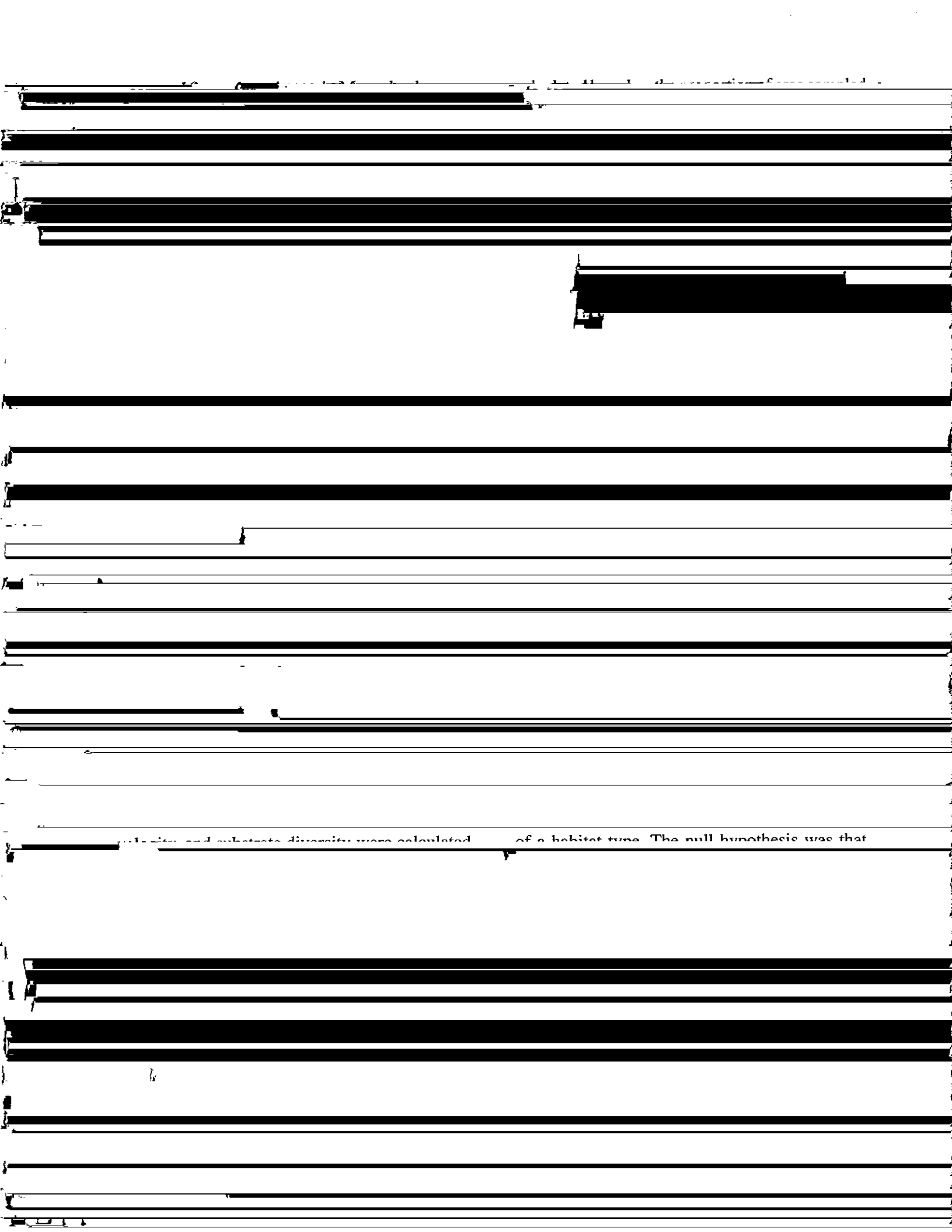
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Fig. 1

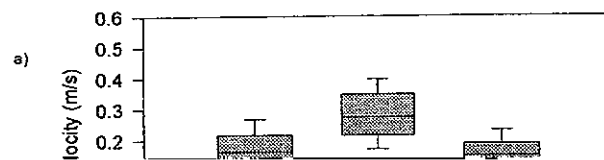
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TABLE 1. Key physical, chemical, and biological attributes of the six study streams. Geologic types are, UGB, unglaciated belt; GB, glaciated belt; and GM, granitic mix. Other trout species are: ctt, cutthroat trout; rbt, rainbow trout; brt, brook trout. Discharge was measured on 27 and 28 August.

Stream	Geologic type	Altitude (m)	Length (km)	Discharge (m ³ /s)	Trout species
1	UGB	1,200	1.5	0.5	rbt
2	UGB	1,100	1.2	0.3	rbt
3	UGB	1,000	1.0	0.2	rbt
4	UGB	900	0.8	0.1	rbt
5	UGB	800	0.6	0.05	rbt
6	UGB	700	0.4	0.02	rbt
7	UGB	600	0.3	0.01	rbt
8	UGB	500	0.2	0.005	rbt
9	UGB	400	0.1	0.002	rbt
10	UGB	300	0.05	0.001	rbt
11	UGB	200	0.02	0.0005	rbt
12	UGB	100	0.01	0.0002	rbt
13	UGB	50	0.005	0.0001	rbt
14	UGB	0	0.002	0.00005	rbt
15	UGB	-50	0.001	0.00002	rbt
16	UGB	-100	0.0005	0.00001	rbt
17	UGB	-150	0.0002	0.000005	rbt
18	UGB	-200	0.0001	0.000002	rbt
19	UGB	-250	0.00005	0.000001	rbt
20	UGB	-300	0.00002	0.0000005	rbt
21	UGB	-350	0.00001	0.0000002	rbt
22	UGB	-400	0.000005	0.0000001	rbt
23	UGB	-450	0.000002	0.00000005	rbt
24	UGB	-500	0.000001	0.00000002	rbt
25	UGB	-550	0.0000005	0.00000001	rbt
26	UGB	-600	0.0000002	0.000000005	rbt
27	UGB	-650	0.0000001	0.000000002	rbt
28	UGB	-700	0.00000005	0.000000001	rbt
29	UGB	-750	0.00000002	0.0000000005	rbt
30	UGB	-800	0.00000001	0.0000000002	rbt
31	UGB	-850	0.000000005	0.0000000001	rbt
32	UGB	-900	0.000000002	0.00000000005	rbt
33	UGB	-950	0.000000001	0.00000000002	rbt
34	UGB	-1,000	0.0000000005	0.00000000001	rbt
35	UGB	-1,050	0.0000000002	0.000000000005	rbt
36	UGB	-1,100	0.0000000001	0.000000000002	rbt
37	UGB	-1,150	0.00000000005	0.000000000001	rbt
38	UGB	-1,200	0.00000000002	0.0000000000005	rbt
39	UGB	-1,250	0.00000000001	0.0000000000002	rbt
40	UGB	-1,300	0.000000000005	0.0000000000001	rbt
41	UGB	-1,350	0.000000000002	0.00000000000005	rbt
42	UGB	-1,400	0.000000000001	0.00000000000002	rbt
43	UGB	-1,450	0.0000000000005	0.00000000000001	rbt
44	UGB	-1,500	0.0000000000002	0.000000000000005	rbt
45	UGB	-1,550	0.0000000000001	0.000000000000002	rbt
46	UGB	-1,600	0.00000000000005	0.000000000000001	rbt
47	UGB	-1,650	0.00000000000002	0.0000000000000005	rbt
48	UGB	-1,700	0.00000000000001	0.0000000000000002	rbt
49	UGB	-1,750	0.000000000000005	0.0000000000000001	rbt
50	UGB	-1,800	0.000000000000002	0.00000000000000005	rbt
51	UGB	-1,850	0.000000000000001	0.00000000000000002	rbt
52	UGB	-1,900	0.0000000000000005	0.00000000000000001	rbt
53	UGB	-1,950	0.0000000000000002	0.000000000000000005	rbt
54	UGB	-2,000	0.0000000000000001	0.000000000000000002	rbt
55	UGB	-2,050	0.00000000000000005	0.000000000000000001	rbt
56	UGB	-2,100	0.00000000000000002	0.0000000000000000005	rbt
57	UGB	-2,150	0.00000000000000001	0.0000000000000000002	rbt
58	UGB	-2,200	0.000000000000000005	0.0000000000000000001	rbt
59	UGB	-2,250	0.000000000000000002	0.00000000000000000005	rbt
60	UGB	-2,300	0.000000000000000001	0.00000000000000000002	rbt
61	UGB	-2,350	0.0000000000000000005	0.00000000000000000001	rbt
62	UGB	-2,400	0.0000000000000000002	0.000000000000000000005	rbt
63	UGB	-2,450	0.0000000000000000001	0.000000000000000000002	rbt
64	UGB	-2,500	0.00000000000000000005	0.000000000000000000001	rbt
65	UGB	-2,550	0.00000000000000000002	0.0000000000000000000005	rbt
66	UGB	-2,600	0.00000000000000000001	0.0000000000000000000002	rbt
67	UGB	-2,650	0.000000000000000000005	0.0000000000000000000001	rbt
68	UGB	-2,700	0.000000000000000000002	0.00000000000000000000005	rbt
69	UGB	-2,750	0.000000000000000000001	0.00000000000000000000002	rbt
70	UGB	-2,800	0.0000000000000000000005	0.00000000000000000000001	rbt
71	UGB	-2,850	0.0000000000000000000002	0.000000000000000000000005	rbt
72	UGB	-2,900	0.0000000000000000000001	0.000000000000000000000002	rbt
73	UGB	-2,950	0.00000000000000000000005	0.000000000000000000000001	rbt
74	UGB	-3,000	0.00000000000000000000002	0.0000000000000000000000005	rbt
75	UGB	-3,050	0.00000000000000000000001	0.0000000000000000000000002	rbt
76	UGB	-3,100	0.000000000000000000000005	0.0000000000000000000000001	rbt
77	UGB	-3,150	0.000000000000000000000002	0.00000000000000000000000005	rbt
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85	UGB	-3,550	0.000000000000000000000000005	0.0000000000000000000000000001	rbt
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89	UGB	-3,750	0.0000000000000000000000000002	0.000000000000000000000000000005	rbt
90	UGB	-3,800	0.0000000000000000000000000001	0.000000000000000000000000000002	rbt
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95	UGB	-4,050	0.000000000000000000000000000002	0.00000000000000000000000000000005	rbt
96	UGB	-4,100	0.000000000000000000000000000001	0.00000000000000000000000000000002	rbt
97	UGB	-4,150	0.0000000000000000000000000000005	0.00000000000000000000000000000001	rbt
98	UGB	-4,200	0.0000000000000000000000000000002	0.000000000000000000000000000000005	rbt
99	UGB	-4,250	0.0000000000000000000000000000001	0.000000000000000000000000000000002	rbt
100	UGB	-4,300	0.00000000000000000000000000000005	0.000000000000000000000000000000001	rbt
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102	UGB	-4,400	0.00000000000000000000000000000001	0.0000000000000000000000000000000002	rbt
103	UGB	-4,450	0.000000000000000000000000000000005	0.0000000000000000000000000000000001	rbt
104	UGB	-4,500	0.000000000000000000000000000000002	0.00000000000000000000000000000000005	rbt
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111	UGB	-4,850	0.00000000000000000000000000000000001	0.0000000000000000000000000000000000002	rbt
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118	UGB	-5,200	0.0000000000000000000000000000000000000005	0.0000000000000000000000000000000000000001	rbt
119	UGB	-5,250	0.0000000000000000000000000000000000000002	0.005	rbt
120	UGB	-5,300	0.0000000000000000000000000000000000000001	0.002	rbt
121	UGB	-5,350	0.0005	0.0001	rbt
122	UGB	-5,400	0.0002	0.005	rbt
123	UGB	-5,450	0.0001	0.002	rbt
124	UGB	-5,500	0.0005	0.0001	rbt
125	UGB	-5,550	0.0002	0.005	rbt
126	UGB	-5,600	0.0001	0.002	rbt
127	UGB	-5,650	0.0005	0.0001	rbt
128	UGB	-5,700	0.0002	0.005	rbt
129	UGB	-5,750	0.0001	0.002	rbt
130	UGB	-5,800	0.0005	0.0001	rbt
131	UGB	-5,850			



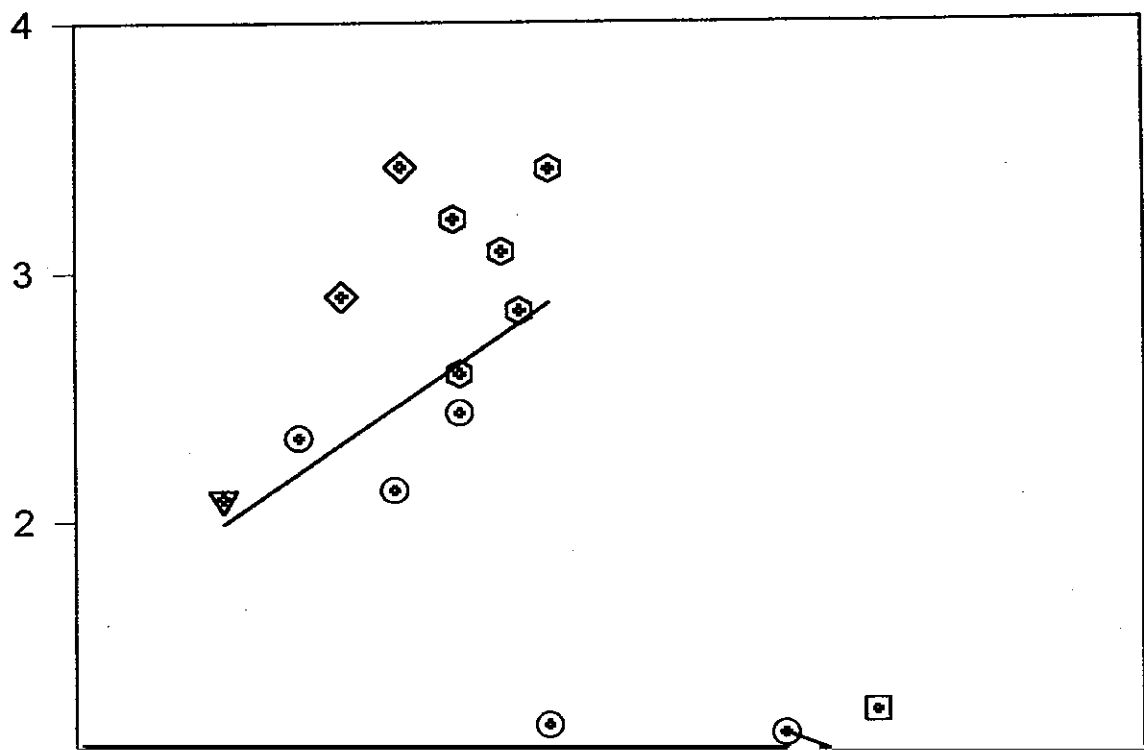
Results



1. Volume of large woody debris

10/10

not Juvenile Bull Trout + 0.5/100 m²



5 10 15 20 25

Maximum Summer Temperature (°C)

□ Grouse Cr. ▲ NF Grouse Cr. ◇ Gold Cr. [REDACTED]

reaches (df = 17) of six streams.

Independent Variable (X)	r ²	F	Probability	Equation
No. of pocket pools/100 m	0.33	7.87	0.01	$Y = 1.26 + 0.06(X)$
Mean bottom velocity	0.04	0.59	0.46	$Y = 1.33 + 3.75(X)$
Mean depth	0.06	1.01	0.33	$Y = 0.84 + 0.09(X)$
Substrate diversity	0.05	0.88	0.36	$Y = 0.87 + 0.35(X)$
Substrate diversity index (S.D.I.)	0.00	1.6	0.22	$Y = 1.63 + 1.65(X)$

4). Density of juvenile bull trout in the four reaches within Grouse Creek and North Fork Grouse Creek was poorly described by the linear model and decreased the amount of variation explained (r^2). These four reaches differed from the others in that maximum summer temperatures were $> 18^\circ\text{C}$ whereas the other reaches had maximum summer temperatures of $< 14^\circ\text{C}$.

Using multiple best subsets linear regression, transformed juvenile bull trout density (Y) was best predicted by the model: $Y = 2.919 - 0.119(X_1) + 0.055(X_2)$ where X_1 = maximum summer temperature, and X_2 = number of pocket pools/100 m ($R^2 = 0.64$; $df = 16$; $P < 0.001$; Table 5; Figure 5). Number of pocket pools accounted for 33%

the upper reaches, warm stream temperatures (13.9 and 18.3°C) in the middle reaches, and low temperatures (12.2°C) at the lowermost reach, where the stream was influenced by a large, cold water spring. Densities of bull trout were highest in the upper and lowermost reaches where temperatures were coolest, and lowest in the middle two reaches.

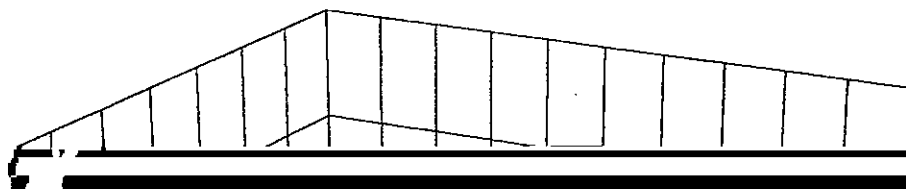
Discussion

Age 0 bull trout used habitat differently than age ≥ 1 bull trout. Age 0 fish were found primarily in the channel margins of runs and riffles, whereas the older juveniles selected deeper, slower pool areas and exhibited an avoidance of riffles and

of the variation and maximum summer temperature accounted for 31%. Colinearity between number of pocket pools and maximum summer temperature was insignificant ($r = -0.02$; $P > 0.90$). Model numbers 2 through 5 (Table 5) were also significant, however, in each case either maximum summer temperature or number of pocket pools were included in the model and accounted for most of the variation.

The interpretation of the temperature data in this study is limited because of the dependence

salmonids and younger, smaller salmonids has been reported for bull trout in the upper Arrow Lakes drainage, British Columbia (McPhail and Murray 1979), for age 0 and older char (bull trout and brook trout) in Sun Creek, Oregon (Dambacher et al. 1992) and for steelhead trout (*O. mykiss*) and chinook salmon (*O. tshawytscha*) in two Idaho streams (Everest and Chapman 1972). Use of higher velocity, main channel areas for food acquisition requires stronger swimming, which may also exclude smaller fish. Channel margins often provide the necessary habitat for salmonid fry to



because they may demonstrate a fixed-site territoriality (Pratt 1984). Pratt (1985) suggested that densities of bull trout may be controlled by the

1934; MacCrimmon and Campbell 1969; Meisner 1990). In this study, stream reaches with maximum summer temperatures below 13.9°C showed increasing density of bull trout with increasing

refuge from higher velocities. Unlike cutthroat trout, which are commonly found throughout the

temperature. Little is known about how temperature regulates density of fish in the wild. In labo

fastest survival and growth was between 8 to 10°C

Creek is largely spring fed with low temperatures

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We thank Brooks Sanford, Kara Saffel, Brett Turley, and Chris Wells for field assistance. Drs. Christine Moffitt and Dale Everson reviewed earlier drafts of this manuscript. Dr. Douglas Markle provided helpful comments during the editorial

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Literature Cited

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