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FOOD HABITS OF COEXISTING JUVENILE COHO SALMON, BROWN TROUT AND RAINBOW TROUT IN PLATTE RIVER, 1967 AND 1972 [1]

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ABSTRACT

Stomachs of age-0 and age-I coho salmon, brown trout and rainbow trout from a 3-mile section of Platte River were examined to determine if coho salmon were competing for food with resident trout. Collections were made in June and September, 1967, and in April, June, July and September, 1972. Ephemeroptera and Tendipedidae were the items most frequently eaten. Correlation analysis of the overall food habits of the various groups of salmonids demonstrated a similarity of food habits. I judge, though, that a significant degree of competition for food between trout and salmon did not occur because growth of trout was not affected and because of evidence that coho salmon and rainbow trout are spatially segregated in streams.

Introduction

The effect of recently introduced coho salmon (Oncorhynchus kisutch) on resident brown trout (Salmo trutta) and rainbow trout (Salmo gairdneri) was studied on a 3-mile portion of the Platte River, Benzie County, during 1967-72. The portion of the study that concerns the possibility of competition for food between juvenile coho salmon and trout is reported here. Competition, as defined by Milne (1961), is the demand, at the same time, of more than one organism for the same resources of the environment in excess of immediate supply. In my study, no data were available on the amount of food available, so only potential competition is considered.

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[1] Contribution from Dingell-Johnson Project F-35-R, Michigan.

Stomach samples were collected from salmonids in three 1-mile sections of the river in 1967 and 1972. The lower section was located immediately downstream from the Platte River Anadromous Fish Hatchery, the middle section was upstream from the hatchery, and the upper section was immediately above the middle one. These sections were described by Taube (1974).

The numbers of salmonids in the study area were determined by population estimates made in April and September of each year (Taube, 1975). The densities of salmonids present in 1967 and 1972 are shown in Table 1.

Methods

During June 1967, age-0 coho salmon and age-I brown trout and rainbow trout were collected from the lower two sections. During September, age-0 fish of all three species were collected from all three sections. Fish were collected throughout the sections during both periods. The brown and rainbow trout were wild fish, while the coho salmon were escapees from the hatchery. (Salmon did not spawn in the Platte River until 1967.)

In 1972, collections of juvenile salmonids were made in April, June, July and September from the lower two study sections. Age-0 coho salmon and age-I brown and rainbow trout were collected during all periods; age-I coho were collected in April; age-0 brown trout, in July and September; and age-0 rainbow trout, in June, July and September. Collections were not made in the upper one-third of the lower section, because this area was atypical due to enrichment from the hatchery. The trout were wild fish, but the coho could have been either wild or escapees from the hatchery.

Juvenile salmonids for this study were collected with a 220-volt, direct-current shocker. The fish were preserved in 10% formalin shortly after they were collected. In the laboratory, the preserved fish were measured (TL) and the measurements were converted to live length

by a correction factor of 1.035. Stomach contents were removed, separated into taxonomic classifications (family or higher), and counted. In 1967, each taxonomic classification from each group of fish was weighed to 0.1 mg. The fish examined are listed in Table 2.

For analysis, data from all sections for each month of collection were grouped by species and age. Correlation coefficients (r) were calculated to measure the similarity of foods eaten by the various groups of salmonids within each collection period. The average number of items of each taxonomic classification eaten per fish were used to calculate r. Of the two groups of fish being compared, when only one group ate food of a certain taxonomic classification, zero was used for the other group of fish. A significant positive correlation coefficient would indicate that the food habits were similar, and that potential competition exists. The one-tailed t test was used to test the significance of r. A similar method was used by Griswold and Smith (1973) to measure similarity of the diets of ninespine sticklebacks (Pungitius pungitius) and other species of fish.

Results

In June 1967, Brachycentridae, Simuliidae, Ephemeroptera and Trichoptera were most heavily utilized by all three salmonids (Table 3). These items comprised 55% of the food items eaten by age-0 coho, 71% of the food eaten by age-I brown trout, and 84% of the diet of age-I rainbow trout. By weight, these items were 26% of the coho diet, 57% of the brown trout diet and 73% of the rainbow diet. In September 1967, Simuliidae, Ephemeroptera, Tendipedidae and Homoptera were most prevalent in the diet, and made up 73, 92 and 91%, respectively, of the diets of age-0 coho, age-I brown trout and age-I rainbow trout (Table 4). By weight, these items were 46, 78 and 73% of the diets of coho, brown trout and rainbow trout, respectively. In April 1972, two food items--Tendipedidae and Ephemeroptera--made up 74 to 90% of the diet of age-0 and age-I coho salmon, and of age-I brown and rainbow trout (Table 5). Age-0 coho salmon and age-0 rainbow trout had similar

food habits in June; 72 and 89% of their diets, respectively, were made up of Tendipedidae, Ephemeroptera and Hydropsychidae. Age-I brown and rainbow trout had a more varied diet (Table 6). Again, in July, food habits of age-0 salmonids were similar (69-72% Ephemeroptera and Tendipedidae), whereas the diets of age-I trout were more diversified (Table 7). In September, age-0 salmon and trout and age-I rainbow trout fed heavily (73% to 97% of their diets) on Simuliidae, Tendipedidae and Ephemeroptera, but age-I brown trout had a more diversified diet (Table 8).

In general, Ephemeroptera and Tendipedidae comprised a large proportion of the diet of age-0 salmonids. These food items were eaten somewhat less frequently by age-I salmonids which had a more diversified diet.

Correlation coefficients for the comparison of overall food habits of the various groups of salmonids demonstrated a similarity of food habits (Table 9). Correlations were significant for five of nine comparisons of coho salmon and brown trout. Food habits were most similar in April, for which correlations of 0.94 and 0.87 were obtained when age-0 and age-I coho were compared with age-I brown trout. Correlations were significant for nine of ten comparisons of coho and rainbow trout. The greatest similarity in their food habits also was in April. Correlations between all groups of trout were significant except for age-I brown trout and age-0 rainbow trout in June and July 1972.

Discussion

The diets of juvenile coho salmon and brown and rainbow trout were similar in many instances. This similarity demonstrates that a potential for competition exists. I judge, though, that competition for food between salmon and trout did not occur in the Platte River. This judgment is based upon the absence of an inverse relationship between numbers of juvenile coho salmon and growth of trout (Taube, 1975) and evidence that coho salmon and rainbow trout are spatially segregated in

Table 1.--Estimated density (number per 1000 square meters) of age-0 and age-I salmonids in the Platte River study sections, 1967 and 1972

Month, year, and section	Coho salmon		Brown trout		Rainbow trout	
	0	I	0	I	0	I
April 1967						
Upper	..	..	..	24	..	44
Middle	..	..	..	39	..	50
Lower	..	..	..	..	..	..
September 1967						
Upper	4	..	53	20	138	21
Middle	14	..	32	22	73	23
Lower	62	..	11	16	140	49
April 1972						
Upper	..	7	..	42	..	83
Middle	..	13	..	33	..	88
Lower	..	60	..	3	..	123
September 1972						
Upper	7	..	44	14	95	19
Middle	17	..	38	14	108	28
Lower	165	..	7	4	355	50

Table 2.--Number and total length of juvenile salmonids examined to determine food habits, Platte River, 1967 and 1972

Species and age	Month	Year	Number	Total length (mm)	
				Mean	Range
Coho salmon - 0	April	1972	20	38	31 42
	June	1967	18	86	66 103
	June	1972	15	63	46 84
	July	1972	20	84	68 108
	Sep	1967	30	109	92 124
	Sep	1972	15	105	85 127
Coho salmon - I	April	1972	30	124	104 158
Brown trout - 0	July	1972	14	70	58 87
	Sep	1967	30	102	86 128
	Sep	1972	10	97	80 112
Brown trout - I	April	1972	33	116	88 140
	June	1967	20	144	114 183
	June	1972	20	149	124 174
	July	1972	12	169	127 203
	Sep	1972	6	169	131 194
Rainbow trout - 0	June	1972	15	38	25 59
	July	1972	20	56	24 92
	Sep	1967	30	93	72 124
	Sep	1972	15	90	50 120
Rainbow trout - I	April	1972	40	112	70 153
	June	1967	20	135	101 180
	June	1972	40	142	108 177
	July	1972	20	165	132 194
	Sep	1972	15	156	113 192

Table 3.--Number, weight and frequency of occurrence of foods eaten by juvenile salmonids in Platte River, June 1967

Food item [1]	Percent of the total number of items eaten by fish group [2]			Percent of the total weight of food eaten by fish group			Frequency of occurrence (Percent)		
	C-0	B-I	R-I	C-0	B-I	R-I	C-0	B-I	R-I
Brachycentridae	5	49	35	5	46	50	39	85	95
Simuliidae	22	7	21	4	tr [3]	2	44	50	45
Ephemeroptera	14	8	23	8	3	13	67	65	80
Trichoptera [4]	14	7	5	9	8	8	67	45	50
Tendipedidae	16	4	3	1	1	tr	67	40	65
Hydropsychidae	5	9	2	4	8	3	44	15	45
Coleoptera	2	4	1	11	13	2	17	45	40
Nematoda	2	3	tr	tr	tr	tr	22	15	10
Rhagionidae	..	1	4	..	1	5	..	15	30
Hymenoptera	4	..	tr	2	..	tr	28	..	25
Homoptera	2	1	tr	1	4	tr	11	5	10
Isopoda	4	tr	tr	10	tr	tr	22	5	10
Hydracarina	1	1	1	tr	tr	tr	11	25	45
Diptera adult [4]	..	1	1	..	1	tr	..	5	15
Diptera [4]	3	..	..	1	..	..	22	..	..
Amphipoda	1	1	tr	tr	2	tr	6	15	10
Decapoda	2	tr	tr	1	1	4	22	5	5
Helicopsychidae	..	1	1	..	6	5	..	15	10
Diplopoda	1	tr	tr	2	1	tr	17	10	5
Gastropoda	..	1	..	..	1	..	..	10	..
Araneae	1	tr	..	tr	tr	..	17	10	..
Miscellaneous [5]	1	1	1	40	2	3	..	..	..
Mean number and weight (mg) of items eaten	16	28	54	47	140	188	..	..	..

[1] Listed in order by percentage of number of items eaten by the three fish groups.

[2] C-0 = age-0 coho salmon; B-I = age-I brown trout; R-I = age-I rainbow trout.

[3] tr (trace) = less than 0.5.

[4] Organisms which could not be identified to family.

[5] Nine food classifications, each of which accounted for less than 0.5% of the number eaten by any fish group.

Table 4.--Number, weight and frequency of occurrence of foods eaten by juvenile salmonids in Platte River, September 1967

Food item [1]	Percent of the total number of items eaten by fish group [2]			Percent of the total weight of food eaten by fish group			Frequency of occurrence (Percent)		
	C-0	B-0	R-0	C-0	B-0	R-0	C-0	B-0	R-0
Simuliidae	8	51	50	5	50	45	63	80	73
Ephemeroptera	28	31	28	23	26	23	100	97	93
Tendipedidae	18	8	12	8	2	5	73	90	87
Homoptera	19	2	1	10	tr [3]	tr	47	27	27
Diptera [4]	8	tr	tr	7	1	tr	30	3	17
Hydropsychidae	3	2	1	4	8	3	43	67	43
Trichoptera [4]	2	2	2	3	6	3	30	49	30
Coleoptera	2	tr	1	12	tr	2	30	3	40
Hymenoptera	2	tr	1	2	1	10	23	10	13
Diplopoda	2	tr	tr	10	tr	2	30	3	10
Diptera adult	1	..	tr	2	..	tr	7	..	3
Hemiptera	1	..	tr	1	..	tr	23	..	13
Isopoda	1	tr	tr	1	tr	tr	20	3	7
Helicopsychidae	tr	1	tr	1	1	tr	7	20	10
Hydracarina	1	tr	tr	tr	tr	tr	13	3	3
Tipulidae	1	..	tr	tr	..	tr	13	..	3
Brachycendridae	..	tr	1	..	tr	tr	..	10	20
Nematoda	1	tr	tr	tr	tr	tr	10	3	3
Miscellaneous [5]	1	1	2	9	3	5	..	..	..
Mean number and weight (mg) of items eaten per fish	29	52	63	17	25	30	..	..	..

[1] Listed in order by percentage of number of items eaten by the three fish groups.

[2] C-0 = age-0 coho salmon; B-0 = age-0 brown trout; R-0 = age-0 rainbow trout.

[3] tr (trace) = less than 0.5.

[4] Organisms which could not be identified to family.

[5] Ten food classifications, each of which accounted for less than 0.5% of the number eaten by any fish group.

Table 5.--Number and frequency of occurrence of foods eaten by juvenile salmonids in Platte River, April 1972

Food item [1]	Percent of the total number of items eaten by fish group [2]				Frequency of occurrence (Percent)			
	C-0	C-I	B-I	R-I	C-0	C-I	B-I	R-I
Tendipedidae	88	37	62	29	90	53	79	52
Ephemeroptera	2	41	22	45	15	57	58	72
Hydropsychidae	..	4	5	15	..	27	33	55
Simuliidae	4	1	1	1	25	3	6	5
Tendipedidae adult	..	5	..	..	..	13	..	..
Coleoptera	1	3	..	..	5	17	..	..
Amphipoda	..	..	1	2	..	..	6	12
Isopoda	1	tr [3]	1	1	5	3	9	8
Pisces egg	..	tr	..	2	..	3	..	8
Trichoptera [4]	..	1	1	..	..	7	15	..
Gastropoda	1	..	1	..	5	..	6	..
Brachycentridae	1	..	tr	1	5	..	3	5
Collembola	1	tr	..	..	10	3	..	..
Plecoptera	..	1	1	tr	..	7	6	2
Diptera	..	1	1	..	..	3	3	..
Ceratopogonidae	..	1	1	..	..	10	6	..
Tipulidae	1	..	..	1	5	..	..	2
Araneae	..	1	..	..	..	7	..	..
Pisces	..	1	..	..	..	7	..	..
Tabanidae	..	..	1	tr	..	..	6	2
Rhyacophilidea	..	1	..	..	..	7	..	..
Oligochaeta	..	..	1	..	..	..	6	..
Miscellaneous [5]	..	2	1	2	..	..	..	..
Mean number of items eaten per fish	7	11	10	7	..	..	..	..

[1] Listed in order by percentage of number of items eaten by the four fish groups.

[2] C-0 = age-0 coho salmon; C-I = age-I coho salmon; B-I = age-I brown trout; R-I = age-I rainbow trout.

[3] tr (trace) = less than 0.5.

[4] Organisms which could not be identified to family.

[5] Eleven food classifications, each of which accounted for less than 0.5% of the number eaten by any fish group.

Table 6.--Number and frequency of occurrence of foods eaten by juvenile salmonids in Platte River, June 1972

Food item [1]	Percent of the total number of items eaten by fish group [2]				Frequency of occurrence (Percent)			
	C-0	B-I	R-0	R-I	C-0	B-I	R-0	R-I
Tendipedidae	44	4	45	3	87	60	87	65
Ephemeroptera	16	9	43	9	33	75	53	80
Hydropsychidae	12	22	1	19	47	90	7	90
Simuliidae	..	3	8	35	..	40	27	45
Brachycentridae	..	22	..	21	..	75	..	75
Ephydridae adult	..	22	..	..	..	10	..	..
Hydropsychidae adult	..	3	..	4	..	5	..	30
Ceratopogonidae	4	tr [3]	1	..	27	5	7	..
Trichoptera adult [4]	5	1	..	tr	20	20	..	5
Ephemeroptera adult	3	1	..	2	27	15	..	25
Diptera adult [4]	4	tr	..	tr	27	5	..	5
Tipulidae	..	1	2	..	..	15	7	..
Isopoda	1	1	..	1	13	40	..	20
Coleoptera adult	..	1	..	2	..	10	..	40
Limnephilidae adult	3	..	..	..	7	..	..	..
Limnephilidae	..	2	..	tr	..	40	..	5
Helicopsychidae	..	2	..	1	..	35	..	20
Trichoptera [4]	1	1	..	tr	7	15	..	5
Tendipedidae adult	1	..	..	tr	13	..	..	10
Hemiptera adult	1	tr	..	tr	7	5	..	5
Hydroptilidae	1	..	..	tr	13	..	..	5
Ptychopteridae	1	..	..	..	7	..	..	..
Culicidae	1	..	..	..	7	..	..	..
Hydracarina	..	tr	..	1	..	5	..	30
Hymenoptera	1	tr	..	tr	7	5	..	5
Oligochaeta	..	1	..	tr	..	10	..	5
Drosophilidae	1	..	..	..	7	..	..	..
Tipulidae adult	..	1	..	..	..	5	..	..
Miscellaneous [5]	..	2	..	..	..	..	..	..
Mean number of items eaten	10	45	5	43	..	..	..	..

[1] Listed in order by percentage of number of items eaten by the four fish groups.

[2] C-0 = age-0 coho salmon; B-I = age-I brown trout; R-0 = age-0 rainbow trout; R-I = age-I rainbow trout.

[3] tr (trace) = less than 0.5

[4] Organisms which could not be identified to family.

[5] Sixteen food classifications, each of which accounted for less than 0.5% of the number eaten by any fish group.

Table 7.--Number and frequency of occurrence of foods eaten by juvenile salmonids in Platte River, July 1972

Food item [1]	Percent of total number of items eaten by fish group [2]					Frequency of occurrence (Percent)				
	C-0	B-0	B-I	R-0	R-I	C-0	B-0	B-I	R-0	R-I
Ephemeroptera	17	66	8	44	16	85	100	75	95	95
Tendipedidae	52	6	4	26	21	95	50	67	80	80
Brachycentridae	tr [3]	1	58	1	25	10	21	75	35	65
Simuliidae	5	20	3	26	7	55	71	67	65	65
Simuliidae adult	3	..	tr	1	13	30	..	17	20	50
Limnophilidae	..	..	11	..	2	..	..	58	..	40
Hydropsychidae	5	1	2	..	4	50	21	33	..	65
Tipulidae	1	2	tr	1	tr	10	28	17	15	10
Rhyacophilidae	1	tr	2	..	2	10	7	25	..	35
Hydracarina	2	..	1	1	..	20	..	8	25	..
Ephemeroptera adult	1	..	2	..	tr	15	..	17	..	5
Amphipoda	tr	1	1	tr	tr	5	14	33	5	10
Homoptera	1	tr	2	..	tr	5	7	8	..	10
Hemiptera adult	1	..	1	..	1	15	..	8	..	15
Trichoptera [4]	tr	..	1	..	1	5	..	17	..	20
Hymenoptera	1	..	1	tr	tr	10	..	25	10	15
Coleoptera	..	..	2	tr	tr	..	..	42	5	5
Tabanidae	1	..	..	..	1	5	..	..	..	20
Gastropoda	tr	..	1	tr	..	10	..	25	5	..
Rhagionidae	..	..	..	..	2	..	..	..	..	10
Hemiptera	..	..	1	..	tr	..	..	25	..	10
Hydroptilidae	..	1	..	..	tr	..	7	..	..	5
Empididae adult	1	..	..	..	..	5	..	..	..	..
Nematoda	1	..	..	tr	..	25	..	..	5	..
Coleoptera adult	..	..	..	..	1	..	..	..	..	25
Helicopsychidae	..	..	1	..	tr	..	..	25	..	5
Ceratopogonidae	1	..	..	..	tr	20	..	..	..	5
Araneae	1	..	..	..	..	15	..	..	..	..
Tendipedidae adult	1	..	..	..	..	5	..	..	..	..
Diplopoda	1	..	..	..	..	10	..	..	..	..
Miscellaneous [5]	3	tr	3	tr	3	..	..	..	..	..
Mean number of items eaten per fish	26	20	38	44	45	..	..	..	..	..

[1] Listed in order by percentage of number of items eaten by the five fish groups.

[2] C-0 = age-0 coho salmon; B-0 = age-0 brown trout; B-I = age-I brown trout; R-0 = age-0 rainbow trout; R-I = age-I rainbow trout.

[3] tr (trace) = less than 0.5.

[4] Organisms which could not be identified to family.

[5] Twelve food classifications, each of which accounted for less than 0.5% of the number eaten by any fish group.

Table 8.--Number and frequency of occurrence of foods eaten by juvenile salmonids in Platte River, September 1972

Food item [1]	Percent of total number of items eaten by fish group [2]					Frequency of occurrence (Percent)				
	C-0	B-0	B-I	R-0	R-I	C-0	B-0	B-I	R-0	R-I
Simuliidae	15	83	21	47	38	67	80	50	87	87
Tendipedidae	57	5	6	23	28	80	90	33	100	93
Ephemeroptera	5	9	11	18	7	67	90	17	93	73
Helicopsychidae	..	tr [3]	23	tr	2	..	10	50	7	27
Hydropsychidae	3	1	7	2	2	60	50	33	47	53
Hymenoptera	3	..	..	1	8	20	..	..	33	53
Simuliidae adult	7	..	2	1	1	20	..	17	27	33
Oligochaeta	tr	..	8	..	tr	13	..	17	..	7
Ephemeroptera adult	1	..	..	2	2	20	..	..	33	27
Diplopoda	..	..	5	..	..	..	..	17	..	..
Rhyacophilidae	..	tr	3	tr	1	..	10	17	7	27
Drosophilidae	tr	..	3	tr	..	7	..	17	7	..
Brachycentridae	..	tr	..	1	2	..	10	..	33	33
Isopoda	tr	tr	3	..	..	7	10	17	..	..
Hydracarina	tr	..	2	tr	1	13	..	17	20	27
Hydroptilidae	..	1	..	1	1	..	40	..	40	27
Nematoda	2	tr	..	..	tr	20	10	..	..	13
Empididae adult	..	..	2	tr	tr	..	..	17	7	7
Trichoptera adult [4]	tr	tr	..	1	1	7	10	..	13	27
Hemiptera adult	..	..	..	tr	1	..	..	..	13	13
Diptera [4]	..	..	2	tr	..	..	17	7	..	..
Decapoda	..	..	2	..	..	..	..	17	..	..
Trichoptera [4]	1	tr	..	..	tr	7	20	..	..	13
Gastropoda	..	..	..	tr	1	..	..	..	7	20
Tendipedidae adult	..	..	..	1	1	..	..	..	13	7
Diptera adult [4]	1	..	..	tr	tr	13	..	..	7	13
Hemiptera	1	..	..	..	tr	7	..	..	..	7
Miscellaneous [5]	3	..	..	1	2	..	..	..	..	..
Mean number of items eaten	38	119	11	84	53	..	..	..	..	..

[1] Listed in order by percentage of number of items eaten by the five fish groups.

[2] C-0 = age-0 coho salmon; B-0 = age-0 brown trout, B-I = age-I brown trout; R-0 = age-0 rainbow trout; R-I = age-I rainbow trout.

[3] tr (trace) = less than 0.5.

[4] Organisms which could not be identified to family.

[5] Nine food classifications, each of which accounted for less than 0.5% of the number eaten by any fish group.

Table 9.--Correlation coefficients of the mean number of food items, within taxonomic classifications, eaten by juvenile salmonids in Platte River, 1967 and 1972

Fish groups compared	Month	Year	n [1]	r	t
Coho-0 - Brown-0	July	1972	28	0.36	1.96* [a]
	Sep	1967	29	0.56	3.47**
	Sep	1972	24	0.35	1.23
Coho-0 - Brown-I	April	1972	22	0.94	12.47**
	June	1967	29	0.32	1.73*
	June	1972	38	0.20	1.20
	July	1972	33	0.04	0.20
	Sep	1972	26	0.23	1.15
Coho-0 - Rainbow-0	June	1972	18	0.87	7.31**
	July	1972	29	0.68	4.75**
	Sep	1967	26	0.54	3.32**
	Sep	1972	32	0.60	4.14**
Coho-0 - Rainbow-I	April	1972	18	0.50	2.28*
	June	1967	27	0.55	3.33**
	June	1972	36	0.20	1.21
	July	1972	40	0.65	5.33**
	Sep	1972	32	0.75	6.27**
Coho-I - Brown-I	April	1972	27	0.87	9.17**
Coho-I - Rainbow-I	April	1972	29	0.95	16.53**
Brown-0 - Rainbow-0	July	1972	17	0.89	7.41**
	Sep	1967	26	0.99	52.14**
	Sep	1972	28	0.90	10.40**
Brown-0 - Rainbow-I	July	1972	32	0.44	2.65**
	Sep	1972	30	0.82	7.55**
Brown-I - Rainbow-0	June	1972	32	0.15	0.83
	July	1972	27	0.09	0.47
	Sep	1972	29	0.63	4.20**
Brown-I - Rainbow-I	April	1972	23	0.76	5.41**
	June	1967	25	0.86	7.98**
	June	1972	40	0.53	3.81**
	July	1972	38	0.60	4.52**
	Sep	1972	34	0.58	3.98**

[1] Number of taxonomic groups compared, from Tables 3-8.

[a] *Significant at 0.05 level of probability
**Significant at 0.01 level of probability.

streams (Hartman, 1965). However, it is conceivable that competition could occur, should high salmonid abundance and/or scanty food supplies cause the spatial segregation to break down.

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