# APPENDIX G

## Use of Major Habitat Types by Juvenile Salmon and Resident Species

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## INTRODUCTION

The preference of fish for a certain kind of habitat varies with species, life history stage, time of year, and other factors. This appendix presents an analysis of preferences of resident fish and juvenile salmon during the open water season for six major habitat types occurring on the Susitna River between Cook Inlet and Devil Canyon. The six major habitat types were defined as tributary mouths, side channels with large tributary mouth, side sloughs with large tributary mouth, side sloughs with small tributary mouth or groundwater input, upland sloughs, and mainstem channels or side channels.

## METHODS

Two types of proportions were analyzed using chi-square analysis (Snedecor and Cochran 1974; Summers et al. 1981). The first type was the distribution of a group of species among several different habitat types. The second was similar except that the distribution of a single species among these habitat types was tested. These tests were performed for both juvenile salmon (pink salmon not included because of low numbers captured) and resident species. A third type of comparison which was conducted graphically but not with chi-square analysis was the proportion of the four juvenile salmon species at one particular habitat type.

Statistical significance for all the chi square tests was set at the 95% confidence level. Continuity correction factors were calculated for all 2 X 2 contingency tables. Species, dates, or sites were pooled where necessary to keep the expected values greater than five.

Presence/absence data were extracted from Volume 3 of the Basic Data Report (ADF&G 1983) and were collected by a number of gear types and methods (Appendix Table G-1). Appendix Table G-2 shows how the 17 Designated Fish Habitat (DFH) sites were grouped into five major habitat types along with sampling effort at each type.

## RESULTS

### Juvenile Salmon

The presence/absence of the four species of juvenile salmon at the five major habitat types at DFH sites is shown in Appendix Table G-2. A 4 x 5 chi-square test of the presence/absence of four species of juvenile salmon versus five major habitat types (Appendix Table G-3) indicated that juvenile salmon did exhibit habitat preferences. A closer examination conducted by individual species revealed that coho and sockeye salmon exhibited a significant preference for certain habitat types but no such preference by chinook and chums was demonstrated (Appendix Table G-3).

Appendix Table G-1. Summary of chi square analyses performed on 1982 presence/absence or species proportion data.

| Method and Type of Data | Where Collected | Species | Chi-Square Comparisons |
|---|---|---|---|
| All gear types[a] except boat electrofishing, presence/absence by species | 17 DFH sites[b] | All juvenile salmon species | Among habitat types by all species |
| | | Chinook salmon<br>Coho salmon | Among habitat types by species |
| Beach seine or backpack electrofishing[c], presence/absence by species | 17 DFH sites | Chum salmon<br>Sockeye salmon<br>Round whitefish<br>Arctic grayling<br>Longnose sucker<br>Slimy sculpin | Among habitat types by species |
| Boat electrofishing, catch numbers | Cook Inlet to Devil Canyon | All resident species | Comparison of species proportions between habitat types and by season within mainstem and tributary types |
| Boat electrofishing, presence/absence by species | Above Chulitna River confluence (RM 98.5) | Round whitefish<br>Arctic grayling<br>Longnose sucker<br>Burbot<br>Humpback whitefish<br>Rainbow trout<br>Dolly varden | 1) Among habitat type or pooled habitat type by species<br>2) Within habitat types by season by species |

[a] Gear types include minnow traps, beach seines, and backpack electrofishing units.

[b] The 17 DFH (Designated Fish Habitat) sites ranged from Goose Creek (RM 73.1) to Portage Creek (RM 148.8).

[c] These methods were the only effective techniques for capturing these species at these sites.

Appendix Table G-2. Effort (number of sampling trips) and presence (number of trips that each species was present) of juvenile salmon at DFH sites. Compiled from catch by all gear types, June through September, 1982.

| | Effort | Presence | | | | Sub-Total |
|---|---|---|---|---|---|---|
| | | Chinook | Coho | Chum | Sockeye | |
| Tributary mouths | | | | | | |
| Fourth of July Creek | 8 | 5 | 2 | 1 | 1 | |
| Indian River | 8 | 6 | 1 | 1 | 2 | |
| Portage Creek | 7 | 0 | 0 | 0 | 0 | |
| sub-total | 23 | 11 | 3 | 2 | 3 | 19 |
| Upland sloughs | | | | | | |
| Whitefish Slough | 7 | 3 | 4 | 0 | 3 | |
| Slough 6A | 8 | 7 | 7 | 2 | 8 | |
| Slough 19 | 8 | 3 | 0 | 1 | 6 | |
| sub-total | 23 | 13 | 11 | 3 | 17 | 44 |
| Side sloughs w/large tribs | | | | | | |
| Rabideux Creek | 6 | 5 | 6 | 0 | 1 | |
| Birch Creek | 8 | 6 | 8 | 5 | 4 | |
| Whiskers Creek | 8 | 8 | 7 | 2 | 2 | |
| Lane Creek | 8 | 6 | 4 | 1 | 4 | |
| Slough 20 | 8 | 5 | 1 | 1 | 3 | |
| sub-total | 38 | 30 | 26 | 9 | 14 | 79 |
| Side sloughs w/small trib or groundwater | | | | | | |
| Slough 8A | 8 | 5 | 1 | 1 | 7 | |
| Slough 9 | 8 | 7 | 1 | 3 | 4 | |
| Slough 11 | 8 | 3 | 2 | 1 | 3 | |
| Slough 21 | 8 | 5 | 1 | 2 | 4 | |
| sub-total | 32 | 20 | 5 | 7 | 18 | 50 |
| Side channels w/trib | | | | | | |
| Goose Creek | 8 | 6 | 6 | 2 | 5 | |
| Sunshine Creek | 8 | 6 | 8 | 1 | 1 | |
| sub-total | 16 | 12 | 14 | 3 | 6 | 35 |
| TOTAL | 132 | 86 | 59 | 24 | 58 | 227 |

Appendix Table G-3. Summary of results of chi-square tests of association between juvenile salmon presence/absence and habitat type at DFH sites. Habitat types were tributary mouths, upland sloughs, side sloughs with large tributaries, side sloughs without large tributaries and side channels with large tributaries, June through September, 1982.

| Species | Chi-square | df | Significance Level |
|---|---|---|---|
| All four species of juvenile salmon[a] | 22.8 | 12 | $p < .05$ |
| Chinook[a] | 7.8 | 4 | NS[c] |
| Coho[a] | 40.9 | 4 | $p < .01$ |
| Chum[b] | 0.0 | 1[d] | NS |
| Sockeye[b] | 11.1 | 4 | $p < .01$ |

[a]All gear types

[b]Beach seining and electrofishing only

[c]NS = Not significant

[d]Habitat types were pooled into tributary sites and sloughs with no large tributaries.

Ratios of observed presence to expected presence show an association of coho salmon juveniles with upland sloughs, side sloughs with large tributary mouths, and side channels with large tributary mouths (Appendix Table G-4). Sockeye salmon juveniles were associated with upland sloughs and side sloughs without large tributary mouths. The distribution of each species among the major habitat types is illustrated in Appendix Figure G-1.

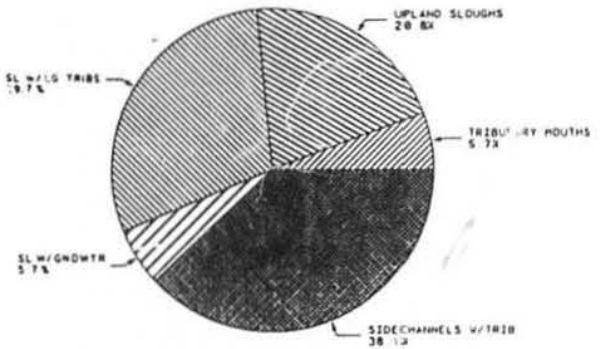
An examination of juvenile salmon species proportions at each of the five major habitat types (Appendix Figure G-2) shows that each habitat type had a rather distinctive community of juvenile salmon. Chi-square tests were not performed on these proportions.

Resident Species

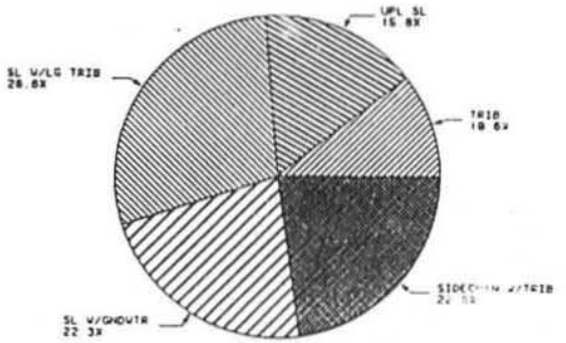
Boat electrofishing catch data were used to characterize species proportions of the resident fish community at five different habitat types of the Susitna River at sites both above and below the Chulitna River confluence (Appendix Table G-5). After less abundant species were pooled to increase sample sizes, species proportions between habitat types were tested, using actual numbers from catch data, with chi-square analysis and found to be significantly different (Appendix Table G-6). The seasonal differences in species proportions at mainstem and tributary sites were also significantly different (Appendix Table G-6).

Appendix Table G-4. Ratios of observed to expected presence of coho and sockeye salmon juveniles at five different habitat types at DFH sites, June through September, 1982. Based on results presented in Appendix Table G-3.

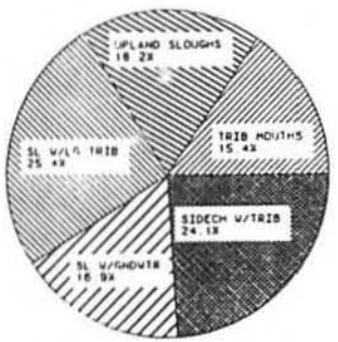
| Habitat type | Coho | Sockeye |
|---|---|---|
| Tributary | 0.29 | 0.36 |
| Upland Slough | 1.07 | 1.46 |
| Side Slough with large tributary | 1.53 | 0.78 |
| Side Slough w/o large tributary | 0.35 | 1.25 |
| Side channel with tributary | 1.96 | 0.92 |



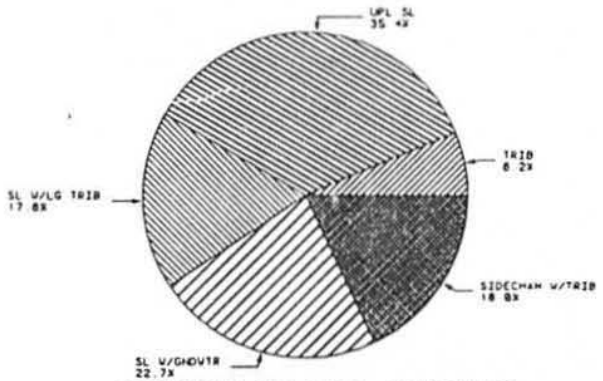

COHO SALMON JUVENILES




CHUM SALMON JUVENILES

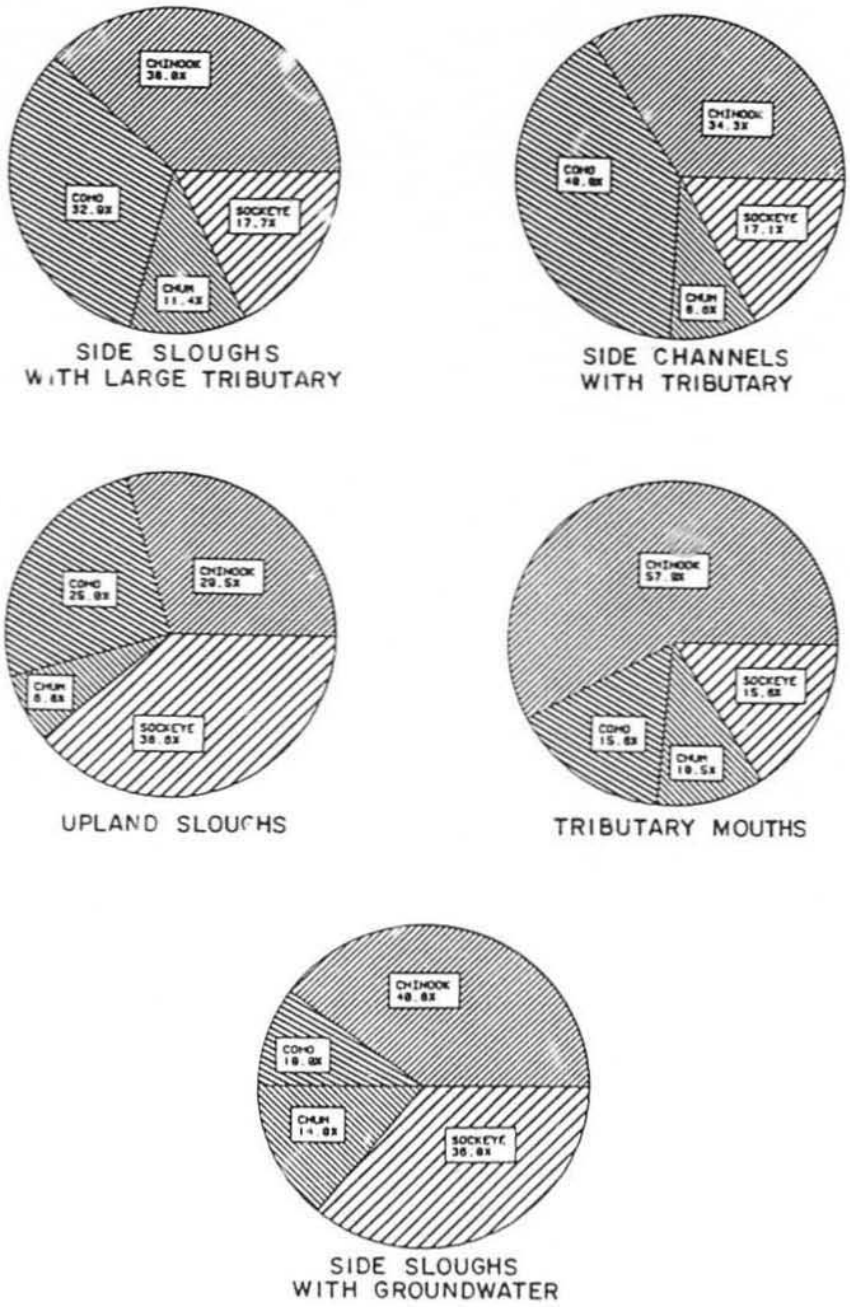



CHINOOK SALMON JUVENILES




SOCKEYE SALMON JUVENILES

Appendix Figure G-1. Distribution of juvenile salmon by species among the major habitat types at DFH sites, June through September, 1982. Based on the number of times the species was present as a percentage of the total number of times the sites were sampled. Effort by all gear types included. Percentages corrected for unequal sampling effort at the different habitat types.




Appendix Figure G-2. Proportions of juveniles of four species of salmon at each of five major habitat types located on the Susitna River, June through September, 1982. Based on the number of times the species was present as a percentage of the total number of times the sites were fished. Effort by all gear types included. Percentages corrected for unequal sampling effort at the different habitat types. Chum percentages are low because chums were not present in the Susitna system for the entire sampling season.

Appendix Table G-5. Resident species percentages by habitat type and by season within two habitat types at sites boat-electrofished between Cook Inlet and Devil Canyon, May through September 1982.

| | No. of Resident Fish Captured | Percentage by Species | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Rainbow | Arctic Grayling | Burbot | Round Whitefish | Humpback Whitefish | Longnose Sucker | Other |
| Habitat Type | | | | | | | | |
| Mainstem | 1057 | 2.4 | 20.2 | 7.2 | 30.9 | 3.3 | 30.7 | 5.2 |
| Tributary mouths | 1494 | 5.0 | 28.6 | 2.1 | 38.5 | 2.9 | 18.5 | 4.4 |
| Upland sloughs | 263 | 3.8 | 12.9 | 2.7 | 30.0 | 12.5 | 33.8 | 4.2 |
| Side sloughs without trib | 119 | 5.9 | 18.5 | 1.7 | 47.1 | 5.0 | 16.8 | 5.0 |
| Side sloughs w/large tribs | 377 | 5.6 | 19.4 | 2.1 | 19.4 | 2.4 | 47.5 | 3.7 |
| Mainstem Month | | | | | | | | |
| May-June | 347 | 2.9 | 30.8 | 2.9 | 38.9 | 1.2 | 14.1 | 9.2 |
| July-August | 356 | 0.8 | 8.7 | 14.3 | 23.0 | 5.6 | 43.0 | 4.5 |
| September | 354 | 3.4 | 21.5 | 4.5 | 31.1 | 3.1 | 34.5 | 2.0 |
| Tributary Month | | | | | | | | |
| May-June | 599 | 4.3 | 29.4 | 1.3 | 42.2 | 3.0 | 15.2 | 4.5 |
| July-August | 509 | 1.0 | 30.1 | 4.1 | 34.4 | 3.5 | 20.0 | 6.9 |
| September | 386 | 11.1 | 25.4 | 0.8 | 38.1 | 2.1 | 21.8 | 0.8 |

Appendix Table G-6. Comparison of species proportions of resident fish (rainbow trout, round whitefish, Arctic grayling, longnose sucker, and other) between habitat types and by season within each habitat type, May through September, 1982.

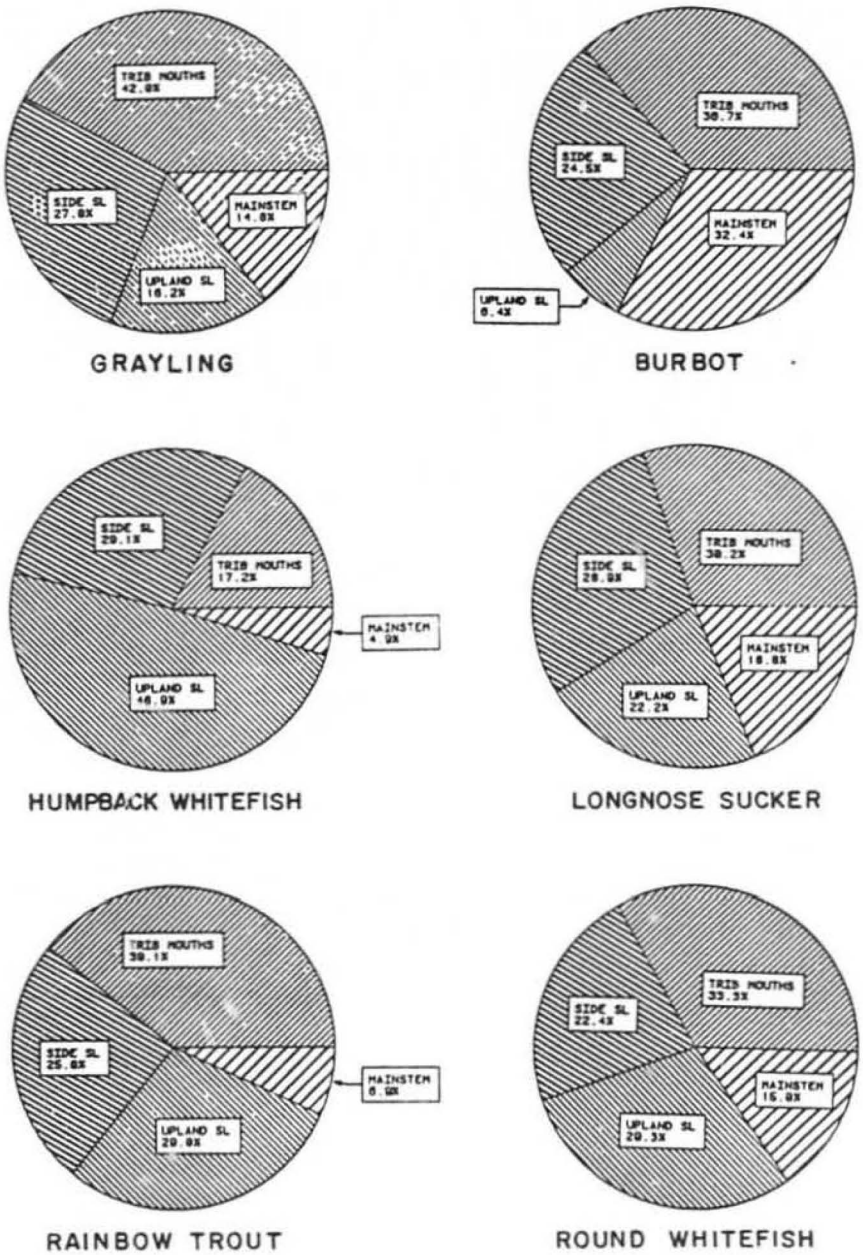
1 - Upland Sloughs
2 - Side Sloughs
3 - Mainstem
4 - Trib
5 - Slough w/tributary

| Comparison | Chi-square | df | Significance level |
|---|---|---|---|
| 1 vs 2 vs 3 vs 4 vs 5 | 244.0 | 16 | $p < .01$ |
| 1 vs 2 | 20.4 | 4 | $p < .01$ |
| 4 vs 5 | 145.5 | 4 | $p < .01$ |
| By season for mainstem sites: | | | |
| May-Jun vs Jul-Aug vs Sept | 139.7 | 8 | $p < .01$ |
| By season for Trib sites: | | | |
| May-Jun vs Jul-Aug vs Sept | 87.3 | 8 | $p < .01$ |

Resident species proportions at tributary, side slough, upland slough, and mainstem sites above the Chulitna River confluence were further examined with presence/absence data collected with boat electrofishing gear for six species of resident fish. The relative distribution of each species among the four major habitat types is illustrated in Appendix Figure G-3.

Differences in species presence/absence at the four different habitat types above the confluence were tested for seven species of resident fish. If necessary, habitat types were pooled to increase sample sizes. Significant differences in habitat use were found for all except burbot (Appendix Table G-7). Ratios of observed to expected use of the various habitat types by species (only for those that were significantly different) are presented in Appendix Table G-8. A few seasonal differences in species use of a given habitat type were also significant (Appendix Table G-9). In July and August, use of a given habitat type was often lower than in May, June and September (Appendix Table G-10).

In another series of tests, resident fish distribution among five different habitat types at the 17 DFH sites were examined using catch data collected with beach seines and backpack electrofishing gear (Appendix Table G-11). Of the four species of resident fish examined, only Arctic grayling showed significant differences in their use of different habitat types. Arctic grayling were present at tributary sites relatively more than they were present at sloughs.




Appendix Figure G-3. Relative distribution of six resident species among four major habitat types located above the Chulitna River confluence and sampled by boat electrofishing, May through September, 1982. Based on presence/absence data which were corrected for unequal effort at the different habitat types.

Appendix Table G-7. Chi-square tests of resident fish presence/absence associations among four major habitat types at sites above the Chulitna River confluence sampled by boat electrofishing. The four habitat types were tributaries, upland sloughs, side sloughs with no large tributaries, and mainstem sites, May through September, 1982.

| Species | Chi-square | df | Significance level |
|---|---|---|---|
| Round whitefish | 38.5 | 3 | $p < .01$ |
| Arctic grayling | 46.0 | 3 | $p < .01$ |
| Longnose sucker | 9.5 | 3 | $p < .05$ |
| Burbot | 4.7 | 3 | NS |
| Humpback whitefish | 32.3 | 3 | $p < .01$ |
| Rainbow trout[a] | 31.5 | 2 | $p < .01$ |
| Dolly varden[b] | 7.5 | 1 | $p < .01$ |

[a]Upland and side sloughs were pooled due to small sample size
[b]Tributaries and mainstem only. No Dolly Varden were captured in upland or side sloughs.

Appendix Table G-8. Ratios of observed to expected presence of resident fish by species at four different habitat types on the Susitna River between the Chulitna River and Devil Canyon, May through September, 1982. Only for those chi-square tests which were statistically significant.

| | Round Whitefish | Arctic Grayling | Longnose Sucker | Humpback Whitefish |
|---|---|---|---|---|
| Tributaries | 1.62 | 1.94 | 1.36 | 1.22 |
| Side sloughs | 1.08 | 1.25 | 1.30 | 2.04 |
| Upland sloughs | 1.42 | 0.75 | 1.00 | 3.45 |
| Mainstem | 0.73 | 0.69 | 0.85 | 0.50 |

| | Dolly Varden | | Rainbow |
|---|---|---|---|
| Tributaries | 2.42 | Tributaries | 2.31 |
| Mainstem | 0.52 | Upland & Side Sloughs (pooled) | 1.61 |
| | | Mainstem | 0.41 |

(No Dolly Varden were captured in upland or side sloughs)

Appendix Table G-9. Chi-square tests of seasonal associations of resident fish presence within a major habitat type at sites above the Chulitna River confluence which were boat electrofished, May through September, 1982.

| Species | Chi-square | df | Significance Level |
|---|---|---|---|
| Rainbow | | | |
| within tributaries: Spring (May, Jun) & Fall (Sep) vs Summer (Jul, Aug) | 7.4 | 1 | $p < .01$ |
| Grayling | | | |
| within tributaries: Spring & Fall vs Summer | 0.5 | 1 | NS |
| within side sloughs & upland sloughs: Spring & Fall vs Summer | 3.3 | 1 | NS |
| within mainstem sites: Spring & Fall vs Summer | 14.5 | 1 | $p < .01$ |
| Round Whitefish | | | |
| within tributaries: Spring & Fall vs Summer | 0.1 | 1 | NS |
| within side sloughs & upland sloughs: Spring & Fall vs Summer | 0.7 | 1 | NS |
| within mainstem sites: Spring vs Summer vs Fall | 36.6 | 2 | $p < .01$ |
| Longnose Sucker | | | |
| within tributaries: Spring & Fall vs Summer | 1.2 | 1 | NS |
| within side sloughs & upland sloughs: Spring & Fall vs Summer | 0.1 | 1 | NS |
| within mainstem sites: Spring vs Summer vs Fall | 15.5 | 2 | $p < .01$ |
| Burbot | | | |
| within tributaries: Spring & Summer vs Fall | 0.0 | 1 | NS |
| within mainstem sites: Spring & Summer vs Fall | 0.0 | 1 | NS |

Appendix Table G-10. Ratios of observed to expected presence of resident fish by season at sites above the Chulitna River confluence which were boat-electrofished, May through September, 1982. Only those ratios from significant chi-square tests are presented.

| Species | Season | Obs/Exp |
|---|---|---|
| Rainbow | Spring & Fall | 1.5 |
| Tributaries | Summer | 0.5 |
| Grayling | Spring & Fall | 1.6 |
| Mainstem | Summer | 0.6 |
| Round Whitefish | Spring | 2.7 |
| Mainstem | Summer | 0.6 |
| | Fall | 1.2 |
| Longnose Sucker | Spring | 2.1 |
| Mainstem | Summer | 0.7 |
| | Fall | 1.1 |

Appendix Table G-11. Chi-square tests of resident fish presence/absence associations among five major habitat types (the same as those used in Appendix Table G-3) at DFH sites, May through September, 1982. Only catch data from beach seining or backpack electrofishing were used.

| Species | Chi-square | df | Significance Level |
|---|---|---|---|
| Round whitefish | 8.6 | 4 | NS |
| Arctic grayling[a] | 6.9 | 1 | $p < .01$ |
| Longnose sucker[a] | 0.4 | 1 | NS |
| Slimy Sculpin | 6.9 | 4 | NS |

[a] Sites were pooled into tributary mouths versus sloughs because of small sample size.

## DISCUSSION

### Juvenile Salmon

Chinook salmon juveniles apparently show less preference for particular major habitat types than the other species and are more broadly distributed.

No significant association of juvenile chum salmon with any of the five major habitat types was demonstrated; this was probably a result of the relatively short time chum juveniles are present in the Susitna system. Because most chums have outmigrated by the end of July, there were only four or five possible sampling periods that they could have been present, as opposed to eight periods for the other species.

Coho salmon juveniles showed a definite preference for side sloughs with large tributary mouths and side channels with large tributary mouths. This results from their preference for tributary water as demonstrated in Appendix F of this report. Sockeye salmon juveniles exhibited a strong preference for upland sloughs and side sloughs not associated with tributary mouths. Possibly many did not move from their natal areas (sloughs) to other habitat types.

The attractiveness of different major habitat types for juvenile salmon can be seen from examining Appendix Figure G-2. Sites that include large tributary mouths (both sloughs and side channels) attract chinook

and coho salmon. Side sloughs without large tributary mouths attract chinook and sockeye.

Resident Species

Definite major habitat type preferences were demonstrated for all species except burbot. Burbot have a strong preference for turbid water (see Appendix F), but this was not established with the present analysis probably because all of the sampling sites included areas of turbid water.

Of the six species examined, longnose suckers showed the least preference for certain habitat types (the chi-square test for longnose sucker was significant at the 95% level, but not at the 99% level). Arctic grayling preferred tributary mouths and side sloughs over upland sloughs and the mainstem. Rainbow trout and Dolly Varden mainly used tributary mouths. Round whitefish were most likely to be found in tributary mouths and upland sloughs and humpback whitefish preferred sloughs.

Additionally, seasonal differences in habitat use were demonstrated for rainbow trout, Arctic grayling, round whitefish, and longnose suckers. Rainbow trout were more likely to be found at tributary mouths in the spring and fall than in the summer. This probably results from migration patterns into and out of tributaries.

Arctic grayling, round whitefish, and longnose suckers were all more likely to be found in the mainstem in the spring and fall than in the

summer. These species apparently use tributaries and sloughs in the summer, the mainstem in the spring and fall during migrations, and the mainstem in the winter as over-wintering habitat.

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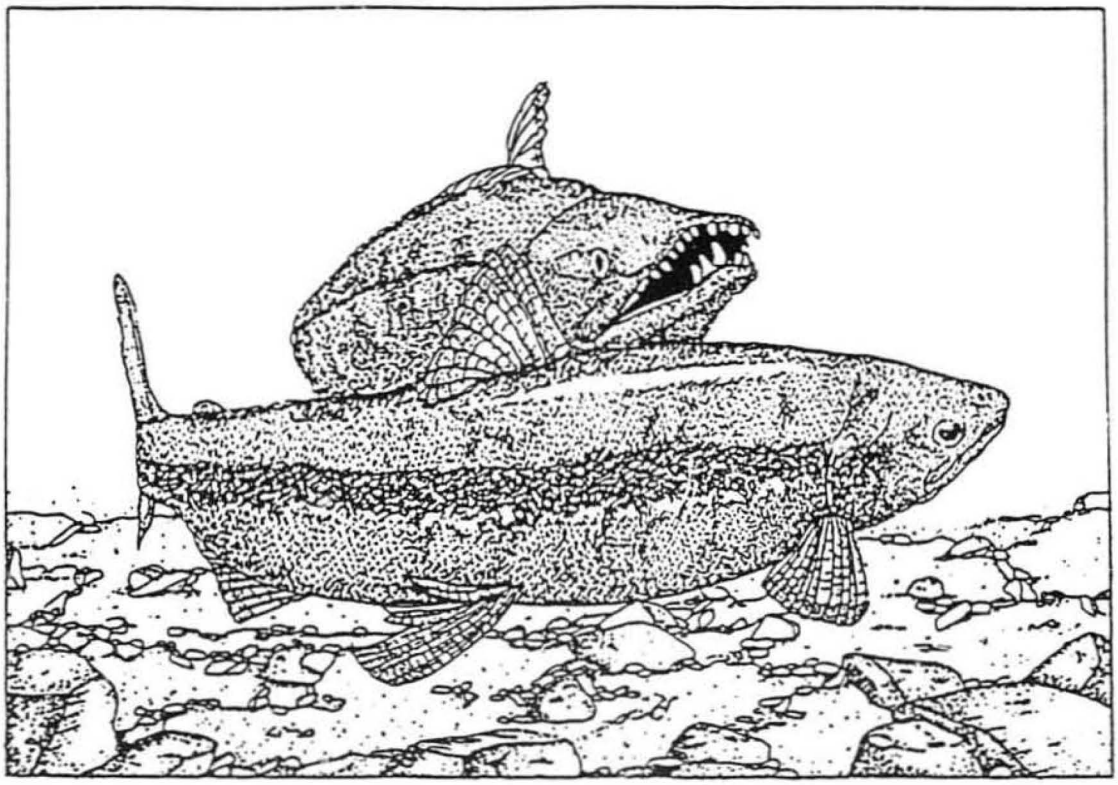

# SUSITNA HYDRO AQUATIC STUDIES
## PHASE II REPORT

Synopsis of the 1982
Aquatic Studies and Analysis of
Fish and Habitat Relationships

— APPENDICES —

by

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1983