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# HABITAT UTILIZATION BY WESTSLOPE CUTTHROAT AND BULL TROUT IN THE UPPER FLATHEAD RIVER BASIN, MONTANA

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One of the goals of the Flathead River Basin Study is to predict and if need be mitigate the effects of environmental perturbation on fish populations. In order to address this problem, we must first understand the types of stream or riverine habitat required by the indigenous fish species for the purposes of spawning, rearing and migration. Consequently, this past year we began an extensive survey of stream habitat and associated fish popultions in tributaries to the North and Middle Forks of the Flathead River.

## Habitat evaluation

Existing stream habitat was inventoried using a modification of a system developed by the Resource Analysis Branch of the British Columbia Ministry of the Environment which has been used in the Canadian portion of the North Fork drainage. It draws upon multidisciplinary knowledge to describe the various biological and physical factors which interact to form the environment of a particular reach of stream.

Drainages were partioned into one or more reaches. A reach is defined as a segment within the drainage having distinct associations of stream habitat components. Stream gradient was usually the overriding factor considered in reach delineation as slight gradient changes (on the order of tenths of one percent) were found to noticeably alter channel morphology and bed material composition.

Initially, reaches on Middle Fork and North Fork tributaries were identified by survey parties consisting of two or three persons traveling down the stream on foot. Two North Fork drainages were surveyed by helicopter prior to ground surveys. This method was a rapid and effective means for delineating reaches and identifying important stream features and representative portions of each reach were later checked by ground crews. Representative sections of reaches varied from one to four kilometers in length depending upon the length and uniformity of the entire reach.

A habitat inventory card was completed by survey crews for each reach or portion of reach surveyed (Figure 1). The extensive abbreviation system developed by the Canadian agency allowed a large amount of information and commentary to be effectively recorded on the compact water-resistent cards. Virtually all of the important physical and biological components of the stream were addressed. Field personnel carried a 36-page glossary of terminology published by the Resource Analysis Branch to aid in completing the cards. One significant addition by our group to the Canadian system was the pool rating scheme outlined in Table 1, which is currently being used in Forest Service stream inventories in the Kootenai National Forest.

## Fish populations and stream order relationships

A 120-150 meter section within each stream reach was selected for fish population censusing. Fish present in each section were counted by a single diver working slowly upstream wearing a diving mask, snorkel and wetsuit. This method of fish abundance estimation is well suited for streams in the Flathead drainage because of their high clarity and has been successfully used in similar areas in Idaho (Pollard and Bjornn 1973; Thurow and Bjornn 1978).

The fish species assemblage in upper Flathead tributaries was quite simple. Westslope cutthroat (*Salmo clarki lewisi*) and bull trout (*Salvelinus confluentus*) together comprised more than 87 percent of all fish observed; the remainder consisted of mountain whitefish (*Prosopium williamsoni*) and two species of sculpins (*Cottus cognatus* and *C. confusus*) shown in Table 2.

Fish densities in upper Flathead tributaries were low. Cutthroat densities in tributaries to the North and Middle Forks averaged 16 fish per 100 m (Table 3), which translates to approximately 48 fish per 1000 feet of stream.

A total of 33 transects were snorkeled during 1979 in tributaries to the North and Middle Forks. Using a stream ordering procedure described by Platts(1979) it was found that a total of 6 second order, 15 third order and 12 fourth order stream sections were snorkeled. No first order sections were examined since these streams were ephemeral and typically dry during low water periods. Cutthroat were the dominant species in second and third order reaches where they comprised 71 percent of the trout observed with bull trout accounting for the remaining 29 percent. The converse was true for fourth order reaches which were dominated by bull trout (65 percent) with cutthroat comprising the remaining 35 percent.

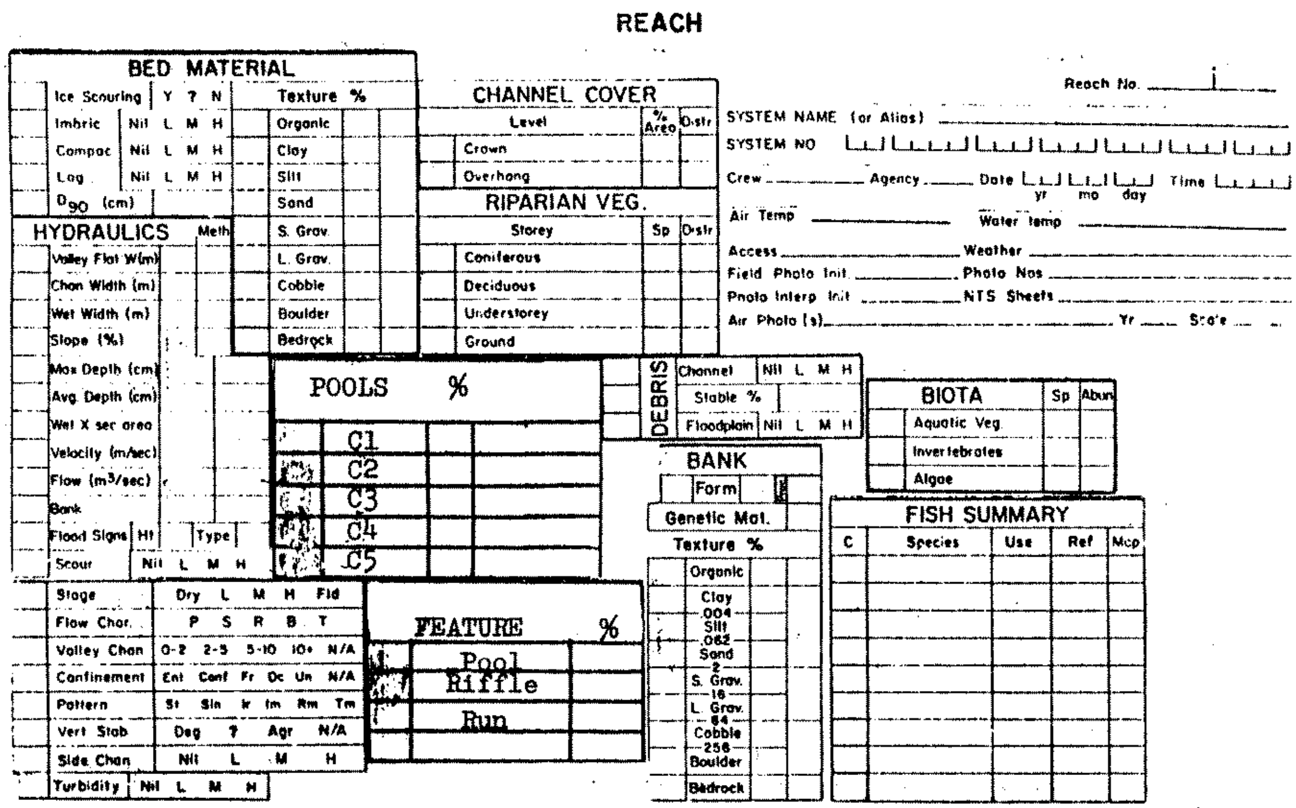


Figure 1. Reach card employed in habitat surveys of triutaries to the North and Middle Forks of the Flathead River

Table 1. Pool rating system used in habitat inventories conducted on North and Middle Fork Flathead River tributaries during 1979.

| Parameter | Description | Points |
| --- | --- | --- |
| Area | The length or width of the pool is much larger than the average stream width | 3 |
| | The length or width of the pool is nearly equal to average stream width | 2 |
| | The length or width of the pool is much smaller than the average stream width | 1 |
| Depth | The deepest part of the pool is greater than three feet deep | 3 |
| | The deepest part of the pool is two to three feet deep | 2 |
| | The deepest part of the pool is less than two feet deep | 1 |
| Cover | Abundant cover | 3 |
| | Partial cover | 2 |
| | Exposed | 1 |

| Total points | | Pool class |
| --- | --- | --- |
| 8 - 9 | = | 1 |
| 7 | = | 2 |
| 5[1/] - 6 | = | 3 |
| 4 - 5 | = | 4 |
| 3 | = | 5 |

1/ The total of five points for class 3 pools must include two points for depth and two points for cover.

Table 2. Species composition by numbers and percent of fish observed in 33 underwater fish census transects in tributaries to the North and Middle Forks of the Flathead River during 1979.

| | Cutthroat | Bull Trout | Mountain Whitefish | Sculpins | Total |
|---|---|---|---|---|---|
| Number observed | 740 | 397 | 115 | 48 | 1,300 |
| Percent of total | 56.9 | 30.5 | 8.8 | 3.7 | -- |

Table 3. Average density (fish per 100 m stream length) of the three principal fish species in upper Flathead tributaries.

| | Westslope cutthroat | Bull trout | Mountain whitefish | total |
|---|---|---|---|---|
| Middle Fork tributaries | 14.9 | 12.6 | 3.1 | 30.6 |
| North Fork tributaries | 17.1 | 6.6 | 1.9 | 25.6 |

We suspect that the apparent segregation of the two trout species by stream order reflects their respective spawning habitat preferences. Spring spawning cutthroat apparently utilize small tributaries which were frequently inaccessible to the much larger fall spawning bull trout. As will be pointed out later, the highest quality bull trout spawning reaches in North Fork drainages were characteristically wider and deeper than reaches utilized to a lesser extent. Hartman and Gill (1967) proposed a similar hypothesis to explain segregation of cutthroat trout and anadromous steelhead trout in coastal British Columbia drainages.

Fish species composition and densities were markedly different in twelve Middle Fork River pools snorkeled in the late summer as compared to tributaries. Cutthroat densities in second and third order tributaries were approximately three times larger than numbers found in fourth order reaches or in the river (Table 4). The trend for mountain whitefish was exactly opposite of that observed for cutthroat (Table 4). This species achieved largest densities in river pools (an average of 325 per 100 m) which was nearly three orders of magnitude larger than the mean density in second and third order reaches (0.4 fish per 100 m). Whitefish densities were also markedly larger in fourth order reaches (8.3 per 100 m) than in upstream reaches. Fish trapping information on several North Fork tributaries suggests that mountain whitefish move into the tributaries during spring runoff and return to the river by late July. Similar movements were documented by Davies and Thompson (1976) in an Alberta watershed.

## Bull trout spawning habitat

Bull trout redds were counted in a total of five major North Fork and seven Middle Fork drainages during October of 1979. These counts serve to monitor the spawning adult bull trout population in the system and also aid in elucidating the spawning habitat requirements of this species.

Data presented in Figure 2 indicate that bull trout spawning occurs primarily in third and fourth order stream reaches. The following analysis incudes only North Fork data since habitat surveys were not completed on half of the six high quality bull trout spawning reaches in Middle Fork tributaries.

Three classes of bull trout spawning reach quality were assigned to North Fork tributaries (Table 5). Five North Fork reaches provided medium-high quality bull trout spawning habitat and supported an average of 28 redds. Seven reaches provided low quality spawning habitat and had only four redds present on the average. Ten reaches supported a nil amount of spawning.

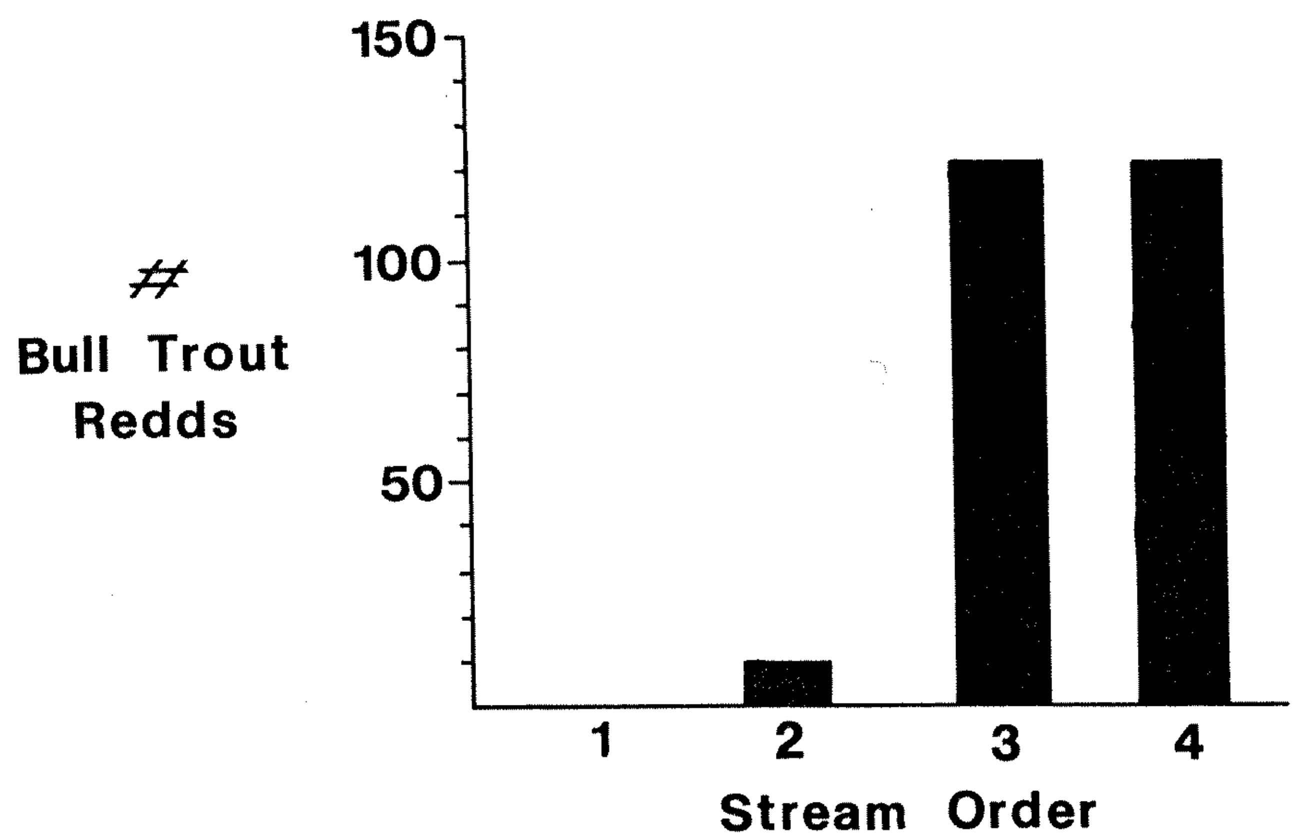


Figure 2. Numbers of bull trout redds observed in reaches of various order in tributaries to the North and Middle Forks of the Flathead River.

Table 4. Average cutthroat and mountain whitefish densities (fish per 100 m) in Middle Fork River pools and in tributaries to the Middle Fork Flathead River.

| | Tributaries | | |
|---|---|---|---|
| | Second and Third order | Fourth order | River pools |
| Westslope cutthroat | 19.5 | 6.6 | 7.5 |
| Mountain whitefish | 0.4 | 8.3 | 325.0 |

Table 5. Sample size and mean number of bull trout redds in reaches of various spawning habitat quality in tributaries to the North Fork of the Flathead River.

| | Reach quality | | |
|---|---|---|---|
| | Nil | Low | Medium-high |
| Number of reaches | 10 | 7 | 5 |
| Mean number of redds | 0 | 4 | 28 |

Table 6. Relationships between bull trout spawning habitat quality and mean stream gradient, flow, width, and depth of reaches in tributaries to North Fork Flathead River.

| | Reach quality | | |
|---|---|---|---|
| | Nil | Low | Medium-high |
| Gradient (%) | 6.3 | 2.5 | 1.5 |
| Late summer flow (cfs) | 11 | 12 | 31 |
| Wetted width (m) | 5.5 | 6.5 | 16.5 |
| Mean depth (cm) | 20 | 21 | 30 |

Relationships between bull trout spawning reach quality and stream size and gradient were apparent (Table 6). Reaches providing high quality spawning habitat typically had a low gradient (1.5 percent) and were characterized as having large late summer flows (31 cfs), wetted widths (16.5 m) and mean depths (30 cm).

Reaches of North Fork tributaries selected by bull trout for spawning purposes had a higher percentage of run and lower percentage of riffle than did unsuitable reaches (Table 7). Medium-high quality spawning reaches characteristically displayed a hgiher percentage of pool (28 percent) than did low quality reaches (17 percent) or reaches which were not used (14 percent; Table 7). In addition, it was found that medium-high quality spawning reaches had a much higher percentage of large, high quality (class one and two) pools than other reaches (Table 7).

The substrate of medium-high quality bull trout spawning reaches was generally comprised of higher amounts of fine materials and gravel and lower amounts of coarse textured materials (cobbles, boulders and bedrock) than poorer quality reaches (Table 8). The D90 (average size of the largest 10 percent of substrate material in a reach) of medium-high quality reaches (35.6 cm) was much lower than that observed in non-spawning reaches (59 cm; Table 8). This supports other substrate data indicating that spawning bull trout prefer reaches having relatively small bed materials.

## SUMMARY

An extensive pre-impact survey of fish populations and associated stream habitat was initiated during 1979 in tributaries to the North and Middle Forks of the Flathead River. Average fish density in 33 snorkel transects was approximately 28 per 100 meters and was comprised almost exclusively of westslope cutthroat trout, bull trout, mountain whitefish and sculpins. Cutthroat were the predominant trout species in second and third order stream reaches where they comprised 71 percent of the trout observed, whereas bull trout were dominant in fourth order reaches, accounting for 65 percent of observed trout. Cutthroat densities in the Middle Fork drainage were three times greater in second and third order tributaries than in fourth order reaches or in river pools, whereas the reverse was true for mountain whitefish. Bull trout redd locations indicate that spawning activity was greatest in large streams (third and fourth order) having low gradients, high percentage of high quality pools and relatively small substrates.

Table 7. Characteristics of bull trout spawning reaches of various quality in tributaries to the North Fork Flathead River.

| | Reach quality | | |
|---|---|---|---|
| | Nil | Low | Medium-high |
| Run (%) | 35 | 47 | 48 |
| Riffle (%) | 42 | 36 | 30 |
| Pool (%) | 14 | 17 | 28 |
| Class I & II pools (%) | 9 | 13 | 33 |

Table 8. Substrate composition in bull trout spawning reaches of various quality in tributaries to the North Fork Flathead River.

| | Reach quality | | |
|---|---|---|---|
| | Nil | Low | Medium-high |
| Fines (%) | 16 | 24 | 28 |
| Gravel (%) | 21 | 35 | 42 |
| Cobble-boulder (%) | 38 | 36 | 30 |
| Bedrock (%) | 24 | 4 | trace |
| D90 (cm) | 59.0 | 38.4 | 35.6 |

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