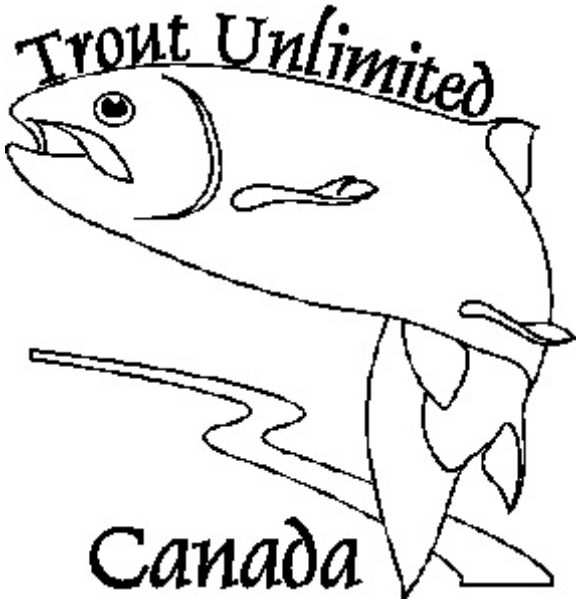
FISHERIES RESOURCES OF THE FISH CREEK WATERSHED



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EXECUTIVE SUMMARY

Fisheries investigations to assess the status of sportfish in Fish Creek and selected tributaries were conducted by Trout Unlimited Canada (TUC) staff with assistance from TUC volunteers during the spring and fall of 1993. Fisheries investigations included: backpack electrofishing to determine species composition and relative abundance; redd surveys to document spawning activity; the installation of thermographs to partially describe the thermal regime; an aerial video survey to document riparian habitat characteristics; and an aerial survey to locate ice-free reaches of Fish Creek to facilitate electrofishing.

Backpack electrofishing was conducted at six sites in Fish Creek, two sites in Priddis Creek and one site in Whiskey Creek between May 20 and June 10, 1993. Four sites in Fish Creek were backpack electrofished between November 8 and 12, 1993. Redd surveys for rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) were conducted on May 18 and November 10, 1993, respectively. Two thermographs recorded temperature data between May 25 and November 9, 1993. An aerial video survey of Fish Creek and Whiskey Creek was performed on May 19, 1993. An aerial survey of Fish Creek to identify ice-free reaches was performed on November 10, 1993.

Spring and fall backpack electrofishing surveys resulted in the capture of six sportfish and nine non-sportfish. Sportfish species captured included native: westslope cutthroat trout (*Oncorhynchus clarki lewisi*); bull trout (*Salvelinus confluentus*) and mountain whitefish (*Prosopium williamsoni*). Non-native rainbow trout; brook trout (*Salvelinus fontinalis*) and brown trout were also captured. Non-sportfish species captured included: white sucker *(Catostomus commersoni);* longnose sucker (*Catostomus catostomus*); mountain sucker (*Catostomus platyrhynchus*); lake chub (*Couesius plumbeus*); longnose dace (*Rhinichthys cataractae);* pearl dace (*Margariscus margarita*); trout-perch (*Percopsis omiscomaycus*); brook stickleback (*Culea inconstans*); and fathead minnow (*Pimephales promelas*). Longnose dace, white sucker, and lake chub were the most widely distributed species (i.e., each found at 10 of 13 sites).

Fish were captured at all of the sampling sites and sportfish were captured at 12 of the 13 sample sites. A sample site in Priddis Creek was the only site where sportfish were not captured. Rainbow trout and brook trout were the most widely distributed sportfish species, each occurring at seven of the 13 sample sites. During the spring sampling period, Catch-Per-Unit-Effort was generally lower for sportfish in most locations as compared to the fall sampling period.

The most common sportfish species in the lower reaches of Fish Creek within Fish Creek Provincial Park (FCPP) were brown trout and mountain whitefish. Their abundance increased substantially in the fall. Brown trout and mountain whitefish captured in this reach were suspected to primarily be Bow River migrants.

The only sportfish species captured in the middle reaches of Fish Creek (Fish Creek between Tsuu T'ina Reservation and Highway 762) were brook trout. They were found in very low numbers. No fall sampling occurred in the middle reaches of Fish Creek.

The most common species of sportfish captured in the upper reaches of Fish Creek (Highway 762 to its headwaters) were brook trout. Native cutthroat trout and introduced rainbow trout were present in moderate numbers in the upper reaches. This stream reach contained the highest densities of sportfish, which were thought to be Fish Creek residents.

The only sportfish species captured in Priddis Creek and Whiskey Creek was rainbow trout. The abundance of rainbow trout at sites sampled in these streams was low. One site sampled in Priddis Creek did not result in the capture of any sportfish.

A rainbow trout redd survey was performed on May 18, 1993, on the lower 3 km of Fish Creek below a beaver (*Castor canadensis*) dam that was thought to be impassable. No rainbow trout redds were observed during this survey. Due to turbid conditions in Fish Creek during the rainbow trout spawning season, no subsequent redd surveys could be conducted. Therefore, the limited temporal scope of this redd survey did not conclusively prove or disprove whether rainbow trout use this reach of Fish Creek for spawning. A brown trout redd survey was performed on November 10, 1993, in the reach of Fish Creek within FCPP. High flows during the summer of 1993 breached beaverdams in this reach, thus allowing brown trout access to this portion of Fish Creek. During the redd survey, a total of 29 brown trout redds were observed.

Thermographs were installed at an upstream site (near the 240 Street Bridge, SW, Calgary) and at a downstream site (approximately 300 m downstream of the western boundary of FCPP). The upstream thermograph recorded temperatures that were within the tolerance limits for cold-water salmonids; however, the downstream thermograph recorded temperatures which approached upper tolerance limits.

Observations of general riparian habitat conditions from the May 19, 1993, aerial video survey suggest both Fish and Whiskey creeks' riparian areas have been damaged. The riparian area of Fish Creek is primarily degraded between the western boundary of the Tsuu T'ina Reservation and Highway 762. Whiskey Creek's riparian area is generally degraded downstream of the Kananaskis Country boundary. The primary agents suspected to be causing degradation of riparian habitats adjacent to Fish Creek and Whiskey Creek were agriculture (e.g., feedlots, cattle grazing and cropping) and residential/recreational developments. Riparian habitats along Fish Creek appeared to be generally intact within FCPP, Tsuu T'ina Reservation and upstream of Highway 762.

The aerial survey performed on November 10, 1993, identified a number of sites in Fish Creek that were ice-free. It is suspected that a number of the ice-free reaches identified in this aerial survey, especially those in the upper and middle reaches, are ice-free because of groundwater influence. These reaches are likely to be critical habitats for overwintering fish and fall spawning trout.

Based on a review of past scientific reports on the Fish Creek watershed, a number of trends became apparent when related to data from the 1993 surveys.

The lower reaches of Fish Creek are subject to de-watering, habitat degradation and excessive beaver damming. These factors have likely had a negative impact on resident sportfish and the migratory population of Bow River rainbow trout which historically used Fish Creek for spawning and rearing. Habitat in the lower reaches is important to brown trout for spawning and as a feeding or overwintering area for juvenile mountain whitefish and brown trout.

The middle reaches of Fish Creek are subject to habitat degradation, de-watering and excessive beaver damming. These negative impacts have likely caused declines in the populations of resident sportfish and Bow River rainbow trout that previously utilized this reach of Fish Creek for spawning and rearing.

The upper reaches of Fish Creek are located within Kananaskis Country, where habitat has remained largely intact. Sportfish populations in this reach are believed to be predominantly resident and are much more abundant compared to the lower and middle reaches. Data collected since 1987 suggests introduced brook trout have become the dominant species in this reach as opposed to native westslope cutthroat trout.

Priddis Creek is subject to habitat degradation, de-watering and excessive beaver damming. These negative impacts have likely caused declines in the populations of resident sportfish and Bow River rainbow trout that previously utilized Priddis Creek for spawning and rearing.

The present study encountered rainbow trout near the mouth of Whiskey Creek, however, historical evidence suggests this stream supported cutthroat trout. Aerial video surveys performed in 1993 suggest riparian habitat adjacent to Whiskey Creek is degraded. As little is known about sportfish in Whiskey Creek, no major conclusions could be made.

In order to restore degraded habitats and maintain or enhance sportfish populations in the Fish Creek watershed, the following recommendations are made:

1) Minimum instream flow needs (IFN) need to be established and implemented for Fish Creek and its tributaries. Currently there are 31 licensed water users in the Fish Creek watershed. Collectively they can legally withdraw 1,180,800 m^3 of water annually, but only three have restrictions for minimum flows (Water Administration Branch staff, Alberta Environment pers. comm., 1998). The de-watering of Fish Creek and Priddis Creek clearly demonstrates the need for an overall water management plan for this watershed to meet user demand, improve water quality and maintain sportfish habitat. Without a water management plan that has restrictions on minimum flows to protect fish habitat, sportfish populations in the Fish Creek watershed are unlikely to increase or recover in Priddis Creek and the middle and lower reaches of Fish Creek.

In the Summary of Comments from the Public Meetings of the Bow Basin Plan by the Bow River Water Quality Council (1996), the Council has committed to having instream needs and objectives for Fish Creek included in the Bow Basin Plan. To address instream needs and objectives, the council will investigate: the cumulative impacts on water users; water withdrawals; pollution; and recommendations for achieving instream objectives. This information is scheduled to be incorporated into the Bow Basin Plan in the 1998-99 and 1999-

2000 fiscal years. This has been delayed, it is hoped that the required information will be incorporated into the Bow Basin Plan in the 2000-2001 fiscal year (Bob Morrison, Water Planner, Bow Region, Alberta Environment, pers. comm., 1999).

2) Encourage landowners upstream of FCPP to modify operating/development practices for the benefit of the riparian zones adjacent to Fish Creek and its tributaries.

3) Limit and/or properly mitigate the effects of resource, recreational and urban developments in Kananaskis Country, private lands, Tsuu T'ina Reservation and FCPP that may have negative impacts on fish stocks in the Fish Creek watershed.

4) Sportfish populations in Fish Creek near the McLean Creek Road should be investigated. Based on visual observations cutthroat trout captured below the McLean Creek Road in the present study were suspected to be pure. Genetic analysis would be required to determine the purity of suspected westslope cutthroat trout, since rainbow trout spawning has been documented in the upper reaches of Fish Creek. Native westslope cutthroat trout stocks in Alberta are almost nonexistent and opportunities to identify stocks that may be pure should be examined.

5) Fisheries inventories should be conducted within the Tsuu T'ina Reservation for Fish Creek and Priddis Creek since there is no sportfish data available on these stream reaches. Opportunities to partner with Tsuu T'ina Nation should be explored for the better management and understanding of the fisheries resources in the Fish Creek watershed.

6) Decisions regarding recommendations made by Golder (1996) related to beaver management are required. They recommended and described beaver management plans for the middle, lower and Tsuu T'ina reaches of Fish Creek.

7) Hydroconsult (1995) reported that there is potential to excavate pools in the main channel of Fish Creek within FCPP to serve as overwintering pools and holding water during low flows. These opportunities should be examined.

8) Fisheries and habitat inventories should be conducted on Whiskey Creek since there is little information on sportfish in this stream and cutthroat trout historically utilized this stream in some capacity.

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Garry Szabo, Habitat Biologist, Trout Unlimited Canada (TUC) wrote the original proposal and managed aspects of this project. Project funding was provided to TUC by a grant from the Alberta Conservation Association's (ACA) Fisheries Management Enhancement Program. Assistance during electrofishing surveys by TUC volunteers (Mike Guinn, Chris Beers, Dennis Arkly, Chris McDonald, Robert Thuillier, Matt Sparrow, Dallas Hoffman, Al Peterson, Scott Wilson, Travis Lindeman, George Scott, Richard Seraphin, Dick Seywerd, Terry Seywerd and Patti Brewin) was critical to the success of this project and is gratefully acknowledged. The contributions of Don Dabbs (Kardon Video), who donated a substantial amount of time to complete various video surveys, are appreciated. Eric Beveridge, Mike Bryski and other TUC staff also contributed greatly to this project. Assistance from Fish Creek Provincial Park staff and Eric Vuori (Fisheries Management Division, Natural Resources Service, Alberta Environment, Red Deer) is also appreciated. Various landowners in the Fish Creek watershed helped to ease the collection of data by providing access to stream reaches. The authors are also grateful to Jim Stelfox (Fisheries and Wildlife Division, Natural Resources Service, Alberta Environment, Calgary), Brian Lajeunesse (Fisheries and Wildlife Division, Natural Resources Service, Alberta Environment, Canmore), Kirsten Norris (TUC), Christina Hall (TUC) and Cal McLeod (ACA, Rocky Mountain House) for comments on an earlier draft of this report.

1.0 INTRODUCTION

1.1 General

In the fall of 1992, Trout Unlimited Canada (TUC) was approached by Fish Creek Provincial Park (FCPP) staff to assist the Park with a strategy to restore degraded habitats in Fish Creek

(Garry Szabo, TUC, pers. comm., 1997). A variety of factors were considered to have contributed to habitat degradation in the reach of Fish Creek flowing through FCPP. These factors included: stormwater drainage from adjacent residential areas; upstream water withdrawals for golf courses, recreational lakes and agricultural uses which contributed to low flows in the lower reaches of Fish Creek; negative impacts of upstream livestock grazing (Paetz 1986); and beaver (*Castor canadensis*) activity which damaged riparian vegetation and caused excessive damming of Fish Creek. TUC believed that an assessment of various aspects of Fish Creek's fisheries resources was required before degraded habitats along Fish Creek could be restored.

Historically, Fish Creek supported a significant trout fishery. In 1915, the Department of the Naval Service (DNS 1916) reported that the value of Fish Creek's trout fishery was almost eight times that of the Bow River. During the last century, the abundance of native species [i.e., westslope cutthroat trout (*Oncorhynchus clarki lewisi*), bull trout (*Salvelinus confluentus*) and mountain whitefish (*Prosopium williamsoni*)] has declined. These species have, for the most part, been replaced by introduced species which have also experienced hardships in this watershed. Excellent trout populations in the upper reaches of Fish Creek were reported by Wileman (1952) and Cunningham (1960). As recently as 1972, Fish Creek was known to provide important spawning habitat for rainbow trout (*Oncorhynchus mykiss*) migrating from the Bow River (McDonald 1975). Stelfox and Konynenbelt (1980) indicated that the upper reaches of Fish Creek downstream from the Kananaskis Country boundary were an important rearing area for rainbow trout. However, more recent studies (Sosiak 1984) suggest that spawning runs of rainbow trout from the Bow River into Fish Creek had declined and may no longer occur. Deteriorating surface flow conditions and water volumes in Fish Creek were believed to be hindering the spawning migration of rainbow trout from the Bow River (Paetz 1986).

To better understand the fishery resource in Fish Creek, it was determined that fisheries inventories (i.e., electrofishing and redd surveys) within, and upstream of FCPP were required. To relate TUC's 1993 fisheries inventories to habitat conditions and previous fisheries work in the Fish Creek watershed, aerial surveys of Fish Creek and a literature review were also required. The following report summarizes fishery inventories, aerial surveys and a literature review conducted by TUC as part of the Fish Creek Rehabilitation and Enhancement Feasibility Study. This feasibility study also included educational, hydrological, Instream Flow Needs and management components. The results of other components can be found in Golder (1995 and 1996) and Hydroconsult (1995).

1.2 Objectives

The purpose of this study was to:

- document fish populations at several sample sites and assess the status of sportfish in Fish Creek and selected tributaries.

The specific objectives of this study were to:

- utilize electrofishing techniques to determine the species composition and relative abundance of sportfish in Fish Creek and selected tributaries.
- document spawning distribution of rainbow trout and brown trout (*Salmo trutta*) in Fish Creek within FCPP during the spring and fall of 1993.
- describe the thermal regime of Fish Creek during the open water period at two locations.
- video tape an aerial survey of Fish Creek in 1993.
- perform a literature review of fisheries related studies in the Fish Creek watershed and relate them to the present study

1.3 Study Area

The following study area description is from: an aerial video survey of Fish Creek (Kardon 1993); background literature; and 1:50,000 provisional maps (Surveys and Mapping Branch, Department of Energy, Mines and Natural Resources).

The study area includes the entire Fish Creek watershed. An illustration of the study area and sample site locations are provided in Figure 1.

Approximately 77 km long, Fish Creek originates southwest of the Hamlet of Bragg Creek at an elevation of 1555 metres (Rees 1987**)** in the foothills of Kananaskis Country. Fish Creek flows through public lands in Kananaskis Country for approximately 12 km before reaching private lands primarily utilized for grazing and some cropping (Paetz 1986). Leaving private land, Fish Creek then flows for approximately 13 km through the southeast corner of the Tsuu T'ina Reserve. Land bordering Fish Creek on the Tsuu T'ina Reserve is utilized for grazing with very little cropping (J. Meguinis, Tsuu T'ina Nation, pers. comm., 1997). From the reserve, Fish Creek flows for 13.5 km through FCPP (located within the City of Calgary) where it drains into the Bow River, a major tributary of the South Saskatchewan River, at an elevation of 1006 m (Rees 1987). Land is utilized in FCPP to protect natural systems and wildlife while providing opportunities for recreation and outdoor education (W. Nadasde-Hogg, FCPP, pers. comm., 1997).

Priddis Creek (approximately 36 km long) and Whiskey Creek (approximately 13 km long) are major tributaries of Fish Creek. These streams both originate in Kananaskis Country and flow for short distances before reaching private land that is primarily utilized for grazing with some row cropping. Priddis Creek leaves private land and flows for approximately 11 km through the Tsuu T'ina Reservation before returning to private lands. Within the Tsuu T'ina Reserve the land adjacent to Priddis Creek is primarily utilized for grazing (J. Meguinis, Tsuu T'ina Nation, pers. comm., 1997).

2.0 METHODS

2.1 Assessment of distribution and abundance of fish species

2.1.1 Backpack electrofishing surveys

Backpack electrofishing surveys were conducted by TUC staff and volunteers equipped with a Smith-Root Model 15 POW Backpack Electrofisher. The electrical outputs used during this study were designed to minimize injuries to fish (L. Carscanden, Smith-Root Inc., WA, pers. comm. in Brewin 1996) and are provided in Table 1.

All electrofishing surveys were conducted by crews wading in an upstream direction. Electrofishing crews attempted to capture all observed fish with dipnets, however, capturing sportfish took priority over non-sportfish. Whenever possible, representative stream reaches of 300 m, or greater, were chosen as sample sites. Average stream width was determined by recording stream widths at 30 m intervals and calculating the mean. Block nets were used at all sites, except during fall sampling, when mark-recapture population estimates were conducted over a two day period.

When three or fewer sportfish were captured on the first pass through a site, or when five or more ripe or spawning fish were encountered, backpack electrofishing surveys were limited to a single-pass through the sample reach. The relative abundance [i.e., catch-per-unit-effort (CPUE)] of fish at each reach was then determined by calculating: number of fish captured per number of active seconds expended electrofishing; number of fish captured per unit of stream length; and number of fish captured per unit area.

Population estimates, using the removal method, were conducted at two sites during the spring sampling period and two sites during the fall sampling period. Blocking nets were installed at the upper and lower limits of the sample reach. Within the reach a series of two or three electrofishing passes were conducted. Generally, three passes were attempted. However, unanticipated circumstances such as light conditions, time constraints by volunteers and localized ice conditions sometimes prevented a third pass. Each pass involved thoroughly electrofishing the entire sample reach. Fish captured from each pass were kept in separate live wells until they were processed. After the electrofishing passes were completed, captured fish were processed and released throughout the length of the study section. Maximum-likelihood population estimates were calculated using Micro-Fish 3.0, a computer software program (Van Deventer and Platts 1989).

Population estimates, using the mark-recapture method, were conducted at two sites during the fall sampling period. Fish were captured by electrofishing the reach, processed and marked (i.e., fin clipped) and released throughout the sample reach. The next day the process was repeated with the exclusion of marking captured fish. Mark-recapture population estimates were calculated using the Peterson/Chapman Method, as described in the Alberta Fish and Wildlife Electrofishing Guidelines (Kraft et al. 1982).

Table 1: Electrical outputs used during electrofishing surveys.
Smith-Root Model 15 Electrofisher

Voltage range	Pulse Width	Time between pulses	Number of pulses in bursts
300-400v	1 ms	2 ms	3

300-400v	1 ms	2 ms	4

2.1.2 Fish processing

Processing captured fish involved recording their species, fork length to the nearest mm, live wet-weight, sex and sexual condition (when possible) and general condition or unusual remarks (e.g., physical injury). During mark-recapture population estimates, fish captured on the initial pass were clipped on the right or left pectoral fin to enable them to be identified as recaptured fish if they were caught during the second run. Live wet-weights were measured to the nearest gram or two grams using one of two electronic balances (i.e., one measured to the nearest gram and the other to the nearest two grams). When large numbers of small, but uniformly-sized fish (i.e., estimated to weigh less than a gram) were captured, small groups were weighed together. The total group weight was then recorded and divided by the number of fish in the group to attain an average weight. Weights of some non-sportfish were not recorded. Sex and sexual condition of mature fish were determined by external sexual dimorphisms (e.g., presence of a kype on males) and the expulsion of gametes, respectively. Sportfish were anaesthetized with 2-phenoxy-ethanol and most trout over 100 mm were tagged with Visible Implant (VI) tags (Northwest Marine Technology, Inc, Shaw Island, WA). Tagged fish were also permanently marked by clipping their adipose fin. After processing, sportfish were placed in a basin of clean water to recover before being released.

Captured fish were identified to species level. In the fall sampling period, 'suspected' cutthroat trout x rainbow trout hybrids were identified by field crews using methods described by Marnell et al. (1987) and Behnke (1992) in Mayhood and Paczkowski (1993).

2.2 Redd surveys

Rainbow trout redd surveys in Fish Creek were conducted on May 18, 1993, within FCPP from the creek's confluence with the Bow River to approximately 3 km upstream where a beaver dam, thought to be an impassible barrier to upstream fish migration, was located. Redd surveys involved wading and walking along Fish Creek in an upstream direction, and mapping the approximate location of all rainbow trout redds observed. Methods employed for this redd survey are described by Brewin (1994), with rainbow trout being the target species rather than brown trout. Additional surveys were planned, but turbid water conditions after May 18, 1993, prevented the surveys from being conducted.

Brown trout redd surveys were conducted on November 10, 1993, on 13.5 km of Fish Creek within FCPP. High flow conditions in Fish Creek during the summer of 1993 breached most beaver dams on the lower portions of the creek, allowing brown trout access to these reaches for spawning. Redd surveys involved wading and walking along Fish Creek in an upstream direction, and mapping the approximate location of all observed brown trout redds. Methods employed during redd surveys are described by Brewin (1994).

2.3 Temperature recording

Instantaneous stream temperatures were recorded every hour at two locations in Fish Creek by Ryan TempMentor ™ thermographs. Before installation, both thermographs were factory-calibrated and tested to meet the manufacturer's accuracy standard.

A thermograph was deployed at 8:05 AM Mountain Standard Time (MST) on May 21, 1993, and installed near the 240 St. SW bridge, Calgary (see Figure 1) at approximately noon the same day. This thermograph was removed on November 9, 1993, at approximately 2:00 PM (MST). A second thermograph was deployed on May 21, 1993, at 10:00 AM (MST). Due to unexpected circumstances (i.e., high water), this thermograph was not installed until May 25, 1993, at approximately 1:30 PM (MST). It was installed approximately 300 m downstream of the FCPP western boundary (see Figure 1). This thermograph was removed on November 9, 1993, at approximately 4:00 PM (MST).

2.4 Aerial Surveys

An aerial video survey of Fish Creek was performed on May 19, 1993, by Kardon Video Productions, Calgary, with assistance from TUC staff. The aerial video survey involved the use of a helicopter to fly over the entire length of Fish Creek and Whiskey Creek while habitat conditions were recorded with a camcorder on Hi Band 8 mm videotape. Habitat conditions were videotaped from an approximate elevation of 150 m and an air speed of approximately 60 km/hr. The Hi Band 8 mm videotape was converted to VHS and a number of copies of the aerial survey were produced.

Fall sampling in Fish Creek was affected by adverse ice-conditions. To identify reaches where electrofishing techniques could be employed, TUC staff performed an aerial survey of Fish Creek on November 10, 1993. This aerial survey involved the use of a fixed-wing aircraft, flown at low altitudes, to identify reaches of Fish Creek that were ice-free. Approximate locations of ice-free reaches in Fish Creek were recorded by TUC staff.

3.0 RESULTS

3.1 Electrofishing surveys in the Fish Creek watershed

3.1.1 General

Electrofishing surveys during the spring were conducted at six sites in Fish Creek, two sites in Priddis Creek and one site in Whiskey Creek (Table 3). Four sites were sampled in Fish Creek during the fall sampling period (Table 3). Raw data collected for the spring and fall sampling periods is presented in Tables II-1 and II-2**,** respectively (Appendix II).

Finding suitable sample sites for electrofishing surveys in the fall was affected by ice conditions on Fish Creek and its tributaries. An aerial survey using fixed-wing aircraft was conducted on November 10, 1993, to locate ice-free areas where electrofishing could be performed. Observed ice-free reaches are presented in Table 2. Wherever possible, the same sites sampled in the spring were used for fall sampling.

Table 2. Ice-free reaches in Fish Creek that were observed from a fixed-wing aircraft on November 10, 1993.

Approximate locations of downstream and upstream limits for ice-free reaches on Fish Creek	Approximate reach length	Description
Confluence with the Bow River to 1.5 km downstream of the FCPP western boundary	12 km	Predominately ice-free
From the FCPP western boundary to 3 km upstream	3 km	Ice-free
3 km below Highway 762 to l km above Highway 762	4 km	Ice-free
1.5 km below the McLean Creek Road to 4.5 km below the McLean Creek Road	3 km	Ice-free

3.1.2 Presence of fish species

Species of fish (six sportfish and nine non-sportfish) captured during spring and fall electrofishing surveys are presented in Table 4. Fish were captured at all of the sampling sites. Sportfish species captured included: cutthroat trout; rainbow trout; brown trout; bull trout; mountain whitefish; and brook trout (*Salvelinus fontinalis*). Non-sportfish species captured included: white sucker *(Catostomus commersoni);* longnose sucker (*Catostomus catostomus*); mountain sucker (*Catostomus platyrhynchus*); lake chub (*Couesius plumbeus*); longnose dace (*Rhinichthys cataractae);* pearl dace (*Margariscus margarita*); trout-perch (*Percopsis omiscomaycus*); brook stickleback (*Culea inconstans*); and fathead minnow (*Pimephales promelas*). Longnose dace, white sucker and lake chub were the most widely distributed species (i.e., each found at 10 of 13 sites).

Sportfish were captured at 12 of the 13 sample sites. A sample site in Priddis Creek (Ps1) was the only site where sportfish were not captured. Rainbow trout and brook trout were the most widely distributed sportfish, each found at seven of the 13 sites (Table 4). Two native trout species were captured in Fish Creek [cutthroat trout at four locations (Fs2, Fs5, Fs6 and Ff4) and bull trout at one location (Ff2)]. Mountain whitefish were not captured during the spring sampling period, but were found in large numbers in the lower reaches (sites Ff1 and Ff2) of Fish Creek in the fall.

'Suspected' cutthroat trout x rainbow trout hybrids were found at two locations (Ff3 and Ff4) in Fish Creek during the fall sampling period. Suspected hybrids may have also been present in the spring sampling period; however, no attempt was made to distinguish them from other cutthroat trout. Because no morphological examinations or genetic analysis were performed to confirm these fish as hybrids, these fish were recorded as 'suspected' cutthroat trout x rainbow trout hybrids.

3.1.3 Relative Abundance of Sportfish

The relative abundance of sportfish captured at sample sites in the Fish Creek watershed during the spring and fall sampling periods is presented in Table 5. During the spring sampling period, CPUE was generally lower for sportfish in most locations as compared to the fall sampling period. For example, CPUE for brown trout at spring sample site Fs1 was 0.05 fish/minute, but increased to 1.06 fish/minute at the same site (Ff1) in the fall sampling period. The CPUE for brook trout also increased, from 1.12 fish/minute in the spring at site Fs5 to 3.06 fish/minute at approximately the same site (Ff3) in the fall. Mountain whitefish were not captured at any sites in the spring sampling period, but were abundant in the fall at site Ff1 (CPUE = 6.44 fish/minute).

The highest CPUE for sportfish sampled during the spring sampling period was 1.53 fish/minute (cutthroat trout, rainbow trout and brook trout combined) at site Fs5. The highest CPUE for single species were 1.39 fish/minute for cutthroat trout at site Fs6 and 1.12 fish/minute for brook trout at site Fs5. CPUE for other sportfish at all other sites during spring sampling were less than 0.06 fish/minute (i.e., all sportfish species combined at a single site).

The highest CPUE for sportfish captured during the fall sampling period was 7.50 fish/minute for mountain whitefish and brown trout combined at site Ff1. The next highest CPUE encountered during the fall sampling period was 3.21 fish/minute (brook trout, rainbow trout, cutthroat trout and 'suspected' cutthroat trout x rainbow trout hybrids combined) at site Ff3. CPUE's for sportfish during the fall sampling period were all higher than 0.06 fish/minute (i.e., all sportfish species combined at a single site).

3.1.4 Population estimates

Population estimates for sportfish using the removal method were attempted at sites Fs1 and Fs5 and Ff1 and Ff2 for the spring and fall sampling periods, respectively. Population estimates at sites Fs1 and Ff2 were found to be invalid. Removal method population estimates for sites Fs5 and Ff1 are presented in Table 6. Population estimates for sportfish using the mark-recapture method (Table 7) were attained from fish sampled at sites Ff3 and Ff4 during the fall sampling period.

3.1.4.1 *Removal-method population estimates*

Brown trout were captured at site Fs1 on consecutive runs, however the population estimate was found to be invalid (i.e., fewer brown trout were caught in successive runs). The majority of fish captured at this site were non-sportfish, which included longnose sucker, white sucker, lake chub and longnose dace (Appendix II, Table II-1).

The dominant sportfish species captured at site Fs5 was brook trout followed by rainbow trout (Table 6). Cutthroat trout were also present at site Fs5, but not in large numbers. Non-sportfish (longnose dace, mountain sucker and pearl dace) were less common than sportfish at this site (Appendix II, Table II-1).

Mountain whitefish were well represented at site Ff1. While electrofishing, mountain whitefish (likely juveniles) were encountered in dense schools. Brown trout were the next most common

fish species at site Ff1. Sportfish dominated the fish composition at this site.

Non-sportfish (longnose sucker, white sucker, lake chub, trout perch, brook stickleback and longnose dace) were the most common fishes sampled at site Ff2 (Appendix II, Table II-2). Although sportfish were captured at this site, catchability was affected by adverse ice conditions (i.e., fewer sportfish were captured in the first run than successive runs) and the population estimate was found to be invalid.

3.1.4.2 *Mark-recapture population estimates*

Brook trout were the dominant fish species at site Ff3 (Table 7). Population estimates for rainbow trout and 'suspected' cutthroat trout x rainbow trout captured at site Ff3 were less than 40 fish/ha. Non-sportfish were also common at this site (Appendix II, Table II-2).

Only sportfish were captured at site Ff4 (Table 7). Brook trout were the most common sportfish, while cutthroat trout and 'suspected' cutthroat trout x rainbow trout hybrids were also abundant.

Table 7. Chapman/Peterson population estimates for sportfish captured in Fish Creek during the fall sampling period.

Species*	Number of fish caught	Percentage of sportfish captured**	Population estimate		Lower 95%CI		Upper 95%CI	
			#/km	#/ha	#/km	#/ha	#/km	#/ha
Site Ff3 (length 400 m, average width 7.6 m)								
BKTR	142	94%	796	1047	548	721	1043	1372
CTTR hybrid	5	3%	28	37	19	25	37	48
RNTR	4	3%	22	29	15	20	29	39
Total sportfish	151	100%	846	1113	583	767	1109	1459
Site Ff4 (length 400m, average width 3.15 m)								
BKTR	121	70%	573	1819	449	1425	697	2212
CTTR	17	10%	80	256	63	200	98	311
CTTR hybrid	35	20%	166	526	130	412	202	640
Total sportfish	173	100%	819	2601	642	2038	997	3163

* = Species abbreviations are described in Table 4 and Appendix II

** = individual fish were only counted once to determine species composition (i.e., recaptures not counted)

3.1.5 Fish in spawning condition

The capture of fish in spawning condition can be useful to identify stream reaches where fish may be spawning or to identify spawning migration routes. Fish in spawning condition were identified by the expulsion of gametes from cutthroat trout, rainbow trout, longnose sucker, white sucker and longnose dace captured during the spring sampling period, and brook trout and brown trout captured during the fall sampling period. Raw data for fish in spawning condition is provided in Appendix II, Tables II-1 and II-2 for the spring and fall sampling periods, respectively.

Spring spawners were found in spawning condition at several locations. Cutthroat trout were captured in spawning condition on May 27, 1993, at site Fs6 in Fish Creek (i.e, immediately downstream of where Fish Creek crosses the McLean Creek Road). The cutthroat trout were captured below a culvert that was elevated 30 cm above the stream. These cutthroat trout included 14 ripe males and two ripe females. On May 31, 1993, rainbow trout in spawning condition were captured at site Fs5 in Fish Creek (i.e., immediately upstream of the Highway 762 bridge). These rainbow trout were all ripe males (n=5).

Non-sportfish in spawning condition were found in Fish, Priddis and Whiskey creeks during spring sampling. On May 20, 1993, one ripe male longnose sucker and one ripe male white sucker were captured at site Fs1 near the mouth of Fish Creek. One ripe female white sucker and two ripe female longnose dace were captured near the mouth of Priddis Creek (site Ps1) on May 27, 1993. On June 4, 1993, at site Ws1, near the mouth of Whiskey Creek, one ripe male white sucker and one spent female white sucker were captured.

Fall spawners were also found in spawning condition at several locations. On November 8, 1993, one ripe female and two ripe male brown trout were captured at site Ff1 (downstream of the lowest pedestrian bridge in FCPP). On November 12, 1993, one ripe male brook trout was captured at site Ff3 (upstream of the Highway 762 bridge in Fish Creek). A spent female brook trout was also captured at this site. Two ripe male and two ripe female brook trout were captured in Fish Creek at site Ff4 (approximately 3 km below the McLean Creek Road) on November 12, 1993. Three spent female brook trout were also captured at this site on November 12 (two fish) and November 13 (one fish), 1993.

3.1.6 Sportfish fork length distributions.
When more than 14 individuals of a sportfish species were captured between all sample sites combined during the spring or fall sampling periods, fork length distributions were graphed (Figures 2, 3 and 4). Fork length distributions for sportfish where more than 14 individuals of a single species were captured at a specific sample site are illustrated in Appendix I, Figures I-1, I-2 and I-3.

Fork length distributions for brook trout, cutthroat trout and rainbow trout captured during the spring sampling period are illustrated in Figure 2. Cutthroat trout and rainbow trout were divided into male, female and 'sex unknown' categories. Sexes of brook trout could not be determined, since external sexual differences were not apparent during the spring sampling period. The fork length distribution for brook trout suggests good recruitment in this population. Cutthroat trout and rainbow trout fork length distributions are from a small number of fish, but suggest limited recruitment and/or year class failures. A fork length distribution was not prepared for brown trout due to a limited number (n=4) captured during spring sampling. These brown trout, all captured at site Fs1, ranged in length from 130 mm to 445 mm.

Fork length distributions for brown trout, rainbow trout and mountain whitefish captured during fall sampling are presented in Figure 3. Brown trout were divided into male, female and 'sex unknown' categories. Rainbow trout and mountain whitefish could not be sexed during fall sampling. The brown trout fork length distribution suggests good recruitment; however, it is unknown as to whether or not these fish are Fish Creek residents or Bow River migrants. When

compared to the numbers of brown trout captured in the spring at this site, and considering that all the of brown trout were captured at site Ff1 (less than 1 km upstream of Fish Creek's mouth), the data suggests these brown trout are Bow River migrants. The rainbow trout fork length distribution is from a small sample, but illustrates a slight decreasing trend. The mountain whitefish fork length distribution contains large numbers of small fish, all captured at sites Ff1 and Ff2 (near Fish Creek's confluence with the Bow River) which suggests they are juvenile Bow River migrants. A single 232 mm bull trout was captured during fall sampling at site (Ff2).

Fork length distributions for brook trout, cutthroat trout and 'suspected' cutthroat trout x rainbow trout hybrids, captured during the fall sampling period, are presented in Figure 4. Brook trout were divided into male, female and sex unknown categories. Cutthroat trout and 'suspected' cutthroat trout x rainbow trout hybrids could not be sexed. The brook trout fork length distribution for fish captured at sites Ff3 and Ff4 (near the Highway 762 bridge) suggests good recruitment. Fork length distributions for cutthroat trout and 'suspected' cutthroat trout x rainbow trout hybrids suggest poor recruitment.

3.1.7 Relationships between fork length and weight for sportfish

Fork length and weight relationships are presented in Figure 5 for brook trout, rainbow trout and cutthroat trout captured during the spring sampling period (May 20 to June 10, 1993). Fork length and weight relationships for brown trout, rainbow trout and mountain whitefish captured during the fall sampling period (November 8 to 13, 1993) are presented in Figure 6. Fork length and weight relationships for brook trout, cutthroat trout and 'suspected' cutthroat trout x rainbow trout hybrids captured during the fall sampling period are presented in Figure 7.

3.2 Redd surveys

A rainbow trout redd survey was performed on May 18, 1993, on the lower 3 km of Fish Creek below a beaver dam that was thought to be impassable. No rainbow trout redds were observed during this survey. Due to turbid conditions in Fish Creek during the rainbow trout spawning season, no subsequent redd surveys could be conducted. Therefore, the limited temporal scope of this redd survey did not conclusively prove, or disprove, whether rainbow trout use this reach of Fish Creek for spawning.

Numerous longnose suckers and white suckers were observed spawning throughout this reach during the rainbow trout redd survey. Youths were observed spearing and treating suckers in a wasteful manner. A short time later, FCPP Rangers arrived and reprimanded the youths (E. Beveridge, TUC, pers. comm., 1997).

A brown trout redd survey was performed on November 10, 1993, in the reach of Fish Creek within FCPP. High water in Fish Creek during the summer of 1993 breached beaver dams, thus improving brown trout access to this portion of the stream. Approximate locations of observed brown trout redds are provided in Figure 8. During the redd survey, a total of 29 brown trout redds were observed.

3.3 Water temperature

Stream temperature data from thermographs installed at the upstream and downstream locations are presented in Figures 9 and 10, respectively.

3.4 Aerial surveys

Observations of general riparian habitat conditions from the May 19, 1993, aerial video survey suggest both Fish and Whiskey creeks' riparian areas have been damaged. The riparian area of Fish Creek is primarily degraded between the western boundary of the Tsuu T'ina Reservation and Highway 762. Whiskey Creek's riparian area is generally degraded downstream of the Kananaskis Country boundary. The primary agents suspected to be causing degradation of riparian habitats adjacent to Fish Creek and Whiskey Creek were agriculture (e.g., feedlots, cattle grazing and cropping) and residential/recreational developments. Riparian habitats along Fish Creek appeared to be generally intact within FCPP, Tsuu T'ina Reservation and upstream of Highway 762. The aerial video survey of Fish Creek and Whiskey Creek performed on May 19, 1993, (Kardon 1993) is available from the TUC office.

Ice-free reaches of Fish Creek observed from a fixed-wing aircraft on November 10, 1993, is presented in Table 2.

4.0 DISCUSSION

4.1 Species composition and relative abundance of sportfish

Because capture probability can vary between sampling sites and electrofishing crews, it is not always possible to make conclusive statements regarding the abundance of fish between sample sites or dates based on CPUE data. However, with CPUE data, it is possible to make observations of relative abundance and species composition and distribution between sampling sites or dates.

When making comparisons of relative abundance and species composition and distribution with CPUE data between sample sites and sample dates, the following biases should be recognized:

a) sites were not sampled unless they could be effectively sampled using a backpack

electrofisher;
b) the same electrofishing crew and size of crew was not utilized at all the sites sampled;
c) the sites chosen during the fall sampling period were ice-free when most of the remainder of the stream was covered in ice;
d) there was heavier than normal rainfall throughout the fall of 1993; consequently, Fish Creek experienced unusually high flows for this time of year (G. Szabo, TUC, pers. comm., 1997); and
e) some migratory sportfish species were sampled during their spawning seasons (i.e., rainbow trout and cutthroat trout during the spring and brown trout, brook trout, bull trout and mountain whitefish during the fall).

To facilitate comparisons of data between studies, the study area has been broken down into six distinct reaches. Separate reaches were used because of differences in general habitat condition, type of ownership and stream order (Table 8; also see Figure 1 for a map displaying these reaches).

Table 8. Description of reaches in the Fish Creek watershed.

Reach	Location	General riparian conditions	Ownership
Lower	Fish Creek within FCPP	Riparian area primarily intact	Public
Tsuu T'ina	Fish Creek within Tsuu T'ina Reservation	Riparian area intact	Tsuu T'ina Nation
Middle	Fish Creek between Tsuu T'ina and 2.5 km below Highway 762	Degraded riparian area: relatively heavy clearing or development	Predominately private
Upper	Highway 762 to headwaters	Riparian area primarily intact	Predominately public, some private
Priddis Creek	Priddis Creek downstream from Tsuu T'ina Reservation	Degraded riparian area: relatively heavy clearing or development	Predominately private
Whiskey Creek	Entire length of Whiskey Creek	Degraded riparian area: relatively heavy clearing or development	Predominately private, some public

A summarization of fisheries related studies/observations in the Fish Creek watershed is presented in Table 9. Table 9 was created to present fishery-related trends that are apparent from a review of previous studies in the Fish Creek watershed.

4.1.1 Lower Reach

Previous studies (Table 9) suggest that Fish Creek was an important spawning stream for rainbow trout. Spring sampling in the lower reaches of Fish Creek did not result in the capture of large numbers of sportfish during the present study. The capture of a single rainbow trout at the two sample sites within FCPP suggests it's importance as spawning migration habitat for rainbow trout has diminished. The failure to capture more than a single rainbow trout in Priddis Creek (which was historically important rainbow trout spawning habitat) during spring sampling also supports the previous conclusion (Sosiak 1984) that it is unlikely that a large population of rainbow trout from the Bow River migrate into the Fish Creek watershed to spawn. Studies summarized in Table 9 suggest that de-watering and habitat degradation are the likely causes of the deterioration of this spawning population and any resident populations that may have existed. An Instream Flow Needs (IFN) scoping study for the fish of Fish Creek (Table 9) suggests an

IFN study could help direct the development of management strategies for the Fish Creek watercourse.

Sportfish data collected during the present study as well as related literature (Table 9) suggest that the lower reach of Fish Creek is important habitat for migratory sportfish in the fall. This reach is used for spawning by brown trout and is likely used as a feeding or overwintering area for juvenile mountain whitefish and brown trout. It is suspected that mountain whitefish and brown trout using this reach are primarily Bow River migrants.

During a fixed-wing aerial survey of Fish Creek on November 10, 1993, ice-free water was encountered throughout most of the lower 12 km of Fish Creek. Hildebrand (1985) used fixed-wing aircraft to identify ice-free sites in the winter and found that most of the ice-free sites were situated in areas denoted as 'locally higher groundwater yield areas with primarily sand/gravel lithology'. Golder Associates Ltd. (1996) reported that it is unlikely groundwater is a significant contributor to late season flows in Fish Creek within FCPP. However, data collected by Hydroconsult (1995) suggests that storm-water outfalls in FCPP convey significant amounts of groundwater to Fish Creek in the winter months. Groundwater flow and runoff from storm-water outfalls are likely responsible for this reach of Fish Creek being ice-free during the aerial survey.

4.1.2 Tsuu T'ina Reach

Sportfish resources within the Tsuu T'ina reach are unknown. Aerial surveys performed by TUC in 1993 and personal observations by TUC staff in 1997 suggest that riparian habitat within this reach has not experienced extensive degradation. This reach likely supports coldwater sportfish, when there are sufficient flows (Table 9).

4.1.3 Middle Reach

Data collected during the spring sampling period suggests that the middle reaches of Fish Creek contain moderate to low numbers of sportfish, which is consistent with post-1980 literature (Table 9). Pre-1980 studies (Table 9) reported large numbers of small and young-of-the-year rainbow trout in this reach. Electrofishing during the present study resulted in the capture of few brook trout and no other sportfish species from the middle reaches of Fish Creek. Habitat degradation on private lands and cessations of flow since the 1970s (Table 9) have likely impacted recruitment in this area. Habitat degradation and flow cessation, combined with excessive beaver damming in this reach, appear to have caused declines in the migratory population of Bow River rainbow trout that utilized this reach of Fish Creek for spawning and rearing. It is likely that these factors have also negatively impacted resident populations in this reach, thus contributing to an overall decrease in the fishery resources of the middle and lower reaches of Fish Creek and possibly the Bow River.

Ice-free sites within this reach (Table 9) are suspected to provide important fall spawning habitat for brook trout and overwintering habitat (see section 4.1.4 Upper Reach).

4.1.4 Upper Reach

A large portion of this reach is within Kananaskis Country where riparian habitat has remained in a relatively natural condition. Large numbers of sportfish were captured during both the spring and fall sampling periods.

Spring sampling in the upper reaches revealed the importance of this reach to rainbow trout, cutthroat trout, 'suspected' cutthroat trout x rainbow trout hybrids and brook trout. Brook trout were the most numerous sportfish species captured in this reach and had strong representation from smaller size classes (i.e., indicating good recruitment). Studies previous to 1987 reported the dominant sportfish species in this reach were cutthroat trout and/or rainbow trout (Table 9). However, post-1987 data show brook trout have become the dominant sportfish species in this reach (Table 9). Fisheries inventories and low to absent surface flows recorded in downstream reaches during some years (Table 9) suggest sportfish populations in the upper reaches are predominantly resident.

The only species of fish captured at site Fs6 (immediately below the culvert on the McLean Creek Road) during the present study was cutthroat trout. Several of these cutthroat trout were in spawning condition. At the time these fish were captured, the culvert appeared to be impassible, since it was overhanging and approximately 30 cm above the level of the water. A culvert has been in place on the McLean Creek Road in this location since at least 1961 (Joe Burritt, Kananaskis Country Ranger, pers. comm., 1998). If this culvert was a barrier to fish migration, it may potentially have isolated a population of pure westslope cutthroat trout from hybridization with introduced rainbow trout and/or cutthroat trout. However, J. Stelfox, Fish and Wildlife Division, Alberta Environment, Calgary, visited the site in September, 1997, and observed a trout exiting the upstream end of the culvert and believed the culvert was only a partial barrier. Further to this development, the culvert has been replaced and now provides adequate fish passage (Table 9).

Brook trout are a threat to the continued survival of native cutthroat trout in the upper reaches of Fish Creek. Griffith (1988) reported that cutthroat trout are less likely to co-exist with brook trout than any other non-native salmonid species. De Staso and Rahel (1994) determined that brook trout and Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) are nearly equal competitors at 10°C, whereas brook trout displayed a clear competitive dominance over cutthroat trout at 20°C. The replacement of the culvert on the McLean Creek Road allowed cutthroat trout better access to a section of stream, likely to have cooler temperatures, where the chances of brook trout having a competitive advantage are lessened.

In the present study numbers of sportfish captured in the upper reaches during the fall (Ff3 and Ff4) were very high, this is suspected to be due to the presence of groundwater inputs near sampled sites. Groundwater input is suspected because: a) these locations were ice-free when the rest of Fish Creek was ice-covered; b) several brook trout were captured in spawning condition -- brook trout are known to seek out areas of groundwater seepage for spawning (Reiser and Wesche 1977, Witzel and MacCrimmon 1983 and Curry and Noakes 1995); and c) large numbers of trout were located in ice-free sites within this reach, suggesting that trout may be using these sites as overwintering areas [i.e., Cunjak (1986) and Cunjak and Power (1986) reported large aggregations of brook trout and brown trout in pools close to point sources of groundwater discharge in the winter and Brown et al. (1994) reported cutthroat trout finding refuge from frazil ice near warm groundwater inputs]. Sites sampled within this reach may be critical habitats for overwintering and fall spawning trout.

4.1.5 Priddis Creek

Low numbers of rainbow trout were captured in Priddis Creek during the present study (i.e., n=1; CPUE=0.04 fish/min. at site Ps2 and no sportfish captured at site Ps1). Post-1984 inventories have failed to encounter sportfish in Priddis Creek (Table 9). Previous to 1980, Priddis Creek was shown to be an important spawning and rearing stream for migratory Bow River rainbow trout (Table 9). Data collected during the present study support data from post-1980 studies which indicate rainbow trout from the Bow River are unlikely to still be using Priddis Creek for spawning. Habitat deterioration, excessive beaver damming and low flows (Table 9) are believed to be limiting sportfish production in Priddis Creek.

4.1.6 Whiskey Creek

The present study encountered rainbow trout near the mouth of Whiskey Creek, however, historical evidence suggests this stream supported cutthroat trout (Table 9). As little is known about sportfish in Whiskey Creek, no major conclusions could be made.

Aerial video surveys performed in 1993 (Table 9) suggest riparian habitat adjacent to Whiskey Creek is degraded.

4.2 'Suspected' cutthroat trout x rainbow trout hybrids

Mayhood and Paczkowski (1993) state that most stream-resident cutthroat trout in Alberta are probable cutthroat trout x rainbow trout hybrids. During spring sampling, no attempt was made to differentiate between cutthroat trout and cutthroat trout x rainbow trout hybrids. During the fall sampling period, 'suspected' cutthroat trout x rainbow trout were recorded in substantial numbers. The presence of 'suspected' cutthroat trout x rainbow trout hybrids, rainbow trout and observations of rainbow trout spawning (Table 9) in the Fish Creek watershed threatens the continued existence of native westslope cutthroat trout in this stream.

In 1950, Priddis Creek was stocked four times with cutthroat trout from hatcheries in British Columbia and Montana (W. Schenk, Sam Livingston Fish Hatchery, Alberta Environment, Calgary, pers. comm., 1998) and Fish Creek was stocked once in 1948 with cutthroat trout of unknown origin (Rees 1987a). These stocked cutthroat trout could have been another subspecies [e.g., coastal cutthroat trout (*O. clarki clarki*) or Yellowstone cutthroat trout (*O. clarki bouvieri*)] and may have hybridized with native stocks. Although the survival of hatchery-raised trout is generally poor when stocked into waters with a healthy resident population (Miller 1952, 1954, 1955 and 1958 from Mayhood 1989), there is no information available on the status of Priddis Creek or Fish Creek fish populations at the time of stocking, or on the success of the cutthroat trout stockings. Stocking of cutthroat trout may have affected the genetic purity of the westslope cutthroat trout in Fish and Priddis creeks.

4.3 Temperature

In the present study, a thermograph placed in the 'Middle Reach' of Fish Creek describes a thermal regime that is within the tolerance limits for coldwater fish described by Nelson and Paetz (1992). The temperature readings from a thermograph placed in the uppermost portion of the 'Lower Reach' of Fish Creek push the upper tolerance limits for coldwater sportfish (i.e., salmonids), having temperatures often exceeding 20°C. For a detailed discussion of the potential effects of temperature on salmonids in Fish Creek see Golder (1995).

Data collected by Hydroconsult (1995) reveals that Fish Creek had continuous flow throughout the summer of 1993 and the mean March - October flow in 1993 was the highest average flow

since 1970. From an analysis of the last 44 years (i.e., 1951 - 1995) of flow data collected on Fish Creek at Priddis, it was found that the monthly surface flow was measured to be zero at some points in March, July, August, September and October (Hydroconsult 1995). Therefore, summertime stream temperatures recorded in 1993 were likely cooler than in most years.

Unless there is a significant, downstream source of groundwater, aquatic habitat downstream from Priddis (Tsuu T'ina and Lower reaches) may be of limited importance to salmonids in the summer months due to intermittent surface flows and higher temperatures associated with low flows. From an analysis of stormwater outfalls in FCPP (Hydroconsult 1995), groundwater was determined to be a significant contributor to flow in Fish Creek during the winter months. It is unknown whether groundwater inputs within FCPP during the summer have enough volume to reduce temperatures to a more desirable level for salmonids.

5.0 RECOMMENDATIONS

1) Minimum instream flow needs (IFN) need to be established and implemented for Fish Creek and its tributaries. Currently, there are 31 licensed water users in the Fish Creek watershed, who can legally withdraw 1,180,800 m^3 of water annually; of these 31 licensed water users, only three have restrictions for minimum flows (Water Administration Branch staff, Alberta Environment, pers. comm., 1998). Hydroconsult (1995) reported that Fish Creek has de-watered at some points in March, July, August, September and October from 1951 - 1995 at Priddis. Paetz (1986) indicated that the lower reaches of Fish Creek are subject to de-watering and Stelfox and Konynenbelt (1980) reported Priddis Creek being dry 300 m upstream from the mouth. The de-watering of Fish Creek and Priddis Creek clearly demonstrates the need for an overall water management plan for this watershed to meet user demand, improve water quality and maintain sportfish habitat. Without a water management plan that has restrictions on minimum flows to protect fish habitat, the sportfish populations in Priddis Creek and the middle and lower reaches of Fish Creek are unlikely to increase or recover.

In the Summary of Comments from the Public Meetings of the Bow Basin Plan by the Bow River Water Quality Council (1996), the Council has committed to having instream needs and objectives for Fish Creek included in the Bow Basin Plan. To address instream needs and objectives, the council will investigate: the cumulative impacts on water users; water withdrawals; pollution; and recommendations for achieving instream objectives. This information was scheduled to be incorporated into the Bow Basin Plan in the 1998-99 and 1999-2000 fiscal years. This has been delayed and it is hoped that the required information will be incorporated into the Bow Basin Plan in the 2000-2001 fiscal year (Bob Morrison, Water Planner, Bow Region, Alberta Environment, pers. comm., 1999).

2) Encourage landowners upstream of FCPP to modify operating/development practices for the benefit of the riparian zones adjacent to Fish Creek and its tributaries. In Alberta, there are two ongoing multi-stakeholder projects that address riparian issues through education, awareness and providing technical expertise. The Alberta Riparian Habitat Management Project ("Cows and Fish") is a co-operative effort between government, TUC, the Alberta Cattle Commission, the

Canadian Cattleman's Association and others. This program promotes a better understanding of how improvements in grazing management on riparian areas can enhance landscape health and productivity, for the benefit of ranchers and others who use and value riparian areas. The Bow River Project is a multi-agency project that promotes public awareness of noxious and restricted weeds, and educates landowners and the public about wise riparian management (e.g., urban development that integrates the needs of riparian areas into planning processes) in areas adjacent to the Bow River from Banff National Park to the Bow River's confluence with the Oldman River.

Education of landowners and the general public about the value of riparian areas is critical to restoring degraded habitats in the Fish Creek watershed. Both the Cows and Fish Project and the Bow River Project have educational materials and speakers available to explain the value of maintaining the integrity of riparian areas. The Cows and Fish Project also has demonstration plots and hands-on expertise available to help ranchers better understand and make adjustments to improve riparian areas on their lands. Education leading to improved land management would likely have a positive impact on sportfish populations in portions of the Fish Creek watershed that are not subject to de-watering.

The Cows and Fish Project has made some contacts with land owners in the Fish Creek watershed and has performed vegetation inventories on a number of sites along Fish Creek and Priddis Creek (Greg Hale, Alberta Riparian Habitat Management Project Provincial Coordinator, pers. comm., 1999).

3) Limit and/or properly mitigate the effects of resource, recreational and urban developments in Kananaskis Country, private lands, Tsuu T'ina Reservation and FCPP that may have negative impacts on fish stocks in the Fish Creek watershed. It is especially critical to ensure the continued viability of the headwater populations in Fish Creek, because if downstream habitats were improved, source stocks from the upper reaches would be required to supply sportfish to repopulate tributaries and downstream reaches.

4) Sportfish populations in Fish Creek near the McLean Creek Road should be investigated. Based on visual observations cutthroat trout captured below the McLean Creek Road in the present study were suspected to be pure. Genetic analysis should be conducted to determine the purity of suspected westslope cutthroat trout, since rainbow trout spawning has been documented in the upper reaches of Fish Creek. Native westslope cutthroat trout stocks in Alberta are almost nonexistent and opportunities to identify stocks that may be pure should be examined.

5) Fisheries inventories should be conducted within the Tsuu T'ina Reservation for Fish Creek and Priddis Creek, since there is no sportfish data available on these stream reaches. Opportunities to partner with Tsuu T'ina Nation should be explored for the better management and understanding of the fisheries resources in the Fish Creek watershed.

6) A decision to pursue recommendations made by Golder (1996) related to beaver management is required. They recommended and described beaver management plans for the middle, lower and Tsuu T'ina reaches of Fish Creek.

7) Hydroconsult (1995) reported that there is potential to excavate pools in the main channel of Fish Creek within FCPP to serve as overwintering pools and holding water during low flows. These opportunities should be examined.

8) Fisheries and habitat inventories should be conducted on Whiskey Creek since there is little information on sportfish in this stream and cutthroat trout were known to utilize this stream in some capacity.

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7.0 APPENDIX I: Additional figures

8.0 APPENDIX II: Additional tables

Abbreviations used in Appendix II

recap	-recapture
BNTR	-brown trout
BKTR	-brook trout
BLTR	-bull trout
CTTR	-cutthroat trout
CTTR-Hy	- 'suspected' cutthroat trout x rainbow trout hybrid
RNTR	-rainbow trout
MNWH	-mountain whitefish
LNSC	-longnose sucker
WHSC	-white sucker
LKCH	-lake chub
LNDC	-longnose dace
TRPR	-trout perch
BRST	-brook stickleback
PRDC	-pearl dace

FTMN -fathead minnow
MNSC -mountain sucker

Abbreviations for fish species from MacKay et al. (1990), except CTTR-Hy.