Fisheries Population Assessment of Little Red Deer River, Dogpound Creek and Beaverdam Creek, 2003

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EXECUTIVE SUMMARY

In June–July 2003 the Alberta Conservation Association collected sport fish abundance, size-structure and fish community composition information using electrofishing gear at established sites on the Little Red Deer River (n = 1) and Dogpound Creek (n = 3). Two new sites were also established on Beaverdam Creek. These data may be useful for evaluation of area riparian protection projects undertaken through the Buck for Wildlife Habitat Enhancement Program, and more recently through the Little Red Deer River Watershed Initiative. Fisheries information was entered into the Government of Alberta's Fisheries Management Information System, Project ID: 4687.

Brown trout and mountain whitefish abundance was greatly reduced at the Little Red Deer River and Dogpound Creek sites in 2003. The length-range of sport fish in the catch was narrower and mean size was generally smaller. Northern pike were not captured in Dogpound Creek in 2003 although they were observed at two of the three sites in 1997. Similarly, brook trout were captured in the uppermost site on Dogpound Creek in 1997 but not in 2003.

Identifying the cause of these apparent changes to the sport fishery is beyond the scope of this report. However, drought conditions throughout the watershed in 2001–2003 reduced stream flows and resulted in elevated water temperatures and documented fish kills which likely contributed to the observed decline in sport fish abundance and distribution.

1.0 INTRODUCTION

1.1 General Introduction

The Little Red Deer River watershed and its sport fishery have interested anglers, fisheries managers and conservation groups since the 1960s. Poor agricultural practices within the watershed were identified as causing excessive sediment input to the steam which in turn was negatively impacting the sport fishery (Cunningham and Pinsent 1964; Pinsent 1964). In the 1980s, Alberta Fish and Wildlife Division initiated a stream bank restoration program on Dogpound and Beaverdam creeks under the Buck for Wildlife (BFW), Habitat Enhancement Program. A primary objective of the program was protection of riparian areas from livestock grazing and trampling through stream-bank fencing and development of on-stream watering sites. The program was expected to improve bank stability, riparian function and water quality, thereby enhancing sport fish populations.

In 1997 the Alberta Conservation Association (ACA) was formed and was delegated management of the BFW Habitat Enhancement program including those projects on Dogpound Creek. At the time the Little Red Deer River sub-basin had the ninth highest level of estimated faecal coli form in Canada, likely a result of the large number of livestock (primarily beef cows) in the watershed (Hofmann 2001). Of increasing concern to area residents and the agricultural sector, the issue of water quality was placed in the spotlight by the report. In response, a number of groups and organization began to work collaboratively to mitigate threats to the watershed's riparian and aquatic environments in 1999. Participants initially included the counties of Mountain View and Rocky View, Improvement District of Bighorn, Prairie Farm Rehabilitation Association, Alberta Environment and ACA. It later expanded to include representation from the County of Red Deer, Alberta Environmentally Sustainable Agriculture and Friends of the Little Red Deer River Society. This cooperative venture developed into the Little Red Deer River Watershed Initiative (LRDRWI). The LRDRWI's mandate was to coordinate the efforts of agencies and livestock producers in the Little Red Deer River watershed to develop on-the-ground projects that reduced the amount of manure entering area waterways while increasing local ranchers understanding of watershed-related issues.

Since the inception of the LRDRWI various water quality and riparian health data have been collected throughout the Little Red Deer River watershed for monitoring purposes. In 2003, LRDRWI and ACA partnered to collect sport fish (primarily brown trout) abundance information in the watershed. This information could be used to document the response of sport fish populations to watershed-based riparian initiatives being implemented throughout the Little Red Deer River watershed.

1.2 Study Rationale

To provide the LRDRWI and its member groups with baseline sport fish abundance information from established population estimate sites on the Little Red Deer River, Dogpound

and Beaverdam creeks. This information would then be available for future evaluation of watershed initiatives.

1.3 Study Objectives

1. Estimate 2003 sport fish abundance in the Little Red Deer River, Dogpound and Beaverdam creeks at established sites.

2. Compare 2003 brown trout abundance estimates with the most recent estimate where possible.

3. Update the Alberta Government's Fisheries Management Information System (FMIS) with the fisheries and habitat information collected during the study.

4. Provide the Little Red Deer Watershed Initiative with baseline fish community composition and sport fish abundance and size-structure information for the Little Red Deer River, Dogpound and Beaverdam creek sites.

2.0 STUDY AREA

2.1 Watershed Description

Located in west-central Alberta, the Little Red Deer River drainage originates in the Foothills Ecoregion (Strong and Leggat 1992), west of the Hamlet of Cremona (Figure 1). The Little Red Deer River is a tributary to the Red Deer River and part of the South Saskatchewan River basin. Approximately 200 km long, with an estimated drainage area of 2356 km^2, the Little Red Deer River drops approximately 735 m from its headwaters to the confluence with the Red Deer River (Rees 1988[b]). Land use within the watershed is primarily agricultural with forage production and ranching accounting for most of this activity. Urban development in the watershed is limited to the hamlets of Cremona, Bottrel, Madden and Water Valley.

2.2 Fish Community

Sport fish native to the Little Red Deer River drainage include bull trout (*Salvelinus confluentus*), burbot (*Lota lota)*, mountain whitefish (*Prosopium williamsoni*), northern pike (*Esox lucius*) and walleye (*Sander vitreus*). Non-sport species include brook stickleback (*Culaea inconstans*), lake chub (*Couesius plumbeus*), longnose dace (*Rhinichthys cataractae*), longnose sucker (*Catostomus catostomus*), trout perch (*Percopsis omiscomaycus*) and white sucker (*Catostomus commersoni*). Introduced sport species include brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) and lake whitefish (*Coregonus clupeaformis*) (Scott and Crossman 1973; Nelson and Paetz 1992).

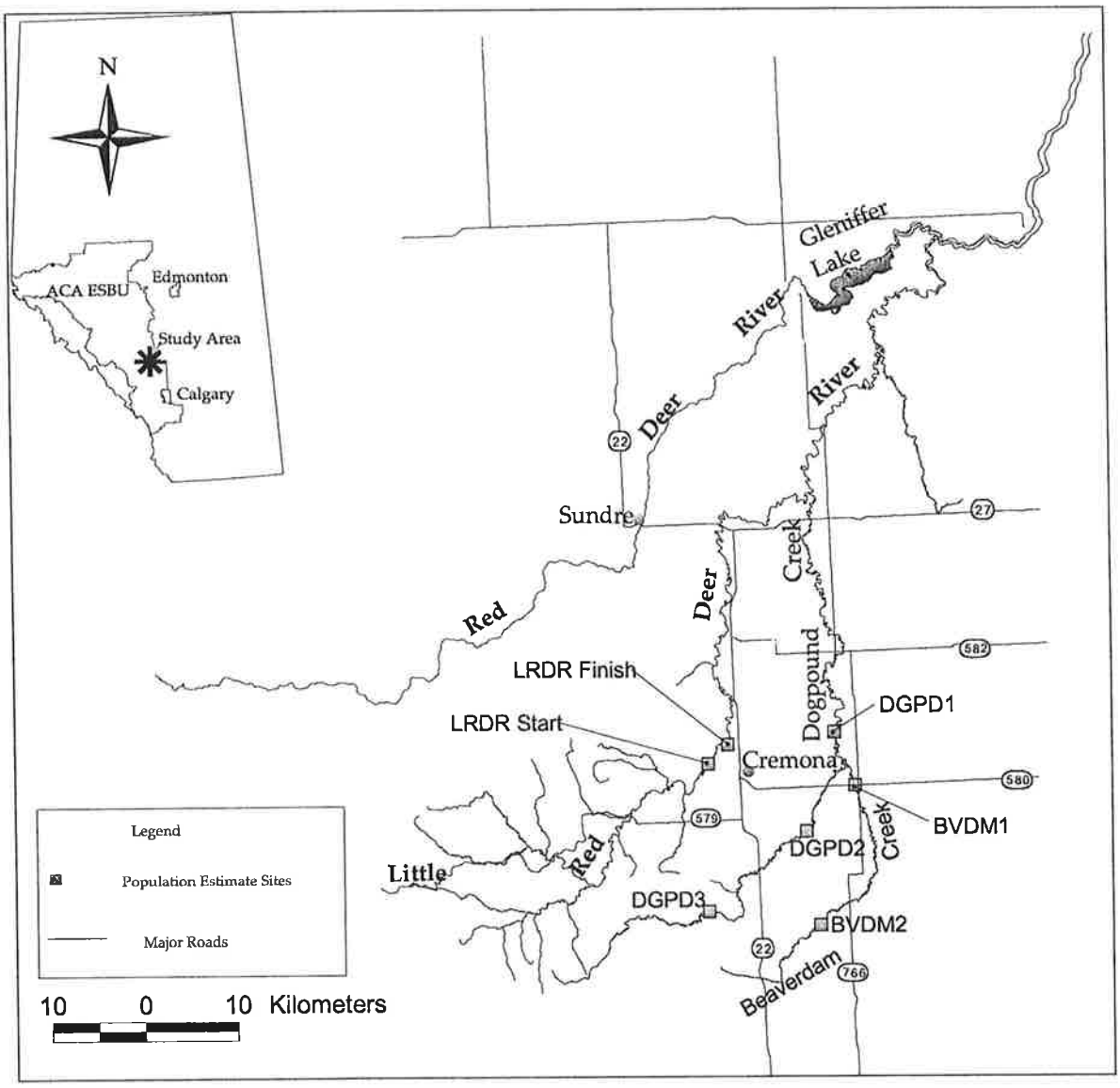

Figure 1. Location of sport fish abundance estimate sites on the Little Red Deer River, Dogpound and Beaverdam creeks in the ACA East Slopes Business Unit, July 2003.

2.3 Site Locations

2.3.1 Little Red Deer River

The Little Red Deer River sport fishery has been assessed in various locations and for different reasons over the years. In 1998, Wieliczko and McLeod (2000) established two sites in the upper portion of the Little Red Deer River (upstream of the Shantz weir) to monitor the brown trout population. Limited resources dictated that only one site was revisited in 2003. Site LRDR

(Figure 1) was chosen as sport fish abundance and size-distribution data were available from 1998 and several riparian enhancement projects were located within or upstream of the site.

- LRDR – located west of the Town of Cremona, starting at the Big Prairie Road Bridge (NE7-30-4-W5) and continuing downstream 4.3 km to a road allowance SW21-30-4-W5 (Appendix 1 and 2).

2.3.2 Dogpound Creek

The three existing sites on Dogpound Creek (DGPD 1–3; Figure 1) were all sampled in 2003. First sampled in 1987 (Matkowski et al. 1988), these sites have been revisited on a roughly five-year rotation, in 1992 (Bjornson and Barton 1993) and 1997 (Wielickzo unpublished data).

- DGPD1 – starting at the crossing on NW22-30-3-W5 and concluding at the old oxbow confluence NE22-30-3-W5 (Appendix 1 and 3).
- DGPD2 – starting at the livestock crossing NE17-29-3-W5 and concluding at the lowest downstream livestock crossing on SW20-29-3-W5 (Appendix 1 and 4).
- DGPD3 – starting at the livestock crossing near the picnic area NW19-28-4-W5 and concluding 100 m upstream of the bridge on Horse Creek Road (Appendix 1 and 5).

2.4.3 Beaverdam Creek

Only relatively informal fishery inventory information is available for Beaverdam Creek (e.g. Rees 1988[a, b]). For this study two sites were selected for sampling (Figure 1) based on availability of prior sampling information and proximity to prior riparian enhancement work.

- BVDM1– located on the lower portion of Beaverdam Creek just upstream of Highway 580 at NE35-29-3-W5. (Appendix 1 and 6)
- BVDM2 – located in a quarter-section with riparian fencing (SE17-28-3-W5; Appendix 1 and 7).

3.0 METHODS

3.1 Electrofishing

All sites were sampled using one of three different types of electrofishing gear. The gear used was based on prior sampling techniques at the site and water conditions at time of sampling. A site-specific summary of sampling information is contained in Appendix 1.

As a result of the relatively wide channel and sporadic deep (>1 m) pools at the Little Red Deer River site (LRDR), it was sampled using a 16-foot fiberglass, flat-bottom electrofishing boat, an "egg-beater" style throwing-anode, 8500-watt Honda generator and Coffelt (Model VVP-15) electrofisher. The electrofisher was set to produce 160 volts of straight-line DC at 5–9 amps.

Mark-recapture (White et al. 1982) was used to estimate sport fish abundance at the Little Red Deer River site. The marking run was performed July 13, brown trout and mountain whitefish were marked with a left pectoral fin punch. The initial recapture run occurred July 17 but was not completed because of electrofishing equipment failure. The run was completed July 24, commencing where the previous recapture run ended. Low water in the upper portion of the reach prevented the crew from repeating the entire run.

The lowermost sites on Dogpound Creek (DGPD1, 2) were sampled using a 2.6 m flat-bottomed, aluminum punt equipped with a Coffelt (Model VVP-15) electrofisher powered by a 4000-watt Homelite generator and "eggbeater" style throwing-anode. The electrofisher was set to produce 160 volts of straight-line DC at 5–9 amps.

A Smith-Root model 12 backpack electrofisher powered with either a generator or battery was used to sample the shallowest sites on Beaverdam (BVDM1, 2) and Dogpound (DGPD3) creeks. The electrofisher was equipped with a ring anode and set to produce 150 volts of pulsed DC at 0.5 amps.

Fish abundance at sites on Dogpound and Beaverdam creeks was estimated using removal methods (Zippin 1958); blocking seine nets were placed at either end of the site to better ensure population closure.

3.2 Fish Sampling

Fish stunned by electrofishing were netted using a fiberglass-handled dip net and placed in either a plastic bucket (backpack electrofishing) or onboard live well (boat and punt electrofishing). Fish were transferred to in-stream holding cages to minimize stress and returned to the reach as soon as possible after capture. All sport fish and a sub-sample of 10 non-sport fish of each species were measured (fork length; nearest mm), and weighed (nearest gram) using an electronic balance. Brown trout and mountain whitefish life history information from site LRDR was collected during the marking run only in an effort limit fish handling and associated stress during the recapture run.

3.3 Statistical Analyses

Calculation of the mark-recapture population estimate was based on Chapman's modification of the Petersen formula (White et al. 1982) using Alberta Government software (Population Estimate Program, Basic Language Version 2.4). Removal population estimates on Dogpound and Beaverdam creeks were calculated using program MicroFish 3.0 (Van Deventer and Platts 1989). All fish life history information was entered into the Alberta Government's FMIS database, Project ID 4687.

4.0 RESULTS

4.1 Little Red Deer River

4.1.1 Fish Community

The fish community in the Little Red Deer River at site LRDR included eight species (Appendix 1), white sucker (n = 164), mountain whitefish (n = 148), brown trout (n = 92), longnose sucker (n = 73), longnose dace (n = 50), lake chub (n = 19), burbot (n = 14), and trout perch (n = 12). Sport fish comprised 44% of the catch in 2003. Northern pike, brook trout and bull trout, sport fish species known to historically occur within the area, were not observed in 2003.

4.1.2 Sport Fish Abundance

Of the 62 brown trout and 93 mountain whitefish marked during the abundance estimate, 18 and 20 fish respectively were recaptured (Table 1). Estimated abundance of brown trout and mountain whitefish at site LRDR is presented in Table 1.

Table 1. Summary of total marked (n_1), total recaptured (n_2) and marked recaptures (m_2), abundance estimate and 95% confidence limits of sport fish from the Little Red Deer River, site LRDR, July 2003. Recaptures from both recapture runs are combined.

Species	n_1	n_2	m_2	N (95% CL)
BNTR	62	49	18	166 (138–270)
MNWH	93	75	20	340 (266–775)

Density of sport fish at site LRDR appears reduced since 1998 (Table 2). The mean size of brown trout and mountain whitefish also appears reduced since 1998 (Table 3). Fork-length frequency distributions of brown trout (Figure 2) and mountain whitefish (Figure 3) were narrower in 2003 than observed in 1998. Abundance of brown trout with a fork-length frequency between 320–399 mm appeared to experience the greatest decline, along with mountain whitefish between 240–299 mm fork length.

Table 2. Sport fish density estimates at site LRDR and 95% confidence limits, 1998 and 2003.

Species	1998[1] Fish/km (95% CL)	2003[2] Fish/km (95% CL)
BNTR	80 (65–94)	39 (32–63)
MNWH	269 (225–313)	79 (62–180)

[1] LRDR was 4.0 km in length in 1998
[2] LRDR was 4.3 km in length in 2003

Table 3. Sample size, mean and range of sport fish fork length and weight at the LRDR site, 1998 and 2003.

Species	Year	n	Fork Length (mm)		Weight (g)	
			Mean	Range	Mean	Range
BNTR	1998	122	315	92–533	391	16–1602
	2003	62	294	144–511	388	35–1372
MNWH	1998	298	255	75–414	277	35–612
	2003	93	210	111–360	141	11–522

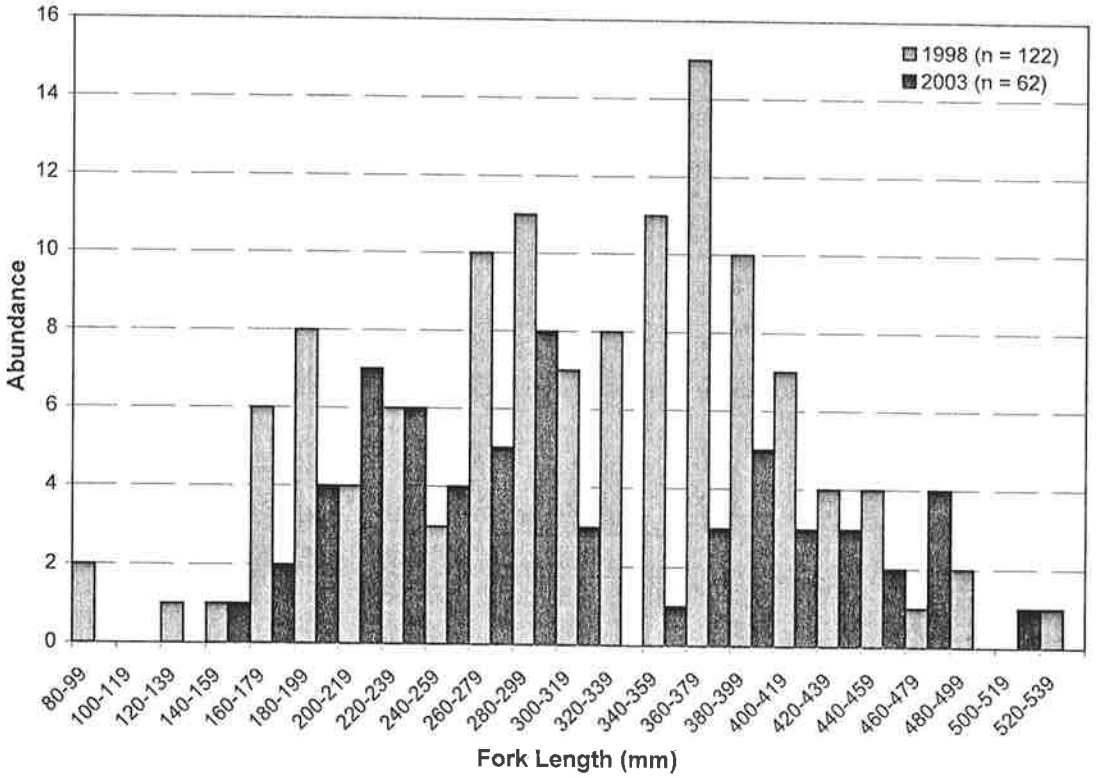

Figure 2. Comparative fork-length frequency histogram of brown trout from 1998 and 2003 from site LRDR on the Little Red Deer River. Note the sample size for each year identified in the legend.

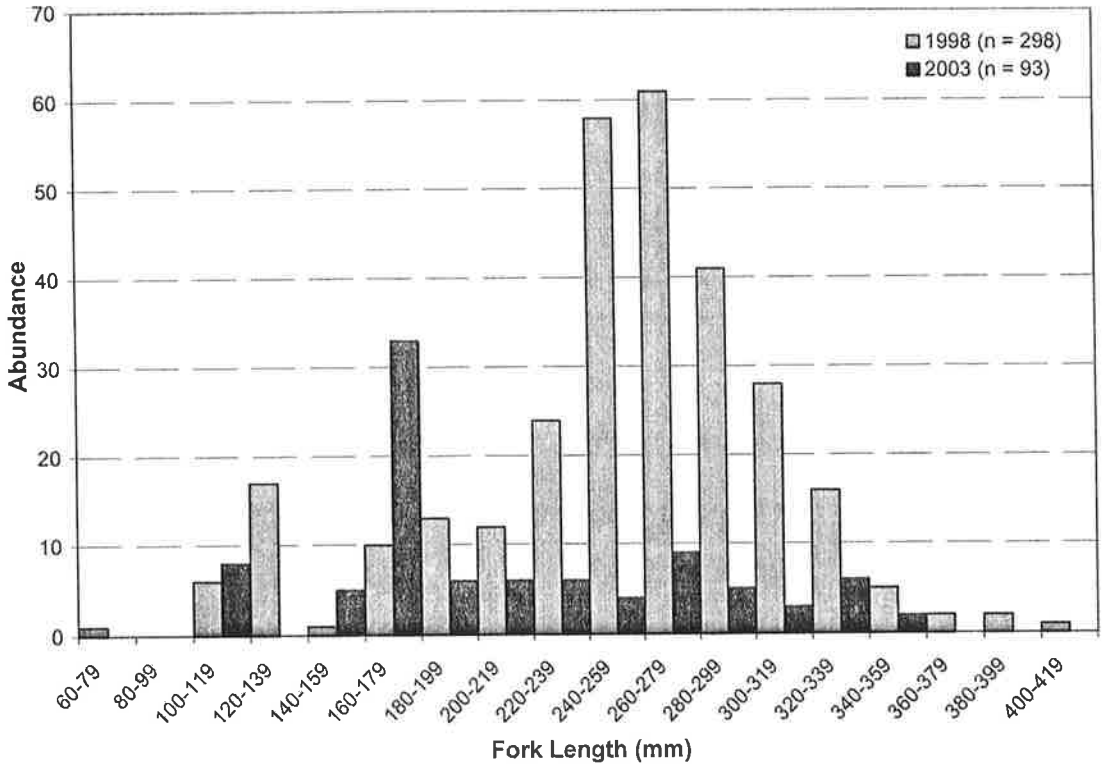

Figure 3. Comparative fork-length frequency histogram of mountain whitefish from 1998 and 2003 from site LRDR on the Little Red Deer River. Note the sample size for each year identified in the legend.

4.2 Dogpound Creek

4.2.1 Fish Community

The fish community in Dogpound Creek at sites DGPD 1–3 included ten species (Appendix 1), white sucker (n = 1286), longnose dace (n = 228), longnose sucker (n = 213), lake chub (n = 72), brown trout (n = 66), trout perch (n = 63), brook stickleback (n = 15), pearl dace (n = 14), mountain whitefish (n = 2) and burbot (n = 2). Sport fish comprised 4% of the catch in 2003. Brook trout and northern pike were captured in Dogpound Creek in 1997 (Wieliczko unpublished data) but were not observed in 2003.

4.2.2 Sport Fish Abundance

Estimated brown trout abundance at each of the three Dogpound Creek sites is presented in Table 4. Brown trout density appears reduced in 2003 particularly at DGPD3 where estimated brown trout abundance fell from 273 fish/km in 1997 to 73 fish/km in 2003 (Table 5).

Table 4. Brown trout abundance estimates and 95% confidence limits for three sites on Dogpound Creek, July 2003.

Site	Species	Pass			n	*N* (95% CL[1])
		1	2	3		
DGPD1	BNTR	6	1	1	8	8 (8–9)
DGPD2	BNTR	13	10	2	25	27 (25–33)
DGPD3	BNTR	20	9	4	33	35 (33–40)

[1]Lower bound of confidence limit set to observed fish abundance if otherwise greater.

Table 5. Brown trout density estimates at DGPD 1–3 and 95% confidence limits 1997, 2003.

Site	1997 fish/km (95% CL)	2003 fish/km (95%CL)
DGPD1[1]	35 (35–36)	8 (8–9)
DGPD2[2]	67 (64–70)	23 (21–28)
DGPD3[3]	273 (262–285)	73 (69–83)

[1] DGPD1 was 1.0 km in length in both 2003 and in 1997
[2] DGPD2 was 1.2 km in length in 2003 and 1.3 km in 1997
[3] DGPD3 was 480 m in length in 2003 and 575 m in 1997

The mean size of brown trout in the Dogpound Creek catch generally declined between 1997 and 2003 except at DGPD1 (Table 6). In 2003 more than half the brown trout from DGPD1 had a fork length > 500 mm compared to less than six percent of the 1997 catch.

Table 6. Sample size, mean and range of brown trout fork length and weight at DGPD1–3, 1997 and 2003.

Site	Fork Length (mm)			Weight (g)		
	n	Mean	Range	n	Mean	Range
DGPD1						
1997	35	365	304–491	13	494	300–728
2003	8	450	130–570	8	1229	20–2230
DGPD2						
1997	87	322	210–522	2	480	460–500
2003	25	280	128–480	25	271	18–643
DGPD3						
1997	152	206	99–422	152	129	10–681
2003	33	156	98–300	33	64	10–316
All Sites Combined						
1997	274	263	99–522	167	162	10–728
2003	66	239	98–570	64	269	10–2230

Relatively distinct size classes of brown trout were observed at each site (Figure 4) with the largest fish generally being captured at the lowest downstream site (DGPD1) and the smallest fish being captured at the most upstream site (DGPD3). Brown trout spawning at DGPD3 has been documented (Matkowski et al. 1988), presumably the young fish move downstream to more suitable habitat as they grow.

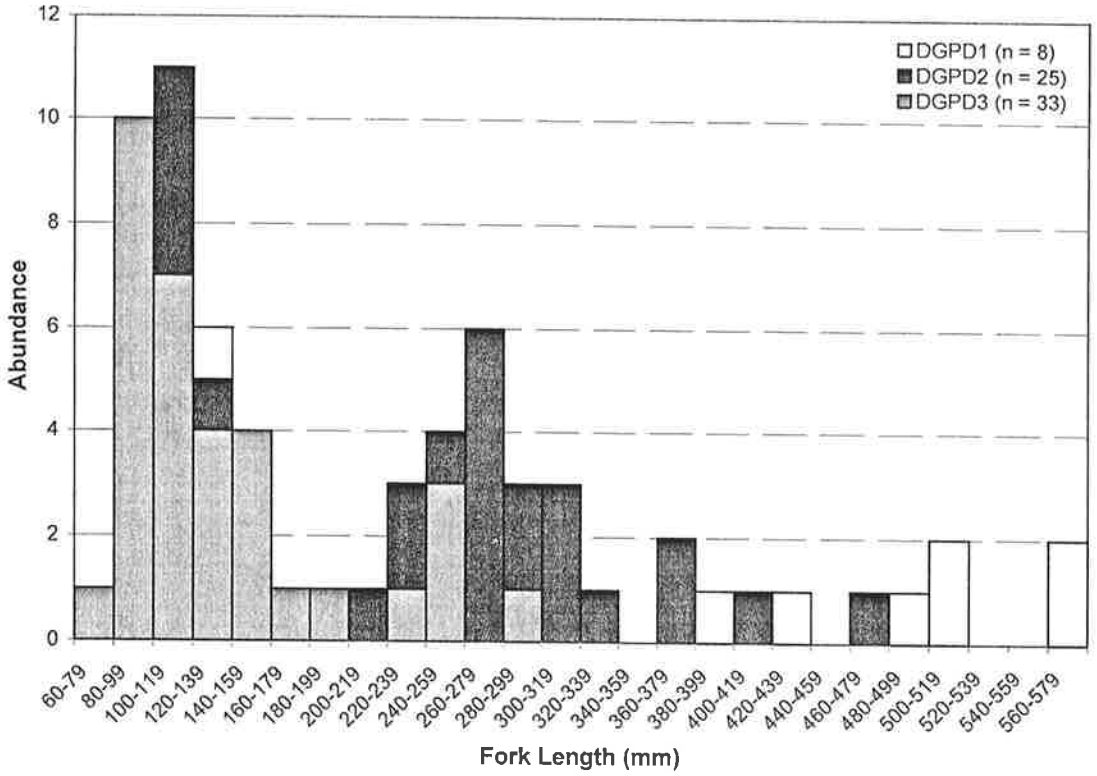

Figure 4. Fork-length frequency histogram illustrating the distribution of brown trout by size class at threes sites on Dogpound Creek, 2003. Note the sample size for each year identified in the legend.

Overall shape of the size-class distribution of brown trout in Dogpound Creek was similar between years. However, fish in the middle size classes (i.e. ~200–500 mm fork length) were relatively underrepresented in the 2003 catch (Figure 5).

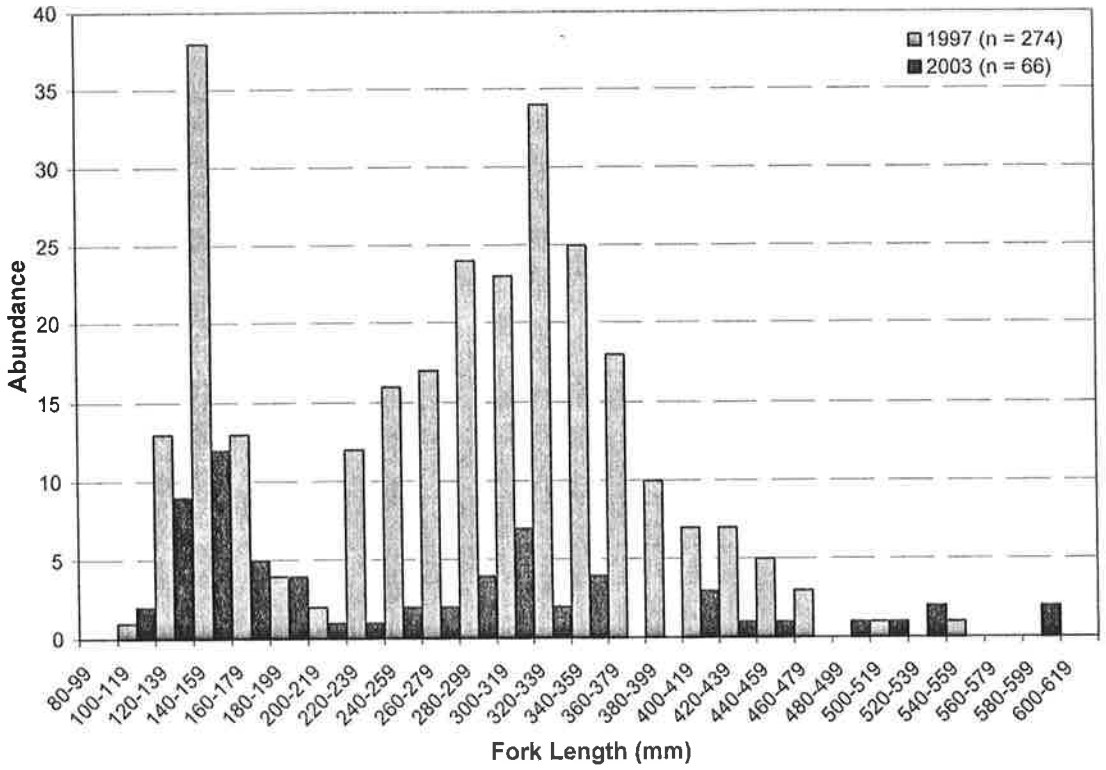

Figure 5. Comparative fork-length frequency histogram of brown trout from 1997 and 2003 from three sites on Dogpound Creek. Note the sample size for each year identified in the legend.

4.3 Beaverdam Creek

4.3.1 Fish Community

Fish community composition information was only collected at BVDM1. The fish community at site BVDM1 in Beaverdam Creek included six species (Appendix 1), longnose dace (n = 166), white sucker (n = 14), lake chub (n = 9), brook stickleback (n = 5), longnose sucker (n = 4), and brown trout (n = 1). Northern pike were the only native sport fish species known to historically occur within the area but were not observed in 2003.

4.3.2 Sport Fish Abundance

Estimated brook trout abundance at BVDM2 is presented in Table 7. No estimate was possible for any sport species at BVDM1 as only a single brown trout was captured in two electrofishing passes (Table 7). Density of brook trout at BVDM2 was estimated as 102 fish/km (95% CL 100–104). Mean size of sport species captured in Beaverdam Creek is presented in Table 8. No prior information suitable for comparison to 2003 results was available.

Table 7. Sport fish abundance estimates and 95% confidence limits for two sites on Beaverdam Creek, 2003.

Site	Species	Pass			n	*N* (95% CL[1])
		1	2	3		
BVDM1	BNTR	0	1	–	1	NA
BVDM2	BKTR	34	15	1	50	51 (50–54)

[1]Lower bound of confidence limit set to observed fish abundance if otherwise greater.

Table 8. Sample size, mean and range of sport fish fork length and weight at BVDM1, 2, 2003.

Site	Species	Fork length (mm)			Weight (g)		
		n	Mean	Range	n	Mean	Range
BVDM1	BNTR	1	44	NA	1	1	NA
BVDM2	BKTR	50	139	96–255	50	40	10–201

5.0 Discussion

The 2003 electrofishing survey of the Little Red Deer River watershed collected fish community assemblage and sport fish abundance data from existing sites on the Little Red Deer River and Dogpound Creek and established two new sites on Beaverdam Creek. This information is not only useful to provincial fisheries managers but also provides a baseline for evaluation of the LRDRWI's current and future conservation activities and their possible effect on sport fisheries within the watershed.

Mountain whitefish and burbot were the only native sport fish captured in any of the three streams surveyed. The absence of northern pike from all sample sites is concerning because they were present (although in low numbers) in two of the three sites on Dogpound Creek in 1997. Non-native brook trout were also found in the upper reach in previous surveys but none were observed at site DGPD3 in 2003. While identification of the cause of these apparent shifts in distribution is beyond the scope of this study; changes in habitat, stream flow, water temperature or increased competition with other fish species are all plausible explanations.

Estimated sport fish abundance was also reduced at all sample sites in 2003. In the Little Red Deer River brown trout and mountain whitefish abundance was down (49% and 69% respectively) since 1998. Results for brown trout corroborate the findings of a spawning survey of the Little Red Deer River that found redd numbers had declined 93% since 1998 in the upper reaches of the river (Wieliczko 2003).

Results were similar at the Dogpound Creek sites. Brown trout numbers had shown large increases (up to 2000%) since 1987, when the BFW Habitat Enhancement Program began in the area in earnest, but were down as much as 77% since 1997. Not only was sport fish abundance lower, biomass was likely reduced as well. Average size of brown trout and mountain whitefish was down at the majority of sites throughout the watershed in 2003.

While every effort was made to ensure 2003 results were comparable to those of prior studies some methodological changes were necessary. Electrofisher malfunction at the Little Red Deer River site forced completion of the recapture run in two events separated by several days. No immigration and emigration of fish into and out of the reach, an assumption of the mark-recapture population estimate model used, is therefore questionable. Unfortunately time and budget restraints coupled with unusually low water conditions precluded further effort at the site.

Dogpound Creek site DGPD3 had been sampled previously using two backpack electrofishers in tandem but only a single electrofisher was used in 2003. Low water made the use of two electrofishers unnecessary. The site was also shortened to exclude a large log jam which could not be electrofished safely or efficiently. In previous years the log jam was much smaller; it is likely that exclusion of this fish habitat in 2003 resulted in a lower sport fish abundance estimate for the reach. These shortcomings alone do not account for the consistent decline of sport fish

abundance in the watershed documented in 2003. Angling regulations have also remained unchanged for these waters since 1998. A more likely explanation for the observed decline is the drought that occurred in the area between 2001 and 2003.

While no daily stream flow data for Dogpound or Beaverdam creeks is available, the Water Survey Branch of Canada maintains a river gauging station (05CB001) near the mouth of the Little Red Deer River (Environment Canada 2003). Stream flow at the mouth of the Little Red Deer River dropped to < 0.1m^3/sec in the winter and < 1.0 m^3/sec in the summer of 2002, well below historical quartiles (see Appendix 8 for the Environment Canada hydrograph).

Low-water level events alone do not necessarily result in dramatic sport fish population declines but when combined with short-term or sustained elevated water temperatures or increased biological oxygen demand the net result may be significant. Fish, unlike many terrestrial animals, have very specific temperature criteria. Brown trout and mountain whitefish are cool-water species with an optimal living temperature ranging from 4 to 23.9 °C (Oliver and Fidler 2001). During the summer of 2002 fish kills were reported in the watershed and water temperatures as high as 26°C were recorded in July in Dogpound Creek and the Little Red Deer River (Alberta Sustainable Resource Development unpublished data). As a result of the high water temperatures and low flows Alberta Sustainable Resource Development requested anglers observe a voluntary fishing closure in the area (see Appendix 9 for a copy of the public notice).

The drought of 2001 to 2003 appears to have had a major impact on cool-water fisheries in the Little Red Deer River watershed although this hypothesis remains untested. While short-term impacts to the sport fishery appear dramatic, healthy riparian areas have the potential to buffer aquatic ecosystems from the extreme effects of drought by storing water during high flows and returning it gradually to the stream. Without the extensive riparian habitat protection that has occurred in the watershed the impacts of three-years of drought to the Little Red Deer fishery may have been much worse. The longer-term impacts of the drought to the sport fishery, if any, remain to be evaluated.

6.0 LITERATURE CITED

Bjornson, C.P., and B.A. Barton. 1993. Survey of Fall-Spawning Sport Fish Populations in Dogpound Creek, 1992. Environmental Management Associates.
Notes: Report prepared for Fish and Wildlife Division Alberta Environmental Protection Red Deer, Alberta.

Cunningham E.B. and M.E. Pinsent. 1964. Dogpound Creek Stream Survey Report, Calgary 1964. Unpublished Report. Fish &Wildlife Division, Alberta.

Environment Canada. 2003. Historical Stream flow data for Alberta 1950–2003. Water Survey Branch.

Hofmann. N. 2001. Statistics Canada, Econnection - A Geographical Profile of Manure Production in Canada. Statistics Canada, Catalogue Number 16F0025X1B.

Matkowski, S.M., C.P. Bjornson, and D.A. Fernet. 1988. A survey of fall-spawning sportfish populations in Dogpound Creek. Environmental Management Associates. Prepared for Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division, Red Deer, Alberta.

Nelson, J.S., and M. J. Paetz. 1992. The Fishes of Alberta, 2nd Edition. University of Alberta Press and University of Calgary Press, Alberta.

Oliver, G.G., and L.E. Fidler. 2001. Towards Water Quality Guidelines for Temperature in the Province of British Columbia. Aspen Applied Science Ltd for the Ministry of Environment , Lands and Parks Water quality Section, Website:
http://www.env.gov.bc.ca/wq/BCguidelines/temptech/index.html

Pinsent, M.E. 1964. Population Survey of Upper Dogpound Creek, 1964. Unpublished Report, Fish and Wildlife Division, Alberta.

[a]Rees, K. 1988. A Fisheries Phase II Survey Of The Dogpound Creek Watershed (NE 9-33-3-W5). Forestry, Lands and Wildlife, Fish and Wildlife Division.

[b]Rees, K. 1988. A Fisheries Phase II Survey in the Little Red Deer River Watershed. Forestry, Lands and Wildlife, Fish and Wildlife Division.

Scott, W.B., and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada Bulletin 184.

Strong, W.L, and K.R. Leggat. 1992. Ecoregions of Alberta. Land Information Services Division, Alberta Forestry, Lands and Wildlife, Edmonton, Alberta, Canada.

Van Deventer, J.S., and W.S. Platts. 1989. Microcomputer software system for generating population statistics form electrofishing data-users guide for Microfish 3.0. U.S. Forest

Service General Technical Report INT-254.

White, G.C., D.R. Anderson, and D.L. Otis. 1982. Capture-Recapture and Removal Methods for Sampling Closed Populations. Los Alamos National Laboratory. LA-8787-NERP.

Wieliczko, J., and C. McLeod. 2000. Upper Little Red Deer River Fisheries Investigation, 1998. Alberta Conservation Association, Cochrane Alberta.
Notes: Prepared for Natural Resource Services, Fisheries Management Canmore Alberta.

Wieliczko, J. 2002. Brown trout Spawning Survey for the Upper Little Red Deer River, 2004. Internal Memo, Alberta Conservation Association, Cochrane, Alberta.
Notes: Prepared for Natural Resource Services, Fisheries Management Canmore Alberta.

Zippin, C. 1958. The removal method of population estimation. Journal of Wildlife Management 22: 82–90.

APPENDICES

Appendix 1. Electrofishing sample site summary table for the Little Red Deer River, Dogpound Creek and Beaverdam Creek, 2003

Site name	BVDM 1	BVDM 2	DGPD 1	DGPD 2	DGPD 3	LRDR
Waterbody	Beaverdam Creek	Beaverdam Creek	Dogpound Creek	Dogpound Creek	Dogpound Creek	Little Red Deer River
Location UTM start	11U 686336/ 5712511	11U 682163/ 5696845	11U 684315/ 5717695	11U 681205/ 57073114	11U 669588/ 5698637	11U 670166/ 5714852
Location UTM finish	11U 686536/ 5712275	11U 681113/ 5707720	11U 684248/ 5718496	11U 681113/ 5707720	11U 669308/ 5698347	11U 672230/ 5716936
Date sampled	June 30, 2003	June 30, 2003	July 3, 2003	July 2, 2003	July 4, 2003	July 13, 17, 24, 2003
Length (m)	500	500	1000	1200	480	4300
Effort (sec)	NA	1636, 2323, NA	5225,NA, 3527	5853, 3127, 3063	2047,2146, 1507	Timer malfunction
Type of electrofisher	Back Pack Type 12	Back Pack Type 12	Punt - Coffelt	Punt -Coffelt	Back Pack Type 12	Boat -Coffelt
Type of Pop'n est.	Removal	Removal	Removal	Removal	Removal	Mark/Recap
Mean depth (m)	0.33	0.23	0.54	NA	0.18	0.36
Mean wetted width (m)	2.97	3.39	5.16	NA	6.37	18.9
BKTR	0	50	0	0	0	0
BNTR	1 (0.5%)	0	8 (0.7%)	25 (3.6%)	33 (21.2%)	92 (16.1%)
BURB	0	0	2 (0.1%)	0	0	14 (2.5%)
MNWH	0	0	1 (0.1%)	1 (0.1%)	0	148 (25.9%)
BKSC	5 (2.5%)	NA	15 (1.3%)	0	0	0
LNDC	166 (83.5%)	NA	147 (12.3%)	59 (8.5%)	22 (14.1%)	50 (8.8%)
LNSC	4 (2.0%)	NA	204 (17.0%)	2 (0.3%)	7 (4.5%)	73 (12.8%)
LKCH	9 (4.5%)	NA	55 (4.6%)	17 (2.4%)	0	19 (3.3%)
PRDC	0	NA	0	0	14 (9.0%)	0
TRPR	0	NA	25 (2.1%)	38 (5.5%)	0	12 (2.1%)
WHSC	14 (7%)	NA	740 (61.8%)	554 (79.6%)	2 (1.3%)	164 (28.8%)
Total	199 (398 fish/km)	50 (100 fish/km)	1197 (1197 fish/km)	696 (696 fish/km)	78 (156 fish/km)	572 (133 fish/km)

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Waterbody	Beaverdam Creek	Beaverdam Creek	Dogpound Creek	Dogpound Creek	Dogpound Creek	Little Red Deer River
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Location UTM finish	686536/ 5712275	681113/ 5707720	684248/ 5718496	681113/ 5707720	669308/ 5698347	0672230/ 5716936
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Type of electrofisher	Back Pack Type 12	Back Pack Type 12	Punt - Coffelt	Punt -Coffelt	Back Pack Type 12	Boat -Coffelt
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LNDC	166 (83.5%)	NA	59 (8.5%)	147 (12.3%)	22 (14.1%)	50 (8.8%)
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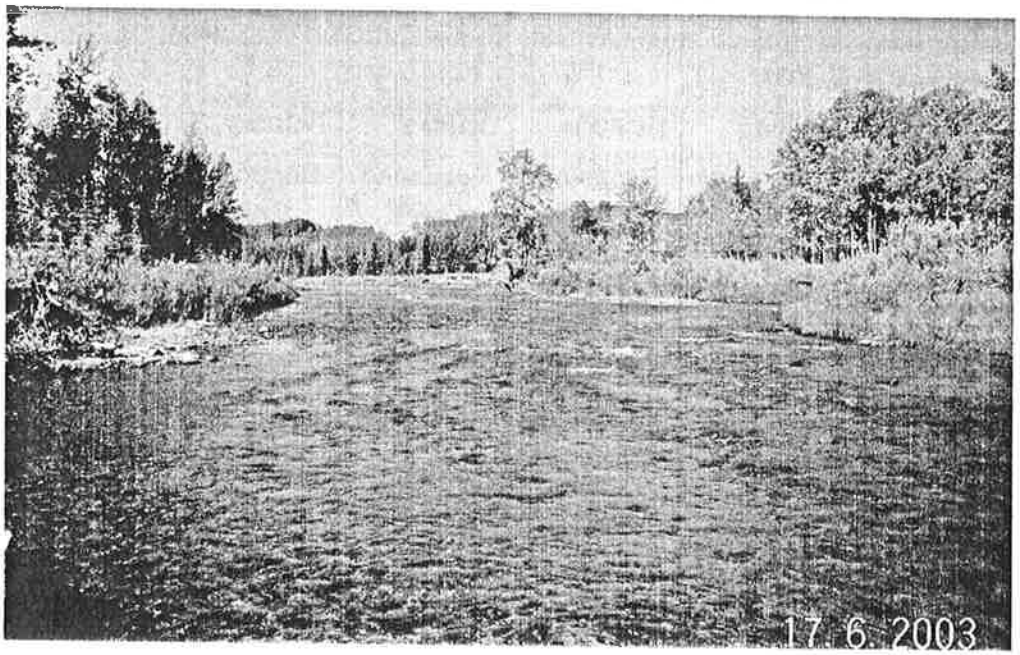
Total	199 (398 fish/km)	50 (100 fish/km)	696 (696 fish/km)	1197 (1197 fish/km)	78 (156 fish/km)	572 (133 fish/km)

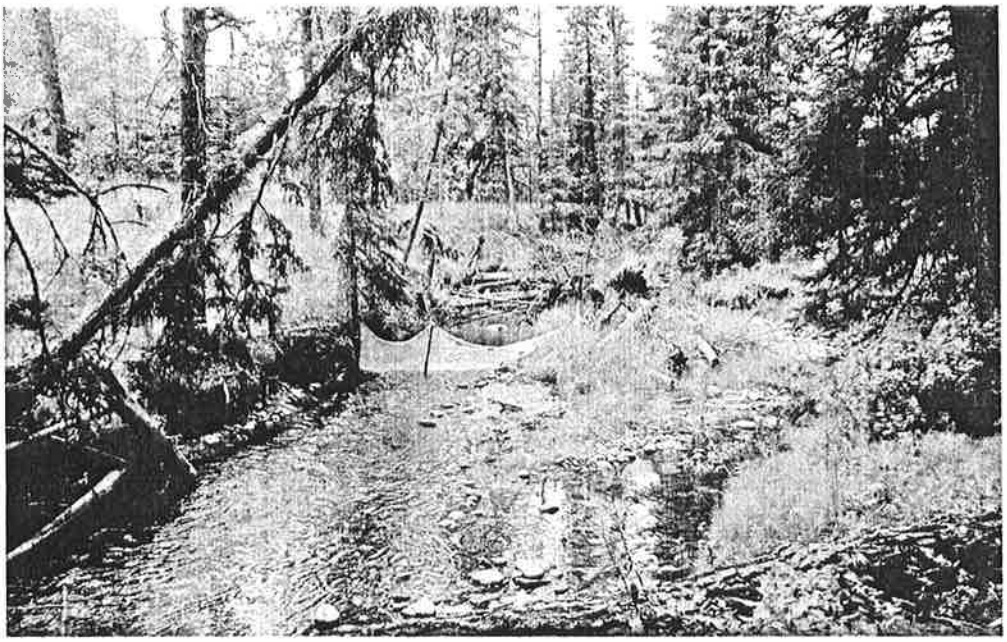
Appendix 2. Little Red Deer River at site LRDR looking upstream June 17 2003.



Appendix 3. Fisheries inventory crew taking time to talk with a landowner tour group from Mountain View County at Dogpound Creek, DPGD1, July 2003 (photo by Lesley Gavelin).

Appendix 4. Inventory crew checking fish in holding cage on Dogpound Creek, Site DGPD2. Property has stream bank fencing and developed livestock watering areas.

Appendix 5. Upper blocking net on Dogpound Creek at site DGPD3 below log jam.



Appendix 6. Beaverdam Creek, site 2 looking downstream at Highway at 568 in the background, July 2003.

Appendix 7. Beaverdam Creek at site BVDM2 looking upstream within protected riparian area.