A Summary of Sport Fish Communities in Seven High Mountain Lakes in Southwest Alberta

Alberta Conservation Association

The Alberta Conservation Association is a Delegated Administrative Organization under Alberta's Wildlife Act.

25% Post Consumer Fibre
When separated, both the binding and paper in this document are recyclable

A Summary of Sport Fish Communities in Seven High Mountain Lakes in Southwest Alberta

Michael Jokinen

Alberta Conservation Association
1ST Floor Provincial Building,
Box 1139, 12501 – 20th Ave,
Blairmore, Alberta, Canada T0K 0E0

Alberta Conservation Association®

Report Series Co-editors

GARRY J. SCRIMGEOUR
Alberta Conservation Association
P.O. Box 40027
Baker Centre Postal Outlet
Edmonton, AB, T5J 4M9

DAVID FAIRLESS
Alberta Conservation Association
7th Floor, OS Longman Building
6909, 116th Street
Edmonton, AB, T6H 4PZ

Conservation Report Series Type
Data, Technical

ISBN printed: 0-7785-4817-1
ISBN online: 0-7785-4818-X
Publication No.: T/116

Suggested Citation:

Jokinen, M. 2005. A summary of sport fish communities in seven high mountain lakes in Southwest Alberta. Data Report, D-2005-010, produced by Alberta Conservation Association, Blairmore, Alberta, Canada. 19 pp + App.

Cover photo credit: David Fairless

Digital copies of conservation reports can be obtained from:
Alberta Conservation Association
P.O. Box 40027,
Baker Centre Postal Outlet
Edmonton, AB, T5J 4M9
Toll Free: 1-877-969-9091
Tel: (780) 427-5192
Fax: (780) 422-6441
Email: info@ab-conservation.com
Website: www.ab-conservation.com

EXECUTIVE SUMMARY

The 2004 assessment of sport fish communities in high mountain lakes represented a collaborative effort between Alberta Sustainable Resource Development, Shell Canada Ltd. and the Alberta Conservation Association (ACA). In 2004, the ACA assessed sport fish communities in seven high mountain lakes using test netting and test angling methods. These data were contrasted to previous data on sport fish communities collected between 1968 and 1991. Of the seven lakes assessed, three contained one of three species each i.e., cutthroat trout, rainbow trout, or brook trout and four contained golden trout.

A total of 22 cutthroat trout were netted in Phillipps Lake while angling resulted in a total of 7 trout and a catch-per-unit-effort (CPUE) of 0.93 fish/hour of test angling. Phillipps Lake had the highest angling CPUE of all the high mountain lakes.

A total of 22 rainbow trout were gill-netted over a 16-hour period at Window Mountain Lake, while the CPUE ranged from 0.53 on day one to 0.35 trout/hour on day two. The 1977-1990 voluntary creel average CPUE for Window Mountain Lake was 0.36 trout/hour.

A total of 24 brook trout were captured during 28 hours of gill netting at Grizzly Lake. Grizzly Lake had a CPUE of 0.86 brook trout/hour. The brook trout population in Grizzly Lake proves to be self-sustaining since the lake's last trout stocking was in 1962.

Lower Southfork Lake produced the most golden trout compared to Upper Southfork and Barnaby lakes with 21 golden trout gill-netted within 3 hours and a CPUE of 0.20 golden trout/hour of test angling. Some habitat alterations may enhance these three fisheries. The Alberta Fish and Wildlife Division have conducted golden trout fry transfers from Rainy Ridge Lake to Southfork lakes and Barnaby Lake over the years. The 2004 aging results show that some natural reproduction may have occurred in Lower Southfork Lake but without these trout transfers the lakes would likely become fishless overtime. The golden trout transfers are conducted approximately every other year and appear to be successful at sustaining trout numbers in the three lakes.

Rainy Ridge Lake had a CPUE of 0.45 golden trout/hour in 2004, the highest CPUE of the four golden trout lakes. The voluntary creel average CPUE at Rainy Ridge Lake during 1981-1990 was much lower at 0.18 fish/hour. Rainy Ridge Lake had the highest gill net captures at 32 golden trout within 8.5 hours and 57 golden trout within 12 hours. The Rainy Ridge Lake population estimate increased since the 1988 estimate of 532 trout to 912 golden trout (>471 and <6804) in 2004.

The trout populations at these seven high mountain lakes appear to be stable with current angling pressures and current stocking or natural reproductive rates. Habitat improvements at the outlets of some of the lakes may encourage self-reproduction and enhance the total fish population within the lakes.

ACKNOWLEDGEMENTS

A number of individuals and organizations must be acknowledged for their contributions to this project. In particular I thank D. Genereux, B. Taylor, C. Jokinen, J. Hall, M. Neufeld, T. Clayton and L. Ripley for assisting with field collections. Shell Canada Ltd. provided funding to cover the use of a helicopter to access the high mountain lakes and D. Wig, Alberta Sustainable Resource Development (Fish and Wildlife Division) provided additional field equipment and assistance. L. Bilyk and L. Matthias, Alberta Sustainable Resource Development, provided valuable assistance with database management. Lastly, I thank D. Wig, T. Council, and T. Johns for editing the earlier version of this report and J. Blackburn for aging of the otoliths.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

High mountain lakes in southwest Alberta represent important sport fisheries in Alberta. Effective management of these fisheries requires monitoring of the presence, abundance, size, and age structure of these populations. This information assists with fisheries management by determining if a lake requires additional stocking of fish to maintain desired population levels.

Despite the importance of high mountain lakes to provide angling opportunities, our previous efforts have shown that there is general lack of information on the abundance and population structure of sport fish communities in these lakes. In deed, our data review showed a general absence of recent data and that the majority of data were limited to voluntary creels and outdated surveys.

In response, the Alberta Conservation Association initiated a collaborative partnership with Alberta Sustainable Resource Development (ASRD) and Shell Canada Ltd. to obtain information on the sport fish communities in seven high mountain lakes. The limited voluntary creel information indicates that there are poor angler catch rates. As a result, there was a need to verify the status of these trout populations in these important fisheries. These data contribute to the development of management objectives by Government resource managers. In 2004, the following seven high mountain lakes were assessed: Phillipps, Window Mountain, Grizzly, Upper and Lower Southfork, Barnaby and Rainy Ridge lakes. Phillipps and Window Mountain lakes are visited frequently by recreational users because they are easily accessible, but the other high mountain lakes are only visited by the ambitious angler, day hiker, hunter or backpacker due to the lengthy and physical hikes required to access them. These fisheries are unique for their aesthetic value, solitude and fish species composition.

The seven sport fish communities were assessed using test netting and test angling methods. The specific objectives of the study were to:

- Quantify the presence, abundance and size and age class structure of golden, rainbow, cutthroat, and brook trout populations in seven high mountain lakes.

- To provide insight into the poor angler returns documented through voluntary creel returns.
- To make the data available to ASRD to update and develop management plans, fisheries management objectives, and provide a basis for regulation change.

2.0 STUDY AREAS

2.1 Description

Assessments of sport fish populations were completed in the seven high mountain lakes in 2004. All seven lakes are located in southwest Alberta within ACA's Southern Business Unit (SBU), and the Eastern Slopes, ES1 Fish Management Zone (Figure 1).

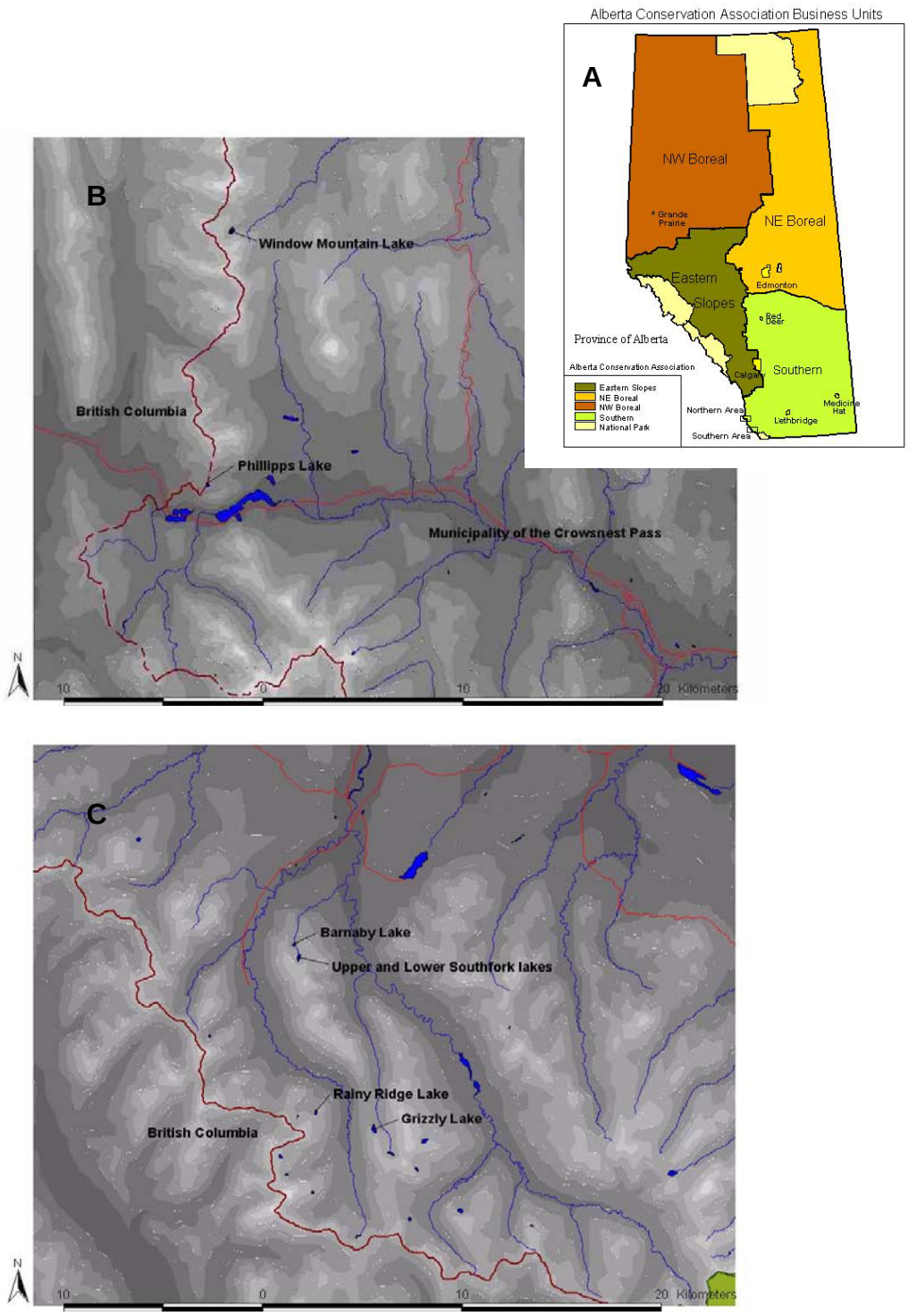


Figure 1. Assessment locations within the Southern Business Unit (A), location of Phillipps and Window Mountain lakes (B) and Barnaby, Upper and Lower Southfork lakes and Rainy Ridge and Grizzly lakes (C) in southwest Alberta.

2.2 Fish populations

The study area is occupied by one native salmonid, the cutthroat trout (*Oncorhynchus clarkii*), and three non-native salmonids, the rainbow trout (*O. mykiss*), golden trout (*Oncorhynchus O. m. aguabonita*), and brook trout (*S. fontinalis*), as well as a cutthroat trout/rainbow trout hybrid (*O. clarki x mykiss*). These high mountain lakes were all naturally fishless prior to introductions (i.e., stockings) of sport fish species.

2.3 Individual study lakes

2.3.1 Phillipps Lake

Phillipps Lake, also known as Summit Lake, is located in Phillipps Pass on the Alberta-British Columbia (BC) border (elevation 1577 m). The lake is accessible via non-paved roads in Alberta and British Columbia. The provincial boundary between Alberta and British Columbia passes through the lake and anglers holding a license issued in either Alberta or British Columbia are permitted to fish this lake. The lake does not have a permanent inlet or outlet and thus, water flow is subterranean and reliant on precipitation. Phillipps Lake has previously been stocked with rainbow trout, kokanee (*O. nerka*) and, inadvertently, lake trout (Clements 1972, Fitch 1980a). Sport fish populations in the lake were previously assessed in 1972 and most recently in 1980. Phillipps Lake has been stocked with cutthroat trout since 1980 and has been restocked biannually over the past decade (ASRD Fish Stocking Report, water body ID 5568, 2004).

The lake has been regularly monitored for dissolved oxygen during the winter, since it is a relatively small lake with limited water circulation. Some winterkill may occur in Phillipps Lake (D. Wig, Alberta Sustainable Resource Development, Fish and Wildlife Division. pers. comm.) but it has never been documented to have completely winterkilled. I recently tested Phillipps Lake for dissolved oxygen in March of 2004 and recorded 7.5 mg/L at the lake surface and 3.70 mg/L at the lake bottom. Fitch (1980a) stated that invertebrate biomass in Phillipps Lake exceeded all other lakes surveyed in southern Alberta during the 1979 assessments. The majority of the biomass consisted of a leech species, but the lake also had significant amounts of Amphipoda

and Tricoptera. Kokanee appeared to thrive on the ample amounts of leeches in the lake (Clements 1972). No natural reproduction occurs in Phillipps Lake and stocking is necessary to maintain the heavily angled fishery.

2.3.2 Window Mountain Lake

Window Mountain Lake is situated in a subalpine cirque created by Mount Ward at an elevation of 1935 m. Window Mountain Lake is supplied with water from snowmelt and subterranean springs. An outlet stream is located at the east end of the lake that flows for approximately 50 m before discharging into a small pond and subsequently going underground. The outlet stream provides spawning habitat for the rainbow trout at Window Mountain Lake that spawn primarily during late June and early July. Sport fish populations in Window Mountain Lake were previously surveyed in 1962, 1972, 1977 and 1979 (Fitch, 1980b). The lake has been stocked since the 1950's with both rainbow and cutthroat trout with the most recent stocking occurring in September of 1985 (ASRD Fish Stocking Report, waterbody ID 6172, 2004).

2.3.3 Grizzly Lake

Grizzly Lake is located in a cirque basin along Barnaby Ridge. It is at an elevation of 1943 m with no inlet stream and one outlet, which flows into Grizzly Creek. Grizzly Creek is formed from the outlet of Ruby Lake, which is a fishless lake located just south of Grizzly Lake. Grizzly Lake is accessible by foot, cycling or horseback along a lengthy old and rugged petroleum exploration trail. The confluence of Grizzly Creek is accessible by 4x4 vehicles along the South Castle River. The trail crosses the South Castle and follows the valley to Grizzly Lake. Fishing pressure at Grizzly Lake is most likely low due to its isolated location and limited access. Prior to special management area closures, the lake was accessible by off-road vehicles and likely experienced more fishing pressure at that time. A total of 12,300 brook trout were stocked in Grizzly Lake in 1961 and 1962 (ASRD Fish Stocking Report, waterbody ID 4752, 2004) as well as 6,300 rainbow trout in 1961 (Fitch 1977a). During the 1977 lake survey, Fitch (1977a) did not encounter any rainbow trout, suggesting that the outlet stream was limiting to rainbow trout from self-reproducing. The lake has not been stocked since 1962. The

lake supports a population of self-sustaining brook trout that reproduce in the lake rather than in the outlet (Fitch 1977a).

2.3.4 Upper Southfork Lake, Lower Southfork Lake and Barnaby Lake

Upper Southfork Lake is one of three lakes situated north of Southfork Mountain on Barnaby Ridge. Steep cirque cliffs surround Upper Southfork Lake at 2027 m. The Upper Southfork Lake drains into Lower Southfork Lake which is located at an elevation of about 2 m lower than Upper Southfork Lake. Lower Southfork Lake flows into Barnaby Lake (elevation 1920 m). Barnaby Creek drains Barnaby Lake, flowing down the valley until it reaches the South Castle River.

These lakes were first stocked with golden trout in 1959 in an attempt to establish a brood stock population of golden trout in Alberta (Clements 1968). The initial fingerlings came from Wyoming and the lakes were closed to angling until 1965. The lakes provide little to no habitat for golden trout to reproduce naturally, thus the lakes have required continual stocking to maintain the fish populations. Since 1989, the lakes have been stocked biannually by transferring golden trout fry from Rainy Ridge Lake, typically during the month of September (D. Wig, Alberta Sustainable Resource Development, Fish and Wildlife Division. pers. comm.). Approximately 200-300 fry are released into each lake during these relocations.

While Upper Southfork Lake, Lower Southfork Lake and Barnaby Lake represent a series of interconnected lakes, fish movement continues to be limited. Some initial habitat improvements were conducted between the lakes in 1977, improving the runs between the lakes (Radford 1977a, Clements 1968). Debris was removed between the Upper and Lower Southfork lakes, making upstream movement possible at the time. Currently, the run between the lakes is overgrown with vegetation and is likely a barrier to upstream movement, although fish may be able to move from the Upper Southfork Lake to the Lower Southfork Lake. A screen was placed at the outlet of Lower Southfork Lake to prevent fish from moving downstream since the waterfall barriers below would inhibit them from moving back up. Gravel and rock were also placed into the outlet above the screen to provide spawning habit. This screen no longer exists. Barnaby Lake had a fish screen placed in the outlet to provide a

spawning stream section but inhibit fish from leaving the system. This screen is present but no longer provides a barrier to fish movement downstream. During the 1970's, spawning was observed in the enhanced sections of streams in both Lower Southfork Lake and Barnaby Lake (Radford 1977a). Today, some spawning may occur in the outlet of Barnaby Lake (D. Wig, Alberta Sustainable Resource Development, Fish and Wildlife Division. pers. comm.).

In 1975, a voluntary creel survey register was put at the lakes trailhead and was then moved to Barnaby Lake in 1977. In 1977, 102 anglers registered in the voluntary creel (Radford 1977b). During the 1977 creel, the catch rates varied greatly and no fish were angled in Upper Southfork Lake while most came from Lower Southfork Lake. The Upper Southfork Lake was snorkeled in 1976 and was void of fish (Radford 1976). Therefore, fish did not naturally reproduce in the Upper Lake and migration from the Lower Lake did not occur.

2.3.5 Rainy Ridge Lake

Rainy Ridge Lake is in a cirque basin at an elevation of 1943 m along the continental divide. The lake has one inlet that drains a small fishless lake (Upper Rainy Lake) immediately above Rainy Ridge Lake and one outlet that drains into the West Castle River. Rainy Ridge Lake was stocked with golden trout in 1969 (Fitch, 1977b, ASRD Fish Stocking Report, waterbody ID 6701, 2004). The trout are self-sustaining, spawning in the outlet of the lake. The flows in the outlet remain adequate throughout most years, allowing the fry to rear in the stream. Several fry become trapped in the outlet in late fall and likely do not survive the winter months (Fitch, 1978). For this reason, Rainy Ridge Lake has been used to stock the other golden trout lakes. The gradient of the outlet eventually increases and barriers dominate the lower sections of the outlet. Some golden trout are lost from the lake system as they move down the outlet.

A population estimate was conducted on Rainy Ridge Lake in 1988 with a sample size of 41 trout. There were only two recaptures and the population estimate was 532 trout (>115 and <3460) (English, 1988). A voluntary creel census at Rainy Ridge Lake from

1981 to 1990 averaged a catch-per-unit-effort (CPUE) of 0.18 fish/hour with angling pressure increasing near the 1990s (English, 1991b).

3.0 METHODS

3.1 High Mountain Lake assessments

The high mountain lakes were each sampled once during the open water period in 2004. Rainy Ridge Lake, that supports a self-reproducing golden trout population, was sampled at the end of July to ensure that all spawning activity was completed. Five of the lakes were accessed by helicopter due to their remote location and the amount of sampling and personal gear required while two additional lakes were accessed on foot and by vehicle. Most lakes required an overnight stay to ensure that sufficient samples were obtained.

The occurrence and abundance of sport fish populations were assessed using the two methods of test netting and angling. Both methods define fish abundance in terms of CPUE. Test netting was completed by setting two multi-mesh monofilament sinking gill nets in each lake for approximately 2 to 3 hours, until a minimum sample of 20 to 30 trout were processed and released. Nets were set for short durations to minimize mortality of trout. However, a minimum number of trout were kept for aging purposes.

A large gillnet consisted of eight 25-foot panels, consisting of 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0 and 6.0-inch mesh sizes. The 5.0 and 6.0-inch mesh panels were tied off and not used in sampling because these sizes were considered too large for the trout inhabiting these waters. A second net consisting of a 50-foot panel of ¾-inch monofilament was also used. The larger mesh was always set in the deepest portion of the lake. Nets were deployed by feeding the net from the lake shore towards the centre of the lake. Nets were deployed using a safety certified float tube used by anglers (i.e., a belly boat). The nets were retrieved by lifting the anchor from the lake bottom and pulling them to shore. Once at shore, fish were removed from the nets and placed into individual holding tanks to separate catches form the individual net panels. Fish were then processed and released. The ¾-inch mesh net was set in shallower water, using the same method for setting and pulling as described above. An inflatable boat was used at

Rainy Ridge Lake to ensure minimal fish mortality. Nets were pulled continually to check for any captures (approximately every hour). It was decided that this sampling intensity would be more efficient with a boat because the net could be checked from the boat, eliminating the need to pull the net into shore each time.

Sample angling was conducted to supplement the sample size and to provide CPUE data that would compare with previous voluntary creel data. The data collected from the test net included relative abundance, growth rate, and size distribution. Voluntary creel boxes were checked and restocked as required.

3.2 Site selection, site location and water quality

The high mountain lake net set locations were determined after reviewing hydrographics of each lake (Swenson 2002) identifying the deepest portion of the lake for setting the large gill net and a shallower location for setting the smaller net. Survey site locations were geo-referenced (NAD 83) in the field as UTM locations using a Garmin 12 GPS unit. Water temperature (^{o}C), conductivity (µS/cm) and pH were recorded using a YSI model 63 conductivity meter. The waypoint location and water quality measurements were taken near the deepest portion of the lake, typically from the offshore end of the large gill net. Site location, water quality and fish sampling data were recorded on field inventory forms (see Appendix 1 and Appendix 2).

3.3 Fish sampling

The focus of the biological assessment was to sample each fish encountered in the gill net. Each fish sampled was identified to species (Nelson and Paetz, 1992). Fish were measured in fork length to the nearest millimeter and weighed to the nearest gram using a Pelouze SP5 digital postal scale. Fork length is defined as the straight-line distance from the most anterior point of the snout to the central part of the caudal fin (tail fin) margin (Nelson and Paetz, 1992).

3.4 Data management

All data collected were entered into Microsoft Excel load forms in the Fisheries Management Information Systems (FMIS) database. The completed forms were loaded into the FMIS database and can be accessed in FMIS using the project code 5417.

4.0 RESULTS

4.1 Phillipps Lake

A sinking gill net was set during the day on 24 June and 25 June 25. Nets were set for 1.5 hours at a time to limit mortality. A total of 22 cutthroat trout were captured during 6.5 hours of soak time. Test angling (fly-fishing, lure casting, fly/bait casting) also produced a small number of cutthroat trout. The CPUE was 0.93 fish/hour of angling. Fish species, fork length and weight were recorded and otoliths were extracted for aging (Mackay et al., 1990). There are no age results for the Phillipps Lake cutthroat trout because the otoliths were transparent, with no distinct annuli. Since 1998, Phillipps Lake has been stocked with cutthroat trout every 2 years (ASRD Fish Stocking Report, waterbody ID 5568 2004). According to these stockings, Phillipps Lake should only have even aged trout starting at 2 years of age (stocked in September of 2002).

4.2 Window Mountain Lake

Two gill nets were set for 3.5 hours during daylight hours on 28 June 2004. The majority of the fish sampled appear to be cutthroat trout/rainbow trout hybrids, but due to a lack of genetic confirmation, the species will be considered rainbow trout throughout this document. A total of 22 rainbow trout were captured during the 16-hour set period. Test angling based on fly-fishing, and lure casting produced a small number of rainbow trout of approximately 300 mm in length. The CPUE on the first and second days were 0.53 fish/hour and 0.35 fish/hour, respectively. All rainbow trout were captured using flies during test angling. The CPUE average for voluntary creel surveys taken from Window Mountain Lake from 1977 to 1990 was 0.36 (English 1991a). The majority of the rainbow trout that were within 250 to 300 mm in length

were sexually mature. Otolith analysis suggests that rainbow trout at this length are 8 to 12 years old (Figure 2).

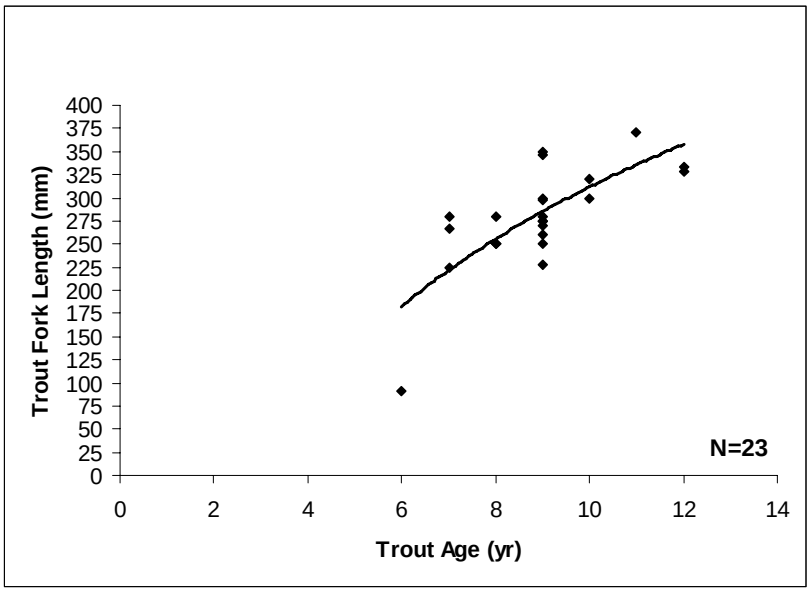


Figure 2. Relation between fork length and age of rainbow trout in Window Mountain Lake, Alberta, 2004. Ages were derived from otolith analysis.

Few immature trout were sampled at Window Mountain Lake. The majority of the sampled rainbow trout were considered mature and were either ripe or spent. A 6 - year old rainbow trout measuring 91 mm was immature and its sex was unknown. The rainbow trout were exhibiting spawning behaviour in and near the outlet of the lake during this survey.

4.3 Grizzly Lake

Two sinking gill nets were set for 4 hours during daylight hours on 5 July and overnight for an additional 10 hours for a total of 28 hours. During the day and night sets, a total of 13 and 11 brook trout were captured, respectively. Test angling, utilizing both flies and lures captured 6 brook trout, ranging in fork length from 300 to 350 mm. The angling CPUE was 0.86 brook trout/hour. Both angling methods appeared to be equally successful. Except for one fish (105 mm), all brook trout ranged between 300 to 350 mm in length and according to Fitch (1977a) fish of this length are likely 5 to 7 years

old. Brook trout in Grizzly Lake appear to grow rapidly during the first few years. For example, in 1977, a 2-year old fish was already 200 mm in length and the maximum age encountered at the time was 11 years old and 352 mm in length (Fitch 1977a). The 2004 ages (Figure 3) appear to differ from the previous aging records.

Figure 3. Relation between fork length and age of brook trout in Grizzly Lake, Alberta, 2004. Ages were derived from otolith analysis.

The youngest brook trout collected from Grizzly Lake was a 4-year old fish with a fork length of 105 mm. The majority of the brook trout collected in Grizzly Lake ranged between 7 to 11 years of age. These brook trout appear to reach a peak fork length of 300 to 350 mm.

4.4 Upper Southfork, Lower Southfork and Barnaby lakes

Two sinking gill nets were set during the day in Upper Southfork Lake on 12 July and a total of 20 golden trout were captured during the 12-hour set period. Two additional golden trout were captured, one overnight during a 13-hour period and another during an additional 6-hour period in the morning. The CPUE in Upper Southfork Lake was 0.10 golden trout/angler hour. One golden trout was angled using a lure during 10.25 hours of angling.

In Lower Southfork Lake, a total of 21 golden trout were captured within a 3-hour net set period on 13 July. Flies and lures were used while test angling Lower Southfork Lake, but only lures captured trout. The CPUE in Lower Southfork Lake was 0.20 golden trout/hour. Several golden trout were surfacing on Lower Southfork Lake, while no golden trout were observed surfacing on the Upper Lake. Few fish were sampled in Upper Southfork Lake therefore no age data is available. The majority of the golden trout sampled in Lower Southfork Lake appear to be 5 years of age (Figure 4).

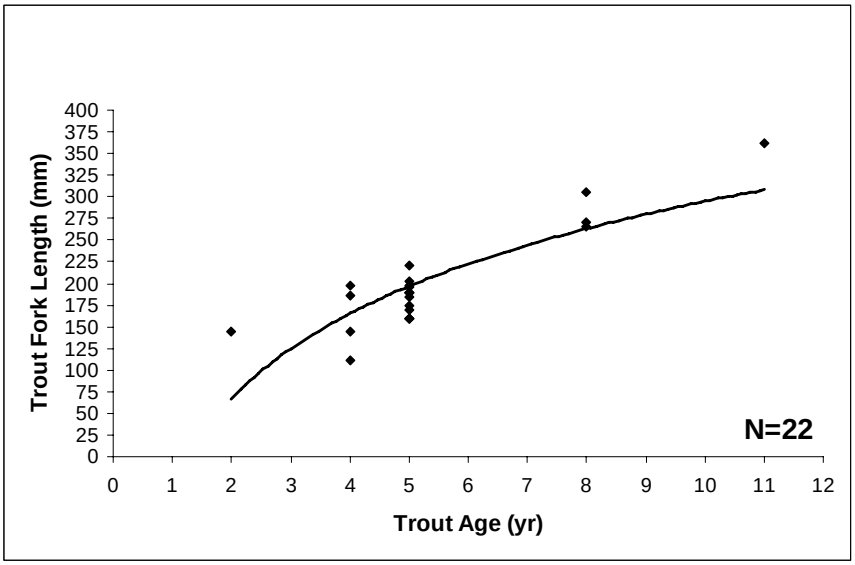


Figure 4. Relation between fork length and age of golden trout in Lower Southfork Lake, Alberta, 2004. Ages were derived from otolith analysis.

One sinking gill net was set overnight on 13 July and two were set during the day on 14 July in Barnaby Lake. A total of 18 golden trout were captured during 3 hours of soak time. A total of 3.75 hours was spent angling with flies and lures but did not result in the capture of any fish. The legal size restriction for keeping a golden trout in Barnaby Lake is a total length of 400 mm. The largest fish sampled was 370 mm in fork length and was sampled at Barnaby Lake. Both Southfork lakes had one fish captured that measured approximately 370 mm in length.

While few fish were kept for aging from Barnaby Lake (n = 7), they ranged from 5 to 8 years of age, similar to that in Southfork Lake. If the trout ages were to follow the years in which Lower Southfork Lake was stocked (considering no natural reproduction), then trout ages should have included 2, 5, 7, 8 and 9-year olds (1996 transfer consisted of fry and some 1-year old fish) and 13-year old fish (D. Wig, Alberta Sustainable Resource Development, Fish and Wildlife Division. pers. comm.). While low sample sizes preclude definitive conclusions on the expected age structure, it appears that the age structure of fish in Lower Southfork lake do not follow that expected from stocking activities (Table 1.). Data collected in 2004 revealed the presence of four 4-year old fish and an 11-year old fish, suggesting that some natural reproduction may have occurred in Lower Southfork Lake.

Table 1. Golden trout stocking history in Southfork and Barnaby lakes.

Year	Upper Southfork	Lower Southfork	Barnaby	Age in 2004
1989	400	0	0	15
1990	200	0	0	14
1991	300	200	200	13
1996	0	117	117	8
1997	113	0	0	7
1998	NS	NS	NS	
1999	350	350	350	5
2000	NS	NS	NS	
2001	NS	NS	NS	
2002	230	230	230	2
2003	NS	NS	NS	
2004	300	130	130	N/A

NS-no stocking due to low water conditions in Rainy Ridge outlet

N/A- not applicable, this stocking occurred after the survey

4.5 Rainy Ridge Lake

Two sinking gill nets were set during the day on 27 July in Rainy Ridge Lake and resulted in the capture of 32 golden trout during a total of 8.5 hours. All trout were fin-clipped to conduct a population estimate similar to that conducted in 1988, by marking one day and recapturing the next. The following day, 28 July, each net was placed in the water for 12 hours and resulted in the capture of 57 golden trout. A total

of 2 golden trout were recaptures from the day before. The fish captured and released on the second day were fin-clipped differently than fish on the first day to differentiate the two marking events. A Maximum Likelihood Estimate was used to calculate the population estimate (Haddon 2000) (see Appendix 3). This estimate assumes the probability of capture is constant for all individual fish in the population and the probability of capturing is constant between the two days. The maximum likelihood estimate resulted in an overall population density estimate of 912 golden trout (with 95% confidence intervals of 471 - 6804). This estimate was substantially higher than the population estimate of 532 trout that was conducted in a 1988 estimate. Results from angling revealed an overall CPUE of 0.45 golden trout/hour on both lure and fly. The largest fish sampled was 310 mm in fork length and was well below the 400 mm size restriction. During the 1988 survey, the largest fish captured was 414 mm in length (English, 1988). The majority of the sampled fish in 2004 were between 6 and 10 years of age (Figure 5). Table 2 provides sampling information on all seven high mountain lakes assessed in 2004.

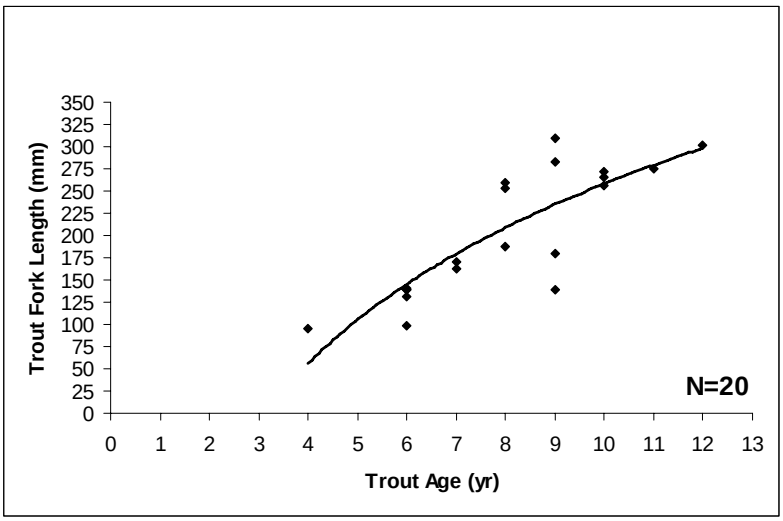


Figure 5. Relation between fork length and age of golden trout in Rainy Ridge Lake, Alberta, 2004. Ages were derived from otolith analysis.

Table 2. Overview of trout netted and catch-per-unit-effort in the seven lakes

Lake sampled	Netting results			Angling results	
	# of trout netted	Species	Total time set	Angling	Catch-per-unit-effort (#fish/hour)
Phillipps	22	cutthroat	6.5	fly/lure	0.93
Window Mtn	22	rainbow	16.0	fly/lure	0.53 and 0.35
Grizzly	24	brook	28.0	fly/lure	0.86
Upper Southfork	22	golden	31.0	fly/lure	0.10
Lower Southfork	21	golden	3.0	fly/lure	0.20
Barnaby	18	golden	36.0	fly/lure	0.00
Rainy Ridge (day1)	32	golden	8.5	fly/lure	0.45
Rainy Ridge (day 2)	57	golden	12.0		

5.0 RECOMMENDATIONS

Based on work completed in 2004, I recommend that discussions of the following issues may assist with the management of sport fish populations in the seven high mountain lakes:

1. Reducing disturbance of streams.

   My observations suggest that foot access currently results in the degradation of the outlet of Window Mountain Lake. Because rainbow trout use this stream reach for spawning, human-induced degradation likely reduces the availability of spawning habitat for the trout. The negative effects of human traffic at Window Mountain Lake could be reduced by installing a bridge crossing over the outlet, minimizing substrate disturbance and stressing of fish. An informational sign could also explain the sensitivity of the area. Window Mountain Lake may require future stocking to maintain an adequate number of trout.

2. Enhancing fish abundance by reducing fish emigration.

The ability of the current fish outflow barrier of Burnaby Lake to reduce emigration is likely poor. As a result, fish are likely leaving the lake. Repair of the barrier could increase fish abundance by reducing rates at which fish leave the lake.

Similarly, an outlet barrier in the Upper Southfork Lake should be evaluated and if required, the addition of a structure could enhance the golden trout population by reducing rates at which they leave without having the ability to return. Lastly, construction of a fish barrier on the outlet of Rainy Ridge Lake would also prevent fish from moving too far downstream where they can no longer return to the lake system.

6.0 LITERATURE CITED

ASRD Fish Stocking Report. 2004. Fish Culture Application, Fish Stocking Report, Available on ASRD Internal Information Network, 2pp.

Clements, S. 1972. Test Netting and Limnology of Summit Lake. Memorandum to D.S. Radford. Alberta Fish and Wildlife Division, Lethbridge, 3pp.

Clements, S. 1968. Upper Southfork Lake: Lake Survey Inventory. Alberta Recreation, Parks and Wildlife. Fish and Wildlife Division, Lethbridge, Alberta. 15 pp.

English, W.G. 1988. Rainy Ridge Lake Survey 16 to 18 August. Alberta Fish and Wildlife Division, Southern, 2pp.

English, W.G. 1991a. Voluntary Creel Census: Window Mountain Lake. Memorandum to F. Bishop. Alberta Fish and Wildlife Division, Southern, 5pp.

English, W.G. 1991b. Voluntary Creel Census: Rainy Ridge Lake. Memorandum to F. Bishop. Alberta Fish and Wildlife Division, Southern, 4pp.

Fitch, L.A. 1977a. Grizzly Lake: Lake Survey Inventory. Alberta Recreation, Parks and Wildlife. Fish and Wildlife Division, Lethbridge, Alberta. 20 pp.

Fitch, L.A. 1977b. Rainy Ridge Lake: Lake Survey Inventory. Alberta Recreation, Parks and Wildlife. Fish and Wildlife Division, Lethbridge, Alberta. 18 pp.

Fitch, L.A. 1978. The Life History of Golden Trout in Rainy Ridge Lake, Alberta with Particular Reference to Observations on Spawning. Alberta Recreation, Parks and Wildlife. Fish and Wildlife Division, Lethbridge, Alberta. 26 pp.

Fitch, L.A. 1980a. Phillipps Lake: Lake Survey Inventory. Alberta Energy and Natural Resources. Fish and Wildlife Division, Lethbridge, Alberta. 22 pp.

Fitch, L.A. 1980b. Window Mountain Lake: Lake Survey Inventory. Alberta Energy and Natural Resources. Fish and Wildlife Division, Lethbridge, Alberta. 21 pp.

Haddon, M. 2000. Modelling and quantitative methods in fisheries. CRC Press. Boca Raton, Florida. 406pp.

Mackay, W.C., G.R. Ash, and H.J. Norris. 1990. Fish ageing methods for Alberta. R.L.&L. Environmental Services Ltd. in assoc. with Alberta Fish and Wildlife Division and University of Alberta, Edmonton. 113pp

Nelson, J.S. and M.J. Paetz. 1992. The Fishes of Alberta. The University of Alberta Press. Edmonton, Alberta. 437 pp.

Radford, D.S. 1976. Upper Southfork Lakes Golden Trout Fishery. Memorandum to C.E. Stenton. Alberta Fish and Wildlife Division, Lethbridge, 1pp

Radford, D.S. 1977a. Southfork Lakes Golden Trout Spawning Runs. Memorandum to C.E. Stenton. Alberta Fish and Wildlife Division, Lethbridge, 3pp

Radford, D.S. 1977b. Southfork Lakes Creel Survey. Report produced by Alberta Recreation, Parks and Wildlife. Fish and Wildlife Division, Lethbridge, Alberta. 15 pp.

Swenson, R. 2002. Lakes, Rivers and Streams of Alberta. Space Maps Incorporated, Spruce Grove, Vol 1, Southern Basins. 423pp. Alberta, Canada.

7.0 APPENDIX

Appendix 1. Field sheet used to define select water quality parameters, location of gill nets and angling effort.

Lake	Date	Personnel

Water quality readings (taken in deep portion of lake)

Time	Depth (meters)	Temperature oC	D.O mg/L	UTM Easting	UTM Northing
	0.25				
	1.0				
	2.0				
	3.0				
	4.0				
	5.0				
	6.0				
	7.0				

Rough sketch of lake and net sets

Sample angling data

Sample #	Length (mm)	Weight (grams)	Sex	Otolith	Lure/Fly	Angler	Time Fished
1							
2							
3							
4							
5							
6							
7							
8							

Appendix 2. Field sheet used to quantify characteristics of sport fish collected from high mountain lakes in Alberta.

FWIN	Time set	Time pulled	Time in	Notes	3/4"	Time set	Time pulled	Time in
set 1					set 1			
set 2					set 2			
set 3					set 3			
set 4					set 4			
set 5					set 5			
set 6					set 6			

Fisheries data (gill nets)

Set (1,2…)	Sample #	Mesh size (inches)	Length (mm)	Weight (grams)	Sex	Otolith	Notes	
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							
	30							
	31							

Appendix 3. Maximum likelihood estimation.

Population Estimate for GLTR: RAINY RIDGE LAKE

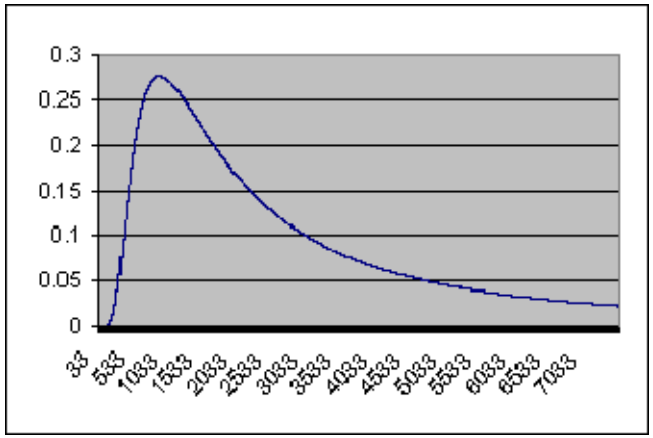
Pop'n Estimate	**912**				
Low CI	**471**	95% Low	0.024794643	KM=0.5	
High CI	**6804**	95% High	0.974973584		

Runs

1	**Marks**	32
2	**Captures**	57
3	**Recaptures**	2

Density total likelihood 718.3871012

Cum. Prob Density	Fish /km	**Pop'n size**	likelihood	Prob density
6.33402E-84	66	33	4.55028E-81	6.33402E-84
4.16223E-68	68	34	2.99009E-65	4.16223E-68
3.86158E-59	70	35	2.77411E-56	3.86158E-59
5.76808E-53	72	36	4.14371E-50	5.76808E-53
2.58724E-48	74	37	1.8586E-45	2.58718E-48
1.28149E-44	76	38	9.20421E-42	1.28123E-44
1.40307E-41	78	39	1.00703E-38	1.40179E-41
5.13679E-39	80	40	3.68013E-36	5.12276E-39
8.21028E-37	82	41	5.86126E-34	8.15892E-37
6.87046E-35	84	42	4.87667E-32	6.78836E-35
3.42508E-33	86	43	2.41117E-30	3.35637E-33
1.11853E-31	88	44	7.78931E-29	1.08428E-31
2.57078E-30	90	45	1.76646E-27	2.45893E-30
4.39536E-29	92	46	2.97289E-26	4.13828E-29
5.83981E-28	94	47	3.87949E-25	5.40027E-28
6.24406E-27	96	48	4.06613E-24	5.66008E-27



The Alberta Conservation Association acknowledges the following partners for their generous support of this project

Alberta Conservation Association