

Fishery Data Series No. 13-44

**Survey of the Rainbow Trout Sport Fishery at
Moraine Creek, 2006**

by

Troy A. Jaecks

September 2013

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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ABSTRACT

The Alaska Department of Fish and Game, Division of Sport Fish, conducted a project to monitor the rainbow trout (*Oncorhynchus mykiss*) fishery at Moraine Creek near the confluence with Funnel Creek in the upper Alagnak River drainage in the Bristol Bay management area. A creel census from 19 August through 29 August 2006 documented 180 angler-days (1171.5 hours) of effort and 1749 rainbow trout caught and released within the study area. Overall catch per unit effort was 1.49 rainbow trout per hour. The typical angler on Moraine Creek was male, guided, and nonresident, and fished from shore using fly-fishing gear. Rainbow trout were sampled for length and weight and averaged 542 mm and 2175 g, respectively. Angler interview data were compared with freshwater logbook entries for guided anglers. This information will be used to monitor and manage the Moraine Creek rainbow trout fishery.

Key words: Rainbow trout, *Oncorhynchus mykiss*, creel survey, Moraine Creek, freshwater logbook comparison

INTRODUCTION

Moraine Creek, in the Bristol Bay management area, is known for its high quality rainbow trout (*Oncorhynchus mykiss*) sport fishery. The creek runs west 39 km from its headwaters to Kukaklek Lake. The confluence of Moraine Creek and Spectacle Lake is 17 km from the creek's headwaters and the Funnel Creek confluence is approximately 24 km from the headwaters (Figure 1). Rainbow trout enter Moraine Creek from Kukaklek Lake in late July to feed on salmon spawn and carcasses. The sport fishery takes advantage of this migration and is most active from late July until early September. Most anglers fishing Moraine Creek are guided nonresidents who fly in daily from the many lodges operating in the Lake Iliamna, Lake Clark, and King Salmon areas. A range of 20 to 40 anglers can be accommodated at any given time at the confluence of Moraine and Funnel creeks where anglers concentrate due to the close distance from float plane access and higher quality fishing habitat. Angling does occur in the lower reaches of Funnel Creek but effort is concentrated on Moraine Creek. These areas were grouped together and referred to as Moraine Creek in this study in order to match the Moraine Creek site code used by commercial guides in the Alaska Department of Fish and Game (ADF&G) freshwater logbook reporting guidelines. Commercial guides also conduct float trips from Spectacle Lake to a location below the study area, and more commonly use Crosswinds Lake as the put-in point for day trips, concentrating effort below the study area. Float trips vary from 1 to 2 days in duration and frequency varies largely depending on water levels.

The Moraine Creek rainbow trout fishery is managed to maintain historic age and size composition and provide a diversity of angling opportunities. By regulation, only fly-fishing and catch-and-release fishing are allowed and the fishery is closed from 10 April through 7 June each year to provide protection to rainbow trout during spawning. Annual fishing effort for all species at Moraine Creek has been estimated by the Statewide Harvest Survey (SWHS) for all but 4 years from 1992 to 2006 with an average of 419 anglers and 852 angler-days per year (Appendix B1). However, the relatively low use rate makes it difficult to estimate fishery parameters using SWHS reporting.

Recently, annual freshwater logbooks (daily records of catch, harvest, and effort that sport fishing guides are required to record) have provided additional information about the effort and catch of rainbow trout, but it is unclear how reliable they are for monitoring the fishery. Creel surveys can facilitate interpretation of SWHS and log book information, but no creel surveys of Moraine Creek have been conducted prior to this study. In addition, length and weight data of rainbow trout catches in Moraine Creek had only been collected sporadically and not published.

The creel survey of the Moraine Creek rainbow trout fishery described here was completed to validate the SWHS and guide logbooks, provide baseline data on size composition of catches, and provide information necessary to address fishery and stock management issues.

OBJECTIVES

The objectives for this study were as follows:

1. Census angler effort in angler-days at Moraine Creek from 13 August through 1 September 2006.
2. Census the proportion of angler-days by angler type (guided or unguided; local, Alaska, United States (U.S.), or non-U.S. residency; and adult or youth) at Moraine Creek from 13 August through 1 September 2006.
3. Estimate the weight and length compositions of the sport catch of rainbow trout at Moraine Creek from 13 August through 1 September 2006 such that the estimated proportions are within 10 percentage points of the actual values 95% of the time.

TASKS

1. Estimate catch per unit effort (CPUE) of rainbow trout at Moraine Creek from 13 August through 1 September 2006.

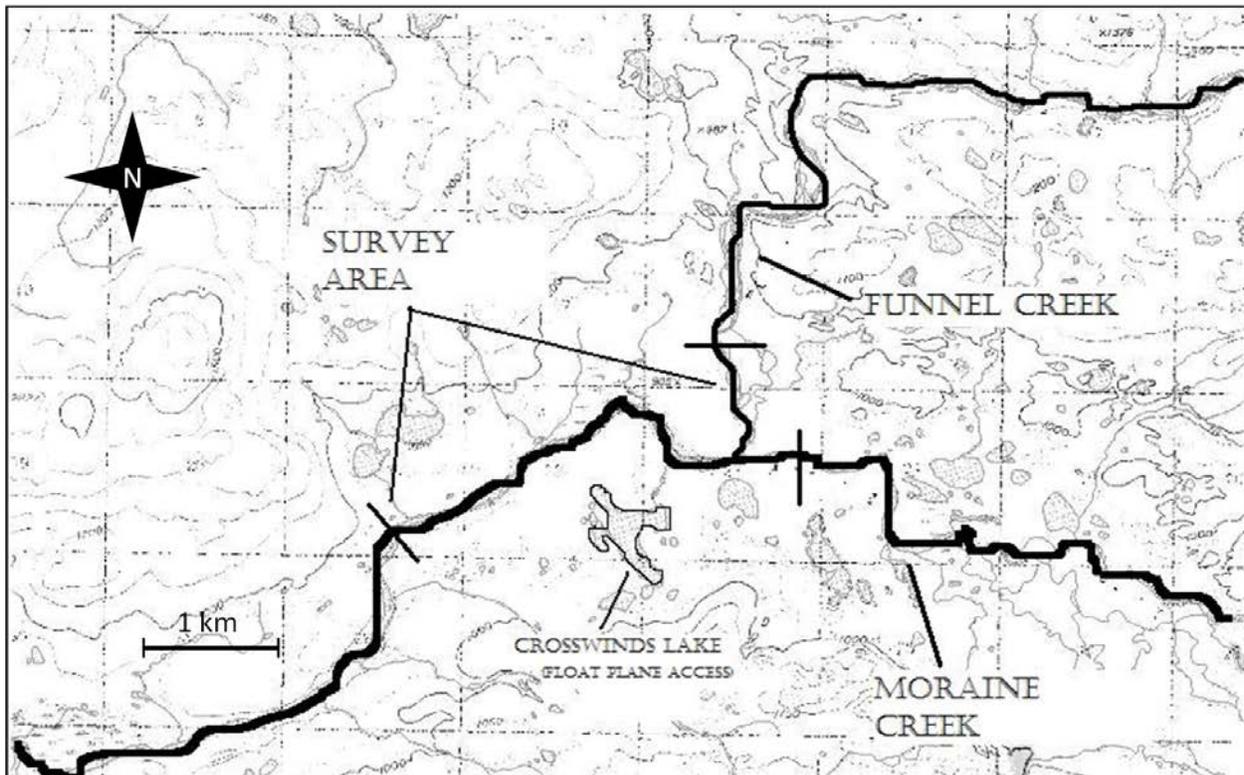


Figure 1.—Moraine Creek survey area; confluence located near 59°12'37"N, 154°57'38"W.

METHODS

STUDY DESIGN

A creel census was used to document angler effort (in units of angler-days), CPUE, and proportion of angler-days by angler type at Moraine Creek during 19–29 August 2006. Late summer is a peak time for this fishery in both popularity and catch rates. Initially the project was scheduled for 13 August through 1 September but inclement weather did not allow ADF&G personnel to reach the survey site until 19 August and impending inclement weather caused an early withdrawal from the area. During 19–29 August, 2 survey technicians counted all anglers fishing at Moraine Creek each day, 7 days a week. Each day of the week, the technicians interviewed all anglers fishing at Moraine Creek that entered and exited the fishery at Crosswinds Lake. The survey technicians camped near the floatplane access to ensure complete coverage of this exit point. This level of sampling constituted a census in calculating angler effort and proportion of angler-days by angler type, which simplified the estimation procedures and ensured the objective criteria (Objectives 1 and 2) were met. As much as possible, anglers were interviewed at the completion of their fishing day (completed-trip interviews). Anglers that accessed and exited the fishery at other locations were not interviewed (e.g., groups floating Moraine Creek from Spectacle Lake or floating day trips originating near or below the survey area). These anglers were noted, but were not interviewed because they would constitute incomplete interviews from multi-day trips making them difficult to match to freshwater logbook entries.

It was possible to census this fishery due to its remoteness, limited access, and small area used by anglers. Nearly all anglers arrived at Crosswinds Lake via float plane at or within a few hours of daylight. These anglers then walked 0.75 km to Moraine Creek and stayed within a 5-km stretch of the river throughout the day, later exiting the fishery from Crosswinds Lake between midafternoon and approximately 1800 hours. The technicians quickly became accustomed to guided angler schedules due to consistencies in end-of-day activities. The technicians intercepted and interviewed anglers as they approached the floatplane access site.

CATCH COMPOSITION

The technicians collected length and weight data from rainbow trout to estimate length and weight compositions (Objective 3), which required sampling a minimum of 130 rainbow trout (Thompson 1987) to attain the desired objective criteria. Samples were obtained from recreational anglers. Technicians asked for anglers' permission to sample fish upon landing. When allowed to do so, fish were netted and sampled for fork length (FL; tip of nose to fork of tail) and weight. When there were few anglers, the catches of ADF&G personnel were used. Data from fish caught by ADF&G personnel were segregated from those collected from sport fish catches to test for differences in the size distribution between the two groups.

DATA ANALYSIS

Sport Fishery

A census of all anglers in the sample area was obtained. The census provided the number of distinct anglers each day, the effort in hours of each angler, demographic information, and catch data. The proportion of angler-days by angler type was calculated as

$$p_i = \frac{x_i}{x}, \quad (1)$$

where

x_i = number of anglers from angler type i , and

x = total number of anglers sampled.

Daily CPUE was calculated from completed angler interviews as follows:

$$cpue_h = \frac{c_h}{e_h}, \quad (2)$$

where

c_h = catch of rainbow trout during day h , and

e_h = effort (hours fished) during day h .

The CPUE within each of 2 periods was then estimated as follows:

$$cpue_j = \frac{\sum_{h=1}^{m_j} c_{h_j}}{\sum_{h=1}^{m_j} e_{h_j}}, \quad (3)$$

where

m_j = number of days during period j .

Catch Composition

Standard summary statistics for length and weight of the catch were calculated. The proportions of rainbow trout of each weight or length class (p_i), and their associated variances, were estimated (rather than calculated) as shown in equation (1). The numerator was the number of rainbow trout caught in length or weight category i , and the denominator was the total number of rainbow trout sampled. The variance of this proportion was estimated by

$$\hat{V}(\hat{p}_i) = \frac{\hat{p}_i(1 - \hat{p}_i)}{c - 1}, \quad (4)$$

where

c = the number of rainbow trout sampled from the sport catch.

A Kolmogorov-Smirnov test was used to test the null hypotheses that the length and weight distributions of sampled rainbow trout did not change over time. This was done by dividing the data into 2 groups: 1) the first 50% of rainbow trout sampled from the sport fishery, and 2) the second 50% of the sample. Test results suggesting that length and weight distributions changed over time would require the data to be stratified by the 2 groups and biological composition subsequently recomputed. Otherwise, the pooled sample provided unbiased estimates of the length and weight distribution of the catch.

Freshwater Logbook Comparison

Only completed trips where all clients (and the guide if he fished) were interviewed were used to compare the difference between the catch reported in the freshwater logbook and the catch reported in the creel survey. Comparisons of effort and harvest were not required because effort was not recorded in the freshwater logbooks, and there was no harvest in this fishery, as per regulations. Differences were calculated as follows:

$$C_{\text{difference}_{gdt}} = C_{\text{logbook}_{gdt}} - \sum_{a=1}^{n_a} C_{\text{creel survey}_{gda}} \quad (5)$$

where

- $C_{\text{difference}_{gdt}}$ = difference between the catch reported in the logbook and the catch reported in the creel survey by guide g on day d and trip t ,
- $C_{\text{logbook}_{gdt}}$ = catch reported in the logbook by guide g on day d and trip t ,
- $C_{\text{creel survey}_{gda}}$ = catch reported in the creel survey by angler a , having been guided by guide g , on day d and trip t ,
- n_a = the number of clients having been guided by guide g on day d and trip t (this includes the guide if he fished).

RESULTS

A total of 180 anglers were interviewed 19–29 August 2006, totaling 180 angler-days of effort. Anglers fished a total of 1171.5 angler-hours and caught and released 1749 rainbow trout, 9 Arctic grayling (*Thymallus arcticus*), and 4 Arctic char (*Salvelinus alpinus*) at Moraine and Funnel creeks (Table 1). Because interviews were conducted at the fishery exit point, there were no incomplete interviews. No fish were harvested during the census period as per regulations.

Table 1.—Daily summary of anglers interviewed, effort, catch, and CPUE at Moraine Creek, 19–29 August 2006.

	Anglers interviewed	Catch	Effort	CPUE ^a
Interval 1				
19 Aug	21	173	128	1.35
20 Aug	26	235	163	1.44
21 Aug	37	249	253.5	0.98
22 Aug	12	111	90	1.23
23 Aug	3	58	24	2.42
Average	19.8	165	132	1.25
Interval 2				
24 Aug	8	101	52	1.94
25 Aug	6	67	41	1.63
26 Aug	12	183	71	2.58
27 Aug	16	195	100	1.95
28 Aug	22	201	125	1.61
29 Aug	17	176	124	1.42
Average	13.5	154	85.5	1.80
Totals	180	1749	1171.5	

^a Daily catch per unit effort (CPUE) calculated as mean of individual angler rates.

Due to the variability in arrival times and behavior of anglers that floated on rafts from and through the study area downstream to Kukaklek Lake, an accurate estimate of effort and catch for these anglers is not available. For interviewed anglers, average angler CPUE during the survey was 1.49 rainbow trout per hour, based on total angler-hours and total catch. The survey was divided into 2 time periods: Intervals 1 (19–23 August) and 2 (24–29 August). Angler CPUE during Intervals 1 and 2 was 1.25 and 1.80 rainbow trout per hour, respectively (Table 1).

Most anglers were guided (93%), adult (98%), male (94%), non-Alaskan U.S. residents (93%) (Table 2). All anglers used single-hook, artificial fly-fishing gear as per regulations and fished from shore. Approximately 98% of anglers caught at least 1 rainbow trout and 73% caught 5 or more fish by the end of the angling day.

Table 2.–Angler characteristics at Moraine Creek, 19–29 August 2006.

Angler type	Angler trips	Percent
Guided	167	93%
Unguided	13	7%
Alaska resident	3	2%
Local	0	0%
Nonlocal	177	98%
U.S. resident	171	95%
Non U.S. resident	9	5%
Female	11	6%
Male	169	94%
Adult	177	98%
Youth	3	2%
Total Angler Trips	180	

Length and weight measurements were taken from 203 rainbow trout, (99 from the sport fishery and 104 from ADF&G samples; Table 3). Rainbow trout sampled from the sport fishery were similar to ADF&G samples in length ($d_{\max} = 0.165$; $n = 99, 104$; $P = 0.56$) and weight ($d_{\max} = 0.105$; $n = 98, 104$; $P = 0.10$) and the data were pooled (Figures 2–3). Rainbow trout sampled in the first and second time intervals were also similar in length ($d_{\max} = 1.02$; $n = 88, 115$; $P = 0.58$) and weight ($d_{\max} = 0.077$; $n = 87, 115$; $P = 0.88$) (Figures 4–5) and as a result, the data were pooled. The mean length and weight of sampled rainbow trout were 542 mm (SD = 79.2, range 310–701 mm) and 2175 g (SD = 779, range 250–4600 g) (Table 3, Figure 6).

Table 3.–Summary statistics for the length and weight of rainbow trout sampled at Moraine Creek, 19–29 August 2006.

Statistic	Sport Fishery	ADF&G Samples	Combined
Mean length (FL, mm)	535	549	542
FL standard deviation	8.0	7.6	5.5
FL sample size	99	104	203
Range (mm)	310–672	310–701	310–701
Weight (g)	2124	2224	2175
Weight standard deviation	78	77	779
Weight sample size	98	104	202
Range (g)	250–3750	300–4600	250–4600

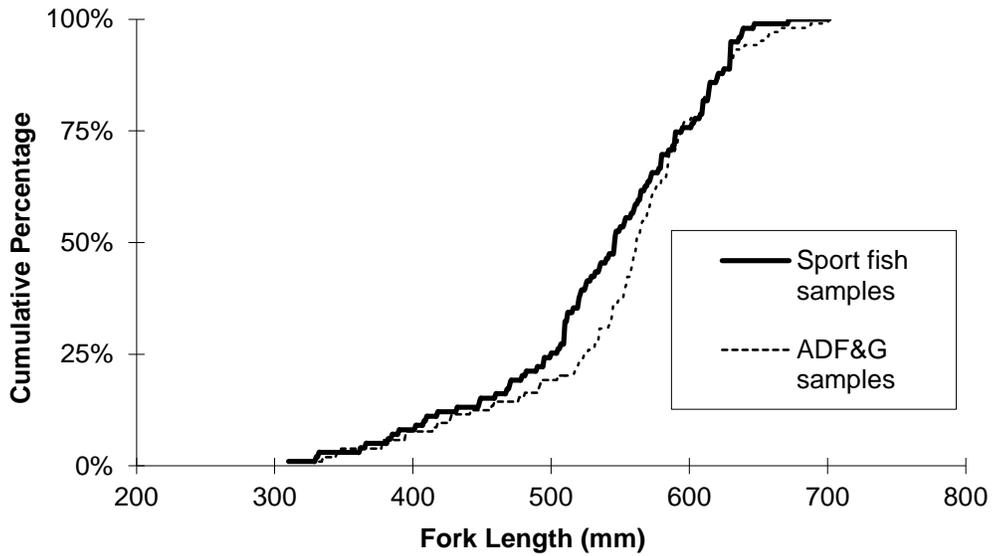


Figure 2.—Cumulative length frequency distributions of rainbow trout samples obtained from the sport fishery and by ADF&G, Moraine Creek, 19–29 August 2006.

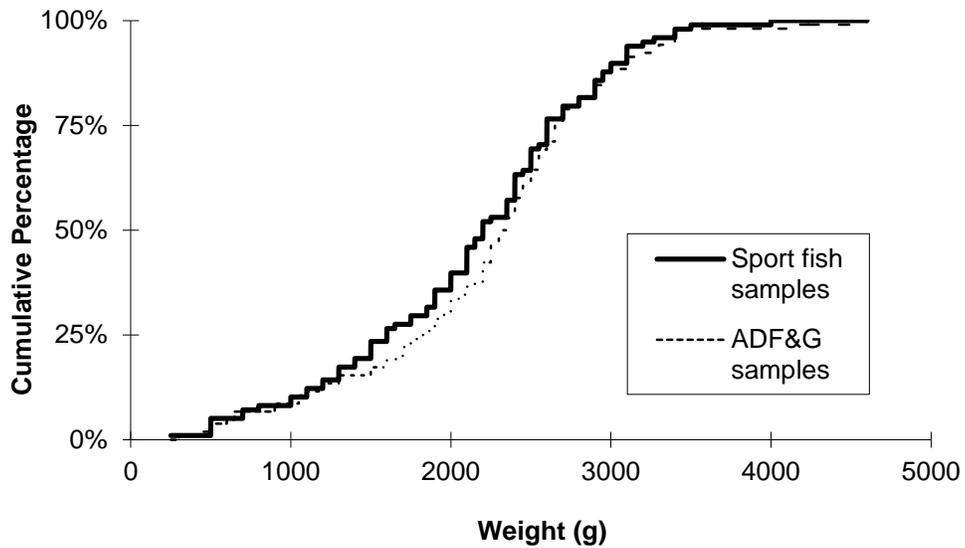


Figure 3.—Cumulative weight frequency distributions of rainbow trout samples obtained from the sport fishery and by ADF&G, Moraine Creek, 19–29 August 2006.

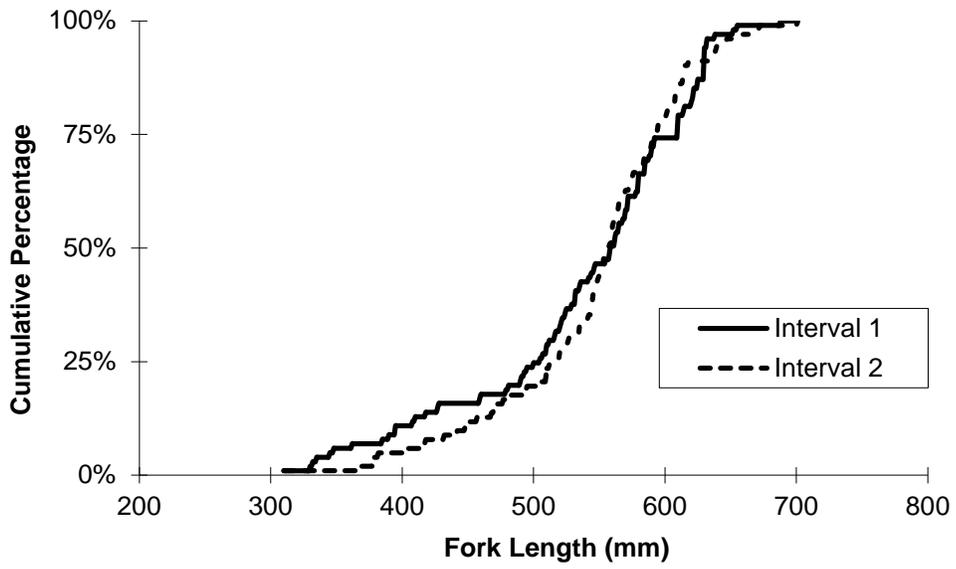


Figure 4.–Cumulative length frequency distributions of all rainbow trout samples obtained during each interval, Moraine Creek, 19–29 August

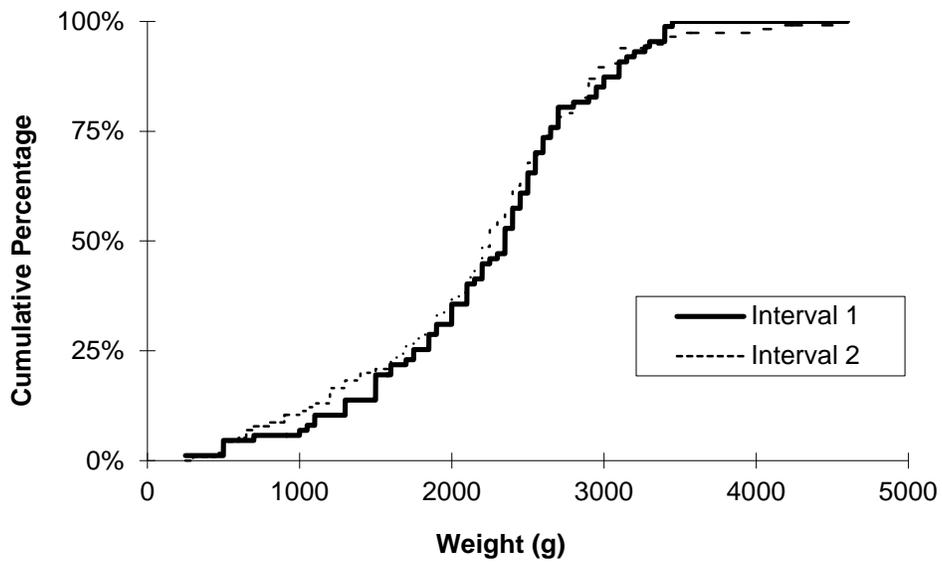


Figure 5.–Cumulative weight frequency distributions of all rainbow trout samples obtained during each interval, Moraine Creek, 19–29 August.

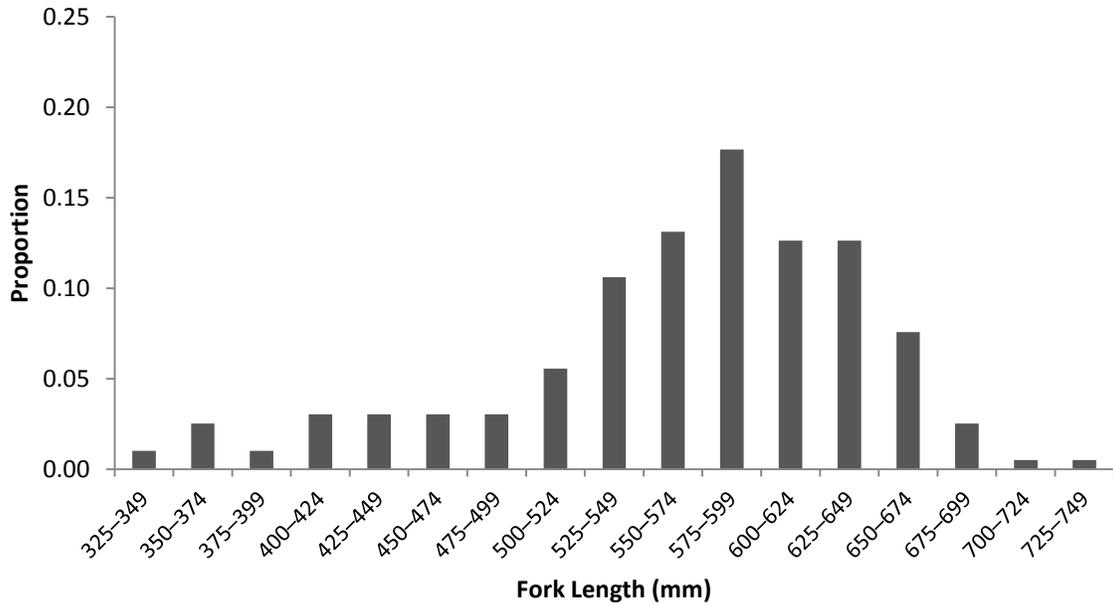


Figure 6.—Length frequency distribution of all rainbow trout sampled at Moraine Creek, 19–29 August 2006.

The incremental relative stock density (RSD) of sampled rainbow trout was computed based on quality total length (TL) classes proposed by Anderson and Neuman (1996) where stock is 250–399 mm TL, quality is 400–499 mm TL, preferred is 500–649 mm TL, and memorable is 650–799 mm TL (Figure 7). Fork length was converted to TL for RSD computations using the equation outlined in Simpkins and Hubert (1996). RSD of sampled rainbow trout was 4% stock, 11% quality, 62% preferred, and 22% memorable; there were no “trophy” fish as defined by the RSD categories.

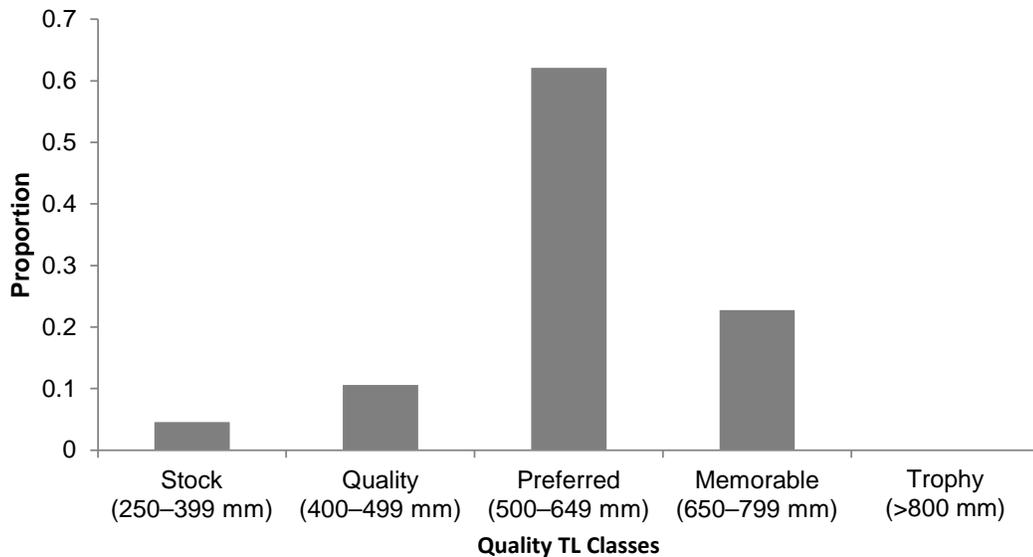


Figure 7.—Relative stock density (RSD) of all rainbow trout sampled at Moraine Creek, 19–29 August 2006.

All anglers that exited the fishery at Crosswinds Lake during the survey dates were interviewed. However, creel results from 15 of 58 trips were not reported within the freshwater logbook database. Agreement between freshwater logbook and creel survey data was 21% (9) of 43 trips. Of the 28 comparisons that did not agree, 14 (32.5%) angler surveys had fewer catches than recorded in logbooks and 20 (46.5%) angler surveys had more catches than recorded in logbooks. (Figure 8).

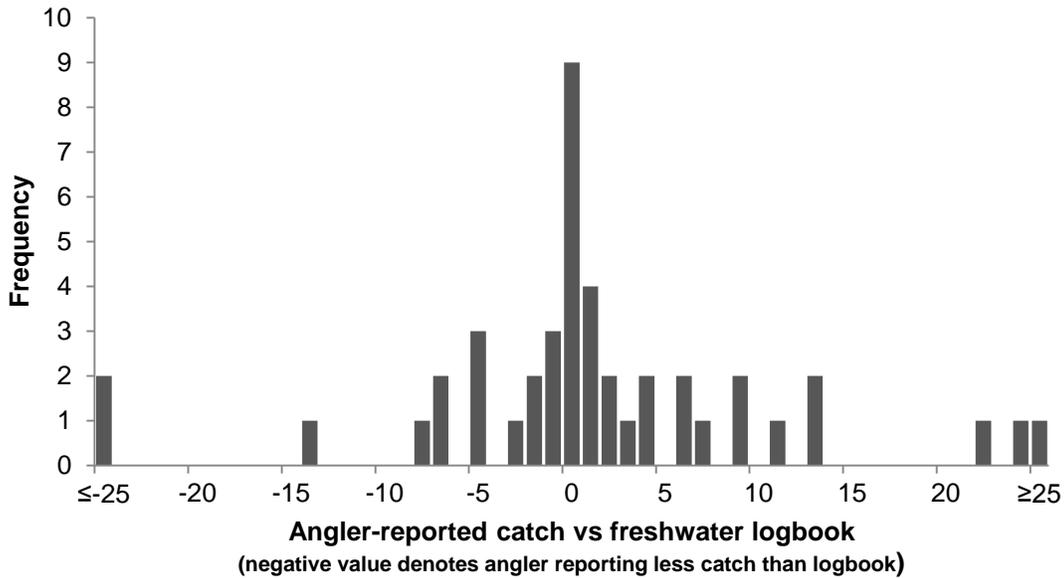


Figure 8.—Frequency and direction of differences in angler-reported catches of rainbow trout and those recorded in freshwater logbooks, Moraine Creek, 19–29 August 2006.

DISCUSSION

Prior to this study, no substantive creel surveys of Moraine Creek had been conducted and size data on Moraine Creek rainbow trout had only been collected sporadically and not published. However, commercial operators have indicated that rainbow trout size and weight have remained stable for many years. Based on the results of this study, the average size of these fish was of the preferred (500–649 mm TL) RSD category.

The composition of angler characteristics (male, guided, nonresident) is consistent with many remote fisheries within the Bristol Bay management area (Jaenicke 1998; Rogan and Jaenicke 1997). Most areas are difficult to access and with minimal or no services offered on site, they require logistical support offered most conveniently through local lodges. Comparisons of angler effort over time were not possible because other unpublished surveys on Moraine Creek were within a different time frame. Angler effort has likely been similar over time based on annual estimates of effort between 2000 and 2005 in the Alaska Statewide Harvest Survey (Appendix B1), as well as the opinions of commercial guides, who also reported to technicians conducting this survey. Catch rates were similar if not better than in previous years.

Due to high numbers of large rainbow trout, Moraine Creek is utilized by many lodges in Bristol Bay despite unpredictable weather in the area. The variability in the daily number of anglers visiting Moraine Creek during this survey was due, in part, to inclement weather conditions impeding access by float planes from 16 commercial fishing lodges of varying distance from the

fishery. Lodges located in the vicinity are able to make the trip during potentially deteriorating weather while those located up to 100 miles away utilize this river only when conditions are agreeable. The lull in angler trips from 23 through 26 August was largely due to unstable weather including extreme wind, rain, and cloud cover, which is common in higher altitude systems in southwest Alaska. The inclement weather in this area also shortened the duration of this project because ADF&G personnel were unable to access the Moraine Creek drainage safely.

The higher CPUE noted during low angler turnout could be a density-dependent reaction to effort. The area utilized by anglers using Crosswinds Lake is somewhat limited due to the normal constraints of pedestrian travel on rough terrain. The river itself, under normal conditions, is shallow and competent anglers can cast across its wetted width. Areas with the highest catch rates are numerous but finite. Although the area can accommodate 20–40 anglers, the higher end of this range often means that anglers are not able to move to unfished reaches after the catch rates decline in the reach they are currently fishing. Conversely, during low angler concentrations, some productive reaches of the area will be unfished during the day, even as anglers move throughout the survey area at will. ADF&G personnel targeted these times of low angler density to increase sampling rates and reduce competition with sport anglers.

The slightly higher CPUE during Interval 2 may be attributed to this density-dependent reaction as well. Interval 1 had a mean daily angler count of 19.8 as compared to interval 2 with a mean angler count of 13.5, allowing anglers to cover more unfished reaches throughout the day and allowing for higher catch rates.

Periodic sampling of rainbow trout for size and fishing effort in Moraine Creek is recommended because access to most of the area fished is focused and would facilitate both biological and creel surveys. Fluctuations in this fishery would be quickly detected and repeated surveys would provide further knowledge of biological dynamics of rainbow trout in the area.

Freshwater logbook comparison analyses revealed that anglers reported catching more rainbow trout than logbook entries more often than they reported catching less rainbow trout. However, beyond this observation, it is difficult to conclude which method offers accurate catch data because the actual number of fish captured is unknown. However, freshwater logbooks are completed by regulation by commercial guides and are therefore less expensive and offer more coverage through time than ADF&G creel surveys and may offer sufficiently accurate data (i.e. angler-days), especially in remote areas where most of the effort is associated with commercial guides.

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**APPENDIX A: COMPUTER FILES USED TO COMPLETE
THIS REPORT**

Appendix A1.–Computer files used to complete this report.

File Name	Description
Moraine 2006 data master.xls	All raw data including number, weight, and length of rainbow trout sampled, interviews, and logbook information
Moraine 2006 CPUE calculation.xls	Calculation of Catch Per Unit Effort
Moraine 2006 logbook comparison.xls	Analysis of interview vs logbooks

APPENDIX B: NUMBER OF ANGLERS AND ANGLER-DAYS PER YEAR FOR MORaine CREEK ESTIMATED BY SWHS FOR 1992–1995

Appendix B1.–Number of anglers and angler-days per year for Moraine Creek estimated by SWHS for 1992–2005.

Year	Anglers	Angler-days
1992	299	405
1993	320	689
1994	259	591
1995	266	739
1996	372	574
1997	360	696
1998	NA	NA
1999	435	821
2000	413	1,168
2001	NA	NA
2002	NA	NA
2003	NA	NA
2004	563	987
2005	687	1,682
2006	639	1,024
Average	419	852

Sources: Mills 1993, 1994; Howe et al. 1995-1996, 2001a, 2001b, 2001d; Walker et al. 2003; Jennings et al. 2004, 2006a, 2006b, 2007, 2009a, 2009b.