Little Salmon River Chinook Salmon Escapement Survey, 2012

Project CRE 143-12

By

Gene J. Sandone[1]

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[1] G. Sandone Consulting, LLC
4950 W. Clayton Ave.
Wasilla, AK 99654

AUTHOR

Gene J. Sandone is a Senior Fishery Research Biologist of G. Sandone Consulting, LLC, 4950 W. Clayton Ave., Wasilla, AK, 99654

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ABSTRACT

Live post-spawning and dead Chinook salmon were sampled in the upper portion of the mainstem Little Salmon River from August 31 through September 4, 2012. The sampling conducted during 2010 was the first escapement sampling conducted on this river in more than 20 years. The sampling continued during 2011 and this past season, 2012. During 2012 period, 72 live Chinook salmon were captured and retained for sampling. Only 18 live Chinook salmon were captured with snagging hooks attached to sport fishing gear, while 54 live salmon were captured using drift gillnets. Extremely high and turbid river water, in addition to associated high water velocities, severely hampered the collection of live fish with snagging gear. In addition to the live capture sample, 72 salmon carcasses were also recovered and sampled. Sex, length information (mid-eye to fork of tail measurements), and scales samples for subsequent age determination were obtained from each fish sampled. The proportion of female salmon in the salmon carcass sample, 86.1% was significantly greater than the proportion of female salmon in the live capture sample, 45.8% ($p<0.00001$). However, within the live capture sample, proportion of females significantly differed by capture gear. The proportion of female salmon captured via snagging, 72.2%, was significantly higher than those fish captured via gillnet, 37.0% ($p=0.0095$). Additionally, the mean length of salmon carcasses, 805 mm, was significantly greater than the mean length of the live captured salmon, 764 mm ($p=0.0035$). Of the total number of Chinook salmon captured and sampled for ASL, 115, or 79.9%, were aged successfully. Percent age class composition of the aged Chinook salmon sampled was: 5.2% age-1.2; 20.9% age-1.3; 71.3% age-1.4; 1.7% age 1.5. Additionally, 1 age-2.5 female salmon was observed in the sample. Females comprised 65.3% of the total number of Chinook salmon sampled. A majority, 58.0%, of the sampled Chinook salmon, were at least 800 mm in length. The vast majority of sampled male salmon, 79.6%, were less than 800mm in length. Female salmon at least 800 mm accounted for 77.7% of the female salmon component. Chinook salmon greater than 900 mm comprised 2.1% of the sample. Local hiring of fishermen/samplers was accomplished through Little Salmon Carmacks First Nation. This employment provided stewardship experiences by sampling and also provided an understanding of how the escapement sampling provides information to aid the management strategy for Chinook salmon of the Yukon River.

KEY WORDS: Chinook salmon, *Oncorhynchus*, Yukon, Alaska, escapement, run assessment, migratory timing, age, sex, length composition, stewardship

INTRODUCTION

The Yukon River drainage supports widely distributed populations of Chinook salmon *Oncorhynchus tshawytscha*. Spawning populations of Chinook salmon have been documented throughout the Yukon River drainage from Andreafsky River, located approximately 167 km from the mouth, to as far upstream as the headwaters of Nisutlin River in Canada, nearly 3,100 km from the mouth . The Little Salmon River empties into the Yukon River at kilometer (Rkm) 2,548 near the village of Carmacks, Yukon (Figure1). Chinook salmon provide for important aboriginal, subsistence, personal use, commercial, and sport fisheries throughout the Yukon River drainage, as summarized in the most recently published yearly management reports (Estensen et al. 2012) and U.S./Canada Joint Technical Committee (JTC) reports (JTC 2012).

Concerns over assumed high exploitation on the older age classes and larger Chinook salmon and the overall decrease in the size of Chinook salmon, in the Yukon River drainage has been discussed in U.S.-Canada Yukon River Panel (Panel) meetings, JTC meetings, Alaska Board of Fisheries (BOF) and Federal Subsistence Board (FSB) meetings, and other forums that involve Yukon River subsistence, aboriginal, commercial, domestic and sport fishers (JTC 2006). In 2006, the Panel directed the JTC to keep them informed of relevant information concerning salmon age, sex, and size trends. Accordingly, the JTC formed a subcommittee to undertake additional examination and analyses of age, sex, weight and length (ASL) trends in Yukon River Chinook salmon. This subcommittee reviewed relevant literature, existing analyses, and discussed potential causes of these trends in their *Potential Causes of Size Trends in River Chinook Salmon Populations* report (JTC 2006). They concluded that evidence that Yukon River Chinook salmon have undergone phenotypic alteration over time is limited, but suggestive.

Over the years, various studies documented a decrease in the weight of commercial harvests (Bigler et al. 1996), a reduction in the prevalence of the largest fish (Hyer and Schleusner 2005) and a decline in the proportion of age-7 fish in the commercial harvest (Hamazaki *In prep*). Bromaghin et al. (2008) investigate the potential long-term effects of large-mesh gill net fisheries on Chinook salmon by stochastic modeling. Their results suggest that long-term, selective exploitation of large Chinook salmon is likely to cause reductions in fish size and maturation age and impair population productivity. More recently, Hamazaki (*In prep*), in his analysis of the commercial harvest from the District 1 unrestricted mesh size periods during the period 1964–2007 also noted: 1) a small increase in the proportion of female Chinook salmon; 2) a small decline in the proportion of large (≥900 mm) fish; 3) no apparent change in the proportion of age-6 Chinook salmon over the time period, but a significant decline in the proportion of age-7 individuals; and 4) declines in length at age for age-6 and age-7 females and males.

Although Chinook salmon escapement has been monitored in various spawning tributaries in the Alaskan portion of the drainage at weirs or through carcass surveys on a regular basis, Chinook salmon ASL escapement sampling in the Canadian portion has been limited since 1990. Recent ASL sampling has occurred continuously at the Whitehorse Fishway and the DFO fish wheels located near the U.S./Canada border through 2008, and more recently from the Big Salmon River and the Blind Creek weir, and intermittently from the Tatchun weir projects. Although some samples of the escapement were taken from the Whitehorse Fishway and from Teslin Village/City in the 1960s and 1970s, most of the historic escapement sampling occurred in the 1980s and 1990s. Based on data in the ADF&G electronic database, it appears most streams were sampled on an infrequent basis, except for the Big Salmon, Nisutlin and Little Salmon Rivers. Chinook salmon carcass surveys on these three rivers were conducted on an annual basis starting in 1980 or 1981 and extending through 1990. Chinook salmon carcasses were also sampled from other spawning tributaries, including: Blind Creek, (1982); Ingersol Islands (1983, 1985, 1988, 1989); Koidern River (1982); McQuesten River (1990); Mitchee Creek, (1980, 1982, 1983); Morley River (1982, 1987, 1989, 1990); Nordenskiold River (1987, 1989, 1990); Ross River (1981, 1982, 1988, 1989); Swift River (1981, 1989); Takhini River (1982, 1988, 1990); Tatchun Creek (1980-1990); Teslin

Village/City (1967, 1968, 1972, 1980, 1981, 1986, 1987); and the Whitehorse Fishway (1968, 1970-1973, 1981, 1984-1986, 1991, 1996) Additionally, ASL samples were collected from the commercial fishers that were prosecuted in Dawson (1966, 1971, 1980- 1985, 1987 and 1999) and Pelly (1966). ASL samples were also collected from the Dawson test fish wheel fishery (1998, 2000) and the Sheep Rock (1988, 1989, 1991-1994, 1996-2008) and White Rock (1989, 1991-1994, 1996-2008) fish wheels that were associated with the DFO mark-recapture project. Age, sex, and length data from the Little Salmon River escapement survey project during 2010 (Sandone 2011) and 2011(Sandone 2012) were the first data collected from this drainage in 20 years. We believe that these data were more representative of the spawning population that previous data from carcass surveys. While carcass survey ASL data are considered to be biased toward larger fish (Stuby 2001), fish wheel data are considered to be biased toward smaller fish.

Data from this project, in conjunction with ASL data collected at the Eagle sonar site, will allow a comparison of Chinook salmon ASL between these two projects within the same year. Additionally, these data may be used to determine relationships among the border sonar, border fish wheel, and the Little Salmon escapement databases. Further, these escapement ASL data will also be used to gain insight into and document changes and trends in the ASL composition and the quality of the escapements when compared to the escapement samples collected from the 1981-1990 time period. Further, specific exploratory size at age comparisons between the commercial fishery samples taken in the 1960s and 1970s in Dawson and Pelly along with the earliest Whitehorse Fishway ASL samples may also provide interesting results.

OBJECTIVES

Accordingly, the specific objectives of this project are to:

1) describe the ASL composition of the Chinook salmon that spawn in the Little Salmon River;
2) build community capacity and foster stewardship through involvement of local rural residents; and
3) document specific locations of individual or groups of Chinook salmon redds within the Little Salmon drainage.

STUDY AREA

The proposed study area for the 2012 sampling within the Little Salmon River drainage was similar to the 2010 and 2011 study area, Rkm 26 to Rkm 70 (Figure 2), located near the mouth of Little Salmon Lake (Sandone 2011). Known spawning within the Little Salmon River drainage is concentrated from the mouth of Bearfeed Creek downstream for 8 km (Figure 2; Walker et al. 1974).

METHODS

Based on the success of sampling live, post spawning Chinook salmon during the 2010 (Sandone 2011) and 2011 season (Sandone 2012), the timing of this year's sampling was planned to coincide with the same post spawning period adjusted for run timing. Because of the overall late run timing of the 2010 Yukon River Chinook salmon run, spawning was delayed approximately 1 week (Sandone 2011). Because of the normal run timing of the 2011 run, the 2011 sampling was scheduled one week earlier than the 2010 sampling (Sandone 2012). Similar to 2010, the 2012 Chinook salmon run exhibited late

timing and adjustments were made to the sampling schedule. The 2012 sampling period was originally scheduled for August 27 – 31 but was delayed 4 days because of a scheduling conflict. In conversations with DFO Canada, it was agreed to start the 2012 sampling on August 31 and continue through September 4. The impact of this delay was considered minimal.

Live Chinook salmon were captured using fishing rods and reels with weighted snagging hooks as terminal tackle and drift gillnets. Heavy, 40 pound test, monofilament fishing line was used to minimize line breakage. However, most, if not all of the few salmon that broke the line were recaptured when they returned to the redd. Snagged fish were landed as quickly as possible to minimize stress to the salmon. Snagged salmon were landed with a hand held landing net and place in a tub of water. Because of the extremely high and turbid water during the 2012 sampling event, snagging of salmon was limited to the clear water in the vicinity of the Bearfeed Creek-Little Salmon River confluence (Figure 2). In other areas of the river, where turbidity precluded the visual sighting of salmon, drift gillnets were used to sample live salmon on redds. Carcasses were collected either by spear or hand picking. GPS information was noted for the location of live captured (Figure 2) and dead (Figure 3) sampled Chinook salmon. Specific location information is provided in Appendix A1 and A2.

Seven scale samples were collected from all Chinook salmon collected from the Little Salmon River for subsequent age determination. A scale smear was taken from each sampled fish from the preferred area with a knife. DFO also provided information on the preferred area that differed from Koo (1955). This information is found on the inside of the front cover of the DFO scale card (Figure 4). However, the smear was taken from an area on left side of the fish, approximately one to two rows above the lateral line on the diagonal that extends down from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Koo 1955). The scale smear was transferred to a plastic surface from which scales were immediately selected for mounting on gum cards. DFO processed and read the scales for age determination.

Sex of each sampled Chinook salmon was determined based on the presence of running milt or eggs, or external characteristics. Spawning condition of the salmon was also noted and recorded for each sampled fish. The primary length measurement was taken from mid-eye to fork of tail (MEFT). When the tail appeared to be severely eroded the post orbital to the end of the hypural plate (POHP) lengths were also measured. In cases where the tail was severely eroded the MEFT measurement was from the mid-eye to the end of the longest remaining caudal ray in the fork of tail area.

Before release of all live fish, the adipose fin was cut off as a mark indicating that the fish was sampled. A blank spaghetti tag was inserted through the pterygiophores of the dorsal fin. The blank floy tag was wrapped with yellow duct tape to increase visibility. This eliminated duplicate sampling of the same fish and proved useful in identifying sampled fish in the water. These marks were apparent to the crew and very few fish were snagged repeatedly. Previously sampled and tagged gillnet-captured salmon were released as quickly as possible from the net. All sampled carcasses were cut along nearly the entire length of the left side of the fish to indicate the fish was sampled.

All comparisons of mean Lengths and proportions of sampled Chinook salmon from the Little Salmon River drainage were conducted using SPC for Excel software (BPI, Consulting, LLC 2012)

Two Little Salmon Carmacks First Nation employees, funded through this project, fully participated in this project. These employees were educated in sampling and handling techniques to avoid undue stress to the salmon. Additionally, ADF&G provided an employee to participate in this project.

RESULTS

Escapement Sampling

The 2012 fishing season was the third year that the Chinook salmon escapement was sampled in the Little Salmon River since 1990. Sampling occurred from August 31 through September 4, 2012. When water clarity allowed, all live Chinook salmon were observed in association with redds. Salmon remained in association with redds and were susceptible to capture, even though they were disturbed by the sampling. During 2012, extremely high and turbid water in association with very high river water velocities severely hampered snagging of live Chinook salmon in the Bearfeed Creek-Little Salmon River confluence area (Rkm 65), located approximately 5 km below the outlet of Little Salmon Lake (Figure 2). High water in conjunction with very turbid water entering the Little Salmon River approximately 1 Rkm downstream from the Bearfeed Creek-Little Salmon River confluence prohibited sampling by visual observation and snagging in the remainder of the study area. In that portion of the river where turbidity preclude visual observation of Chinook salmon, a gillnet was drifted in river sections where either salmon were observed to porpoise or river conditions appeared to suggest that a redd location was possible. Because of the difficulty in capturing live Chinook salmon, more emphasis was directed at obtaining carcasses.

Captured Chinook salmon were sampled for age, sex, and size. However, one live captured fish was inadvertently released before a length measurement was obtained. Of the total number of live and dead fish sampled, exactly half were live and half were carcasses. Locations of live captured salmon and carcass collections are presented in Figures 2 and 3, respectively. Of the 72 live captured fish, 25%, 18, were captured by snagging, while 75%, 54, were captured using drift gillnets (Table 1). All of the fish captured by snagging were obtained from the spawning area in the vicinity of the Bearfeed Creek-Little Salmon River confluence (Figure 2). This area has the highest density of spawning salmon within the entire Little Salmon drainage. Because of the depth and velocity of the water, we believe that the larger fish were more susceptible to capture using the snagging gear.

While nearly all live male Chinook salmon were assessed as “ripe”, none of the live female Chinook salmon had free flowing eggs. Appendix A1 provides biological data, waypoint collection location, and the sampling method for each individually sampled Chinook salmon. Appendix A2 provides the location in latitude and longitude for each waypoint.

Comparison of the total number of samples collected with all the other escapement sampling, conducted on the Little Salmon river, indicates that the 144 total samples collected this year is very similar to the sample size collected during 2010 (Sandone 2011) and 2011 (Sandone 2012) and ranks in the middle of all the other years for samples collected (Table 1). However, the number of live captured salmon is appreciably lower than in the previous 2 years. The low capture or collection rate of Chinook salmon in 2012 is directly attributed to the high and turbid waters within the Little Salmon River.

Age, Sex and Length Composition

Of the total 144 Chinook salmon sampled from the Little Salmon escapement in 2012 (Table 2), 115, 79.9%, were successfully aged (Table 3 and 4). Partial ages, representing marine age, are available for 89.7% of the scales that could not be entirely aged (Appendix A1). One salmon was not aged because the collected scales appeared to have been collected from more than 1 salmon (Appendix A1).

The age composition of Chinooks salmon sampled from the Little Salmon River escapement was comprised of 5 age classes. Age classes ranged from age-1.2 to age-2.5 and represented five brood years,

2004-2008, that returned as 8, 7, 6, 5, and 4 year old fish, respectively. The dominant age classes were age-1.4, 71.3% and age-1.3, 20.9% (Table 4). Age 1.5 salmon comprised 1.7% of the aged sample, while age 1.2 salmon comprised 5.2% (Table 4). A single age-2.5 female salmon also contributed to the sample. It is also interesting to note that the scales that were aged only for marine age, indicated by a "M" followed by the years in the ocean, exhibited a similarly trend in distribution: M2=15.4%; M3= 30.8%, M4= 53.8% and M5= 0.0% (Appendix A1). Overall, the mean age of the spawning Chinook salmon was 5.71 years; the mean age of male salmon was 5.16 years; the mean age for female salmon was 6.00 years (Table 3). While the male Chinook salmon component consisted mainly of smaller and younger salmon, the female Chinook salmon component tended to be composed of larger and older individuals (Figures 5 and 6).

Mean length at age for age-1.2 male salmon was 548 mm; 721 mm for age 1.3; and 810 mm for age 1.4 (Table 4). Mean length at age for female salmon was: 818 mm for age 1.3; 817 mm for age 1.4; and 890 mm for age 1.5 (Table 4). Overall mean length of aged males was 724 mm, while the mean length of all male salmon sampled was slightly smaller, 716 mm. Mean length at age for female salmon was: 818 mm for age 1.3; 817 mm for age 1.4; and 890 mm for age 1.5 (Table 4). Overall mean length of aged males was 724 mm, while the mean length of all male salmon sampled was slightly smaller, 716 mm. Average length of aged females was 819 mm while the mean length of all female salmon sampled was 820mm (Table 4). Mean length of unaged males was 686 mm, while the mean length of unaged females was 825 mm (Table 4).

One peak was observed in the length frequency distribution of sampled Chinook salmon (Figures 5 and 6). A majority, 58.0%, of the sampled Chinook salmon were at least 800 mm in length (Table 2; Figure 5). However, 79.6% of the sampled male salmon were less than 800mm in length (Table 2; Figure 5). Chinook salmon greater than 900 mm comprised 2.1% of the sample (Table 2, Figure 5). Overall, female salmon compromised 65.7% of the fish sampled (Table 3). Female Chinook salmon larger than 800 mm, accounted for 77.7% of the female component; female Chinook salmon larger or equal to 900mm accounted for 2.1% of the female component (Table 2; Figure 5). Age 1.4 females dominated the sample, accounting for 60.0 of the aged sample (Figure 6; Table 4).

Differences regarding the proportion of females and length of salmon between live captured and the carcass samples were significant. The proportion of female salmon in the carcass sample, 86.1% was nearly twice as high as the proportion of female salmon in the live capture sample, 45.8% ($p<0.00001$). However, within the live capture sample, proportion of females significantly differed by capture gear. The proportion of female salmon captured via snagging, 72.2%, was significantly higher than those fish captured via gillnet, 37.0% ($p=0.0095$). Additionally, the mean length of salmon carcasses, 805 mm, was significantly greater than the length of the live captured salmon, 764 mm ($p=0.0035$).

Length frequency distribution comparison of captured male and female salmon from the Little Salmon River for years 2010-2012 are presented in Figure 7. Female Chinook salmon were smaller in 2010 than in the next two years, with the highest proportion of the largest female present in the 2011 sample. In all years, the female salmon distribution exhibited only one peak. Similar to the female sample, male salmon were largest in 2011 with the 2010 and 2012 size proportions similar. However, the 2012 male salmon distribution exhibited two peaks while the 2010 and 2011 male distribution exhibited only one. Additionally, the 2012 proportion of male salmon in the 700-750 mm length bin was appreciably smaller than the proportions in 2010 and 2011.

Conservation and Stewardship Experience for Rural Local Residents

Local hiring of fishermen was accomplished through the Little Salmon Carmacks First Nation. Three employees participated in capturing and sampling live and dead Chinook salmon. This project provided stewardship experiences in capture and sampling techniques and also provided an understanding the importance of escapement monitoring to the management strategy for Chinook salmon of the Yukon River. The crew quickly became adept at catching the fish, handling the fish to avoid undue stress, and sampling for length, sex identification, and scales. During the project, the two biologists and two crew members camped at the Little Salmon Lake campground (Figure 2). Discussions during the work day and occasionally in the evening around the campfire included topics, such as, salmon life history, migrational patterns, and the need to sustain the runs through proper management and achievement of escapement goals. Other discussions focused on the objectives of the international Yukon Salmon Agreement between Canada and the U.S. and role of the Yukon Panel, the JTC, Fist Nations and advisors in the Panel process. On occasion, traditional ecological knowledge was transferred to the professional biologists regarding the salmon, wildlife and habitats. Further, because of the mutual respect for each other, the professional relationship between the LSCFN wildlife manager, Robert Moar, and me, extended beyond the scope of this project.

DISCUSSION

The lowest percent female escapement composition in the Little Salmon escapement database, 24.3%, was observed in 2010 followed by the 29.9% in 2011. From 1981 – 1990 the percent female of the sampled carcasses ranged from a low of 44.6% in 1990 to 75.6% in 1983. However, the 2010 and 2011 sampling efforts were the only two years of record that sampling was primarily directed at live fish. All other previous escapement sampling was accomplished through carcass survey. Carcass surveys are thought to be biased toward larger and female Chinook salmon (Stuby 2001) and they tend to be conducted during a limited time period immediately after the peak die off event. Female salmon are generally larger than males and are easier to see. Additionally, the timing of carcass surveys probably also plays a significant role in determining the sex ratio and length frequency distribution of the sampled population, which may be substantially different than the spawning population. Therefore, the type of escapement sampling, carcass versus live fish capture, may produce very different results with regard to sex and size composition of fish sampled from the spawning grounds. Note that ADF&G corrects for their observed sex ratio results obtained through carcass samples from previous sex ratio comparisons between results from mark-recapture and carcass survey results (see Appendix B10 in JTC 2011). ADF&G adjusted the proportions of male and female Chinook salmon from carcass surveys based on the average of ratios of unbiased estimates from mark-recapture experiments to estimates from carcass samples of those years when both studies were conducted (JTC 2011).

The overall percent female composition of the Chinook salmon escapement sample in 2012, 65.7%, ranks fourth highest among the 14 years of record (Table 1). Additionally, the percent female of the carcass portion of the sample, 85.1%, ranks as the highest on record. Further, the percent female portion of the live salmon collected via snagging, 72.2%, ranks uncharacteristically high, second among the 14 years of record (Table 1). However, percent female in the gillnet portion of the live capture collection, 37.0%, ranks low, just above the two previous years when live capture via snagging was employed, 2010 and 2011.

I suspect that the samples collected by snagging and by gillnet were probably biased toward female and male salmon, respectively. Because of the high and rapidly moving water, snagging the smaller male salmon was severely hampered in the Bearfeed Creek-Little Salmon River confluence area. The high water also impaired visibility of salmon on the spawning grounds, especially the smaller and darker male salmon. Females were easier to spot because of the eroded white tails and easier to snag because of their size and behavior. Males, however, were very difficult to observe and extremely hard to snag because of their size and their behavior. While the female salmon tended to remain fairly stationary over the redd, male salmon tended to defend their territory, frequently darting around and chasing other male salmon. Therefore, I strongly suspect that the portion of the live capture sample contributed by snagging was biased toward the larger female salmon. This suspicion is somewhat verified by the number of female and male salmon observed in his area. Casual observations indicated that there were more male salmon than female salmon but the sample was primarily female. Note, however, that only 18 salmon were captured with snagging gear.

The portion of the live capture sample collected with gillnets, 54 salmon, could have been biased toward male salmon because of the size of the mesh employed, 6.0 inch stretch mesh. Information from Bromaghin et al.(2008), suggests that size of Chinook salmon captured is directly related to the mesh size of the gillnet employed. They indicated that optimal Chinook salmon size for a 6.0 inch stretch mesh gillnet is 620 mm while the optimal size for an 8.5 inch stretch mesh gillnet is 820 mm. While these estimates of optimal fish size for a certain mesh size gillnet were calculated based on catches in the Pilot Station sonar test fishery, it is somewhat applicable to other locations as well. Because fish tend to lose girth and weight during the migration and are noticeably slimmer on the spawning grounds, the optimal size for a specific gillnet mesh probably increases during the migration. Note that the mean length of all male salmon captured in this project during 2012, 716 mm (Table 2), is fairly similar to the Bromaghin et al. (2008) optimal size, 620 mm. If the optimal size increases as the fish migrates upriver, the mean size of the male salmon in the Little Salmon salmon collection may be closer to the 6.0 inch gillnet optimal size of salmon captured by this mesh size on the spawning ground. Because of the larger mean size of the female salmon, I believe that most female salmon were not susceptible to being gilled by the 6.0 inch gillnet, whereas a high proportion of the male salmon were. Note that although fish girth and weight decreases substantially during the migration, the size of the fish head probably does not. The large head of large salmon probably inhibits those fish being gilled in the 6.0 inch mesh gillnets. However, larger fish tend to get tangled in smaller nets.

I suspect that the Chinook salmon sampling conducted in 2010 and 2011 was more representative of the actual composition of the spawning escapement than previous carcass surveys and the 2012 combined sample and also the samples by collection method and gear type. Because of the great disparity in the composition of female Chinook salmon between historic carcass surveys and the previous live fish survey on the Little Salmon River, I also suspect that age, sex, size information gained from carcass surveys may have little utility except for determining the presence or absence of the very largest Chinook salmon on the spawning grounds, those $\geq$900 mm. This is also probably true of the 2012 carcass collection. The 2012 data presents some evidence that carcass surveys are extremely biased toward large salmon, which are predominantly female. Additionally, unlike other years, where the live fish collection probably represented the actual composition of the spawning escapement, it is unlikely that the 18 fish collected via snagging in 2012 represents that actual 2012 spawning population. However, the sample collected by gillnet may provide the best estimate of the actual spawning population, dependent on the efficiency of the gillnet to catch the different size salmon. I suspect that the male component of the gillnet sample may be elevated over the true male portion of the spawning population. Therefore, I suspect that the proportion of female salmon within the actual spawning population may be similar to the previous years' estimates.

The optimal time for live-capture sampling is defined as that period after peak spawning but before peak die off. However, because of the high and turbid water, it is unknown the timing of the peak die off during 2012. Although the actual sampling period occurred after peak spawning, it is unknown if the sampling occurred before peak die off. There was some evidence that peak die off did not occur during the sampling period or started to occur during the later portion of the sampling period because of the increased number of carcasses. Within the Bearfeed Creek-Little Salmon confluence area, visual observations indicated that female salmon were guarding many of the redds. Additionally, there were many male salmon associated with the females and the redds. However, I did note some vacant redds in the confluence area and salmon carcasses appeared to be relatively abundant, compared to the previous 2 years. I also note that only a few decomposed carcasses were observed. Therefore, it is unknown if sampling occurred during the optimal sampling time period, but sampling was definitely later than in 2010 and 2011.

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Table 1. Sampling period, method, number sampled and percent female composition of the Chinook salmon sampled during escapement surveys, Little Salmon River, 1981-1990 and 2010-2012.

	Sampling period		Sampling method	number sampled	female prop.
1980	8-Sep		carcass	2	0.500
1981	29-Aug	30-Aug	carcass	253	0.698
1982	29-Aug	30-Aug [a]	carcass	76	0.612
1983	29-Aug	30-Aug	carcass	197	0.756
1984	29-Aug	30-Aug	carcass	199	0.565
1985	4-Sep	5-Sep	carcass	92	0.705
1986	1-Sep	1-Sep	carcass	66	0.696
1987	24-Aug	28-Aug	carcass	224	0.672
1988	22-Aug	24-Aug	carcass	213	0.573
1989	23-Aug	24-Aug	carcass	67	0.617
1990	27-Aug	27-Aug	carcass	126	0.446
2010	27-Aug	31-Aug	snagging [b]	149	0.243
2011	22-Aug	26-Aug	snagging [c]	157	0.299
2012	31-Aug	5-Sep	snagging	18	0.722
2012	31-Aug	5-Sep	gillnet	54	0.370
2012	31-Aug	5-Sep	carcass	72	0.851

[a] Two fish were collected on August 9.
[b] Approximately 95% of the fish were collected by snagging.
[c] Approximately 94% of the fish were collected by snagging.

Table 2. Length frequency distribution of sampled Chinook salmon from the escapement in the Little Salmon River, August 31- September 4, 2012.

Length Bins (mm)	Total Caught[a]		Males			Females[a]		
	number	%	number	% of total	% of males	number	% of total	% of females
<650	9	6.3	9	6.3	18.4	0	0.0	0.0
650-700	15	10.5	15	10.5	30.6	0	0.0	0.0
700-750	11	7.7	5	3.5	10.2	6	4.2	6.4
755-799	25	17.5	10	7.0	20.4	15	10.5	16.0
800-850	63	44.1	5	3.5	10.2	58	40.6	61.7
855-899	17	11.9	4	2.8	8.2	13	9.1	13.8
900-999	3	2.1	1	0.7	2.0	2	1.4	2.1
>1,000	0	0.0	0	0.0	0.0	0	0.0	0.0
Total	144	1.0	49	34.3	100.0	95	65.7	100.0
Average length (mm)		785	716			820		

[a] Total includes 1 female salmon that was not measured before release.

Table 3. Length frequency distribution and mean age by length bins of aged Chinook salmon from the escapement in the Little Salmon River, August 31- September 4, 2012.

Length Bins (mm)	Total Aged			Males			Females		
	number	%	mean age	number	%	mean age	number	%	mean age
<650	6	5.2	4.00	6	5.2	4.00	0	0.0	NA
650-699	11	9.6	5.08	11	9.6	5.00	0	0.0	NA
700-750	10	8.7	5.35	4	3.5	5.09	6	5.2	5.83
751-799	23	20.0	5.87	10	8.7	5.70	13	11.3	6.00
800-850	49	42.6	5.94	4	3.5	5.50	45	39.1	5.98
851-899	13	11.3	6.00	3	2.6	5.67	10	8.7	6.10
900-999	3	2.6	6.33	1	0.9	6.00	2	1.7	6.50
>=1,000	0	0.0	NA	0	0.0	NA	0	0.0	NA
Total or mean	115	100.0	5.71	39	33.9	5.16	76	66.1	6.00
% aged	79.9			79.6			80.0		
Mean length (mm)		787			724			819	

Table 4. Age and sex composition and mean length (mm) from Chinook salmon sampled from the Little Salmon escapement, 2012.

Season Total				Brood Year (age class)															
				2008		2007		2006		2005		Aged		Unaged		Season	
				(1.2)		(1.3)		(1.4)		(1.5)		Total[a]		Total		Total[b]	
Sample Dates			% Aged	N	%	N	%	N	%	N	%	N	%	N	%	N	%
31-Aug	4-Sep	Male	79.6%	6	5.2	20	17.4	13	11.3	0	0.0	39	33.9	10	7.0	49	34.3
		Female	80.0%	0	0.0	4	3.5	69	60.0	2	1.7	76	66.1	19	12.6	95	66.4
		Subtotal	80.4%	6	5.2	24	20.9	82	71.3	2	1.7	115	100.0	29	20.3	144	100.0
		Male Mean Length		548		721		810		-		724		686		716	
		SE		14.2		14.7		16.3		-		16.7		33.4		14.9	
		Range		485	585	655	875	735	950	0	0	485	950	540	865	485	950
		n		6		20		13		0		39		10		49	
		Female Mean Length		-		818		817		890		819		825		820	
		SE		-		24.9		5.3		20.0		5.2		6.7		4.4	
		Range		-	-	745	850	700	975	870	910	700	975	770	880	700	975
		n		0		4		69		2		76		18		95	
		Total Mean Length		548		737		816		890		787		776		785	
		SE		14.2		14.7		5.1		20.0		7.8		17.8		7.2	
		Range		485	585	655	875	700	975	870	910	485	975	540	880	485	975
		n		6		24		82		2		115		28		143	

[a] Includes one age 2.5 female salmon.
b Includes one female salmon without a length and age.

Figure 1. Map of the Yukon Territory and the Yukon River Drainage in Canada.

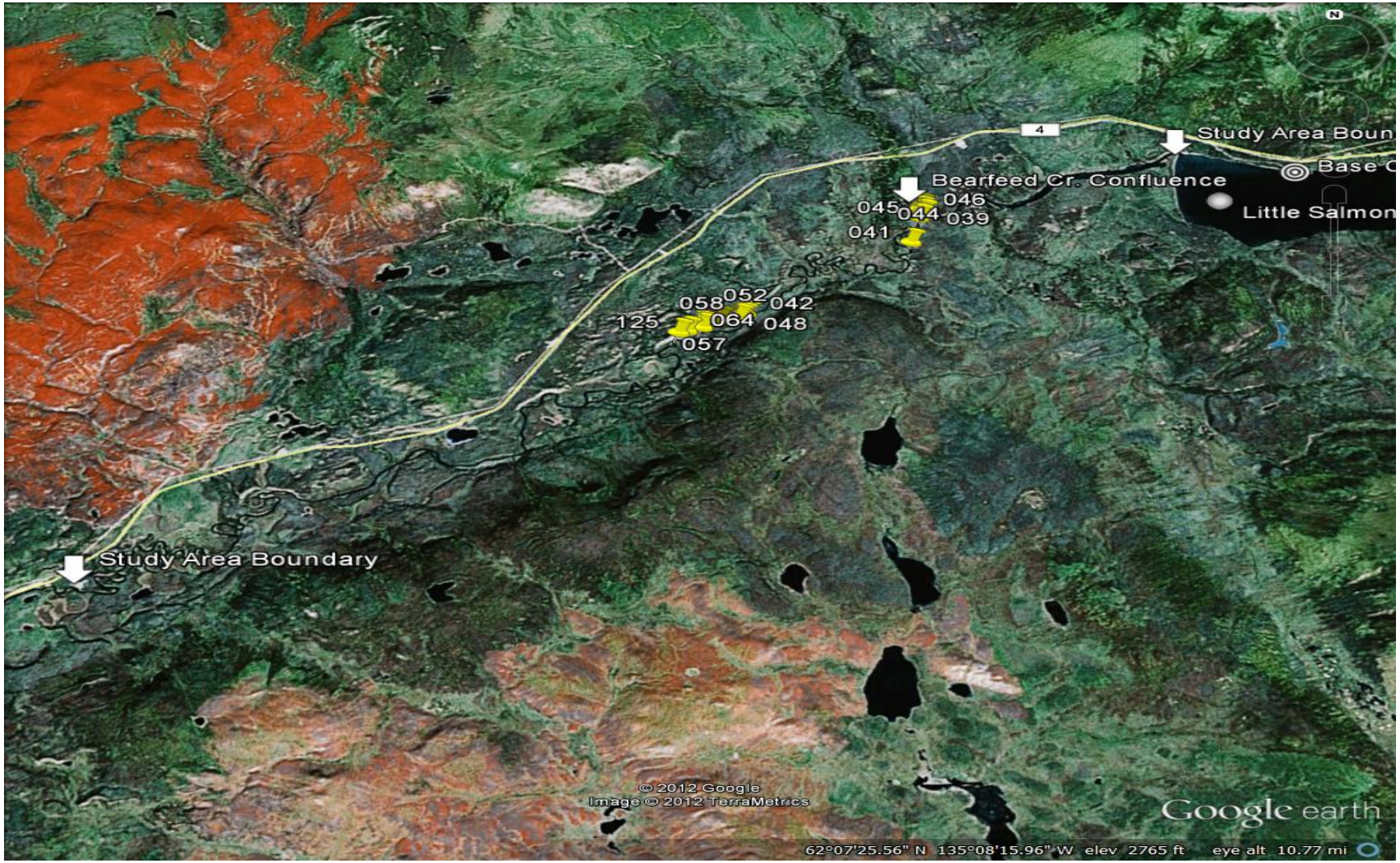

Figure 2. Map of the Little Salmon River drainage, showing Study Area boundaries and locations (waypoints) of live captured salmon, 2012.

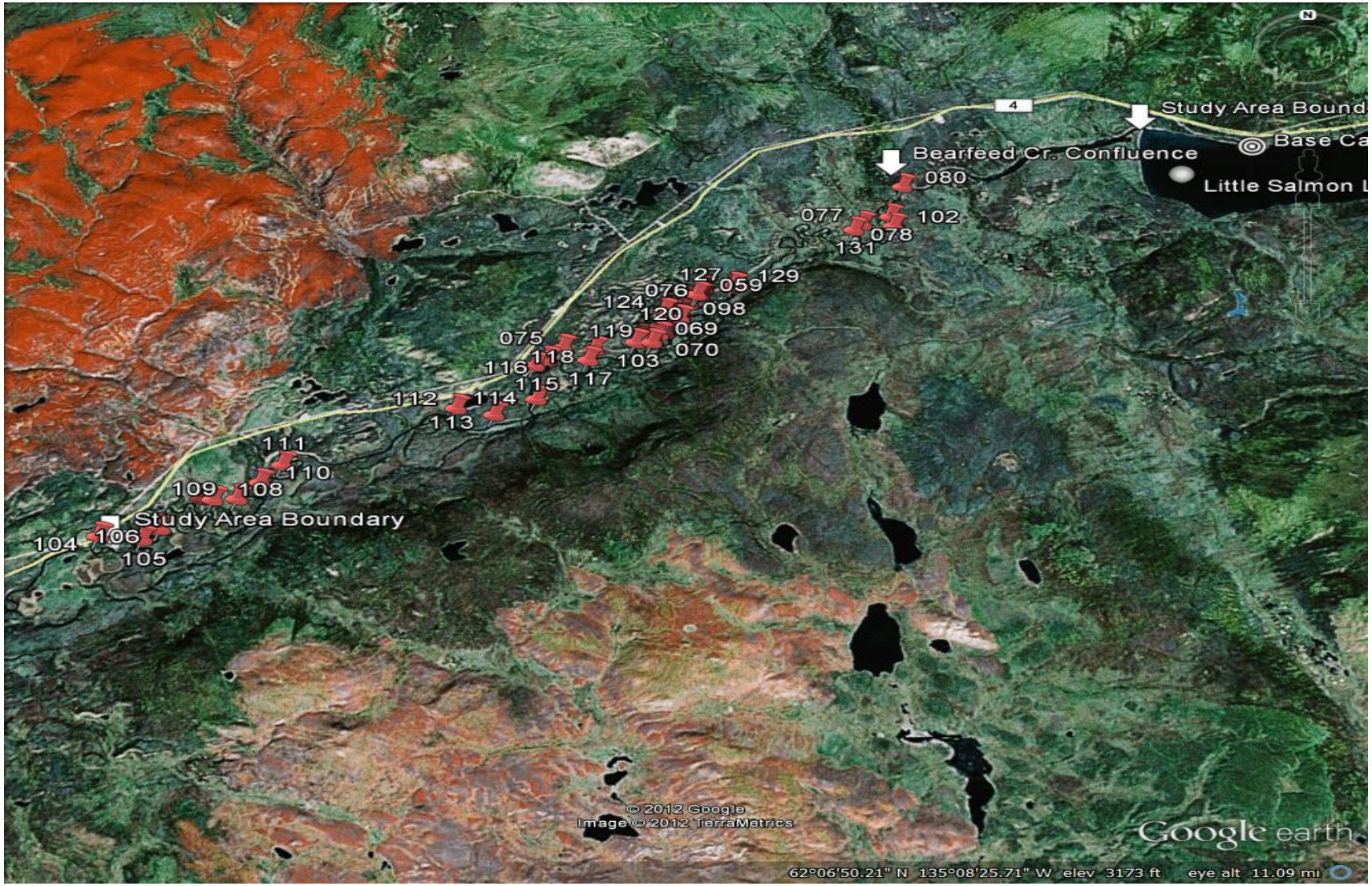

Figure 3. Map of the Little Salmon River drainage, showing Study Area boundaries and carcass collection locations (waypoints), 2012.

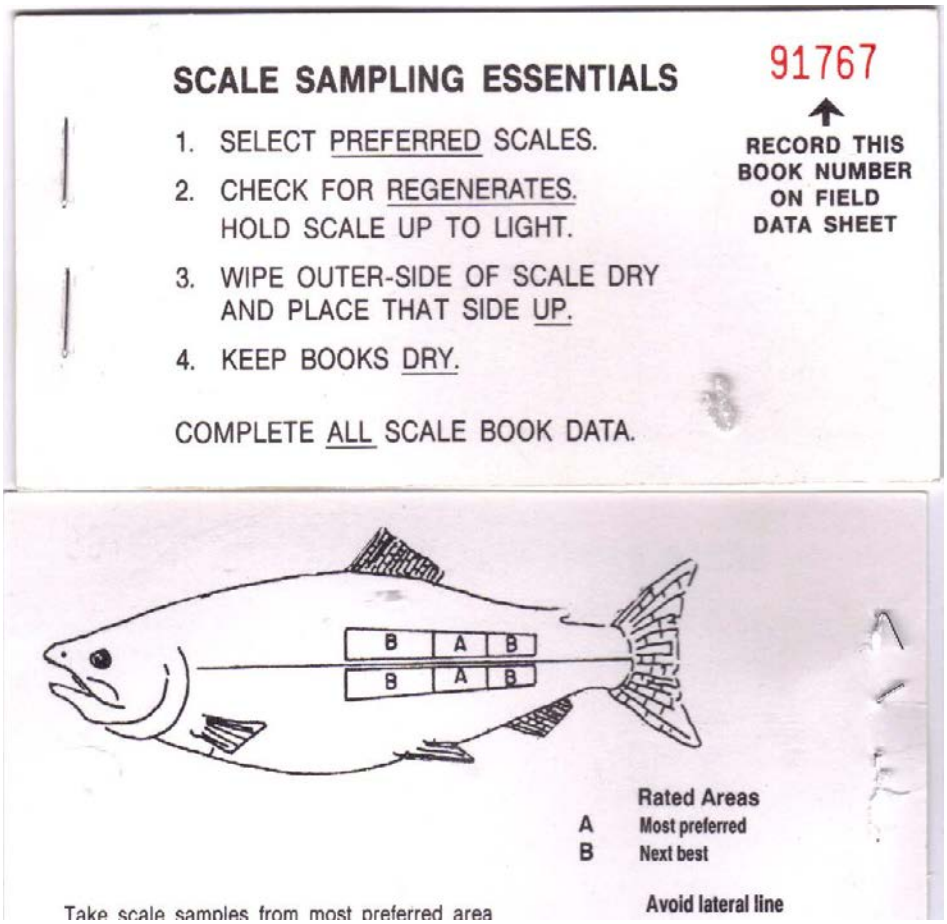

Figure 4. Outside (above) and inside (below) of front cover of DFO scale collecting book. Inside cover shows an illustration of preferred areas for sampling scales from fish.

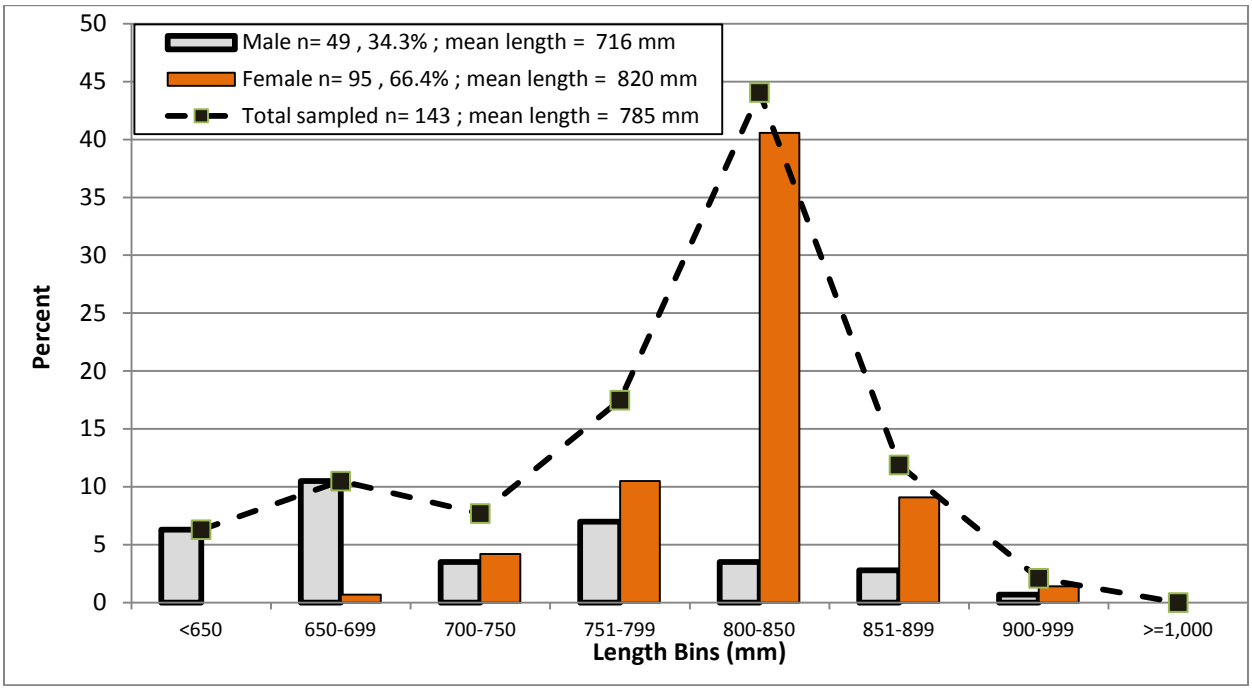

Figure 5. Length frequency distribution of male and female Chinook salmon captured in the Little Salmon River escapement survey project, 2012.

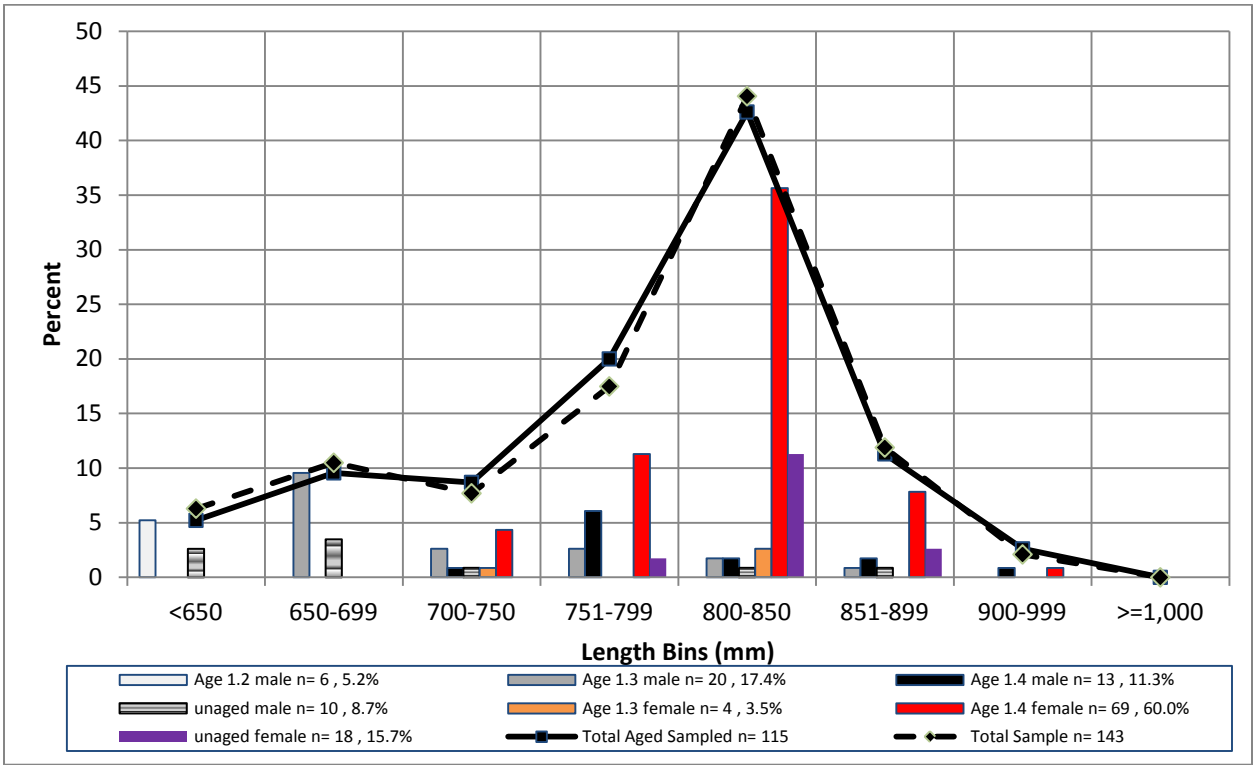

Figure 6. Age, sex and length frequency distribution of Chinook salmon captured in the Little Salmon River escapement survey project, 2012.

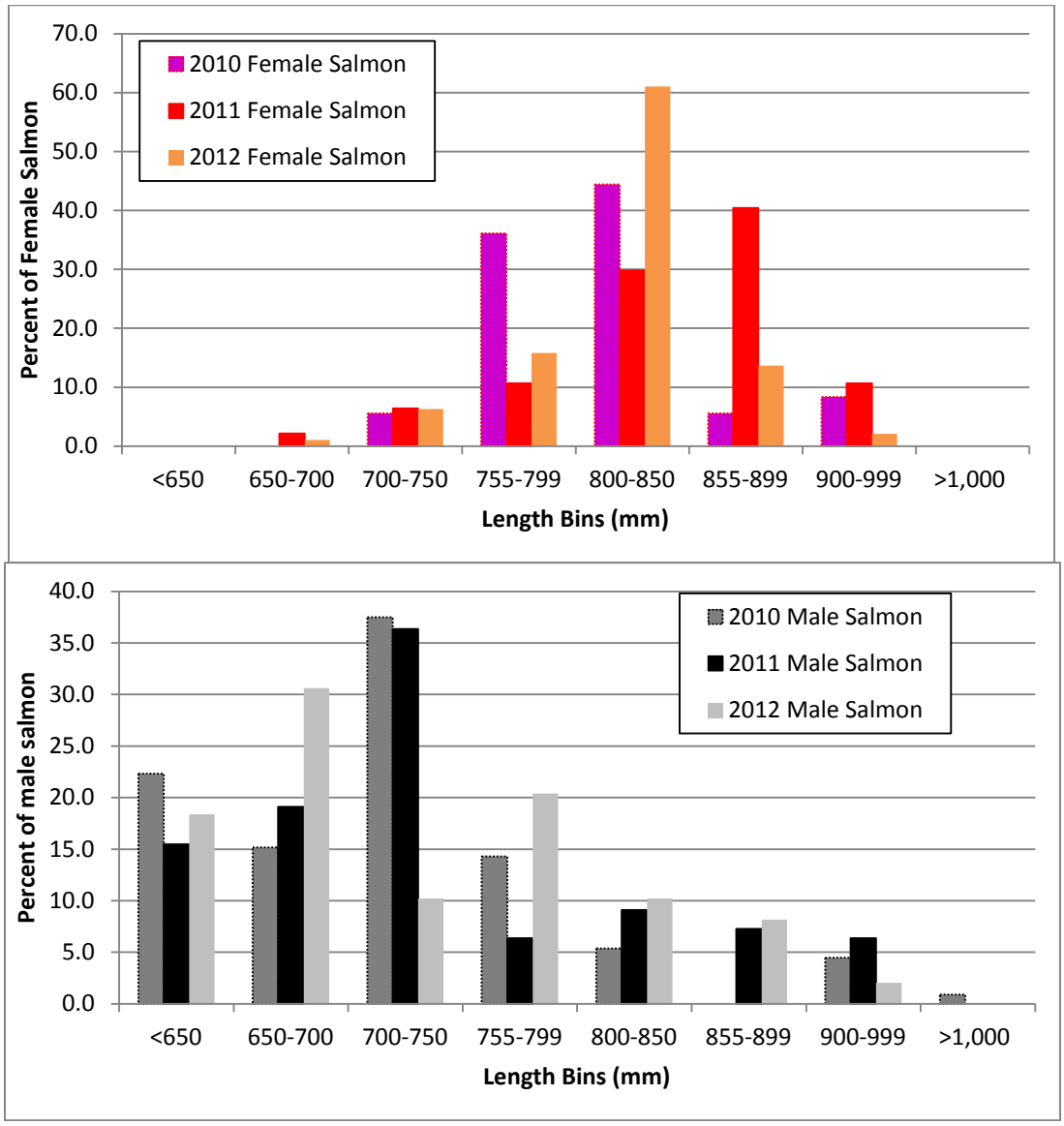

Figure 7. Female (above) and male (below) Chinook salmon length frequency distribution for Chinook Salmon sampled from Little Salmon River escapement, 2010-2012.

Appendix A 1. Information summary table, Chinook salmon escapement, Little Salmon River, Yukon Canada, 2012.

Date	Scale Book Number	Fish #	Waypoint	Collection Method	Sex	Spawning Condition[d]	Length (mm) MEFT[a]	Age	Readable Age[b]	Scale comment[c]
8/31/2012	95421	1	39	Sport	F	S			M3	RG
8/31/2012	95421	2	39	Sport	F	S	825		M4	RG
8/31/2012	95421	3	39	Sport	F	S	790	1.4		
8/31/2012	95421	4	39	Sport	M	R	680	1.3		
8/31/2012	95421	5	39	Sport	F	S	890	1.4		
8/31/2012	95421	6	39	Sport	F	S	890	1.4		
8/31/2012	95421	7	39	Sport	M	R	775	1.4		
8/31/2012	95421	8	39	Sport	M	R	740	1.3		
8/31/2012	95421	9	39	Sport	F	S	875	1.4		
8/31/2012	95421	10	39	Gillnet	F	S	845		M3	RG
8/31/2012	95422	1	39	Gillnet	M	R	585	1.2		
8/31/2012	95422	2	39	Gillnet	M	R	755	1.4		
8/31/2012	95422	3	39	Gillnet	M	R	735	1.4		
8/31/2012	95422	4	39	Gillnet	M	R	680	1.3		
8/31/2012	95422	5	39	Gillnet	F	S	870		M4	RG
8/31/2012	95422	6	39	Gillnet	M	R	660	1.3		
8/31/2012	95422	7	39	Gillnet	F	S	870		M3	RG
8/31/2012	95422	8	39	Gillnet	F	S	835	1.4		
8/31/2012	95422	9	39	Gillnet	M	R	845	1.3		
8/31/2012	95422	10	41	Spear	M	R	795	1.4		
8/31/2012	95423	1	42	Gillnet	F	S	840	1.4		
8/31/2012	95423	2	43	Gillnet	M	R	755	1.3		
8/31/2012	95423	3	43	Gillnet	F	S	810	1.4		
9/1/2012	95423	4	44	Gillnet	M	R	660	1.3		
9/1/2012	95423	5	44	Gillnet	M	R	575	1.2		
9/1/2012	95423	6	44	Gillnet	M	R	730	1.3		
9/1/2012	95423	7	44	Gillnet	M	R	680	1.3		
9/1/2012	95423	8	44	Gillnet	F	S	800			MF
9/1/2012	95423	9	45	Gillnet	M	R	835	1.4		
9/1/2012	95423	10	45	Gillnet	F	S	800	1.4		

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Date	Scale Book Number	Fish #	Waypoint	Collection Method	Sex	Spawning Condition[d]	Length (mm) MEFT[a]	Age	Readable Age[b]	Scale comment[c]
9/1/2012	95424	1	45	Spear	M	C	865	1.4		
9/1/2012	95424	2	46	Gillnet	F	S	865	1.4		
9/1/2012	95424	3	46	Gillnet	F	S	820	1.4		
9/1/2012	95424	4	39	Sport	M	R	655	1.3		
9/1/2012	95424	5	39	Sport	M	R	680	1.3		
9/1/2012	95424	6	39	Sport	F	S	820		M4	RG
9/1/2012	95424	7	47	Sport	F	S	780	1.4		
9/1/2012	95424	8	47	Gillnet	M	R	540		M2	RG
9/1/2012	95424	9	48	Gillnet	F	S	850	1.4		
9/1/2012	95424	10	48	Gillnet	F	S	815	1.4		
9/1/2012	95425	1	48	Gillnet	F	S	745	1.3		
9/1/2012	95425	2	48	Gillnet	M	R	780	1.4		
9/1/2012	95425	3	48	Gillnet	M	R	555		M2	RG
9/1/2012	95425	4	50	Spear	F	C	800	1.4		
9/1/2012	95425	5	49	Hand	F	C	830	1.4		
9/1/2012	95425	6	51	Gillnet	F	S	850	1.3		
9/1/2012	95425	7	51	Gillnet	M	R	690		M3	RG
9/1/2012	95425	8	51	Gillnet	M	R	765	1.3		
9/2/2012	95425	9	39	Sport	F	S	870	1.5		
9/2/2012	95425	10	39	Gillnet	M	R	685	1.3		
9/2/2012	95426	1	52	Gillnet	M	R	855	1.4		
9/2/2012	95426	2	52	Gillnet	M	R	760	1.4		
9/2/2012	95426	3	52	Gillnet	M	R	640		M2	RG
9/2/2012	95426	4	52	Gillnet	M	R	675	1.3		
9/2/2012	95426	5	53	Gillnet	F	S	800	1.4		
9/2/2012	95426	6	53	Gillnet	M	R	820	1.3		
9/2/2012	95426	7	55	Gillnet	M	R	720	1.3		
9/2/2012	95426	8	55	Gillnet	M	R	660		M3	RG
9/2/2012	95426	9	56	Gillnet	M	R	795	1.4		
9/2/2012	95426	10	57	Gillnet	F	S	830	1.4		

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Date	Scale Book Number	Fish #	Waypoint	Collection Method	Sex	Spawning Condition[d]	Length (mm) MEFT[a]	Age	Readable Age[b]	Scale comment[c]
9/2/2012	95427	1	57	Gillnet	M	R	845		M4	RG
9/2/2012	95427	2	57	Gillnet	M	R	665	1.3		
9/2/2012	95427	3	58	Gillnet	M	R	680		M3	RG
9/2/2012	95427	4	59	Spear	F	C	800	1.4		
9/2/2012	95427	5	64	Gillnet	M	R	545	1.2		
9/2/2012	95427	6	64	Gillnet	M	R	665		M2	RG
9/2/2012	95427	7	66	Spear	F	C	820	1.4		
9/2/2012	95427	8	69	Spear	F	C	805	1.4		
9/2/2012	95427	9	70	Spear	F	C	825	1.3		
9/2/2012	95427	10	70	Hand	F	C	825	1.4		
9/2/2012	95428	1	71	Hand	F	C	820		M4	RG
9/2/2012	95428	2	75	Spear	F	C	820	1.4		
9/2/2012	95428	3	75	Spear	M	C	850	1.4		
9/2/2012	95428	4	76	Spear	F	C	790			RG
9/2/2012	95428	5	76	Spear	F	C	825		M4	RG
9/2/2012	95428	6	77	Hand	F	C	800	1.4		
9/2/2012	95428	7	78	Hand	F	C	880		M4	RG
9/3/2012	95428	8	79	Sport	F	S	910	1.5		
9/3/2012	95428	9	80	Spear	F	C	735	1.4		
9/3/2012	95428	10	39	Gillnet	F	S	895	1.4		
9/3/2012	95429	1	39	Sport	F	S	800	1.4		
9/3/2012	95429	2	82	Gillnet	M	R	785	1.4		
9/3/2012	95429	3	82	Gillnet	M	R	770	1.3		
9/3/2012	95429	4	86	Gillnet	F	S	975	1.4		
9/3/2012	95429	5	87	Gillnet	F	S	830	1.4		
9/3/2012	95429	6	87	Gillnet	M	R	550	1.2		
9/3/2012	95429	7	89	Spear	F	C	790	1.4		
9/3/2012	95429	8	89	Gillnet	F	S	810	1.4		
9/3/2012	95429	9	95	Spear	M	R	680	1.3		
9/3/2012	95429	10	96	Spear	F	C	830		M4	RG

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Date	Scale Book Number	Fish #	Waypoint	Collection Method	Sex	Spawning Condition[d]	Length (mm) MEFT[a]	Age	Readable Age[b]	Scale comment[c]
9/3/2012	95430	1	97	Spear	F	C	720	1.4		
9/3/2012	95430	2	98	Spear	F	C	795	1.4		
9/3/2012	95430	3	100	Spear	F	C	845	1.4		
9/3/2012	95430	4	100	Spear	F	C	800	1.4		
9/3/2012	95430	5	100	Spear	F	C	790	1.4		
9/3/2012	95430	6	100	Spear	F	C	840	1.4		
9/3/2012	95430	7	101	Spear	F	C	830	1.4		
9/3/2012	95430	8	101	Spear	F	C	850	1.4		
9/3/2012	95430	9	101	Spear	F	C	805		M4	RG
9/3/2012	95430	10	101	Spear	F	C	850	1.4		
9/3/2012	95431	1	101	Spear	F	C	805	1.4		
9/3/2012	95431	2	101	Spear	F	C	805		M4	RG
9/3/2012	95431	3	101	Spear	F	C	790	1.4		
9/3/2012	95431	4	101	Spear	M	C	865		M4	RG
9/4/2012	95431	5	108	Spear	F	C	835	1.4		
9/4/2012	95431	6	105	Spear	F	C	805	1.4		
9/4/2012	95431	7	104	Spear	F	C	840	1.4		
9/4/2012	95431	8	107	Spear	F	C	840		M4	RG
9/4/2012	95431	9	106	Spear	M	C	875	1.3		
9/4/2012	95431	10	102	Spear	F	C	810	1.4		
9/4/2012	95432	1	103	Spear	F	C	810	1.4		
9/4/2012	95432	2	110	Spear	F	C	870	1.4		
9/4/2012	95432	3	111	Spear	F	C	845	1.4		
9/4/2012	95432	4	112	Spear	F	C	840	1.4		
9/4/2012	95432	5	113	Spear	F	C	770		M4	RG
9/4/2012	95432	6	114	Spear	F	C	780	1.4		
9/4/2012	95432	7	115	Spear	F	C	840	1.4		
9/4/2012	95432	8	115	Spear	M	C	950	1.4		
9/4/2012	95432	9	116	Spear	M	C	485	1.2		
9/4/2012	95432	10	109	Spear	F	C	790	1.4		

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Date	Scale Book Number	Fish #	Waypoint	Collection Method	Sex	Spawning Condition[d]	Length (mm) MEFT[a]	Age	Readable Age[b]	Scale comment[c]
9/4/2012	95433	1	118	Spear	F	C	870	1.4		
9/4/2012	95433	2	117	Spear	F	C	830	1.4		
9/4/2012	95433	3	117	Spear	F	C	800	1.4		
9/4/2012	95433	4	106	Spear	F	C	750	1.4		
9/4/2012	95433	5	106	Spear	F	C	745	1.4		
9/4/2012	95433	6	125	Sport	F	S	765	1.4		
9/4/2012	95433	7	119	Spear	F	C	880	1.4		
9/4/2012	95433	8	119	Spear	F	C	875	1.4		
9/4/2012	95433	9	119	Spear	F	C	805	2.5		
9/4/2012	95433	10	120	Spear	F	C	790	1.4		
9/4/2012	95434	1	121	Spear	F	C	830		M3	RG
9/4/2012	95434	2	122	Spear	F	C	755	1.4		
9/4/2012	95434	3	123	Spear	F	C	760	1.4		
9/4/2012	95434	4	124	Spear	F	C	850	1.3		
9/4/2012	95434	5	124	Spear	F	C	825		M4	RG
9/4/2012	95434	6	125	Spear	F	C	840	1.4		
9/4/2012	95434	7	126	Spear	F	C	815	1.4		
9/4/2012	95434	8	127	Spear	F	C	765	1.4		
9/4/2012	95434	9	128	Spear	F	C	805			RG
9/4/2012	95434	10	129	Spear	M	C	720		M3	RG
9/4/2012	95435	1	130	Spear	F	C	700	1.4		
9/4/2012	95435	2	130	Spear	F	C	845	1.4		
9/4/2012	95435	3	39	Sport	F	S	815	1.4		
9/4/2012	95435	4	131	Spear	M	C	545	1.2		

[a] MEFT= mideye to fork of tail measurement
[b] Readable Age: 2M= 2 Marine Annuli; 3M= 3 Marine Annuli; 4M=4 Marine Annuli; 5M= 5 Marine Annuli

[c] Scale comments: MF=Mixed Fish; RG=Regenerated scale (center is missing from scale):

[d]Spawn Condition: R=Ripe; S=Spent; C=Carcass

Appendix A 2. Waypoint locations, Little Salmon Escapement survey, 2012.

waypoint	longitude/latitude		waypoint	longitude/latitude
39	N62 10.142 W135 04.544		86	N62 08.866 W135 07.654
41	N62 09.742 W135 04.774		87	N62 08.850 W135 07.656
42	N62 08.788 W135 07.612		89	N62 08.699 W135 08.239
43	N62 08.832 W135 07.635		95	N62 08.434 W135 09.013
44	N62 10.101 W135 04.661		96	N62 08.391 W135 08.868
45	N62 10.080 W135 04.619		97	N62 08.385 W135 08.662
46	N62 10.188 W135 04.594		98	N62 08.302 W135 08.666
47	N62 10.229 W135 04.578		100	N62 08.548 W135 08.588
48	N62 08.736 W135 07.716		101	N62 08.491 W135 08.495
49	N62 08.700 W135 08.249		102	N62 09.560 W135 04.784
50	N62 08.635 W135 08.366		103	N62 07.987 W135 09.435
51	N62 08.623 W135 08.205		104	N62 05.566 W135 18.349
52	N62 08.753 W135 07.662		105	N62 05.533 W135 17.612
53	N62 08.807 W135 07.665		106	N62 05.659 W135 17.333
55	N62 08.844 W135 07.667		107	N62 06.017 W135 16.715
56	N62 08.709 W135 08.053		108	N62 06.008 W135 16.518
57	N62 08.614 W135 08.342		109	N62 06.018 W135 16.111
58	N62 08.646 W135 08.388		110	N62 06.213 W135 15.759
59	N62 08.616 W135 08.370		111	N62 06.428 W135 15.415
64	N62 08.570 W135 08.595		112	N62 07.136 W135 12.517
66	N62 08.388 W135 08.862		113	N62 07.057 W135 11.854
69	N62 08.038 W135 09.157		114	N62 07.256 W135 11.136
70	N62 07.984 W135 09.149		115	N62 07.682 W135 11.200
71	N62 08.052 W135 09.329		116	N62 07.754 W135 10.986
75	N62 07.910 W135 10.721		117	N62 07.757 W135 10.263
76	N62 08.396 W135 08.939		118	N62 07.893 W135 10.169
77	N62 09.585 W135 05.352		119	N62 08.008 W135 09.139
78	N62 09.683 W135 04.845		120	N62 08.086 W135 09.039
79	N62 10.140 W135 04.584		121	N62 08.106 W135 08.931
80	N62 10.107 W135 04.583		122	N62 08.311 W135 08.658
82	N62 08.804 W135 07.639		123	N62 08.418 W135 08.739

-continued-

Appendix Table 2. (page 2 of 2).

waypoint	longitude/latitude	waypoint	longitude/latitude
124	N62 08.394 W135 08.951		
125	N62 08.544 W135 08.732		
126	N62 08.603 W135 08.305		
127	N62 08.610 W135 08.336		
128	N62 08.707 W135 07.768		
129	N62 08.744 W135 07.706		
130	N62 08.746 W135 07.694		
131	N62 09.502 W135 05.509		
132	N62 09.540 W135 04.802		