Canadian Data Report of
Fisheries and Aquatic Sciences 1096

2002

RESULTS OF JUVENILE SOCKEYE (*Oncorhynchus nerka*) TRAWL SURVEYS IN STUART, TREMBLEUR, AND TAKLA LAKES FROM 1996 to 1998

by

S.G. MacLellan and J.M.B. Hume

Science Branch
Fisheries and Oceans Canada
Cultus Lake Salmon Research Laboratory
4222 Columbia Valley Highway
Cultus Lake, British Columbia
V2R 5B6

Cat. No. Fs 97-13/1096E ISSN 0706-6465

Correct citation for this publication:

MacLellan, S.G., and J.M.B. Hume. 2002. Results of juvenile sockeye (*Oncorhynchus nerka*) trawl surveys in Stuart, Trembleur, and Takla lakes from 1996 to 1998. Can. Data Rep. Fish. Aquat. Sci. 1096: iii + 41p.

ABSTRACT

MacLellan, S.G., and J.M.B. Hume. 2002. Results of juvenile sockeye (*Oncorhynchus nerka*) trawl surveys in Stuart, Trembleur, and Takla lakes from 1996 to 1998. Can. Data Rep. Fish. Aquat. Sci. 1096: iii + 41p.

Juvenile sockeye (*Oncorhynchus nerka*) and other pelagic fish samples were collected by mid-water trawl during summer and fall from 1996 to 1998 in Stuart, Trembleur and Takla lakes. Most samples were preserved in formalin, but fish collected for electrophoretic analysis were frozen, while others were preserved in alcohol for strontium analysis of otoliths. A total of 9,273 *O. nerka* (9,064 age-0, 60 age-1, 149 age-2+) were captured from the study lakes over the three years. We also captured 18 sculpin (*Cottus asper*), 21 whitefish (*Coregonus clupeaformis*), 1 redside shiner (*Richardsonius balteatus*), 4 lake trout (*Salvelinus namaycush*), and 2 burbot (*Lota lota*). Mean length and weight of age-0 *O. nerka* collected in the fall and preserved in formalin was 69 mm and 3.73 g in Stuart Lake, 78 mm and 5.74 g in Trembleur Lake and 64 mm and 3.02 g in Takla Lake. Strontium/calcium ratios in the core of the otolith were used to indicate the maternal origin of *O. nerka* sampled in the summer of 1997. There was a clear separation between anadromous sockeye (>0.7) and non-anadromous kokanee (<0.7). Electrophoretic analysis provided estimates of sockeye and kokanee proportions for the *O. nerka* populations in the study lakes.

RÉSUMÉ

MacLellan, S.G., and J.M.B. Hume. 2002. Results of juvenile sockeye (*Oncorhynchus nerka*) trawl surveys in Stuart, Trembleur, and Takla lakes from 1996 to 1998. Can. Data Rep. Fish. Aquat. Sci. 1096: iii + 41p.

De 1996 à 1998, à l'été et à l'automne, des saumons rouges juvéniles et d'autres poissons pélagiques ont été échantillonnés au chalut pélagique dans les lacs Stuart, Trembleur et Takla. La plupart des échantillons ont été conservés dans du formaldéhyde, mais les poissons destinés à l'analyse électrophorétique ont été congelés, et d'autres ont été conservés dans l'alcool pour l'analyse du strontium présent dans leurs otolithes. Au total, sur les trois ans d'échantillonnage, nous avons capturé 9 273 *O. nerka*, soit 9 064 poissons d'âge 0, 60 d'âge 1 et 149 d'âge 2+, dans les lacs à l'étude. Nous avons aussi capturé 18 chabots (*Cottus asper*), 21 grands corégones (*Coregonus clupeaformis*), 1 méné rose (*Richardsonius balteatus*), 4 touladis (*Salvelinus namaycush*) et 2 lottes (*Lota lota*). La longueur et le poids moyens des individus d'*O. nerka* d'âge 0 capturés à l'automne et conservés dans du formaldéhyde étaient de 69 mm et de 3,73 g dans le lac Stuart, de 78 mm et de 5,74 g dans le lac Trembleur et de 64 mm et de 3,02 g dans le lac Takla. Le rapport strontium/calcium au centre de l'otolithe a servi à indiquer l'origine maternelle des individus d'*O. nerka* échantillonnés à l'été 1997 : les rapports ont permis de distinguer clairement entre le saumon rouge anadrome (>0.7) et le kokani non anadrome (<0.7). Grâce à l'analyse électrophorétique, nous avons estimé les proportions de saumons rouges et de kokanis dans les populations d'*O. nerka* habitant les lacs à l'étude.

INTRODUCTION

The Stuart system is the northern most migration destination for sockeye (*Oncorhynchus nerka*) in the Fraser River watershed. The system consists of Stuart, Trembleur, and Takla lakes connected by Tachie and Middle Rivers (Fig. 1). Over 40 tributaries to these water bodies provide sockeye spawning habitat. The entire system lies within the sub-boreal spruce biogeoclimatic zone and receives mean annual precipitation of 40 to 75 cm with a frost-free period of 60 to 100 days per year (Farley 1979).

Stuart Lake is a large multibasin lake at the southern end of the system and receives its major inflow from the Tachie River (Fig. 2). Total surface area is 359 km^2 with an average depth of 20.2 m. The broad southern basin, which is known for its potentially rough water during storms, is characterised by a relatively flat bottom of 30 to 40 m depths gradually shallowing to the outlet and sides of the lake. The central portion of the lake is relatively shallow, often less than 20 m deep, and has many islands and shoals. The northern basin is more fjord-like, with deeper water (70 to100 m) and steep sided shorelines.

Trembleur Lake lies between Stuart and Takla lakes. Its major tributaries are Middle River, flowing into the lake's western basin, and Fleming Creek at the east end of the lake. Trembleur empties via the Tachie River at the west end of the lake (Fig. 3). This western basin, which lies between Middle and Tachie Rivers, is relatively shallow with an undulating bottom at depths normally in the 20 to 50 m range. The remainder of the lake consists of a large basin which gradually drops to a depth of over 100 m and is characterised by a rough rocky shoreline. Total surface area is 116 km^2 with a mean depth of 40 m.

Takla Lake is a long fjord-like lake at the northern end of the Stuart system and consists of three basins or arms (Fig. 1 and 4). The southern most arm, running from the junction area to the outlet (Middle River) has relatively shallow waters (mostly < 60m) with shallow and gradually sloped shorelines and several sand bars and fluvial outwash fans extending well out into the lake. The west and north arms are steep sided and deep, with maximum depths of 177 m and 287 m respectively. Overall surface area for Takla Lake is 246 km^2 with an average depth of 106 m. Major tributaries are the Driftwood River at the north end of the lake and Dust Creek at the end of the west arm.

There are two temporally and spatially distinct sockeye populations which migrate to and spawn in the Stuart system, the early and late Stuart runs. The early Stuart run enters the Fraser River in early summer and arrives on the spawning grounds in late July to mid August. They spawn in the Driftwood River and tributary streams to Middle River, Takla Lake, and Trembleur Lake (Schubert and Fanos 1997). The late Stuart run enters the Fraser River in mid summer, arriving on the spawning grounds in September. These fish spawn mainly in Tachie River, Middle River and tributaries to Trembleur and Stuart Lakes (Macdonald et al. 2000, Schubert and Fanos 1997). Both runs are cyclic, with one year of relatively high abundance (the dominant year), followed by three years of much lower abundance. The early Stuart dominant (1993, 1997...) cycle has averaged 310,000 spawners between 1970 and 1996 reaching a high of 688,000 spawners in 1993. The nondominant cycles typically produce less than 100,000 spawners (N. Schubert, Fisheries and Oceans Canada, personal communication). From the 1950's

to the 1990's, the dominant cycle of the late Stuart run (1993, 1997...) averaged 319,000. The following subdominant years averaged 33,000 sockeye while the other years averaged less than 10,000 (Schubert and Fanos 1997). Total escapement affecting the three years of this study, 1996 to 1998 (1995 to1997 brood years) are as follows (NuSEDS V1.0, at http://sci.info.pac.dfo.ca/sein_prod/Default.htm):

		Brood Year		
Lake	Run Timing	1995	1996	1997
Takla	early	36,530	33,929	180,554
Trembleur	early	86,337	76,586	85,149
	late	7,566	9,712	281,472
	total	93,903	86,298	366,621
Stuart	late	26,796	56,186	511,267
Total Escapement		157,229	176,413	1,058,442

Kokanee, the non-anadromous form of *O. nerka*, also exists in all three lakes, and may compete with sockeye for both rearing and spawning habitat. Juvenile kokanee and sockeye in Takla Lake were found to be freely intermixed, with similar behaviour and diet (Wood et al.1999). No estimates of kokanee spawner abundance have been made.

Trawl samples collected over this three-year study will contribute toward determining the abundance and distribution of juvenile sockeye, and the carrying capacities for Stuart, Takla, and Trembleur Lakes. Trawl data along with hydroacoustic data will be used to estimate juvenile sockeye numbers as described in Nunnallee (1973) and in Burczynski and Johnson (1986). Along with other data, these results will also be used to examine in-lake factors (e.g. food supply), which may be affected by the large population cycles, and to evaluate the effectiveness of possible sockeye enhancement activities such as spawning channels, lake fertilization and fishery management for increased escapement. Specific objectives were to determine species composition of the limnetic fish (catch data), age (*O. nerka* only) and size composition of the limnetic fish (length and weight data), and parental origin (anadromous or not) of the age-0 *O. nerka* (genotype analysis and strontium (Sr)/calcium (Ca) ratios in the otolith primordia).

METHODS

Summer surveys (early August) were conducted each year (1996 to 1998) in each of the three Stuart system lakes. Fall surveys were conducted on Stuart Lake in mid-October,1996 and late September in 1997 and 1998; on Takla Lake in late September from 1996 to 1998; and on Trembleur Lake in mid-October, 1996 and late September, 1997. Low water in Middle River, prevented boat access to Trembleur Lake in the fall of 1998.

The Stuart system lakes were divided into trawl sample sections, which contained from two to seven established hydroacoustic transects perpendicular to shore (Fig. 2-4). These sections and transects remained the same throughout the study period. Fish were captured using a midwater closing trawl with a mouth opening 3 m wide by 7 m deep, capable of fishing to 64 m (depth to middle of the mouth opening). The trawl net is described in Enzenhofer and Hume (1989). Depth and duration of each trawl were determined by visually estimating fish density and depth from the acoustic echogram. Normally one tow was done in each sample section, but more were done if fish were stratified in two or more layers. When the hydroacoustics indicated very few fish, tows were not generally carried out.

In 1997, four trawls were completed on two deep, slow moving sections of Middle River to determine if *O. nerka* were utilising these areas as rearing habitat. Section 1 was approximately 4 km downstream from Takla Lake centred at 125° 26.823' W, 55° 01.936' N, with a maximum observed depth of approximately 26 m and was approximately 0.9 km long. Section 2 was approximately 7 km downstream, centred at 125° 25.481' W, 55° 00.950' N with a maximum observed depth of approximately 21 m and was approximately 0.6 km long.

To prevent fish from regurgitating their stomach contents, fish captured in 1996 were first anaesthetised with a lethal dose of 2-phenoxyethanol solution and, in 1997 and 1998, with an ethanol/clove oil solution (Anderson et al.1997). They were then either preserved in 10% formalin for regular size/weight measurements, 85% ethanol for otolith strontium analysis, or frozen for electrophoretic analysis. Each trawl catch was labelled and a trawl log kept; recording survey, tow, section, date, time, duration of trawl, depth, and weather. Usually the total catch from each trawl was preserved, however, on rare occasions when catch was excessively large, only a portion of the catch was preserved and the remainder released. Larger fish (approximately >150 mm), including large kokanee, trout and burbot were usually measured for fork length and released, with the exception of kokanee captured on Stuart and Trembleur Lakes which were retained to provide genetic baseline data for electrophoretic analysis.

Preserved samples were left for at least one month to stabilise fish size before measuring (Rogers 1964). We removed excess moisture from fish with paper towelling in the manner described as heavy blotting by Parker (1963). Fish were identified to species, measured to the nearest 1.0 mm, and weighed to the nearest 0.01 g using an electronic balance. All *O. nerka* were initially assigned to preliminary age classes based on groupings determined from a simple length frequency analysis. In most cases, it was apparent from the observed size distribution that most fish were young of the year (age-0) and up to 20 scales were randomly taken from this group to confirm this age classification. Scales were also taken from up to 30 of the larger *O. nerka* to determine their age. Ages from scales were then used to confirm ages from the length frequency analysis. If any discrepancies were found (very rarely) the scale ageing was used. All scale ageing was done by modifications of the methods described in Clutter and Whitesel (1956), (Shayne MacLellan, DFO, Nanaimo, Pers. Comm.) When the tow was done within 4 hours of dusk and in an area where zooplankton populations had been monitored, the cardiac portion of stomachs from 20 fish were removed for stomach content analysis.

Data storage, processing, and statistical analysis were done with SAS System software (SAS Institute 1988a, b). Juvenile *O. nerka* were divided into age-0, age-1 and

age-2+. These categories were determined from the scale ageing analysis, length frequency distributions, and by date of capture relative to fry emergence. Age-0 are fry from the current year's emergence and have not been in the lake over the winter. Age-1 are from the previous year's emergence and have been in the lake over one winter. Age-2+ are determined to have been in the lake for 2 or more winters. Age-0 includes both sockeye and kokanee. Scale analysis of returning sockeye adults to the Stuart River system show that virtually all sockeye (99.8%) smolt after one year and have left the lake by the end of spring following one year lake residency (Pacific Salmon Commission, Vancouver, data on file). Therefore age-1 and age-2+ *O. nerka* can be for the most part, considered kokanee.

Juvenile sockeye and juvenile kokanee occupy the same lake habitat and freely mix with each other during the first year of their life history (Wood et al.1999). Other than a slight difference in size, these two life cycle forms of *O. nerka* are virtually indistinguishable from one another at this stage in life. Juvenile kokanee can be slightly smaller than sockeye, however there are many factors potentially affecting this difference in size, including genetics, lake productivity, and emergence timing. The end result is that size distribution between the two often involves a great deal of overlap, making size unreliable for distinguishing between the two morphs in most cases. Where possible, we froze a subsample of our trawl catch for electrophoretic analysis to estimate the sockeye proportion of the *O. nerka* catch. The procedure used starch gel electrophoresis methods to reveal genotypes at alanine aminotransferase (ALAT*) and phosphoglucomutase-2 (PGM-2*) as described by Wood et al. (1999) and Wood and Foote (1996). Baseline genetic data was developed from tissue samples collected from adult sockeye and kokanee collected from the three study lakes over the study period or from profiles on file from earlier studies by Wood et al. (1999) and Wood and Foote (1996). The electrophoretic results were analysed using SPAM95, a statistics program for analysing mixtures (Alaska Department of Fish and Game 1997).

During 1998, the final year of the study, we preserved a few *O. nerka* from selected trawl samples in 85% ethanol for otolith microchemistry analysis. The progeny of anadromous sockeye have been found to have significantly higher Sr/Ca ratios in the otolith primordia than do the progeny of fresh water reared kokanee, providing the lake environment does not have an unusually high level of strontium present and yolk deposition is largely completed before anadromous sockeye enter the freshwater environment (Rieman et al. 1994, Volk et al. 2000). Sr and Ca were measured in the otolith origin and on the ototlith rim using a four-spectrometer JEOL model 733-electron microprobe as described by Volk et al. (2000).

RESULTS AND DISCUSSION

Over the three years of the study, 30 tows were completed on Stuart Lake, 37 tows on Takla Lake, 18 on Trembleur Lake and 5 tows on some deep, slow moving sections of Middle River (Table 1). Trawling depths ranged from 9 to 32 m but most trawls (67%) were between 11 and 18 m. There was no visible moon for most trawls, but eight trawls were affected by some moonlight. About half of the trawls were conducted with less than 10% cloud cover and with a light breeze or less (<6 knots). A few trawls (13%) were conducted under more adverse conditions of continuous rain and/or moderate breezes (11 to 16 knots) while two trawls were conducted with winds >17 knots.

During the three-year study period, we caught 4,246 *O. nerka* from Stuart Lake including 4,158 age-0, 4 age-1, and 84 age-2+. Age-0 *O. nerka* captured in the fall (fall fry) and preserved in formalin, averaged 69 mm and 3.73 g. Other species captured in Stuart Lake were; 12 whitefish (*Coregonus clupeaformis*), 15 sculpin (*Cottus asper*), 1 redside shiner (*Richardsonius balteatus*), 1 lake trout (Salvelinus namaycush), and 2 burbot (*Lota lota*).

Trawling in Trembleur Lake captured 2,438 age-0, 2 age-1 and 24 age-2+ for a total of 2,464 *O. nerka* over the three years. Mean length and weight of fall fry preserved in formalin was 78 mm and 5.74 g. Other species included 5 whitefish, 2 sculpin, and 1 lake trout.

The 2,563 *O. nerka* caught in Takla Lake included 2,468 age-0, 54 age-1, and 41 age-2+. Formalin preserved fall fry averaged 64 mm in length and 3.02 g in weight. In addition to *O. nerka,* 4 whitefish, 1 sculpin, and 2 lake trout were caught.

Our 1997 trawls in Middle River captured 46 *O. nerka* (44 age-0, 1 age-1) from the deep basins in the upper stretches of the river. This indicates that some *O. nerka* utilize these areas as rearing habitat, at least through the summer and fall seasons. Average formalin preserved fall fry weighed 5.69 g and were 78 mm in length. Other species caught were 8 whitefish, 9 sculpin, and 1 redside shiner.

The summary length and weight statistics presented here (by survey in Table 2 and by trawl in Table 3) are based on measurements of frozen (thawed for measurement), alcohol, or formalin preserved fish. Although preservation method does have an effect on measured length and weight, no conversion to live size or between preservation methods has been made. Formalin preservation causes a consistent shrinkage in length enabling a simple conversion back to live length, although, various relationships have been established with somewhat different results. Rogers (1964) estimated a factor of +4% for sockeye up to 70 mm and +5% for sockeye smolts 70 to 120 mm. Shields and Carlson (1996) established a formalin length to live length conversion equation (L=0.744+0.998(FL)).

Effects on weight are more complex and are dependent on fish size, original state, and the ionic concentration of the formalin when fish were preserved (Parker 1963). Changes in weight from live to preserved fish ranged from -11% to +6% according to Rogers (1964) and from +5% to +12% as reported by Parker (1963). Shields and Carlson (1996) produced the conversion equation W=0.939(FW)-0.048.

Conversion factors for fish preserved with alcohol or freezing have been researched by Shields and Carlson (1996), DiStefano et al. (1994), and Macdonald et al. (1997). These studies have shown that appropriate conversion factors not only vary between species, but between watersheds and between years within species. Unless researchers are willing to develop and update conversion factors on a study and site specific basis, conversion factors should be used only to roughly estimate live measurements (Shields and Carlson 1996).

Because of the effect preservation has on fish length and weight, tables presented in this report identify the method used to preserve the sample. When portions of a catch were preserved differently, statistics where calculated separately for each

portion. Changes in length due to preservation method are relatively minor, especially when considering the small size of age-0 *O. nerka* and the 3-mm size bins we used in determining length frequencies. Therefore, length frequency graphs presented here include *O. nerka* from all preservation methods (Fig. 7-10).

We analysed 98 fish from our 1998 summer surveys for otolith core strontium/calcium ratios to determine the proportion of *O. nerka* populations having anadromous (sockeye) and non-anadromous parentage (kokanee) for each of the study lakes. The results showed clear separation of the Sr/Ca ratios in the otolith primordia, the higher ratios (>0.7) indicating anadromous maternity (Volk 2000 et al.; Fig. 5, Table 4). The test was controlled by sampling the otolith margin. The margin consists of material that would be laid down during lake rearing and therefore should be identical in both kokanee and sockeye (Volk et al. 2000). All Sr/Ca ratios from the margin, with one exception, were <0.7, thereby validating the methodology.

In general, kokanee identified in these summer analyses were smaller than sockeye (Table 5). There was, however, considerable overlap in size between the two morphs making size alone an unreliable criterion for distinguishing between the two. Thus, we did not attempt to separate the other *O. nerka* reported in the other tables.

We attempted genotype analysis using starch gel electrophoresis methods, similar to those used by Wood et al. (1999) and Wood and Foote (1996), to determine the proportions of kokanee and sockeye in the three lakes. Over the course of the three years, estimates of sockeye ranged from 30% to 81% of the total *O. nerka* population in Stuart Lake, 6% to 98% of the total *O. nerka* population in Trembleur Lake and 33% to 78% in Takla Lake (Table 6). The range in the 90% confidence interval (CI) on these estimates was very large, exceeding 75% of the estimate in many cases.

We compared the determination of sockeye proportions using the results from the two methods, electrophoretic genotyping and determination of the Sr/Ca ratio in the otolith core (Fig. 6). While the relationship is significant ($R^2 = 0.73$, $P<0.05$), the sample size is small and there is little range in the estimates produced by the eight samples available for the analysis. Note that the same fish were not analysed by both methods, rather, samples for each method were collected from the same population. Also, due to the high cost of the Sr/Ca ratio analysis, sample size from individual lake sections tended to be quite small, ranging from 7 to 20 fish.

ACKNOWLEDGEMENTS

We wish to acknowledge the efforts of following people involved in the collection and analysis of these data; Ken Morton for assistance in data collection in the field; Eric Volk of The Department of Fish and Game in Olympia, Washington for his guidance and analysis of strontium in otoliths; Chris Wood and Dennis Rutherford from the Pacific Biological Station in Nanaimo, B.C. for their assistance regarding electrophoretic analysis and interpretation; Cliff Stevens of Alpha-Gen Bioanalysis Ltd. for doing the electophoretic analysis; Shayne MacLellan and the staff at the Ageing Lab at Pacific Biological Station in Nanaimo B.C. for determining fish ages through scale analysis. We also wish extend our appreciation to Kelly Malange and Ken Shortreed for their review of the manuscript and to Vivian Magnusson for her assistance in publishing this report.

REFERENCES

Alaska Department of Fish and Game. 1997. SPAM95 Version 2.0 Statistics Program for Analysing Mixtures. Anchorage, Alaska. 38p.

Anderson, G.W., S.R. McKinley, and M. Colavecchia. 1997. The use of clove oil as an anaesthetic for rainbow trout and its effects on swimming performance. N. Amer. J. Fish. Man. 17:301-307.

Burczynski, J.J., and R.L. Johnson. 1986. Application of dual-beam acoustic survey techniques to limnetic populations of juvenile sockeye salmon (*O. nerka*). Can. J. Fish. Aquat. Sci. 43:1776-1788.

Clutter, R.I., and L.E. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. International Pacific Salmon Fisheries Commission. Bulletin IX. 159p.

DiStefano, R.J., M.J. Roell, B.A. Wagner, and J.J. Decoske. 1994. Relative performances of four preservatives on fish and crayfish. Trans. Am. Fish. Soc. 123:817-823.

Enzenhofer, H.J., and J.M.B. Hume. 1989. Simple closing midwater trawl for small boats. N. Amer. J. Fish. Man. 9:372-377.

Farley, A.L. 1979. Atlas of British Columbia. The University of British Columbia Press. Vancouver, B.C. 136p.

Macdonald, J.S., M.G.G. Foreman, T. Farrel, I.V. Williams, J. Grout, J.C. Woody, H. Enzenhofer, W.C. Clarke, R. Houtman, E.M. Donaldson, and D. Barnes. 2000. The influence of extreme water temperatures on migrating Fraser River sockeye salmon (*Oncorhynchus nerka*) during the 1998 spawning season. Can. Tech. Rep. Fish. Aquat. Sci. 2326: 117p.

Macdonald, J.S., C.J. Williamson, D.A. Patterson, and H.E. Herunter. 1997. The shrinkage of sockeye salmon fry fixed in 10% formalin and preserved in 37.5% isopropanol. Can. Tech. Rep. Fish. Aquat. Sci. 2198: 11p.

Nunnallee, E.P. 1973. A hydroacoustic data acquisition and digital analysis system for the assessment of fish stock abundance. University of Washington. Fisheries Research Institute. Circular 73-3.

Pacific Salmon Commission. 1991. Report of the Fraser River panel to the Pacific Salmon Commission on the 1990 Fraser River sockeye salmon fishing season. Vancouver B.C. 51p.

Parker, Robert R. 1963. Effects of formalin on length and weight of fishes. J. Fish. Res. Bd. Can. 20:1441-1455.

Rieman, B.E., D.L. Myers, and R.L. Nielsen. 1994. Use of otolith microchemistry to discriminate *Oncorhynchus nerka* of resident and anadromous origin. Can J. Fish. Aquat. Sci. 51:68-77

Rogers, D.E. 1964. Variability in measurement of length and weight of juvenile sockeye salmon and three spine stickleback. Fisheries Research Institute, College of Fisheries, University of Washington, Circular No. 224: 1-34.

SAS Institute Inc. 1988a. SAS© Language Guide for Personal Computers, Release 6.03 Edition. Cary, NC: SAS Instit. Inc.: 558p.

SAS Institute Inc. 1988b. SAS© Procedures Guide, Release 6.03 Edition. Cary, NC: SAS Instit. Inc.: 441pp.

Shields, P.A. and S.R. Carlson. 1996. Effects of formalin and alcohol preservation on lengths and weights of juvenile sockeye salmon. Alaska Fish. Res. Bull. 3(2):81-93.

Schubert, N.D. and B.P. Fanos. 1997. Estimation of the 1994 late run sockeye salmon (*Oncorhynchus nerka*) escapement to the Stuart River system. Can. Manuscr. Rep. Fish. Aquat. Sci. 2431: 66p.

Volk, E.C., A. Blakley, S.L. Schroder, and S.M. Kuehner. 2000. Otolith chemistry reflects migratory characteristics of Pacific salmonids: - Using otolith core chemistry to distinguish maternal associations with sea and freshwaters. Fish. Res. 46:251-266

Wood, C.C., and C.J. Foote. 1996. Evidence for sympatric genetic divergence of anadromous and nonanadromous morphs of sockeye salmon (*Oncorhynchus nerka*). Evolution, 50:1265-1279.

Wood, C.C., C.J. Foote and D.T. Rutherford. 1999. Ecological interactions between juveniles of reproductively isolated anadromous and non-anadromous morphs of sockeye salmon, *Oncorhynchus nerka*, sharing the same nursery lake. Environ. Biol. Fish. 54:161-173.

Table 1. Summary of tows completed on the Stuart system from 1996 to 1998.

Water body	Survey (#)	Tow (#)	Sect (#)	Time (PST)	Date	Depth (m) Start	Depth (m) End	Conditions Sky	Conditions Light	Conditions Wind	Catch	
Stuart Lake	1996 02	1996 0002	4	00:35	96/08/08	18	18	Intermittent Rain	Dark	Light Air	Age 0	201
											Age 1	2
											Age 2+	4
											Whitefish	1
Stuart Lake	1996 02	1996 0003	1	22:58	96/08/08	15	9	<10% Overcast	Dark	Gentle Breeze	Age 0	418
											Age 1	2
											Age 2+	1
											Whitefish	1
Stuart Lake	1996 02	1996 0004	1	00:39	96/08/09	11	11	<10% Overcast	Dark	Gentle Breeze	Age 0	502
											Age 2+	2
Stuart Lake	1996 02	1996 0005	2	21:45	96/08/09	18	18	10-50% Overcast	Dark	Moderate Breeze	Age 0	75
											Age 2+	1
											Lake Trout	1
Stuart Lake	1996 02	1996 0006	3	01:39	96/08/10	18	18	<10% Overcast	Dark	Moderate Breeze	Age 0	27
											Age 2+	2
											Whitefish	1
											Sculpin	1
Stuart Lake	1996 07	1996 0030	1	19:25	96/10/16	18	18	>50% Overcast	Dark	Light Breeze	Age 0	346
											Age 2+	6
Stuart Lake	1996 07	1996 0031	1	20:00	96/10/16	32	32	>50% Overcast	Dark	Light Breeze	Age 0	40
											Age 2+	14
Stuart Lake	1996 07	1996 0032	2	23:30	96/10/16	18	18	10-50% Overcast	Dark	Light Breeze	Age 0	33
											Age 2+	2
Stuart Lake	1996 07	1996 0033	3	3:42	96/10/17	18	18	>50% Overcast	Dark	Fresh Breeze	Age 0	70
Stuart Lake	1997 04	1997 0008	4	22:40	97/08/07	22	22	<10% Overcast	Dark	Moderate Breeze	Age 0	245
Stuart Lake	1997 04	1997 0009	1	23:10	97/08/08	11	11	<10% Overcast	Dark	Calm	Age 0	398
Stuart Lake	1997 04	1997 0010	1	23:40	97/08/08	11	11	<10% Overcast	Dark	Calm		0
Stuart Lake	1997 04	1997 0011	2	02:55	97/08/09	18	18	<10% Overcast	Dark	Light Breeze	Age 0	106
											Sculpin	1
Stuart Lake	1997 04	1997 0012	2	03:45	97/08/09	18	18	<10% Overcast	Twilight	Light Breeze		0

Table 1. Summary of tows completed on the Stuart system from 1996 to 1998 (continued).

Water body	Survey (#)	Tow (#)	Sect (#)	Time (PST)	Date	Depth (m) Start	Depth (m) End	Conditions Sky	Conditions Light	Conditions Wind	Catch	
Stuart Lake	1997 04	1997 0013	3	00:50	97/08/10	18	18	<10% Overcast	Dark	Calm	Age 0	11
Stuart Lake	1997 09	1997 0027	4	20:35	97/09/23	23	23	10-50% Overcast	Dark	Light Breeze	Age 0	8
Stuart Lake	1997 09	1997 0028	4	23:20	97/09/23	25	25	10-50% Overcast	Dark	Light Breeze	Age 0	1
Stuart Lake	1997 09	1997 0029	3	04:14	97/09/24	25	25	<10% Overcast	Moderate Moon	Light Breeze		0
Stuart Lake	1997 09	1997 0030	1	20:25	97/09/24	18	18	<10% Overcast	Dark	Light Air	Age 0	258
Stuart Lake	1997 09	1997 0031	2	23:50	97/09/24	23	23	<10% Overcast	Dark	Light Air	Age 0	66
											Whitefish	2
Stuart Lake	1997 09	1997 0032	3	02:35	97/09/25	23	23	<10% Overcast	Moderate Moon	Light Air	Age 0	18
											Whitefish	3
											Burbot	1
Stuart Lake	1997 09	1997 0033	4	04:07	97/09/25	11	11	<10% Overcast	Moderate Moon	Light Air	Age 0	92
											Redside Shiner	1
											Burbot	1
Stuart Lake	1998 03	1998 0002	4	22:24	98/08/11	17	17	>50% Overcast	Dark	Gentle Breeze	Age 0	233
											Age 2+	12
Stuart Lake	1998 03	1998 0003	1	22:35	98/08/12	11	11	<10% Overcast	Dark	Light Breeze	Age 0	396
											Age 2+	5
											Sculpin	1
Stuart Lake	1998 03	1998 0004	2	02:30	98/08/13	18	18	<10% Overcast	Dark	Light Breeze	Age 0	290
											Age 2+	16
Stuart Lake	1998 03	1998 0005	3	22:29	98/08/13	18	18	<10% Overcast	Dark	Gentle Breeze	Age 0	20
											Age 2+	8
											Whitefish	1
											Sculpin	8
Stuart Lake	1998 03	1998 0006	3	02:04	98/08/14	20	20	<10% Overcast	Dark	Gentle Breeze	Age 0	115
											Whitefish	1

Table 1. Summary of tows completed on the Stuart system from 1996 to 1998 (continued).

Water body	Survey (#)	Tow (#)	Sect (#)	Time (PST)	Date	Depth (m) Start	Depth (m) End	Conditions Sky	Conditions Light	Conditions Wind	Catch	
Stuart Lake	1998 08	1998 0016	4	21:55	98/09/22	21	21	<10% Overcast	Dark	Calm		
											Age 0	66
											Age 2+	4
											Sculpin	2
Stuart Lake	1998 08	1998 0017	1	20:20	98/09/23	18	18	10-50% Overcast	Dark	Light Breeze		
											Age 0	85
											Age 2+	6
Stuart Lake	1998 08	1998 0018	2	00:02	98/09/24	18	18	<10% Overcast	Dark	Light Air		
											Age 0	38
											Age 2+	1
											Whitefish	2
											Sculpin	2
Takla Lake	1996 03	1996 0007	1	00:35	96/08/12	11	11	Continuous Rain	Dark	Gentle Breeze		
											Age 0	10
											Age 2+	1
											Lake Trout	1
Takla Lake	1996 03	1996 0008	6	23:15	96/08/12	11	11	<10% Overcast	Dark	Light Breeze		
											Age 0	51
											Age 1	3
Takla Lake	1996 03	1996 0009	5	21:45	96/08/13	11	11	<10% Overcast	Dark	Light Air		
											Age 0	33
											Age 2+	2
Takla Lake	1996 03	1996 0010	4	01:05	96/08/14	11	11	<10% Overcast	Dark	Light Air		
											Age 0	23
											Age 1	4
											Age 2+	4
Takla Lake	1996 03	1996 0011	3	22:15	96/08/14	11	11	>50% Overcast	Dark	Light Air		
											Age 0	29
											Age 1	1
											Age 2+	1
Takla Lake	1996 03	1996 0012	2	00:17	96/08/14	11	11	>50% Overcast	Dark	Light Air		
											Age 0	25
Takla Lake	1996 05	1996 0018	2	22:00	96/09/24	25	25	>50% Overcast	Moderate Moon	Calm		
											Age 0	4
											Age 1	3
											Age 2+	3
Takla Lake	1996 05	1996 0019	3	01:27	96/09/25	25	25	>50% Overcast	Moderate Moon	Calm		
											Age 0	3
											Age 2+	11

Table 1. Summary of tows completed on the Stuart system from 1996 to 1998 (continued).

Water body	Survey (#)	Tow (#)	Sect (#)	Time (PST)	Date	Depth (m) Start	Depth (m) End	Conditions Sky	Conditions Light	Conditions Wind	Catch	
Takla Lake	1996 05	1996 0020	1	21:15	96/09/25	18	18	>50% Overcast	Moderate Moon	Calm	Age 0	20
											Age 2+	1
											Whitefish	1
Takla Lake	1996 05	1996 0021	4	01:20	96/09/26	18	18	>50% Overcast	Moderate Moon	Light Breeze	Age 0	9
Takla Lake	1996 05	1996 0022	6	20:10	96/09/26	18	18	Continuous Rain	Dark	Light Air	Age 0	106
Takla Lake	1996 05	1996 0023	6	21:06	96/09/26	32	32	Continuous Rain	Dark	Light Air	Age 0	70
											Age 2+	1
Takla Lake	1996 05	1996 0024	5	02:00	96/09/27	25	25	Continuous Rain	Dark	Light Air	Age 0	5
											Age 1	4
											Age 2+	1
Takla Lake	1996 05	1996 0025	2	21:10	96/09/27	20	20	>50% Overcast	Dark	Moderate Breeze	Age 0	75
											Age 1	3
Takla Lake	1996 05	1996 0026	2	22:10	96/09/27	32	32	>50% Overcast	Dark	Moderate Breeze	Age 1	6
											Age 2+	2
Takla Lake	1997 05	1997 0014	1	23:10	97/08/10	15	15	<10% Overcast	Dark	Calm	Age 0	35
											Age 1	1
											Age 2+	3
											Lake Trout	1
Takla Lake	1997 05	1997 0015	2	01:55	97/08/11	11	11	<10% Overcast	Dark	Calm	Age 0	132
											Age 2+	1
Takla Lake	1997 05	1997 0016	3	22:20	97/08/11	11	11	<10% Overcast	Dark	Calm	Age 0	35
											Age 1	1
Takla Lake	1997 05	1997 0017	4	01:05	97/08/12	11	11	<10% Overcast	Dark	Light Air	Age 0	62
											Age 1	1
											Age 2+	1
Takla Lake	1997 05	1997 0018	6	23:10	97/08/12	15	15	<10% Overcast	Dark	Light Air	Age 0	92
											Age 1	1
Takla Lake	1997 05	1997 0019	5	02:04	97/08/13	11	11	<10% Overcast	Dark	Light Air	Age 0	62
											Age 2+	1

Table 1. Summary of tows completed on the Stuart system from 1996 to 1998 (continued).

Water body	Survey (#)	Tow (#)	Sect (#)	Time (PST)	Date	Depth (m) Start	Depth (m) End	Conditions Sky	Conditions Light	Conditions Wind	Catch	
Takla Lake	1997 10	1997 0034	1	22:25	97/09/25	18	18	>50% Overcast	Dark	Calm		
											Age 0	6
											Age 1	5
Takla Lake	1997 10	1997 0035	6	19:50	97/09/26	25	25	>50% Overcast	Dark	Light Breeze		
											Age 0	38
											Age 1	4
Takla Lake	1997 10	1997 0036	5	02:35	97/09/27	20	20	>50% Overcast	Dark	Light Air		
											Age 0	104
											Age 1	5
Takla Lake	1997 10	1997 0037	2	20:58	97/09/27	20	20	>50% Overcast	Dark	Calm		
											Age 0	9
											Age 1	5
											Age 2+	2
Takla Lake	1997 10	1997 0038	3	23:57	97/09/27	11	11	>50% Overcast	Dark	Gentle Breeze		
											Age 0	64
											Age 1	2
Takla Lake	1997 10	1997 0039	4	04:40	97/09/28	23	23	>50% Overcast	Dark	Gentle Breeze	Age 0	9
Takla Lake	1998 04	1998 0007	3	22:33	98/08/14	10	10	Fog/Haze	Dark	Gentle Breeze	Age 0	222
Takla Lake	1998 04	1998 0008	2	00:43	98/08/15	11	11	>50% Overcast	Dark	Light Breeze		
											Age 0	289
											Age 2+	3
Takla Lake	1998 04	1998 0009	6	22:55	98/08/15	11	11	<10% Overcast	Dark	Gentle Breeze		
											Age 0	119
											Age 2+	2
Takla Lake	1998 04	1998 0010	5	02:55	98/08/16	11	11	<10% Overcast	Dark	Gentle Breeze	Age 0	60
Takla Lake	1998 04	1998 0011	4	00:44	98/08/17	20	20	<10% Overcast	Dark	Gentle Breeze	Age 0	10
Takla Lake	1998 09	1998 0019	1	21:34	99/09/24	18	18	>50% Overcast	Dark	Light Air		
											Age 0	137
											Whitefish	1
											Sculpin	1
Takla Lake	1998 09	1998 0020	2	01:38	98/09/25	15	15	>50% Overcast	Dark	Light Air		
											Age 0	179
											Whitefish	2
Takla Lake	1998 09	1998 0021	6	21:16	98/09/25	17	17	<10% Overcast	Dark	Light Air		
											Age 0	150

Table 1. Summary of tows completed on the Stuart system from 1996 to 1998 (continued).

Water body	Survey (#)	Tow (#)	Sect (#)	Time (PST)	Date	Depth (m) Start	Depth (m) End	Conditions Sky	Conditions Light	Conditions Wind	Catch	
Takla Lake	1998 09	1998 0022	5	01:00	98/09/26	18	18	<10% Overcast	Dark	Light Breeze	Age 0	77
											Age 1	5
											Age 2+	1
Takla Lake	1998 09	1998 0023	4	03:45	98/09/26	18	18	<10% Overcast	Dark	Light Air	Age 0	114
Trembleur Lake	1996 04	1996 0013	1	22:35	96/08/15	11	11	10-50% Overcast	Dark	Light Breeze	Age 0	162
Trembleur Lake	1996 04	1996 0014	1	23:15	96/08/15	18	18	10-50% Overcast	Dark	Light Breeze	Age 0	56
											Age 2+	10
Trembleur Lake	1996 04	1996 0015	2	01:25	96/08/16	11	11	>50% Overcast	Dark	Light Breeze	Age 0	132
											Age 2+	2
Trembleur Lake	1996 04	1996 0016	3	00:55	96/08/17	18	18	Continuous Rain	Dark	Moderate Breeze	Age 0	34
											Age 1	2
Trembleur Lake	1996 04	1996 0017	1	21:10	96/08/17	18	18	10-50% Overcast	Twilight	Gentle Breeze	Age 0	77
											Age 2+	10
											Lake Trout	1
Trembleur Lake	1996 06	1996 0027	1	20:02	96/10/13	25	25	>50% Overcast	Dark	Gentle Breeze	Age 0	135
											Age 2+	2
Trembleur Lake	1996 06	1996 0028	2	22:55	96/10/13	25	25	10-50% Overcast	Dark	Gentle Breeze	Age 0	39
Trembleur Lake	1996 06	1996 0029	3	02:00	96/10/14	18	18	<10% Overcast	Dark	Gentle Breeze	Age 0	52
											Whitefish	1
											Sculpin	1
Trembleur Lake	1997 07	1997 0022	3	22:50	97/08/14	18	18	>50% Overcast	Dark	Fresh Breeze	Age 0	25
Trembleur Lake	1997 07	1997 0023	3	23:25	97/08/14	22	22	>50% Overcast	Dark	Light Breeze	Age 0	10
Trembleur Lake	1997 07	1997 0024	2	02:11	97/08/15	18	18	>50% Overcast	Dark	Light Breeze	Age 0	320
Trembleur Lake	1997 07	1997 0025	1	22:45	97/08/15	22	22	<10% Overcast	Bright Moon	Light Air	Age 0	297
											Whitefish	3
Trembleur Lake	1997 12	1997 0042	3	20:55	97/09/29	16	16	>50% Overcast	Dark	Moderate Breeze	Age 0	40

Table 1. Summary of tows completed on the Stuart system from 1996 to 1998 (continued).

Water body	Survey (#)	Tow (#)	Sect (#)	Time (PST)	Date	Depth (m) Start	Depth (m) End	Conditions Sky	Conditions Light	Conditions Wind	Catch	
Trembleur Lake	1997 12	1997 0043	2	23:52	97/09/29	25	25	>50% Overcast	Dark	Moderate Breeze	Age 0	77
											Sculpin	1
Trembleur Lake	1997 12	1997 0044	1	03:11	97/09/30	32	32	Continuous Rain	Dark	Moderate Breeze	Age 0	121
											Whitefish	1
Trembleur Lake	1998 05	1998 0012	1	22:45	98/08/18	18	15	<10% Overcast	Dark	Moderate Breeze	Age 0	397
Trembleur Lake	1998 05	1998 0013	2	01:45	98/08/19	18	18	<10% Overcast	Dark	Moderate Breeze	Age 0	83
Trembleur Lake	1998 05	1998 0014	3	22:35	98/08/19	18	18	<10% Overcast	Dark	Light Air	Age 0	381
Middle River	1997 06	1997 0020	2	21:55	97/08/13	11	15	>50% Overcast	Day Light	Light Air	Age 0	19
											Age 1	2
Middle River	1997 06	1997 0021	1	22:25	97/08/13	11	15	>50% Overcast	Day Light	Light Air	Age 0	9
											Whitefish	2
Middle River	1997 11	1997 0040	2	20:30	97/09/28	10	15	<10% Overcast	Dark	Light Breeze	Age 0	9
											Whitefish	3
											Sculpin	7
Middle River	1997 11	1997 0041	1	21:23	97/09/28	10	15	<10% Overcast	Dark	Light Breeze	Age 0	7
											Whitefish	3
											Sculpin	2
											Redside Shiner	1

Table 2. Trawl statistics by lake and survey for the Stuart system.

Water body	Survey (#)	Date	Preservation method	Taxa	N	Weight (g)						Length (mm)					
						N	Mean	+/-95%CI	SD	Min	Max	N	Mean	+/-95%CI	SD	Min	Max
Stuart Lake	199602	Aug 08-10/1996	Formalin	Age 0	825	825	1.12	0.05	0.67	0.22	3.28	825	45.0	0.5	8.0	27	65
			Formalin	Age 1	2	2	40.47	36.47	4.06	37.60	43.34	2	145.0	50.8	5.7	141	149
			Formalin	Whitefish	3	3	3.08	6.63	2.67	0.30	5.62	3	60.3	65.5	26.4	31	82
			Formalin	Sculpin	1	1	1.44			1.44	1.44	1	49.0			49	49
			Formalin	Lake Trout	1	1	0.70			0.70	0.70	1	38.0			38	38
			Frozen	Age 0	398	398	1.24	0.08	0.77	0.05	4.02	398	49.0	1.0	9.7	21	71
			Frozen	Age 1	2	2	26.04	19.95	2.22	24.47	27.61	2	124.5	19.1	2.1	123	126
			Frozen	Age 2+	10	10	63.13	21.24	29.69	27.68	106.54	10	169.7	19.7	27.5	137	208
Stuart Lake	199607	Oct 16-17/1996	Formalin	Age 0	347	347	3.67	0.17	1.63	1.16	9.44	347	68.5	1.0	9.3	47	94
			Frozen	Age 0	142	142	2.11	0.22	1.32	0.36	6.46	142	63.3	2.4	14.3	31	90
			Frozen	Age 2+	22	22	53.44	3.12	7.05	37.32	70.39	22	162.6	3.8	8.5	148	189
Stuart Lake	199704	Aug 07-10/1997	Formalin	Age 0	429	429	1.93	0.07	0.70	0.47	4.34	429	55.0	0.6	6.5	34	72
			Formalin	Sculpin	1	1	1.29			1.29	1.29	1	49.0			49	49
			Frozen	Age 0	331	331	1.61	0.08	0.69	0.51	4.97	331	53.1	0.8	7.0	37	75
Stuart Lake	199709	Sep 23-25/1997	Formalin	Age 0	271	271	4.19	0.17	1.46	1.18	10.36	271	70.8	1.0	8.0	48	93
			Formalin	Whitefish	2	2	4.38	0.64	0.07	4.33	4.43	2	75.5	6.4	0.7	75	76
			Formalin	Redside Shiner	1	1	0.87			0.87	0.87	1	42.0			42	42
			Formalin	Burbot	2	2	3.02	3.68	0.41	2.73	3.31	2	68.5	19.1	2.1	67	70
			Frozen	Age 0	172	172	4.09	0.21	1.40	1.40	8.40	172	68.7	1.1	7.2	50	87
			Frozen	Whitefish	3	3	3.44	0.96	0.39	3.00	3.72	3	66.3	5.2	2.1	64	68
Stuart Lake	199803	Aug 11-14/1998	Formalin	Age 0	686	686	2.18	0.06	0.78	0.53	5.24	686	56.3	0.5	6.6	37	74
			Formalin	Whitefish	1	1	0.55			0.55	0.55	1	36.0			36	36
			Formalin	Sculpin	9	9	0.22	0.05	0.07	0.13	0.33	9	27.0	2.1	2.7	23	31
			Live	Whitefish	1	0						1	200.0			200	200
			Frozen	Age 0	311	266	2.17	0.08	0.69	0.65	4.02	266	54.7	0.7	5.8	39	68
			Frozen	Age 2+	41	0						0					
			Ethanol	Age 0	57	57	1.68	0.18	0.68	0.62	3.56	57	56.6	1.7	6.5	43	73

Table 2. Trawl statistics by lake and survey for the Stuart system (continued).

Water body	Survey (#)	Date	Preservation method	Taxa	N	Weight (g)						Length (mm)					
						N	Mean	+/-95%CI	SD	Min	Max	N	Mean	+/-95%CI	SD	Min	Max
Stuart Lake	199808	Sep 22-24/1998	Formalin	Age 0	117	117	4.03	0.26	1.40	1.32	6.98	117	69.6	1.4	7.9	51	84
			Formalin	Whitefish	2	2	5.43	6.42	0.71	4.92	5.93	2	79.5	6.4	0.7	79	80
			Formalin	Sculpin	4	4	0.39	0.17	0.11	0.30	0.54	4	33.3	4.2	2.6	31	36
			Frozen	Age 0	62	47	4.45	0.46	1.59	1.40	8.29	47	69.1	2.7	9.4	46	86
			Frozen	Age 2+	11	0						0					
			Ethanol	Age 0	10	10	2.83	0.49	0.69	1.75	4.28	10	68.5	3.2	4.5	62	78
Takla Lake	199603	Aug 12-14/1996	Formalin	Age 0	56	56	1.14	0.22	0.83	0.26	2.86	56	44.2	2.8	10.3	29	63
			Formalin	Age 1	1	1	14.60			14.60	14.60	1	109.0			109	109
			Formalin	Age 2+	2	2	45.71	49.68	5.53	41.80	49.62	2	159.0	12.7	1.4	158	160
			Live	Lake Trout	1	0						1	500.0			500	500
			Frozen	Age 0	115	115	0.74	0.11	0.59	0.09	3.21	115	42.3	1.7	9.0	27	67
			Frozen	Age 1	7	7	14.45	3.11	3.36	9.48	18.48	7	109.3	8.9	9.7	95	120
			Frozen	Age 2+	6	6	36.42	4.54	4.33	32.37	44.72	6	149.5	7.0	6.7	143	162
Takla Lake	199605	Sep 24-27/1996	Formalin	Age 0	179	179	2.86	0.24	1.63	0.64	6.94	179	62.0	1.7	11.2	39	86
			Formalin	Age 1	16	16	27.32	2.04	3.82	20.12	31.78	16	134.8	3.1	5.8	124	145
			Formalin	Age 2+	14	14	48.55	3.65	6.33	38.40	59.10	14	162.7	3.5	6.1	152	172
			Live	Age 2+	4	0						4	166.0	0.0	0.0	166	166
			Live	Whitefish	1	0						1	300.0			300	300
			Frozen	Age 0	113	113	2.46	0.27	1.45	0.54	6.40	113	58.1	1.8	9.9	34	82
			Frozen	Age 2+	1	1	27.45			27.45	27.45	1	138.0			138	138
Takla Lake	199705	Aug 10-13/1997	Formalin	Age 0	223	223	1.54	0.11	0.84	0.10	3.95	223	50.3	1.3	10.1	22	70
			Formalin	Age 1	4	4	19.95	3.49	2.19	17.06	22.03	4	118.8	7.9	5.0	112	124
			Formalin	Age 2+	6	6	48.03	5.54	5.28	41.87	54.60	6	159.2	8.1	7.8	150	168
			Live	Lake Trout	1	0						1	530.0			530	530
			Frozen	Age 0	195	195	1.54	0.11	0.76	0.14	3.36	195	50.9	1.4	9.6	25	68
Takla Lake	199710	Sep 25-28/1997	Formalin	Age 0	130	130	3.12	0.32	1.83	0.63	8.81	130	64.9	2.0	11.8	41	92
			Formalin	Age 1	21	21	35.00	4.15	9.11	25.05	53.40	21	144.1	5.7	12.4	131	170
			Formalin	Age 2+	2	2	53.75	23.51	2.62	51.90	55.60	2	165.0	63.5	7.1	160	170
			Frozen	Age 0	100	100	3.77	0.37	1.85	0.72	7.49	100	64.8	2.2	11.2	40	85

Table 2. Trawl statistics by lake and survey for the Stuart system (continued).

Water body	Survey (#)	Date	Preservation method	Taxa	N	Weight (g)						Length (mm)					
						N	Mean	+/-95%CI	SD	Min	Max	N	Mean	+/-95%CI	SD	Min	Max
Takla Lake	199804	Aug 14-17/1998	Formalin	Age 0	464	464	2.01	0.12	1.32	0.33	20.46	464	54.4	0.9	9.3	31	122
			Live	Age 2+	5	0						5	158.0	25.4	20.5	140	180
			Frozen	Age 0	206	176	1.63	0.12	0.83	0.38	4.04	176	48.3	1.2	8.0	31	67
			Ethanol	Age 0	30	30	1.42	0.22	0.59	0.40	2.84	30	54.4	2.8	7.5	39	68
Takla Lake	199809	Sep 24-26/1998	Formalin	Age 0	284	284	3.97	0.21	1.76	0.54	8.85	284	68.2	1.2	10.6	38	91
			Formalin	Age 1	5	5	40.30	2.35	1.89	37.71	42.66	5	146.2	4.6	3.7	140	149
			Formalin	Age 2+	1	1	70.60			70.60	70.60	1	180.0			180	180
			Formalin	Whitefish	3	3	1.25	1.09	0.44	0.74	1.54	3	49.7	14.3	5.8	43	53
			Formalin	Sculpin	1	1	0.25			0.25	0.25	1	29.0			29	29
			Frozen	Age 0	345	315	3.34	0.19	1.73	0.62	10.08	315	61.4	1.2	11.1	36	93
			Ethanol	Age 0	28	28	3.26	0.49	1.26	0.97	5.99	28	68.8	3.7	9.6	45	84
Trembleur Lake	199604	Aug 15-17/1996	Formalin	Age 0	256	256	2.10	0.10	0.81	0.29	4.75	256	55.5	0.9	7.5	30	74
			Formalin	Age 1	2	2	46.80	35.58	3.96	44.00	49.60	2	162.0	12.7	1.4	161	163
			Live	Age 0	10	0						0					
			Live	Lake Trout	1	0						0					
			Frozen	Age 0	195	195	1.22	0.07	0.52	0.35	3.34	195	55.1	1.0	6.7	37	73
			Frozen	Age 2+	22	22	96.81	2.29	5.18	81.61	102.12	22	192.0	3.9	8.7	164	203
Trembleur Lake	199606	Oct 13-14/1996	Formalin	Age 0	142	142	5.60	0.20	1.19	0.68	8.20	142	79.0	1.1	6.6	41	92
			Formalin	Whitefish	1	1	1.50			1.50	1.50	1	52.0			52	52
			Formalin	Sculpin	1	1	0.22			0.22	0.22	1	28.0			28	28
			Frozen	Age 0	84	0						84	74.8	2.0	9.2	28	90
			Frozen	Age 2+	2	0						2	164.5	31.8	3.5	162	167
Trembleur Lake	199707	Aug 14-15/1997	Formalin	Age 0	417	417	2.57	0.10	0.99	0.62	6.09	417	60.3	0.7	7.8	39	80
			Formalin	Whitefish	2	2	1.98	0.57	0.06	1.93	2.02	2	60.5	6.4	0.7	60	61
			Frozen	Age 0	235	235	2.38	0.11	0.86	0.76	5.27	235	59.2	0.8	6.6	43	76
			Frozen	Whitefish	1	1	1.99			1.99	1.99	1	62.0			62	62
Trembleur Lake	199712	Sep 29-30/1997	Formalin	Age 0	150	150	5.84	0.25	1.54	2.73	10.04	150	80.2	1.1	7.0	62	95
			Formalin	Whitefish	1	1	0.79			0.79	0.79	1	44.0			44	44
			Formalin	Sculpin	1	1	0.26			0.26	0.26	1	28.0			28	28
			Frozen	Age 0	88	88	5.80	0.31	1.47	2.87	8.89	88	74.3	1.4	6.6	59	85

Table 2. Trawl statistics by lake and survey for the Stuart system (continued).

Water body	Survey (#)	Date	Preservation method	Taxa	N	Weight (g)						Length (mm)					
						N	Mean	+/-95%CI	SD	Min	Max	N	Mean	+/-95%CI	SD	Min	Max
Trembleur Lake	199805	Aug 18-19/1998	Formalin	Age 0	600	600	2.28	0.06	0.81	0.30	5.87	600	58.2	0.5	6.6	39	79
			Frozen	Age 0	231	201	2.15	0.11	0.78	0.52	4.20	201	54.9	1.0	6.9	35	69
			Ethanol	Age 0	30	30	2.10	0.24	0.65	0.83	3.54	30	61.6	2.3	6.2	48	74
Middle River	199706	Aug 13/1997	Formalin	Age 0	28	28	2.36	0.39	1.01	0.95	5.37	28	57.6	2.7	7.0	43	74
			Formalin	Age 1	2	2	30.06	1.21	0.13	29.96	30.15	2	133.0	25.4	2.8	131	135
			Formalin	Whitefish	1	1	3.40			3.40	3.40	1	68.0			68	68
			Live	Whitefish	1	0						1	300.0			300	300
Middle River	199711	Sep 28/1997	Formalin	Age 0	16	16	5.69	0.77	1.44	3.28	7.63	16	78.4	3.5	6.6	67	88
			Formalin	Whitefish	3	3	7.70	6.08	2.45	4.88	9.20	3	88.0	25.8	10.4	76	94
			Formalin	Sculpin	9	9	2.16	1.94	2.52	0.32	7.55	9	51.6	16.0	20.9	32	88
			Formalin	Redside Shiner	1	1	3.76			3.76	3.76	1	72.0			72	72
			Live	Whitefish	3	0						3	230.0	155.1	62.4	180	300

Table 3. Trawl statistics by lake and tow for the Stuart system.

Water body	Tow	Survey	Sect.	Date	Preservation	Taxa	N	Weight (g)						Length (mm)					
	(#)	(#)	(#)		method			N	Mean	+/- 95%CI	SD	Min	Max	N	Mean	+/- 95%CI	SD	Min	Max
Stuart Lake	19960002	199602	4	1996/08/08	Formalin	Age 0	116	116	2.12	0.10	0.56	0.62	3.28	116	55.8	1.0	5.2	37	65
					Formalin	Age 1	2	2	40.47	36.47	4.06	37.6	43.34	2	145.0	50.8	5.7	141	149
					Formalin	Whitefish	1	1	5.62			5.62	5.62	1	82.0			82	82
					Frozen	Age 0	85	85	2.10	0.12	0.55	0.86	4.02	85	57.9	1.1	5.1	45	71
					Frozen	Age 2+	4	4	49.30	26.20	16.47	35.01	71.97	4	156.8	28.3	17.8	139	181
Stuart Lake	19960003	199602	1	1996/08/08	Formalin	Age 0	280	280	0.98	0.06	0.55	0.22	2.96	280	43.4	0.8	7.1	27	62
					Formalin	Whitefish	1	1	0.30			0.3	0.3	1	31.0			31	31
					Frozen	Age 0	138	138	0.76	0.08	0.47	0.05	2.31	138	42.6	1.3	7.5	22	63
					Frozen	Age 1	2	2	26.04	19.95	2.22	24.47	27.61	2	124.5	19.1	2.1	123	126
					Frozen	Age 2+	1	1	98.07			98.07	98.07	1	200.0			200	200
Stuart Lake	19960004	199602	1	1996/08/09	Formalin	Age 0	364	364	0.84	0.04	0.41	0.3	2.72	364	41.8	0.6	5.9	30	63
					Frozen	Age 0	138	138	1.28	0.13	0.76	0.09	3.84	138	48.7	1.7	9.9	21	71
					Frozen	Age 2+	2	2	51.68	304.95	33.94	27.68	75.68	2	162.5	324.0	36.1	137	188
Stuart Lake	19960005	199602	2	1996/08/09	Formalin	Age 0	38	38	1.68	0.21	0.63	0.74	3.02	38	51.7	2.1	6.3	38	64
					Formalin	Lake Trout	1	1	0.70			0.7	0.7	1	38.0			38	38
					Frozen	Age 0	37	37	0.91	0.11	0.32	0.35	1.88	37	54.0	1.8	5.4	44	67
					Frozen	Age 2+	1	1	93.35			93.35	93.35	1	195.0			195	195
Stuart Lake	19960006	199602	3	1996/08/10	Formalin	Age 0	27	27	1.37	0.22	0.54	0.64	2.52	27	48.0	2.4	6.0	39	59
					Formalin	Whitefish	1	1	3.32			3.32	3.32	1	68.0			68	68
					Formalin	Sculpin	1	1	1.44			1.44	1.44	1	49.0			49	49
					Frozen	Age 2+	2	2	69.65	468.80	52.18	32.75	106.54	2	175.0	419.3	46.7	142	208
Stuart Lake	19960030	199607	1	1996/10/16	Formalin	Age 0	234	234	2.94	0.12	0.94	1.16	6.81	234	64.5	0.8	6.4	47	85
					Frozen	Age 0	112	112	1.64	0.18	0.97	0.36	5.53	112	58.5	2.2	11.9	31	87
					Frozen	Age 2+	6	6	51.97	8.17	7.79	37.32	57.41	6	161.2	8.1	7.7	148	169
Stuart Lake	19960031	199607	1	1996/10/16	Formalin	Age 0	40	40	4.16	0.63	1.98	1.31	9.44	40	70.8	3.2	10.0	49	94
					Frozen	Age 2+	14	14	54.60	4.16	7.20	42.1	70.39	14	163.6	5.5	9.6	151	189
Stuart Lake	19960032	199607	2	1996/10/16	Formalin	Age 0	33	33	5.66	0.45	1.26	3.24	8.44	33	78.7	2.2	6.1	66	90
					Frozen	Age 2+	2	2	49.75	21.54	2.40	48.05	51.44	2	160.5	6.4	0.7	160	161
Stuart Lake	19960033	199607	3	1996/10/17	Formalin	Age 0	40	40	5.85	0.37	1.16	3.38	8.42	40	81.4	1.8	5.6	67	92
					Frozen	Age 0	30	30	3.86	0.34	0.91	2.07	6.46	30	81.0	2.2	5.8	67	90
Stuart Lake	19970008	199704	4	1997/08/07	Formalin	Age 0	155	155	2.31	0.10	0.64	1.07	4.34	155	58.6	0.8	5.3	45	72
					Frozen	Age 0	90	90	2.04	0.13	0.62	0.74	3.61	90	58.0	1.2	5.8	42	71
ke	19970009	199704	1	1997/08/08	Formalin	Age 0	213	213	1.63	0.08	0.59	0.63	3.36	213	52.4	0.8	6.0	40	69

Table 3. Trawl statistics by lake and tow for the Stuart system (continued).

Water body	Tow (#)	Survey (#)	Sect. (#)	Date	Preservation method	Taxa	N	Weight (g) N	Weight (g) Mean	Weight (g) +/- 95%CI	Weight (g) SD	Weight (g) Min	Weight (g) Max	Length (mm) N	Length (mm) Mean	Length (mm) +/- 95%CI	Length (mm) SD	Length (mm) Min	Length (mm) Max
					Frozen	Age 0	185	185	1.38	0.08	0.55	0.51	3.11	185	50.4	0.9	6.0	37	68
Stuart Lake	19970010	199704	1	1997/08/08			0												
Stuart Lake	19970011	199704	2	1997/08/09	Formalin	Age 0	50	50	1.93	0.22	0.76	0.47	3.82	50	54.7	2.1	7.2	34	70
					Formalin	Sculpin	1	1	1.29			1.29	1.29	1	49.0			49	49
					Frozen	Age 0	56	56	1.69	0.23	0.86	0.64	4.97	56	54.1	2.0	7.4	41	75
Stuart Lake	19970012	199704	2	1997/08/09			0												
Stuart Lake	19970013	199704	3	1997/08/10	Formalin	Age 0	11	11	2.13	0.42	0.63	1.02	3.07	11	56.6	3.8	5.7	46	65
Stuart Lake	19970027	199709	4	1997/09/23	Formalin	Age 0	8	8	4.17	1.26	1.51	2.37	6.94	8	71.3	6.9	8.2	60	85
Stuart Lake	19970028	199709	4	1997/09/23	Formalin	Age 0	1	1	2.15			2.15	2.15	1	57.0			57	57
Stuart Lake	19970029	199709	3	1997/09/24			0												
Stuart Lake	19970030	199709	1	1997/09/24	Formalin	Age 0	158	158	3.64	0.19	1.23	1.36	7.32	158	67.7	1.1	7.0	50	85
					Frozen	Age 0	100	100	3.52	0.24	1.19	1.4	7.28	100	65.9	1.3	6.5	50	85
Stuart Lake	19970031	199709	2	1997/09/24	Formalin	Age 0	42	42	4.78	0.42	1.34	1.18	7.44	42	73.7	2.4	7.8	48	87
					Formalin	Whitefish	1	1	4.43			4.43	4.43	1	76.0			76	76
					Frozen	Age 0	24	24	5.36	0.64	1.52	1.94	8.4	24	72.8	3.2	7.5	52	84
					Frozen	Whitefish	1	1	3.60			3.6	3.6	1	67.0			67	67
Stuart Lake	19970032	199709	3	1997/09/25	Formalin	Age 0	10	10	5.85	1.35	1.89	4.11	10.36	10	79.0	5.2	7.3	70	93
					Formalin	Whitefish	1	1	4.33			4.33	4.33	1	75.0			75	75
					Formalin	Burbot	1	1	2.73			2.73	2.73	1	67.0			67	67
					Frozen	Age 0	8	8	4.77	1.18	1.42	3.13	7.34	8	70.3	4.6	5.5	63	79
					Frozen	Whitefish	2	2	3.36	4.57	0.51	3	3.72	2	66.0	25.4	2.8	64	68
Stuart Lake	19970033	199709	4	1997/09/25	Formalin	Age 0	52	52	5.10	0.34	1.22	2.07	7.84	52	76.7	1.7	6.2	59	89
					Formalin	Redside Shiner	1	1	0.87			0.87	0.87	1	42.0			42	42
					Formalin	Burbot	1	1	3.31			3.31	3.31	1	70.0			70	70
					Frozen	Age 0	40	40	4.63	0.32	0.99	2.54	7.84	40	73.0	1.7	5.4	62	87
Stuart Lake	19980002	199803	4	1998/08/11	Formalin	Age 0	111	111	2.41	0.13	0.68	0.91	4.02	111	58.4	1.0	5.5	42	70
					Frozen	Age 0	112	102	2.19	0.13	0.65	0.65	3.92	102	54.7	1.0	5.2	39	66
					Frozen	Age 2+	12	0						0					
					Ethanol	Age 0	10	10	2.05	0.31	0.44	1.43	2.8	10	60.0	3.2	4.5	54	67

Table 3. Trawl statistics by lake and tow for the Stuart system (continued).

Water body	Tow (#)	Survey (#)	Sect. (#)	Date	Preservation method	Taxa	N	Weight (g) N	Weight (g) Mean	Weight (g) +/- 95%CI	Weight (g) SD	Weight (g) Min	Weight (g) Max	Length (mm) N	Length (mm) Mean	Length (mm) +/- 95%CI	Length (mm) SD	Length (mm) Min	Length (mm) Max
Stuart Lake	19980003	199803	1	1998/08/12	Formalin	Age 0	301	301	1.91	0.08	0.70	0.53	3.97	301	54.0	0.7	6.3	37	70
					Formalin	Sculpin	1	1	0.20			0.2	0.2	1	26.0			26	26
					Frozen	Age 0	70	60	2.03	0.17	0.67	0.92	4.02	60	52.9	1.5	5.7	42	68
					Frozen	Age 2+	5	0						0					
					Ethanol	Age 0	25	25	1.28	0.15	0.36	0.62	2.18	25	52.4	1.7	4.2	43	62
Stuart Lake	19980004	199803	2	1998/08/13	Formalin	Age 0	204	204	2.39	0.11	0.79	0.75	5.24	204	58.1	0.9	6.4	40	74
					Frozen	Age 0	75	60	2.18	0.18	0.71	0.81	3.7	60	55.1	1.6	6.4	40	66
					Frozen	Age 2+	16	0						0					
					Ethanol	Age 0	11	11	2.21	0.49	0.72	1.18	3.52	11	61.8	4.1	6.1	54	73
Stuart Lake	19980005	199803	3	1998/08/13	Formalin	Age 0	20	20	2.61	0.43	0.92	1.31	4.75	20	58.9	2.8	6.0	49	73
					Formalin	Sculpin	8	8	0.22	0.06	0.08	0.13	0.33	8	27.1	2.4	2.9	23	31
					Live	Whitefish	1	0						1	200.0			200	200
					Frozen	Age 2+	8	0						0					
Stuart Lake	19980006	199803	3	1998/08/14	Formalin	Age 0	50	50	2.31	0.23	0.81	0.66	4.3	50	57.3	2.0	6.9	38	71
					Formalin	Whitefish	1	1	0.55			0.55	0.55	1	36.0			36	36
					Frozen	Age 0	54	44	2.33	0.23	0.75	0.99	4.01	44	56.2	1.9	6.3	42	67
					Ethanol	Age 0	11	11	1.71	0.57	0.84	0.93	3.56	11	57.6	4.9	7.2	48	71
Stuart Lake	19980016	199808	4	1998/09/22	Formalin	Age 0	34	34	4.09	0.43	1.22	1.86	6.81	34	69.4	2.3	6.6	57	82
					Formalin	Sculpin	2	2	0.33	0.38	0.04	0.3	0.36	2	33.0	25.4	2.8	31	35
					Frozen	Age 0	27	22	4.66	0.74	1.66	1.74	8.29	22	70.5	4.0	9.1	49	86
					Frozen	Age 2+	4	0						0					
					Ethanol	Age 0	5	5	2.96	0.41	0.33	2.49	3.3	5	69.2	3.2	2.6	66	73
Stuart Lake	19980017	199808	1	1998/09/23	Formalin	Age 0	50	50	3.65	0.43	1.51	1.32	6.86	50	67.9	2.5	8.9	51	84
					Frozen	Age 0	35	25	4.26	0.64	1.54	1.4	7.09	25	67.8	4.0	9.6	46	82
					Frozen	Age 2+	6	0						0					
Stuart Lake	19980018	199808	2	1998/09/24	Formalin	Age 0	33	33	4.53	0.45	1.28	2.01	6.98	33	72.5	2.4	6.7	56	83
					Formalin	Whitefish	2	2	5.43	6.42	0.71	4.92	5.93	2	79.5	6.4	0.7	79	80
					Formalin	Sculpin	2	2	0.45	1.21	0.13	0.35	0.54	2	33.5	31.8	3.5	31	36
					Frozen	Age 2+	1	0						0					
					Ethanol	Age 0	5	5	2.70	1.18	0.95	1.75	4.28	5	67.8	7.6	6.1	62	78

Table 3. Trawl statistics by lake and tow for the Stuart system (continued).

Water body	Tow (#)	Survey (#)	Sect. (#)	Date	Preservation method	Taxa	N	Weight (g)						Length (mm)					
								N	Mean	+/- 95%CI	SD	Min	Max	N	Mean	+/- 95%CI	SD	Min	Max
Takla Lake	19960007	199603	1	1996/08/12	Formalin	Age 0	10	10	1.19	0.60	0.84	0.42	2.7	10	45.0	7.9	11.0	34	63
					Formalin	Age 2+	1	1	41.80			41.8	41.8	1	158.0			158	158
					Live	Lake Trout	1	0						1	500.0			500	500
Takla Lake	19960008	199603	6	1996/08/12	Frozen	Age 0	51	51	0.59	0.09	0.33	0.26	1.79	51	39.0	1.5	5.4	32	55
					Frozen	Age 1	3	3	12.86	12.17	4.90	9.48	18.48	3	104.7	33.4	13.4	95	120
Takla Lake	19960009	199603	5	1996/08/13	Formalin	Age 0	17	17	0.82	0.40	0.77	0.28	2.86	17	40.0	4.6	9.0	32	60
					Frozen	Age 0	16	16	0.79	0.35	0.65	0.22	2.58	16	41.3	4.8	9.0	29	61
					Frozen	Age 2+	2	2	35.93	2.35	0.26	35.74	36.11	2	147.0	50.8	5.7	143	151
Takla Lake	19960010	199603	4	1996/08/14	Frozen	Age 0	23	23	1.17	0.36	0.84	0.18	3.21	23	47.3	5.0	11.5	27	67
					Frozen	Age 1	4	4	15.65	2.36	1.48	13.93	17.55	4	112.8	8.6	5.4	106	119
					Frozen	Age 2+	4	4	36.67	8.85	5.56	32.37	44.72	4	150.8	12.1	7.6	145	162
Takla Lake	19960011	199603	3	1996/08/14	Formalin	Age 0	29	29	1.31	0.32	0.83	0.26	2.82	29	46.3	4.0	10.4	29	63
					Formalin	Age 1	1	1	14.60			14.6	14.6	1	109.0			109	109
					Formalin	Age 2+	1	1	49.62			49.62	49.62	1	160.0			160	160
Takla Lake	19960012	199603	2	1996/08/14	Frozen	Age 0	25	25	0.63	0.22	0.53	0.09	1.96	25	44.8	4.1	9.9	30	64
Takla Lake	19960018	199605	2	1996/09/24	Formalin	Age 0	4	4	2.80	3.74	2.35	1.46	6.32	4	59.0	23.5	14.8	50	81
					Formalin	Age 1	3	3	31.16	1.34	0.54	30.82	31.78	3	138.0	0.0	0.0	138	138
					Formalin	Age 2+	3	3	48.66	14.61	5.88	44.34	55.36	3	160.3	3.8	1.5	159	162
Takla Lake	19960019	199605	3	1996/09/25	Formalin	Age 0	3	3	1.85	2.50	1.00	1.16	3	3	55.0	21.5	8.7	50	65
					Formalin	Age 2+	7	7	51.32	5.36	5.80	40.62	59.1	7	165.6	5.1	5.6	154	172
					Live	Age 2+	4	0						4	166.0	0.0	0.0	166	166
Takla Lake	19960020	199605	1	1996/09/25	Live	Whitefish	1	0						1	300.0			300	300
					Frozen	Age 0	20	20	2.71	0.75	1.60	1.03	6.22	20	61.7	4.7	10.1	47	82
					Frozen	Age 2+	1	1	27.45			27.45	27.45	1	138.0			138	138
Takla Lake	19960021	199605	4	1996/09/26	Formalin	Age 0	9	9	2.73	1.57	2.05	0.72	6.6	9	59.2	11.1	14.4	39	81
Takla Lake	19960022	199605	6	1996/09/26	Formalin	Age 0	53	53	2.80	0.43	1.57	0.8	6.7	53	61.8	2.9	10.4	43	86
					Frozen	Age 0	53	53	2.02	0.30	1.09	0.54	6.04	53	54.1	2.2	7.9	34	76
Takla Lake	19960023	199605	6	1996/09/26	Formalin	Age 0	70	70	2.57	0.33	1.40	0.64	5.74	70	60.3	2.5	10.4	41	82
					Formalin	Age 2+	1	1	48.42			48.42	48.42	1	164.0			164	164
Takla Lake	19960024	199605	5	1996/09/27	Formalin	Age 0	5	5	3.66	3.01	2.42	1.76	6.82	5	67.4	18.6	14.9	55	86
					Formalin	Age 1	4	4	23.44	3.65	2.30	21.64	26.46	4	129.5	3.8	2.4	128	133
					Formalin	Age 2+	1	1	38.90			38.9	38.9	1	154.0			154	154

Table 3. Trawl statistics by lake and tow for the Stuart system (continued).

Water body	Tow	Survey	Sect.	Date	Preservation	Taxa	N	Weight (g)						Length (mm)					
	(#)	(#)	(#)		method			N	Mean	+/- 95%CI	SD	Min	Max	N	Mean	+/- 95%CI	SD	Min	Max
Takla Lake	19960025	199605	2	1996/09/27	Formalin	Age 0	35	35	3.54	0.60	1.73	1.2	6.94	35	66.8	4.0	11.6	48	85
					Formalin	Age 1	3	3	27.58	4.88	1.96	25.7	29.62	3	134.7	6.3	2.5	132	137
					Frozen	Age 0	40	40	2.91	0.53	1.65	0.72	6.4	40	61.6	3.3	10.4	42	80
Takla Lake	19960026	199605	2	1996/09/27	Formalin	Age 1	6	6	27.87	4.42	4.21	20.12	31.72	6	136.8	8.2	7.8	124	145
					Formalin	Age 2+	2	2	43.59	65.95	7.34	38.4	48.78	2	160.0	101.6	11.3	152	168
Takla Lake	19970014	199705	1	1997/08/10	Formalin	Age 0	18	18	2.02	0.38	0.76	0.64	3.31	18	55.6	3.9	7.7	38	65
					Formalin	Age 1	1	1	19.50			19.5	19.5	1	119.0			119	119
					Formalin	Age 2+	3	3	52.60	5.53	2.23	50.2	54.6	3	166.0	5.0	2.0	164	168
					Live	Lake Trout	1	0						1	530.0			530	530
					Frozen	Age 0	17	17	1.67	0.41	0.79	0.43	3.35	17	53.0	4.0	7.9	38	68
Takla Lake	19970015	199705	2	1997/08/11	Formalin	Age 0	71	71	1.81	0.18	0.75	0.28	3.26	71	54.3	1.9	8.1	30	67
					Formalin	Age 2+	1	1	44.40			44.4	44.4	1	155.0			155	155
					Frozen	Age 0	61	61	1.78	0.19	0.72	0.25	2.96	61	55.0	2.0	7.8	30	66
Takla Lake	19970016	199705	3	1997/08/11	Formalin	Age 0	17	17	1.61	0.46	0.89	0.41	3.14	17	50.9	5.3	10.2	35	65
					Formalin	Age 1	1	1	21.20			21.2	21.2	1	120.0			120	120
					Frozen	Age 0	18	18	1.45	0.37	0.75	0.23	2.73	18	49.6	4.6	9.3	29	62
Takla Lake	19970017	199705	4	1997/08/12	Formalin	Age 0	32	32	1.78	0.23	0.64	0.49	3.2	32	53.4	2.5	6.9	36	65
					Formalin	Age 1	1	1	22.03			22.03	22.03	1	124.0			124	124
					Formalin	Age 2+	1	1	41.87			41.87	41.87	1	150.0			150	150
					Frozen	Age 0	30	30	1.73	0.25	0.67	0.48	3.32	30	54.2	2.9	7.7	36	68
Takla Lake	19970018	199705	6	1997/08/12	Formalin	Age 0	51	51	1.17	0.25	0.88	0.1	3.95	51	45.0	3.1	11.2	22	70
					Formalin	Age 1	1	1	17.06			17.06	17.06	1	112.0			112	112
					Frozen	Age 0	41	41	1.14	0.21	0.68	0.14	2.67	41	42.7	2.7	8.7	25	59
Takla Lake	19970019	199705	5	1997/08/13	Formalin	Age 0	34	34	0.99	0.23	0.67	0.28	2.52	34	43.6	3.2	9.1	29	62
					Formalin	Age 2+	1	1	44.10			44.1	44.1	1	152.0			152	152
					Frozen	Age 0	28	28	1.37	0.31	0.80	0.2	3.36	28	49.8	3.9	10.1	27	68
Takla Lake	19970034	199710	1	1997/09/25	Formalin	Age 0	6	6	3.70	2.08	1.98	1.23	5.66	6	67.7	14.9	14.2	48	80
					Formalin	Age 1	5	5	39.08	10.10	8.13	32.7	52.1	5	150.8	13.8	11.1	144	170
Takla Lake	19970035	199710	6	1997/09/26	Formalin	Age 0	18	18	2.05	0.61	1.22	0.64	6.49	18	57.4	4.2	8.5	41	83
					Formalin	Age 1	4	4	34.64	20.06	12.61	26.26	53.4	4	142.0	27.7	17.4	131	168
					Frozen	Age 0	20	20	2.97	0.72	1.55	1.26	6.45	20	59.0	4.4	9.4	45	78

Table 3. Trawl statistics by lake and tow for the Stuart system (continued).

Water body	Tow (#)	Survey (#)	Sect. (#)	Date	Preservation method	Taxa	N	Weight (g)						Length (mm)					
								N	Mean	+/- 95%CI	SD	Min	Max	N	Mean	+/- 95%CI	SD	Min	Max
Takla Lake	19970036	199710	5	1997/09/27	Formalin	Age 0	62	62	3.01	0.46	1.83	0.63	8.81	62	64.3	2.9	11.6	41	92
					Formalin	Age 1	5	5	31.20	11.64	9.38	25.05	47.8	5	140.2	15.3	12.3	132	162
					Frozen	Age 0	42	42	3.18	0.56	1.81	0.72	7.13	42	61.4	3.5	11.2	40	85
Takla Lake	19970037	199710	2	1997/09/27	Formalin	Age 1	5	5	31.36	4.20	3.38	28.07	36.15	5	137.8	6.4	5.2	132	144
					Formalin	Age 2+	2	2	53.75	23.51	2.62	51.9	55.6	2	165.0	63.5	7.1	160	170
					Frozen	Age 0	9	9	5.65	1.39	1.81	1.44	7.49	9	75.1	8.0	10.4	49	83
Takla Lake	19970038	199710	3	1997/09/27	Formalin	Age 0	35	35	3.55	0.57	1.66	1.19	6.17	35	68.4	3.7	10.9	49	84
					Formalin	Age 1	2	2	44.11	104.06	11.58	35.92	52.3	2	157.0	101.6	11.3	149	165
					Frozen	Age 0	29	29	4.60	0.53	1.40	1.66	7.4	29	70.5	2.9	7.5	52	84
Takla Lake	19970039	199710	4	1997/09/28	Formalin	Age 0	9	9	4.03	1.96	2.54	1.02	7.83	9	69.0	11.6	15.1	49	89
Takla Lake	19980007	199804	3	1998/08/14	Formalin	Age 0	202	202	2.13	0.11	0.78	0.77	4.4	202	56.0	1.0	7.1	41	72
					Frozen	Age 0	10	0						0					
					Ethanol	Age 0	10	10	1.28	0.39	0.55	0.4	2.14	10	52.9	5.2	7.2	39	61
Takla Lake	19980008	199804	2	1998/08/15	Formalin	Age 0	164	164	1.78	0.12	0.79	0.49	3.8	164	53.1	1.2	8.1	36	70
					Live	Age 2+	3	0						3	170.0	43.0	17.3	150	180
					Frozen	Age 0	115	105	1.72	0.16	0.81	0.38	4.041	105	49.2	1.5	7.6	31	67
					Ethanol	Age 0	10	10	1.40	0.35	0.49	0.74	2.1	10	54.5	5.4	7.5	44	68
Takla Lake	19980009	199804	6	1998/08/15	Formalin	Age 0	53	53	2.20	0.50	1.83	0.38	12.55	53	54.4	3.5	12.6	32	101
					Live	Age 2+	2	0						2	140.0	0.0	0.0	140	140
					Frozen	Age 0	56	46	1.44	0.25	0.84	0.472	3.954	46	46.4	2.5	8.5	33	67
					Ethanol	Age 0	10	10	1.58	0.52	0.73	0.44	2.84	10	55.8	5.9	8.3	40	67
Takla Lake	19980010	199804	5	1998/08/16	Formalin	Age 0	35	35	2.09	1.14	3.32	0.35	20.46	35	51.4	5.5	15.9	31	122
					Frozen	Age 0	25	25	1.59	0.35	0.84	0.494	3.329	25	48.3	3.5	8.4	35	63
Takla Lake	19980011	199804	4	1998/08/17	Formalin	Age 0	10	10	2.06	1.02	1.43	0.33	4.71	10	53.1	9.4	13.1	32	73
Takla Lake	19980019	199809	1	1999/09/24	Formalin	Age 0	58	58	4.20	0.47	1.79	1.04	8.85	58	69.7	2.8	10.5	45	87
					Formalin	Whitefish	1	1	0.74			0.74	0.74	1	43.0			43	43
					Formalin	Sculpin	1	1	0.25			0.25	0.25	1	29.0			29	29
					Frozen	Age 0	74	69	3.30	0.42	1.74	0.62	7.37	69	60.9	2.7	11.4	36	82
					Ethanol	Age 0	5	5	3.54	2.04	1.64	0.97	5	5	68.4	17.6	14.2	45	81

Table 3. Trawl statistics by lake and tow for the Stuart system (continued).

Water body	Tow (#)	Survey (#)	Sect. (#)	Date	Preservation method	Taxa	N	Weight (g) N	Weight (g) Mean	Weight (g) +/- 95%CI	Weight (g) SD	Weight (g) Min	Weight (g) Max	Length (mm) N	Length (mm) Mean	Length (mm) +/- 95%CI	Length (mm) SD	Length (mm) Min	Length (mm) Max
Takla Lake	19980020	199809	2	1998/09/25	Formalin	Age 0	77	77	3.40	0.34	1.52	0.54	7.65	77	65.4	2.2	9.6	39	87
					Formalin	Whitefish	2	2	1.50	0.51	0.06	1.46	1.54	2	53.0	0.0	0.0	53	53
					Frozen	Age 0	96	86	3.31	0.33	1.53	0.62	6.95	86	62.1	2.1	9.9	38	82
					Ethanol	Age 0	6	6	3.17	1.74	1.66	1.08	4.77	6	68.8	14.1	13.5	51	81
Takla Lake	19980021	199809	6	1998/09/25	Formalin	Age 0	51	51	3.36	0.52	1.86	0.61	8.62	51	63.5	3.3	11.6	38	91
					Frozen	Age 0	94	89	2.44	0.25	1.18	0.65	5.98	89	55.1	1.9	8.8	37	79
					Ethanol	Age 0	5	5	2.44	0.83	0.67	1.32	3.08	5	62.2	6.7	5.4	53	66
Takla Lake	19980022	199809	5	1998/09/26	Formalin	Age 0	37	37	4.24	0.65	1.96	1.3	7.53	37	68.9	3.7	11.2	49	86
					Formalin	Age 1	5	5	40.30	2.35	1.89	37.71	42.66	5	146.2	4.6	3.7	140	149
					Formalin	Age 2+	1	1	70.60			70.6	70.6	1	180.0			180	180
					Frozen	Age 0	35	30	4.26	0.91	2.44	1.08	10.08	30	65.6	4.9	13.0	43	93
					Ethanol	Age 0	5	5	4.09	1.66	1.34	2.84	5.99	5	74.2	9.2	7.4	67	84
Takla Lake	19980023	199809	4	1998/09/26	Formalin	Age 0	61	61	4.82	0.35	1.38	1.66	8.18	61	73.6	1.9	7.3	53	88
					Frozen	Age 0	46	41	4.77	0.39	1.23	2.16	7.53	41	71.4	2.0	6.5	56	83
					Ethanol	Age 0	7	7	3.15	0.54	0.58	1.96	3.68	7	69.7	3.5	3.8	63	73
Trembleur Lake	19960013	199604	1	1996/08/15	Formalin	Age 0	50	50	2.06	0.25	0.88	0.32	4.75	50	55.5	2.3	8.1	30	74
					Frozen	Age 0	112	112	1.28	0.10	0.51	0.36	3.34	112	55.2	1.2	6.6	38	73
Trembleur Lake	19960014	199604	1	1996/08/15	Formalin	Age 0	55	55	2.15	0.19	0.69	0.53	4.03	55	55.5	1.7	6.3	37	69
					Frozen	Age 0	1	1	1.72			1.72	1.72	1	55.0			55	55
					Frozen	Age 2+	10	10	96.03	4.83	6.75	81.61	102.11	10	190.2	8.3	11.6	164	203
Trembleur Lake	19960015	199604	2	1996/08/16	Formalin	Age 0	50	50	2.21	0.26	0.93	0.29	4.72	50	56.1	2.3	8.2	30	72
					Frozen	Age 0	82	82	1.12	0.12	0.53	0.35	3.22	82	54.9	1.5	7.0	37	71
					Frozen	Age 2+	2	2	101.59	6.73	0.75	101.1	102.12	2	200.5	31.8	3.5	198	203
Trembleur Lake	19960016	199604	3	1996/08/17	Formalin	Age 0	34	34	2.03	0.30	0.86	0.53	4.29	34	54.6	3.1	8.8	35	71
					Formalin	Age 1	2	2	46.80	35.58	3.96	44	49.6	2	162.0	12.7	1.4	161	163
Trembleur Lake	19960017	199604	1	1996/08/17	Formalin	Age 0	67	67	2.05	0.18	0.75	0.72	3.6	67	55.3	1.7	7.1	38	69
					Live	Age 0	10	0						0					
					Live	Lake Trout	1	0						0					
					Frozen	Age 2+	10	10	96.64	2.38	3.32	92.35	101.74	10	192.1	3.3	4.6	186	201
Trembleur Lake	19960027	199606	1	1996/10/13	Formalin	Age 0	75	75	5.56	0.26	1.14	1.92	8.2	75	78.7	1.4	6.2	59	92
					Frozen	Age 0	60	0						60	75.0	2.4	9.3	28	88
					Frozen	Age 2+	2	0						2	164.5	31.8	3.5	162	167

Table 3. Trawl statistics by lake and tow for the Stuart system (continued).

Water body	Tow	Survey	Sect.	Date	Preservation	Taxa	N	Weight (g)						Length (mm)					
	(#)	(#)	(#)		method			N	Mean	+/- 95%CI	SD	Min	Max	N	Mean	+/- 95%CI	SD	Min	Max
Trembleur Lake	19960028	199606	2	1996/10/13	Formalin	Age 0	39	39	5.30	0.39	1.21	0.68	7.16	39	77.6	2.5	7.6	41	87
Trembleur Lake	19960029	199606	3	1996/10/14	Formalin	Age 0	28	28	6.12	0.45	1.15	3.06	7.98	28	81.7	2.2	5.8	66	90
					Formalin	Whitefish	1	1	1.50			1.5	1.5	1	52.0			52	52
					Formalin	Sculpin	1	1	0.22			0.22	0.22	1	28.0			28	28
					Frozen	Age 0	24	0						24	74.4	3.9	9.1	53	90
Trembleur Lake	19970022	199707	3	1997/08/14	Formalin	Age 0	25	25	2.42	0.46	1.11	0.71	4.67	25	58.7	3.6	8.8	41	74
Trembleur Lake	19970023	199707	3	1997/08/14	Frozen	Age 0	10	10	2.00	0.45	0.63	1.26	3.12	10	56.8	4.4	6.2	50	65
Trembleur Lake	19970024	199707	2	1997/08/15	Formalin	Age 0	219	219	2.74	0.13	0.99	0.62	6.09	219	61.6	1.0	7.6	39	80
					Frozen	Age 0	101	101	2.51	0.15	0.78	0.78	4.58	101	60.7	1.1	5.6	46	72
Trembleur Lake	1997025	199707	1	1997/08/15	Formalin	Age 0	173	173	2.39	0.14	0.94	0.66	5.18	173	58.9	1.1	7.6	39	77
					Formalin	Whitefish	2	2	1.98	0.57	0.06	1.93	2.02	2	60.5	6.4	0.7	60	61
					Frozen	Age 0	124	124	2.30	0.16	0.93	0.76	5.27	124	58.3	1.3	7.1	43	76
					Frozen	Whitefish	1	1	1.99			1.99	1.99	1	62.0			62	62
Trembleur Lake	19970042	199712	3	1997/09/29	Formalin	Age 0	25	25	5.61	0.74	1.80	2.73	9.62	25	78.5	3.5	8.6	62	95
					Frozen	Age 0	15	15	5.37	0.97	1.75	2.87	7.9	15	72.2	4.3	7.8	59	85
Trembleur Lake	19970043	199712	2	1997/09/29	Formalin	Age 0	53	53	5.89	0.44	1.58	3.34	10.04	53	80.1	1.8	6.7	68	93
					Formalin	Sculpin	1	1	0.26			0.26	0.26	1	28.0			28	28
					Frozen	Age 0	24	24	5.71	0.66	1.55	2.96	8.89	24	74.2	3.1	7.2	61	85
Trembleur Lake	19970044	199712	1	1997/09/30	Formalin	Age 0	72	72	5.89	0.34	1.43	3	8.72	72	80.8	1.6	6.6	66	94
					Formalin	Whitefish	1	1	0.79			0.79	0.79	1	44.0			44	44
					Frozen	Age 0	49	49	5.98	0.38	1.34	3.07	8.5	49	75.0	1.7	5.8	61	85
Trembleur Lake	19980012	199805	1	1998/08/18	Formalin	Age 0	277	277	2.47	0.10	0.82	0.93	5.87	277	59.9	0.7	6.3	44	79
					Frozen	Age 0	110	100	2.19	0.17	0.85	0.52	4.2	100	55.0	1.5	7.6	35	69
					Ethanol	Age 0	10	10	2.52	0.51	0.71	1.3	3.54	10	65.4	4.4	6.1	56	74
Trembleur Lake	19980013	199805	2	1998/08/19	Formalin	Age 0	63	63	2.14	0.17	0.68	0.55	3.97	63	57.0	1.6	6.3	39	71
					Frozen	Age 0	10	0						0					
					Ethanol	Age 0	10	10	2.07	0.29	0.40	1.55	2.86	10	60.8	2.5	3.6	55	66
Trembleur Lake	19980014	199805	3	1998/08/19	Formalin	Age 0	260	260	2.11	0.09	0.77	0.3	4.59	260	56.6	0.8	6.6	40	73
					Frozen	Age 0	111	101	2.12	0.14	0.70	0.67	3.79	101	54.8	1.2	6.2	38	67
					Ethanol	Age 0	10	10	1.69	0.41	0.57	0.83	2.53	10	58.6	4.8	6.8	48	68
Middle River	19970020	199706	2	1997/08/13	Formalin	Age 0	19	19	2.16	0.46	0.96	0.95	5.37	19	55.8	3.3	6.9	43	74
					Formalin	Age 1	2	2	30.06	1.21	0.13	29.96	30.15	2	133.0	25.4	2.8	131	135

Table 3. Trawl statistics by lake and tow for the Stuart system (continued).

Water body	Tow	Survey	Sect.	Date	Preservation	Taxa	N	Weight (g)						Length (mm)					
	(#)	(#)	(#)		method			N	Mean	+/- 95%CI	SD	Min	Max	N	Mean	+/- 95%CI	SD	Min	Max
Middle River	19970021	199706	1	1997/08/13	Formalin	Age 0	9	9	2.78	0.80	1.04	1.68	5.25	9	61.2	4.6	6.0	54	74
					Formalin	Whitefish	1	1	3.40			3.4	3.4	1	68.0			68	68
					Live	Whitefish	1	0						1	300.0			300	300
Middle River	19970040	199711	2	1997/09/28	Formalin	Age 0	9	9	5.38	1.27	1.66	3.28	7.63	9	76.6	5.7	7.4	67	87
					Formalin	Whitefish	1	1	4.88			4.88	4.88	1	76.0			76	76
					Formalin	Sculpin	7	7	1.84	2.53	2.74	0.32	7.55	7	47.0	19.7	21.3	32	88
					Live	Whitefish	2	0						2	195.0	190.6	21.2	180	210
Middle River	19970041	199711	1	1997/09/28	Formalin	Age 0	7	7	6.09	1.00	1.08	4.65	7.6	7	80.7	4.7	5.1	72	88
					Formalin	Whitefish	2	2	9.12	1.08	0.12	9.03	9.2	2	94.0	0.0	0.0	94	94
					Formalin	Sculpin	2	2	3.32	13.91	1.55	2.22	4.41	2	67.5	95.3	10.6	60	75
					Formalin	Redside Shiner	1	1	3.76			3.76	3.76	1	72.0			72	72
					Live	Whitefish	1	0						1	300.0			300	300

Table 4. *O. nerka* from which Sr/Ca ratios were derived and resulting identification to sockeye or kokanee.

Lake	Survey #	Section #	Tow #	Date	Scale #	Length (mm)	Weight (g)	Scale age	Sr ID	Sr/Ca ratio Core	Sr/Ca ratio Margin
Stuart	199803	1	19980003	1998/08/12	25	43	0.62	0	KOK	0.3	0.2
					15	48	0.92	0	KOK	0.1	0.3
					3	50	1.11	0	KOK	0.2	0.3
					21	50	1.2	0	KOK	0.2	0.3
					23	50	1.24		SOC	1.5	0.3
					9	51	1.01	0	KOK	0.2	0.2
					19	51	1.27	0	KOK	0.3	0.7
					6	52	1.15	0	KOK	0	0.4
					10	52	1.27	0	KOK	0.2	0.2
					2	53	1.4	0	KOK	0.3	0.3
					14	53	0.98	0	SOC	1.8	0.2
					5	54	1.36	0	KOK	0.1	0.1
					11	54	1.4	0	KOK	0.1	0.3
					8	55	1.04	0	KOK	0.1	0.3
					24	55	1.39	0	KOK	0.2	0.3
					1	56	1.64	0	KOK	0.1	0.2
					12	56	1.67	0	KOK	0.2	0.3
					18	56	1.62	0	KOK	0	0.3
					16	61	2.18	0	SOC	1	0.3
					17	62	2.08	0	KOK	0.3	0.2
		2	19980004	1998/08/13	11	54	1.18	0	SOC	1.5	0.2
					9	56	1.5	0	SOC	1.2	0.1
					8	57	1.7	0	SOC	1.3	0.2
					1	60	2.22	0	SOC	1.4	0.2
					7	61	2.14	0	SOC	1.6	0.2
					5	63	2.4	0	SOC	1.3	0.2
					6	63	2.23	0	SOC	1.3	0.2
					2	68	2.75	0	SOC	1.1	0.1
					3	69	3.15	0	SOC	1.5	0.1
					4	73	3.52	0	SOC	1.6	0.2
		3	19980006	1998/08/14	6	48	0.95	0	SOC	1.5	0.1
					5	52	0.93	0	SOC	1.4	0.1
					4	53	1.14	0	SOC	1.3	0.2
					8	54	1.28	0	KOK	0.2	0.1
					9	54	1.43	0	SOC	1.5	0.1
					2	57	1.4	0	SOC	1.1	0
					3	60	1.7	0	SOC	1.4	0.2
					1	70	3.03	0	SOC	1.7	0.2
					7	71	3.56	0	SOC	1.2	0.2

Table. 4. *O. nerka* from which Sr/Ca ratios were derived and resulting identification to sockeye or kokanee (continued).

Lake	Survey #	Section #	Tow #	Date	Scale #	Length (mm)	Weight (g)	Scale age	Sr ID	Sr/Ca ratio Core	Sr/Ca ratio Margin
Stuart	199803	4	19980002	1998/08/11	7	54	1.56	0	SOC	1.6	0.3
					9	56	1.66	0	SOC	1.7	0.4
					10	56	1.43	0	SOC	1.2	0.5
					5	58	1.92	0	SOC	1.5	0.2
					3	59	2.04	0	SOC	1.5	0.2
					4	60	1.99	0	SOC	1.6	0.4
					6	60	2.2	0	SOC	1.3	0.4
					8	63	2.33	0	SOC	1.1	0.4
					1	67	2.8	0	SOC	1.3	0.4
					2	67	2.56	0	SOC	1.5	0.3
Takla	199804	2	19980008	1998/08/15	8	47	0.89		SOC	1.2	0.3
					9	51	1.15	0	SOC	1.6	0.3
					6	55	1.44	0	SOC	1.4	0.3
					2	57	1.54	0	SOC	1	0.2
					5	57	1.66	0	SOC	1.5	0.1
					7	59	1.86	0	SOC	1.5	0.2
					3	61	1.85	0	SOC	1.2	0.3
					1	68	2.1	0	SOC	1	0.3
		3	19980007	1998/08/14	7	48	0.86	0	SOC	1.4	
					3	50	0.89	0	SOC	1.3	
					10	53	1.37	0	SOC	1.4	
					2	58	1.49	0	SOC	1.1	
					8	59	1.87	0	KOK	0.5	
					1	61	1.77	0	SOC	0.9	
					6	61	2.14	0	SOC	1.3	
		6	19980009	1998/08/15	5	40	0.44		KOK	0.1	0.3
					9	51	1.17	0	SOC	1.2	0.3
					3	57	1.45	0	SOC	1.3	0.2
					7	61	1.94	0	SOC	1	0.3
					1	62	2.22	0	SOC	1.1	0.3
					2	63	2.24	0	SOC	1.3	0.2
					6	67	2.84	0	SOC	1.2	0.2

Table. 4. *O. nerka* from which Sr/Ca ratios were derived and resulting identification to sockeye or kokanee (continued).

Lake	Survey #	Section #	Tow #	Date	Scale #	Length (mm)	Weight (g)	Scale age	Sr ID	Sr/Ca ratio Core	Sr/Ca ratio Margin
Trembleur	199805	1	19980012	1998/08/18	5	56	1.3	0	SOC	1.4	0.3
					9	57	1.62	0	SOC	1.2	0.4
					10	61	2.13	0	SOC	1.3	0.2
					7	63	2.22	0	SOC	1.5	0.3
					2	66	2.59	0	SOC	1.5	0.3
					4	66	2.81	0	SOC	1.5	0.3
					6	68	2.83	0	SOC	2.1	0.4
					8	71	3.31	0	SOC	1.6	0.3
					1	72	2.88	0	SOC	1.4	0.3
					3	74	3.54	0	SOC	1.5	0.2
		2	19980013	1998/08/19	10	55	1.55	0	SOC	1.6	0.2
					5	57	1.74	0	SOC	1.6	0.4
					2	61	1.96	0	SOC	1.3	0.4
					3	61	2.06	0	SOC	1.4	0.3
					9	61	2.05	0	SOC	1.5	0.3
					4	62	2.14	0	SOC	1.8	0.4
					6	63	2.4	0	SOC	1.5	0.4
					1	65	2.38	0	SOC	1.5	0.4
					7	66	2.86	0	SOC	1.4	0.3
		3	19980014	1998/08/19	10	48	1.03	0	SOC	1	0.2
					5	49	0.83	0	SOC	0.9	0.1
					4	58	1.53	0	SOC	1.4	0.2
					8	59	1.66	0	SOC	1.1	0.2
					6	61	2.03	0	SOC	1.2	0.2
					9	63	1.88	0	SOC	1.3	0.2
					2	67	2.53	0	SOC	1.2	0.1
					1	68	2.35	0	KOK	0.2	0.2

Table 5. Sockeye and kokanee/*O. nerka* ratio estimates derived from Sr/Ca ratios in the otolith core of fish collected in the summer of 1998.

Lake	Survey #	Section #	Tow #	Date	Sr ID	Fish Length (mm) N	Mean	Max	Min	% of *O. nerka* Catch
Stuart	199803	1	19980003	1998/08/12	SOC	3	54.7	61	50	15%
					KOK	17	52.8	62	43	85%
		2	19980004	1998/08/13	SOC	10	62.4	73	54	100%
		3	19980006	1998/08/14	SOC	8	58.1	71	48	89%
					KOK	1	54.0	54	54	11%
		4	19980002	1998/08/11	SOC	10	60.0	67	54	100%
			Lake Total		SOC	31	58.8	73	48	63%
					KOK	18	53.4	62	43	37%
Takla	199804	2	19980008	1998/08/15	SOC	8	56.9	68	47	100%
		3	19980007	1998/08/14	SOC	6	55.2	61	48	86%
					KOK	1	59.0	59	59	14%
		6	19980009	1998/08/15	SOC	6	60.2	67	51	86%
					KOK	1	40.0	40	40	14%
			Lake Total		SOC	20	57.4	68	47	91%
					KOK	2	49.5	59	40	9%
Trembleur	199805	1	19980012	1998/08/18	SOC	10	65.4	74	56	100%
		2	19980013	1998/08/19	SOC	9	61.2	66	55	100%
		3	19980014	1998/08/19	SOC	7	57.9	67	48	88%
					KOK	1	68.0	68	68	12%
			Lake Total		SOC	26	61.5	74	48	96%
					KOK	1	68	68	68	4%

Table 6. Results of the electrophoretic genotype analysis showing the estimate (Est.) of the proportion of sockeye salmon in the *O. nerka* catch and 90% confidence intervals.

	Sockeye/*O. Nerka* Ratio																				
	Entire Lake			Section 1			Section 2			Section 3			Section 4			Section 5			Section 6		
		90% CI			90% CI			90% CI			90% CI			90% CI			90% CI			90% CI	
Survey	Est.	Low	High	Est.	Low	High	Est.	Low	High	Est.	Low	High	Est.	Low	High	Est.	Low	High	Est.	Low	High
Stuart																					
199602	0.36	0.21	0.52	0.32	0.13	0.51	0.42	0.12	0.64				0.42	0.15	0.65						
199607	0.36	0.16	0.50	0.37	0.19	0.61				0.34	0.06	0.66									
199704	0.59	0.38	0.72	0.58	0.40	0.66	0.27	0.00	0.61				0.82	0.59	0.96						
199709	0.30	0.15	0.47	0.07	0.00	0.22	0.76	0.48	0.89	0.10	0.00	0.53	0.90	0.58	1.00						
199803	0.81	0.62	0.91	0.38	0.14	0.57	0.98	0.70	1.00	0.95	0.81	1.00	0.93	0.81	1.00						
199808	0.57	0.28	0.71	0.43	0.11	0.65							0.68	0.34	0.88						
Trembleur																					
199604	0.06	0.00	0.32	0.05	0.00	0.35	0.06	0.00	0.46												
199606	0.13	0.01	0.46	0.19	0.04	0.51				0.03	0.00	0.36									
199707	0.70	0.59	0.87	0.66	0.50	0.80	0.87	0.71	1.00	0.48	0.15	0.90									
199712	0.83	0.66	0.94	0.98	0.75	1.00	0.62	0.33	0.81	0.87	0.68	1.00									
199805	0.98	0.85	1.00	0.98	0.86	1.00				0.98	0.86	1.00									
Takla																					
199603	0.33	0.22	0.48				0.37	0.11	0.62				0.43	0.18	0.64	0.34	0.07	0.54	0.29	0.16	0.51
199605	0.34	0.21	0.51	0.41	0.17	0.69	0.32	0.10	0.52										0.38	0.23	0.61
199705	0.78	0.68	0.84	0.94	0.82	1.00	0.92	0.79	1.00	0.79	0.60	0.95	0.92	0.78	1.00	0.60	0.31	0.73	0.51	0.32	0.65
199710	0.59	0.45	0.67				0.91	0.71	1.00	0.97	0.78	1.00				0.41	0.23	0.52	0.18	0.00	0.41
199804	0.75	0.66	0.85				0.88	0.78	0.97							0.69	0.48	0.90	0.58	0.38	0.72
199809	0.62	0.59	0.73	0.77	0.63	0.90	0.83	0.72	0.94				1.00	0.94	1.00	0.51	0.27	.75.2	0.33	0.20	0.43

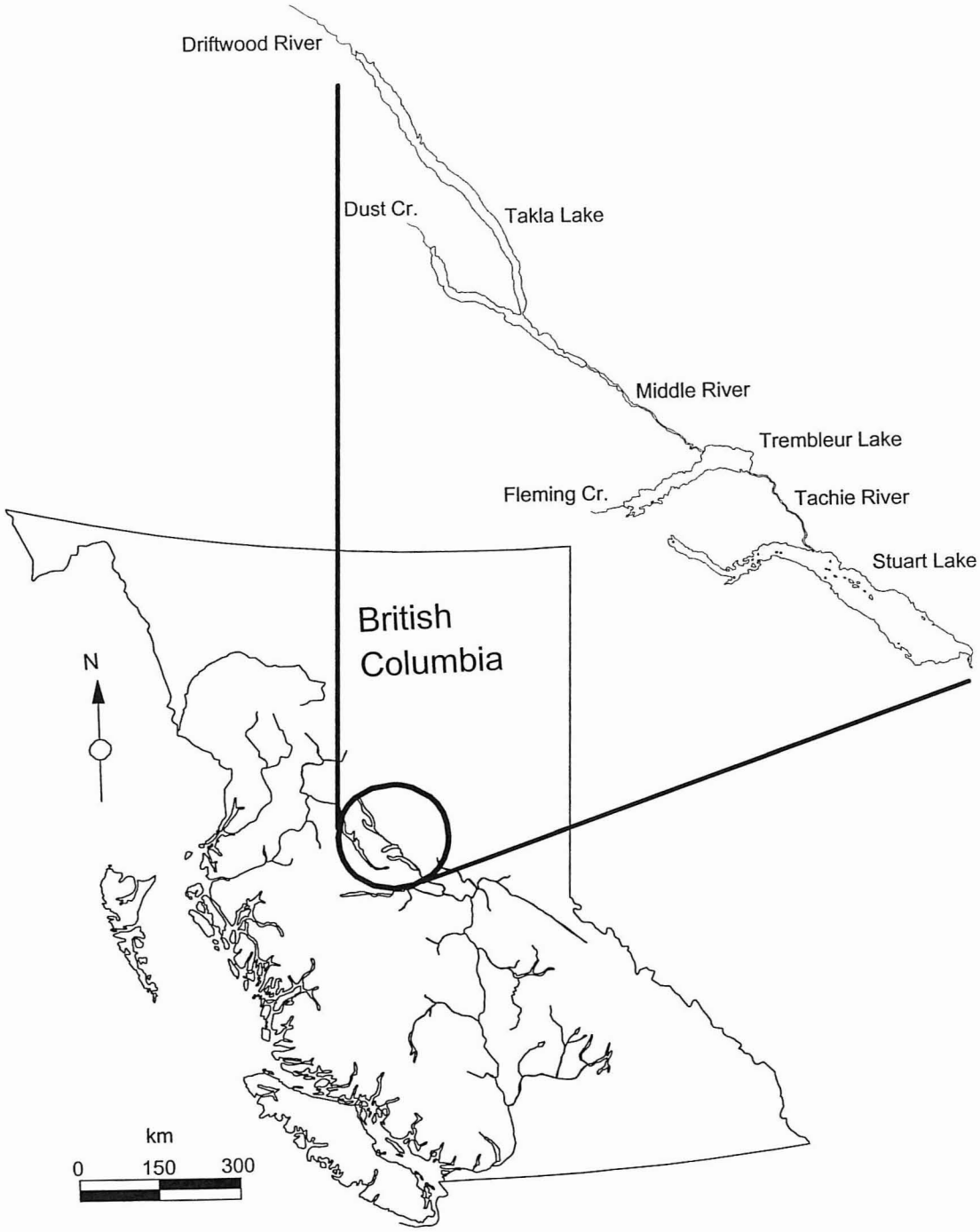

Fig.1. Map showing location and configuration of the Stuart system.

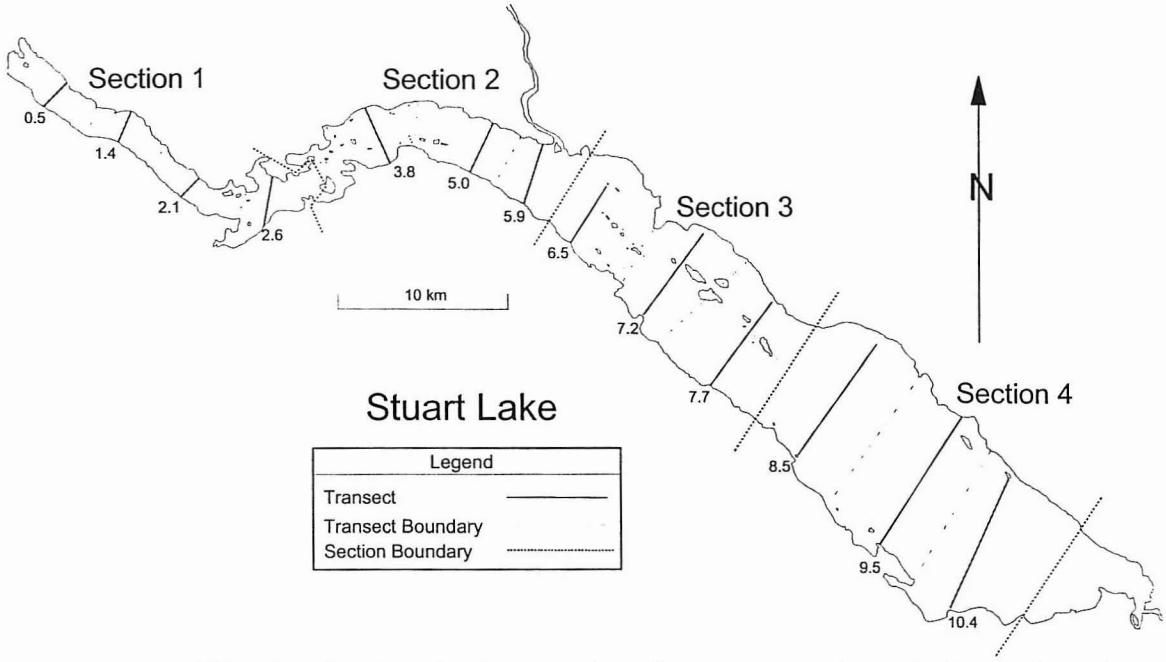

Fig. 2. Map of Stuart Lake showing transect locations, transect boundaries and section boundaries.

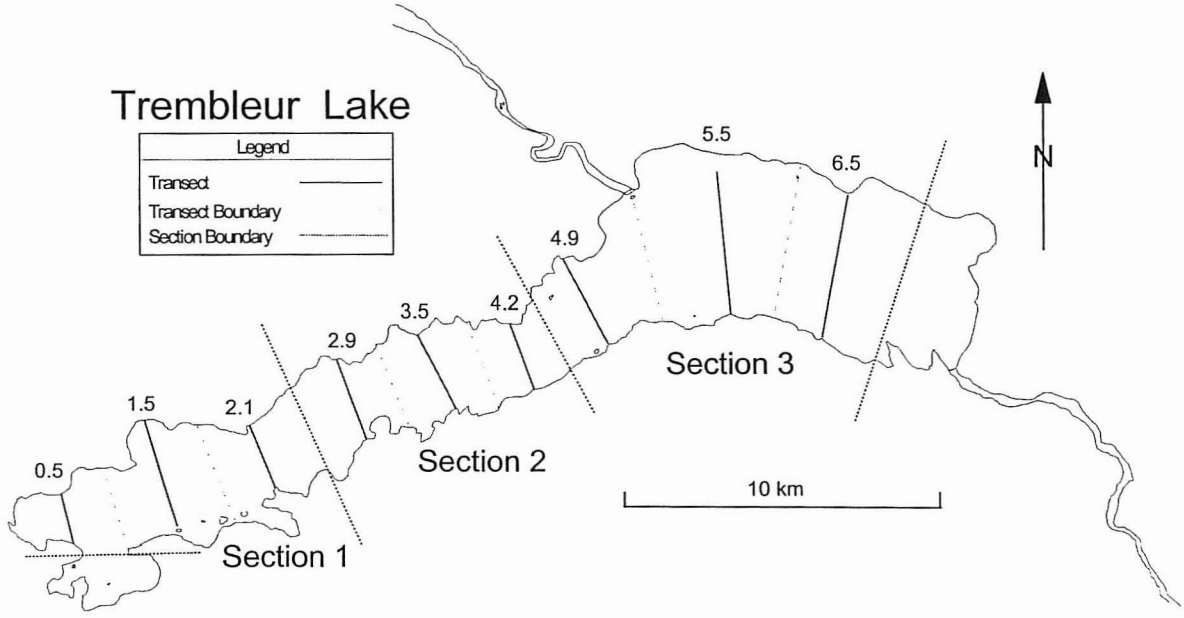

Fig. 3. Map of Trembleur Lake showing transect locations, transect boundaries and section boundaries.

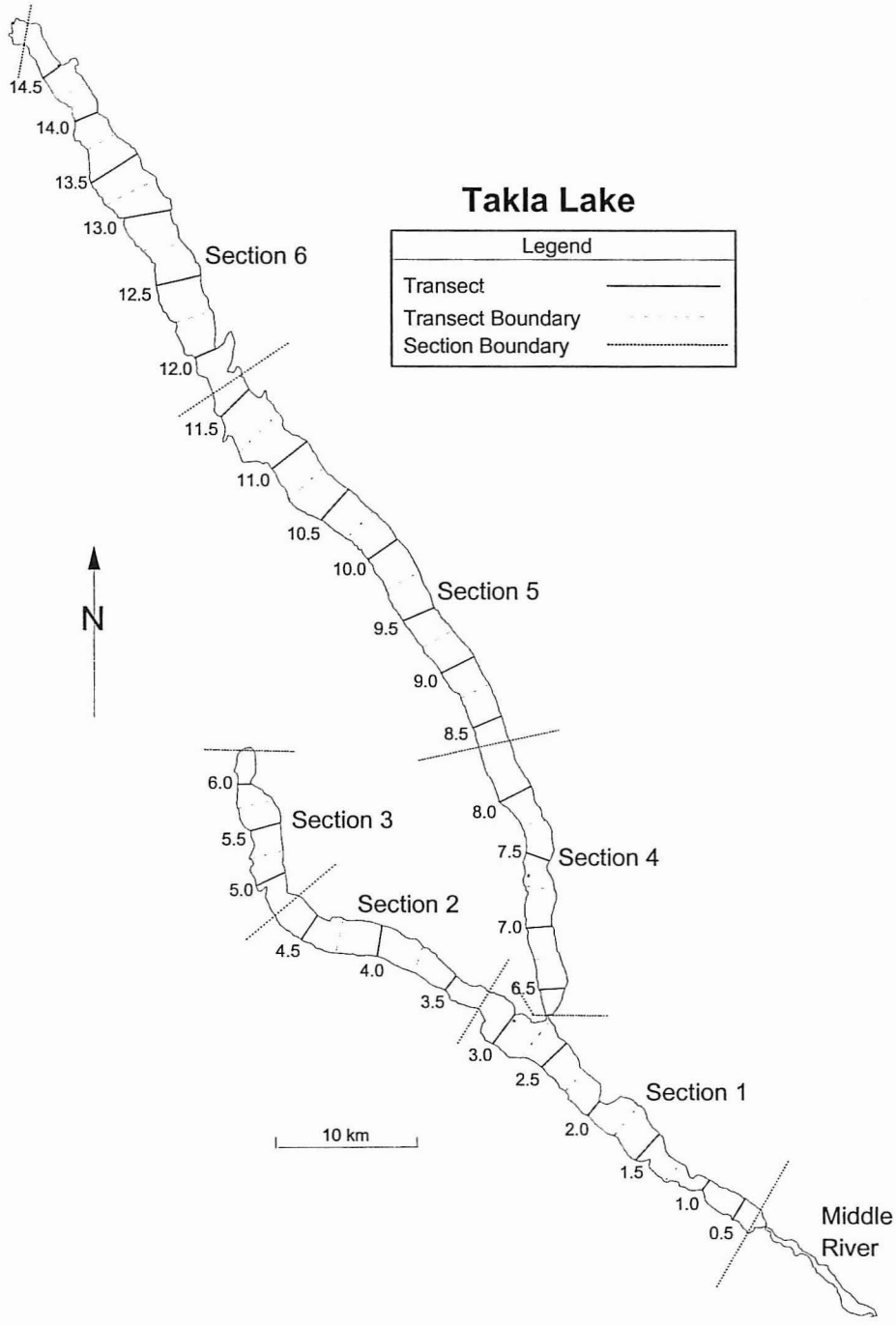

Fig. 4. Map of Takla Lake showing transect locations, transect boundaries and section boundaries.

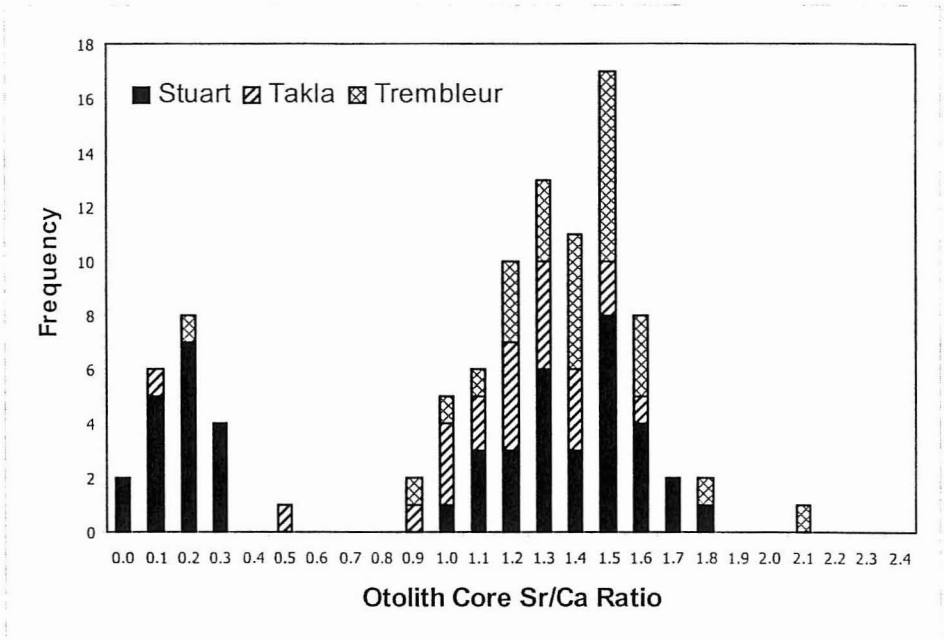

Fig. 5. Distribution of otolith core Sr/Ca ratios of *O. nerka* captured in the summer of 1998 from the three study lakes, showing a clear separation between sockeye (>0.7) and kokanee (<0.7).

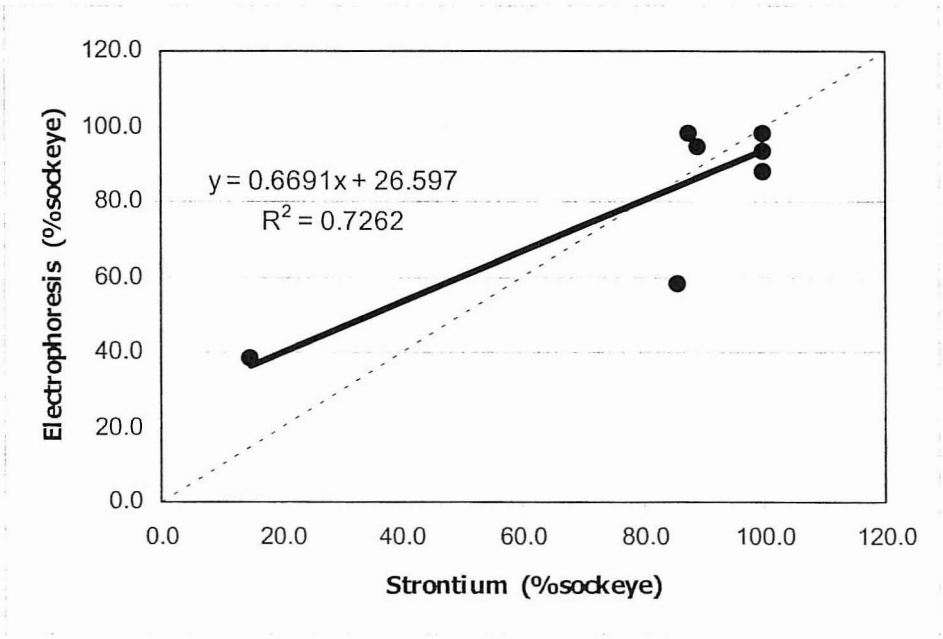

Fig. 6. Proportion of sockeye in the *O. nerka* catch from the summer surveys of the three study lakes in 1998, as derived from electrophoresis and otolith core Sr/Ca ratios.

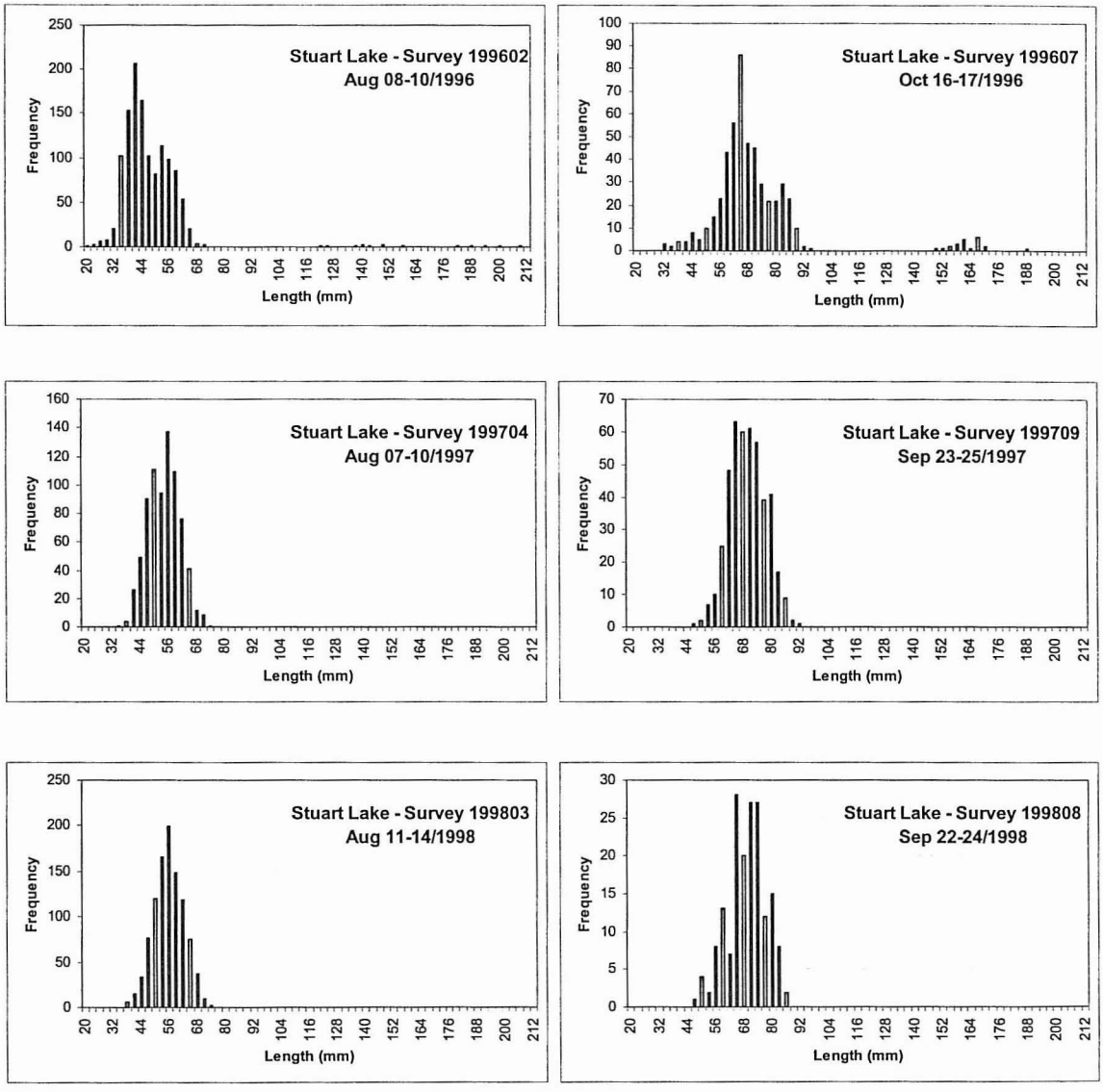

Fig. 7. *O. nerka* length frequencies for Stuart Lake for each survey. The data presented includes all preservation methods and age classes.

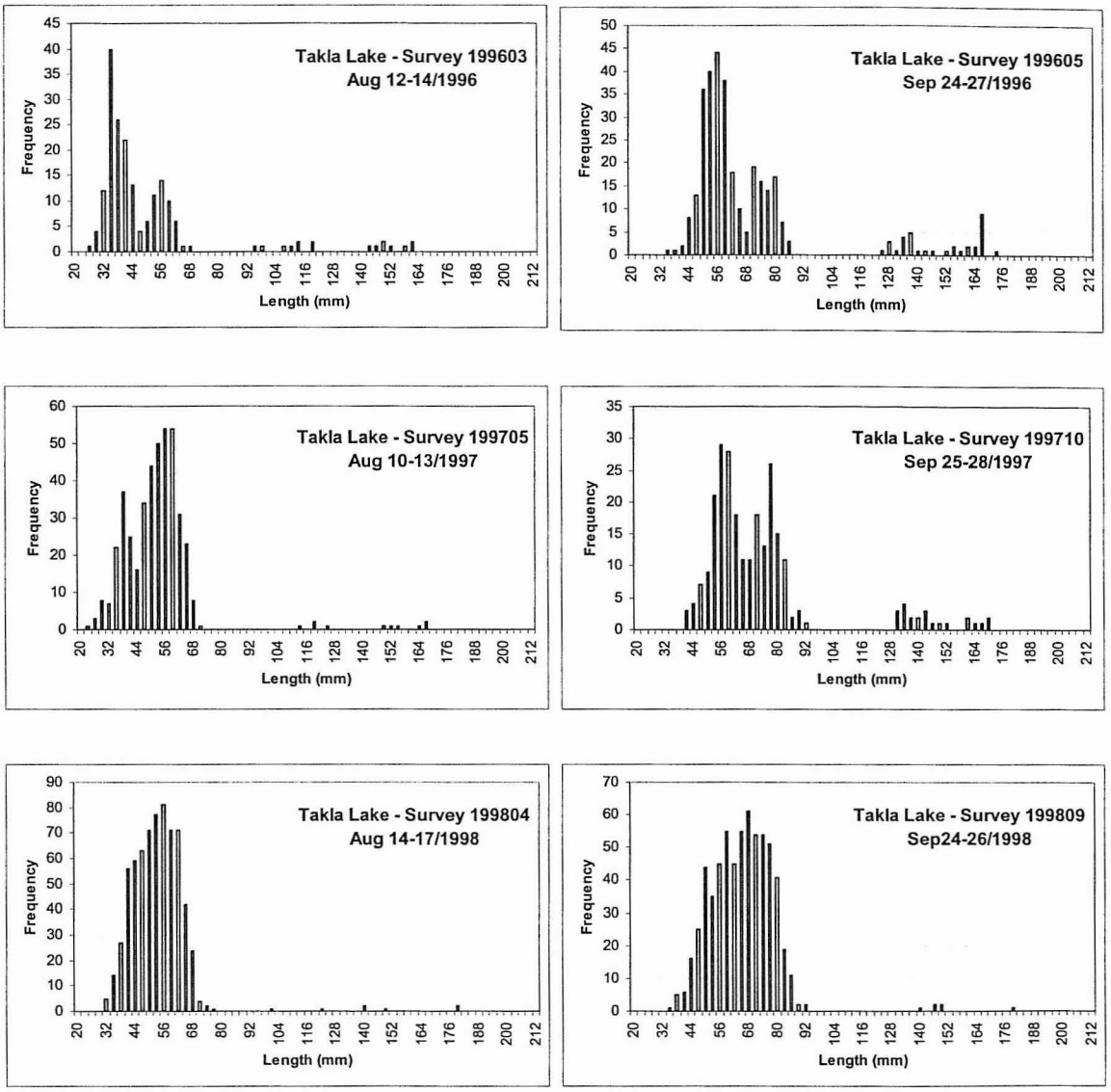

Fig. 8. *O. nerka* length frequencies for Takla Lake for each survey. The data presented includes all preservation methods and age classes.

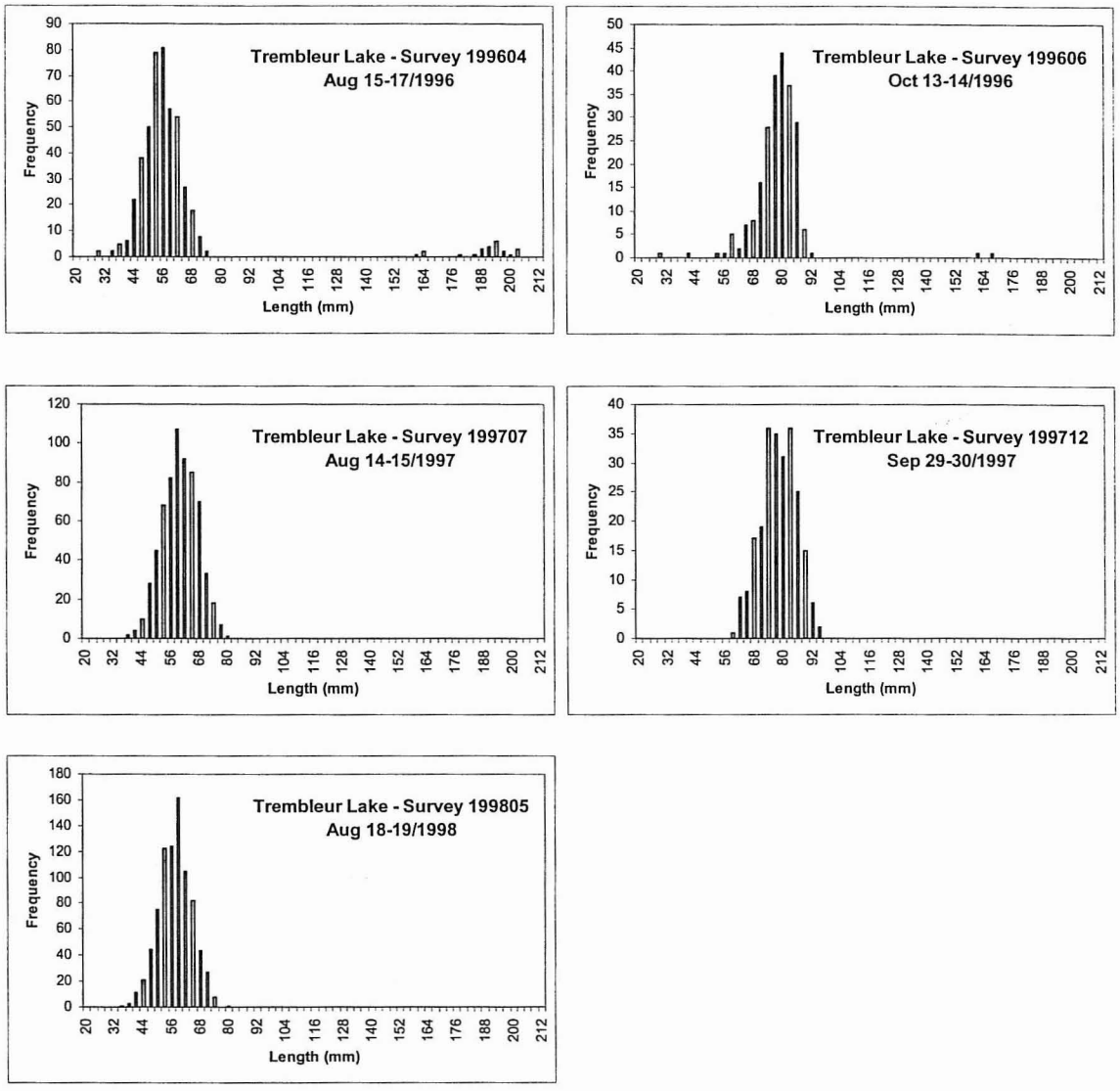

Fig. 9. *O. nerka* length frequencies for Trembleur Lake for each survey. The data presented includes all preservation methods and age classes.

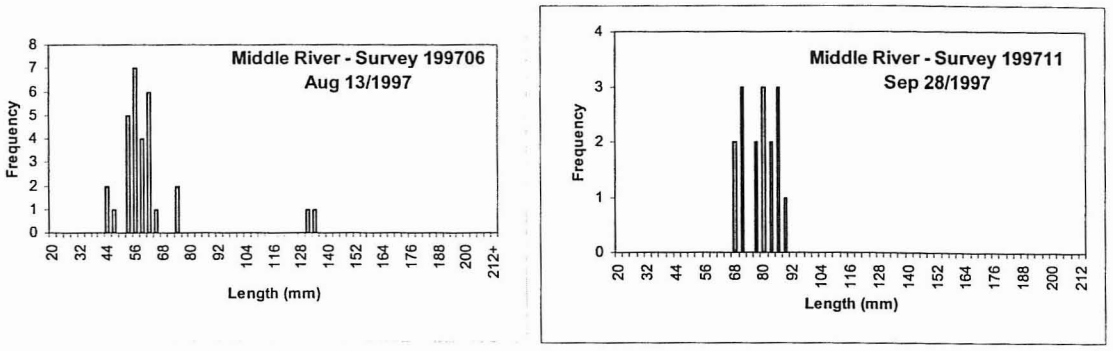

Fig. 10. *O. nerka* length frequencies for Middle River for each survey. The data presented includes all preservation methods and age classes.